

DS #:

5100

APN:

163-05-101-002

PROJECT:

Chick-fil-A @ Charleston ? Fort Apache

SUBMITTAL:

1st

SCANNED BY/DATE:

CHECKED BY/DATE:

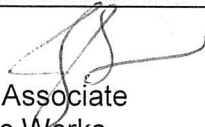


CITY OF LAS VEGAS

INTER-OFFICE MEMORANDUM

DATE: 3/28/2019

TO:
Land Development Services
Department of Building & Safety

FROM:
Jennifer Shinn, P.E. 
Flood Control Engr. Associate
Department of Public Works

SUBJECT: Drainage Study for:
Chick-fil-A @ Charleston & Fort Apache

COPIES TO:
Kimley-Horn

Cross Streets: Charleston Blvd & Fort Apache Road

Crossroads Commons/Chick-fil-A

File Number: F:\Depot\DSMemos\DS5100A.doc

Bart Anderson, P.E., DevCo

Parcel Number: 163-05-101-002

CCRFCD

Zoning Action: SDR-75332

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	2/14/2019 & 3/7/2019	3/4/2019 & 3/28/2019	See Comments Below	\$400.00	503237:\$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:
	must be resubmitted or supplemented including the following:
X	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

- This drainage study is acceptable in concept;** however, City of Las Vegas will not formally accept the study until the Clark County Regional Flood Control District (CCRFCD) has issued a letter of concurrence. Note that effective March 15, 2019, each submittal package for concurrence to the District will require a bound hardcopy of the drainage study and any addenda, drainage exhibits, and improvements plans in addition to an electronic copy of all submittals in PDF format. The District has prepared a checklist to assist in preparing the submittal package, available at (<http://gustfront.ccrfcd.org/LandDev/LandDev.aspx>). It is the responsibility of the applicant to provide this approval letter and all applicable material to the District for review.

In an effort to increase administrative efficiency, for all original and re-submittal packages including updates and the addenda, the City of Las Vegas Public Works Department requires both a hardcopy and a digital copy (PDF) on CD for the drainage study.

A letter sealed and signed by a Nevada registered civil engineer must be included in every submittal certifying documents on the electronic CD matches 100% of the hardcopy submittal. The new submittal requirement is effective on May 1, 2019. If there are any questions regarding these new requirements, please contact Albert Sung in the City Flood Control Section at (702) 229-6541.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is

maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see <http://ndep.nv.gov/bwpc/storm01.htm> or call (775) 687-9429.

END OF REMARKS

T/R/S: T21S/R60E/S05

AREA Q05

**Technical Drainage Study
for**

*Chick-fil-A @
Charleston & Fort Apache*

Date Prepared:
February 14, 2019

Prepared for:
Chick-fil-A
1535 Alston Parkway, Suite 350
Irvine, California 92618
404.305.4834

Prepared by:
Kimley-Horn and Associates, Inc.
6671 Las Vegas Boulevard South, Suite 320
Las Vegas, NV 89119
702.862.3600

Kimley»Horn



February 14, 2019

Mr. Albert Sung, P.E.
City of Las Vegas Flood Control
333 Rancho Drive
Las Vegas, NV 89106

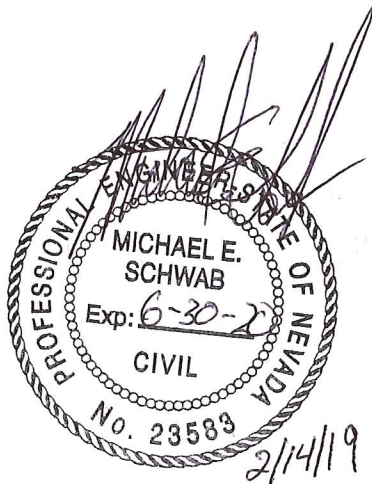
**RE: Technical Drainage Study for Chick-fil-A @ Charleston & Fort Apache
(APN: 163-05-101-002)**

Dear Mr. Sung,

Attached are one (1) copy and one (1) CD of the Technical Drainage Study for *Chick-fil-A @ Charleston & Fort Apache* for your review. The project site consists of a 5,011 sq. foot fast food development and a 4,000 sq. foot retail development. The site will also improve the existing parking lot to incorporate a drive-thru window.

With Kimley-Horn, you should expect more and will experience better. Please contact me at 702.790.0206 or michael.schwab@kimley-horn.com should you have any questions.

Sincerely,



Michael Schwab, P.E.

Adam Lo, E.I.T.

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: Chick-fil-A @ Charleston & Fort Apache Date: February 2019

Location of Development: a) Descriptive (Cross Streets) North/South: Fort Apache Road
East/West: Charleston Boulevard

b) Section: 5 Township: 21S Range: 60E

c) APN : 163-05-101-002

Name of Owner: Crossroads Commons LTD LLC/Chick-fil-A

Telephone No.: 404.305.4834 Fax No.: N/A E-Mail Address: N/A

Address: 851 S Rampart Las Vegas, Nevada 89128

Contact Person-Name: Michael Schwab Telephone No.: 702.790.0206

* E-Mail Address: michael.schwab@kimley-horn.com Fax No.: _____

Firm: KIMLEY-HORN

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

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	GRADING PERMIT

1. Total Owned Land Area: At Site: +/- 16.63 acres Being Developed/Disturbed: +/- 2.0 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

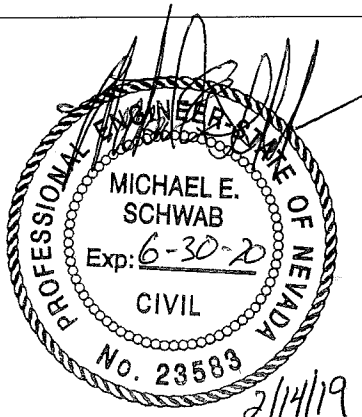
4. Proposed type of development (Residential, Commercial, Etc.): Commercial

5. Approximate upstream land area which drains to the subject site: N/A

6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Technical Drainage Study for Odette Center; Pentacore, February 2001

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Fort Apache Road storm drain to the west, Charleston Blvd to the north and the existing private drive aisle to the south

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.

Local Entity File No.	Revision	Date

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL			
DRAINAGE SUBMITTAL CHECKLIST			
Project Name:	Chick-fil-A @ Charleston/Ft. Apache	Map ID:	
Firm Name:	Kimley-Horn	Engineer:	Michael Schwab
Address:	6671 Las Vegas Boulevard South, Suite 320		
City:	Las Vegas	State:	Nevada
Phone No.:	(702) 862-3600	Zip:	89119
		Fax No.:	
Property Owner:	Crossroads Commons LTD, LLC		
Address:	851 S Rampart Boulevard		
City:	Las Vegas	State:	Nevada
		Zip:	89128
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 (CCRCD) 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 N/A

- | | | | |
|-------------------------------------|--------------------------|-------------------------------------|--|
| ☒ | ☐ | ☐ | Design Manual Standard Form 1 with the Engineer's seal and signature. |
| ☒ | ☐ | ☐ | Design Manual Standard Form 4 . |
| ☒ | ☐ | ☐ | 2 copies of the 24" x 36" Drainage Plan . |
| ☐ | ☐ | ☒ | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |

II. MAPS AND EXHIBITS

YES NO N/A

- | | | | |
|-------------------------------------|--------------------------|--------------------------|--|
| ☒ | ☐ | ☐ | A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated. |
| ☒ | ☐ | ☐ | A copy of the current CCRCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated. |
| ☒ | ☐ | ☐ | Off-site drainage basin maps for existing, interim, and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |

II. MAPS AND EXHIBITS (CONTINUED)

- | | | | |
|-------------------------------------|--------------------------|--------------------------|---|
| ☒ | ☐ | ☐ | Vicinity Map with local and major cross streets identified and a north arrow. |
|-------------------------------------|--------------------------|--------------------------|---|

III. DRAINAGE PLAN

YES	NO	N/A	
☒	☐	☐	Sheet size: 24"x36" 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.
☐	☐	☒	Streets with offset 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 peak flows at basin concentration points.
☒	☐	☐	Concentration points and drainage flow directions with Q_{100} and V_{100} and D_{100} in streets.
☒	☐	☐	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
☒	☐	☐	Location and cross-section of street capacity calculations.
☒	☐	☐	Cross-sectional detail for channels, including cutoff wall locations.

III. DRAINAGE PLAN (CONTINUED)

YES	NO	N/A	
☒	☐	☐	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk ditches, swales, storm drain systems, unimproved channels, and culverts, etc.) stating size, material shape, and slope with plan and profile and HGL calculations.
☐	☐	☒	Existing and proposed drainage easements and widths shown with sufficient detail. A cross-sectional detail must be provided that shows appropriate lining and reinforcement.
☐	☐	☒	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16"x48". Wrought iron gate is required for flows > 10 cfs.
☐	☐	☒	Location and detail of flood-wall(s) illustrating depth of flow, proposed grouting height, etc.
☒	☐	☐	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
☒	☐	☐	Building and/or lot numbers.
☒	☐	☐	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☐	☐	☒	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.
☐	☐	☒	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 the 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	N/A	
☒	☐	☐	Appropriate soil information and Soils Map for existing and future conditions with sub-basins 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 proposed 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 sub-basin 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.

IV. HYDROLOGIC ANALYSIS (CONTINUED)

- | | | | |
|-------------------------------------|--------------------------|--------------------------|--|
| ☒ | ☐ | ☐ | 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) |

V. HYDRAULIC ANALYSIS

YES NO N/A

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



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

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

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

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

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

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
✓		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.
✓		Finished floor elevations for buildings adjacent to public drainage easements must be a minimum of 18 inches above the Q100 weir of submerged weir elevation, whichever is greater.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

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

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

Technical Drainage Study

for

Chick-fil-A @ Charleston & Fort Apache

Date Prepared:

February 14, 2019

Prepared for:

Chick-fil-A

1535 Alston Parkway, Suite 350

Irvine, California 92618

404.305.4834

Prepared by:

Kimley-Horn and Associates, Inc.

6671 Las Vegas Boulevard South, Suite 320

Las Vegas, NV 89119

702.862.3600

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INTRODUCTION

Chick-fil-A @ Charleston & Fort Apache is a commercial development located on the southeast corner (SEC) of Charleston Boulevard and Fort Apache Road. Site improvements consist of a 5,011 sq. foot fast food development and a 4,000 sq. foot retail development. The site will also improve the existing parking lot to incorporate a drive-thru window for the fast food development.

The purpose of this study is as follows:

1. Determine the 10-year and 100-year on-site and off-site peak runoff for existing and developed conditions.
2. Determine the Finish Floor Elevation for the proposed building.
3. Determine the stormwater runoff generated by the 85th Percentile Rainfall for fully developed conditions and recommend on-site water quality structural Best Management Practices (BMP) to meet Parking Lot Low Impact Development (LID) requirements

LOCATION AND DEVELOPMENT DESCRIPTION

The site is located in Section 5, Township 21 South, Range 60 East, and M.D.M. Clark County, Nevada. The project site will develop approximately 2.00 acres at the SEC of Charleston Boulevard and Fort Apache Road. Refer to **Figure 1 – Vicinity Map**. The project site is composed of a portion of Assessor's Parcel Number 163-05-101-002. A copy of the *Assessor's Parcel Map* is included in **Appendix A**.

LAND USE CONDITIONS

The parcel currently has a zoning classification of General Commercial District (C-2). The proposed improvements are consistent with the current zoning. Preliminary Staff Conditions were issued by the Planning Commission on February 12, 2019 (SDR-75322). A copy of SDR-75322 is included in **Appendix A**. Final approval and conditions will be provided once they become available.

PREVIOUS DRAINAGE STUDIES

Previous hydrology studies that were reviewed and referenced as part of the preparation of this report:

1. *TDS Odette Center TDS*; Pentacore. December 2002 (DS-2832).

The *Odette Study*, addresses a retail/office building site downstream east of the project site south of Charleston Boulevard. Per the *Odette Study* all existing runoff west of Fort Apache Road is collected by the existing CCRFCD Facility APP1 0056 located in Fort Apache Road west of the project site.

Kimley-Horn has reviewed the reference studies listed above and is in agreement with the information included therein. The information referenced is for the purpose of determining the existing and future development patterns and quantities of flow adjacent to the proposed project site. Pertinent reference material is included in **Appendix E**.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (CCRFCD) MASTER PLAN FACILITIES

“The Las Vegas Valley Flood Control Master Plan Update”, Figure **F-30**, dated September 2013 (2013 MPU), as prepared by the Clark County Regional Flood Control District (CCRFCD) includes the existing and proposed master planned facilities adjacent to the project site in Fort Apache Road. Per the 2013 MPU, there is an existing CCRFCD Facility west of the project site. The Facility is identified as *APP1 0056*, which is dual (2) - 60” reinforced concrete pipe conveying offsite flows west of the project site and ultimately north and away from the project site. See **Appendix A**.

FLOOD HAZARD DESIGNATION

The Special Flood Hazard Areas for both the unincorporated and the incorporated portions of Clark County, Nevada, are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps. This subject site is located on FEMA Community Panel No. **32003C2145F** effective November 16, 2011. As shown on the *FEMA FIRM Exhibit* (see **Appendix A**), the subject site is located within a flood **Zone X**, which is not a FEMA designated SFHA. Zone X areas are determined to be outside the 0.2% annual flood chance floodplain (500-yr).

HYDROLOGIC METHODOLOGY

The hydrologic model and design of this site development are in compliance with local requirements, including Clark County (CC), the CCRFCD’s “*Hydrologic Criteria and Drainage Design Manual*”, and the CCRFCD’s “*Flood Control Master Plan Update*” (2013 MPU).

HYDROLOGIC MODEL

The hydrologic model utilized in this study is the **HEC-1** Flood Hydrograph Package developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. **HEC-1** is a rainfall runoff event simulation model utilizing an interconnected system of hydrologic and hydraulic components to simulate the surface runoff response of a drainage area to precipitation. The calculations of this study were performed using the SCS Unit Hydrograph of the **HEC-1** Flood Hydrograph Model. The detailed explanation of the theory and background is presented in Section 4 of the SCS National Engineering Handbook and the **HEC-1** User Manual.

PRECIPITATION

According to **Figure 513** of the CCRFCD Manual, the project is **outside** the McCarran Airport Rainfall Area. The precipitation depths used to determine the 10-year and 100-year, six-hour storm event discharges were obtained from **Figures 503** and **506** of the CCRFCD Manual, which can be found in **Appendix B**. Depth-Area-Reduction-Factors (DARF) have not been applied to the point precipitation values used for onsite basins in the HEC-1 analysis. The basin areas analyzed in this study are less than 8 square miles; therefore, the SDN3, six-hour storm distribution from HCDDM **Table 503** has been referenced. **Table 501** and **Table 502** were used to adjust the point rainfall values for the 10-year and 100-year, six-hour storm durations. The precipitation calculations resulted

in point rainfall values of **1.61** inches and **3.00** inches. Refer to **Appendix B** for all referenced Tables and Figures.

CURVE NUMBER

The soils information for the project watershed was referenced from the Soil Survey of Las Vegas Area, Nevada, Part of Clark County” prepared by the United States Department of Agriculture Natural Resources Conservation Services (USDA NRCS). A *Custom Soil Resource Report* for the project site is included in **Appendix B**. The report indicates that the project area is classified as Hydrologic Soil Group “D”. Group “D” is characterized as having high runoff potential. The report indicates that the project area is classified as Soil Type 152.

Onsite subbasins for both existing and proposed conditions referenced a CN value of 95 for a commercial landuse. Offsite streets use a CN of 98 for streets. Refer to **Table 602** in **Appendix B**.

A copy of The *Las Vegas Valley Flood Control Master Plan Update*”, Figure **H-30**, dated September 2008, as prepared by Post, Buckley, Schuh & Jernigan, Inc. (PBS&J), Parsons Brinckerhoff and Louis Berger Group for the CCRFCD is included in **Appendix A** for the purpose of illustrating the Regional’s hydrologic subareas, land use and soils in the area. The proposed project land uses and drainage areas are consistent with the 2013 MPU.

LAG TIME

The time between a brief, heavy rain and maximum runoff rate is called Lag Time. Lag Time can be estimated from historical hydrographs or it can be estimated from specific watershed characteristics such as watershed length, slope and flow impedance. Based on studies of many storm events for a range of watershed conditions, the following empirical relationship between Lag Time (T) and Time of Concentration (T_c) was derived:

$$T = 0.6T_c$$

The Time of Concentration (T_c) is defined as the time required for runoff to the flow from the most remote part of the drainage basin to the outlet or to a combination point. The procedure for calculating the T_c is outlined in **Section 602** of CCRFCD’s *Hydrologic Criteria and Drainage Design Manual*. Lag time calculations for this site are included in **Appendix B** as shown on Standard Form 4.

EXISTING HYDROLOGIC CONDITION

The existing condition drainage patterns are depicted on **EX-1**. Offsite drainage flows west of Fort Apache Road are captured by the existing dual (2) – 60" RCP CCRFCD Facility APP1 0056. An *Existing Condition Basin Map*, **EX-1**, depicting onsite and offsite drainage patterns, is included in **Appendix A**.

Flows generated onsite will be conveyed to Fort Apache Road, Charleston Boulevard, and the existing drive aisle south of the project site, and ultimately east of the project site.

Table 1 summarizes the results of the existing conditions from the HEC-1 model, which is located in **Appendix B**.

Table 1: Existing Flow Summary Table

BASIN ID/ COMB. PT.	BASIN AREA	10-YR FLOW	100-YR FLOW
	(ac)	(cfs)	(cfs)
EON1	0.65	1	2
CHAR1	0.48	1	2
CP1 EON1+CHAR1	-	2	5
EON2	1.13	2	4
EON3	0.22	<1	1
FORT1	0.55	1	2
CP2 EON3+FORT1	-	2	3

PROPOSED HYDROLOGIC CONDITION

The existing condition drainage patterns remain valid during the proposed condition. Reference material and basin maps can be found in **Appendix F**. A *Proposed Condition Basin Map*, **PR-1**, depicting onsite and offsite drainage patterns, is included in **Appendix F**.

Table 2 summarizes the results of the proposed conditions from the HEC-1 model, which is located in **Appendix B**.

Table 2: Proposed Flow Summary Table

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
DON1	1.17	2	4
DON2	0.70	1	3
DON3	0.13	<1	<1
CHAR1	0.48	1	2
FORT1	0.55	1	2
CP1 DON3+FORT1	-	1	3

The runoff generated from DON1 and DON2 has been prorated to determine onsite flows at specific locations. Prorated calculations were performed by taking the percentage of the total area and multiplying it by the total flowrate. The prorated flow rates are shown below in **Table 3**.

Table 3: Proposed Prorated Flow Summary Table

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
DON1A	0.65	1.11	2.22
DON1B	0.52	0.44	1.78
DON2A	0.06	0.09	0.26
DON2B	0.09	0.13	0.39
DON2C	0.11	0.16	0.47
DON2D	0.43	0.61	1.84
DON3	0.13	<1	<1
CHAR1	0.48	1	2
FORT1	0.55	1	2
CP1 DON3+FORT1	-	1	3

HYDRAULIC CALCULATIONS

STREETS

Table 4 below contains a summary of the hydraulic sections taken along Charleston Boulevard and Fort Apache Road. All street and cross section analyses are included in **Appendix C**; please refer to **PR-1** included in **Appendix A** for the location of each section. The results of the street analysis indicate that the product of depth and velocity are less than 6 for the 10-year storm, and less than 8 for the 100-year storm. Furthermore, the depth within the streets are less than 1 foot during a 10-year storm, and 2 feet during a 100-year storm.

Table 4: Existing Offsite Hydraulic Cross Sections

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D*V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D*V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	2	0.30	2.13	0.64	3	0.34	2.34	0.80	OK

Table 5: Proposed Offsite Hydraulic Cross Sections

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D*V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D*V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	1	0.25	1.83	0.46	3	0.34	2.34	0.80	OK

ONSITE

Appendix C includes seven onsite hydraulic normal depth calculations throughout the project site. The physical characteristics of each cross section were taken from the Grading Plan located in **Appendix F**. Runoff flow rates were obtained from the corresponding onsite basin. The resulting water surface elevation for each cross section was checked to confirm that the finished floor elevation of the proposed building is raised such that the building will be protected from onsite runoff. The finished floor check calculations for each onsite hydraulic section can be found in **Appendix C**. The results indicate that the finished floor elevation of the proposed building is adequately raised above more than twice the depth of flow during the 100-year storm event. **Table 6** below is a summary of hydraulic sections for the proposed condition.

Table 6: Hydraulic Section Summary

SECTION NAME	SLOPE	Q100 (CFS)	FLOW DEPTH (FT)	2*D (ft)	FLOW LINE (ft)	FLOW LINE + 2D	FFE BLDG (ft)	FFE CHECK
HS1	0.50	1.78	0.27	0.54	2745.39	2745.93	2747.25	OK
HS2	1.05	2.22	0.27	0.54	2744.15	2744.69	2747.25	OK
HS3	0.50	2.22	0.32	0.64	2745.79	2746.43	2747.25	OK

PARKING LOT LOW IMPACT DEVELOPMENT (LID)

Per Section 1502.2 of the CCRFCD “Hydrologic Criteria and Drainage Design Manual”, this project is categorized as a Large Parking Lot since the size of the site is approximately +/-2.00 acres.

For the Large parking lot category, treatment BMPs are required to treat stormwater runoff from at least 75 percent of the parking lot. BMPs are sized for the 85th Percentile Rainfall. Please refer to **Appendix D** for all LID calculations and **Appendix F** for **Figure LID, Parking Lot LID Map**.

BMPs incorporated into the project design include landscaped swales. Due to site design and grading constraints, the project site was delineated into three (3) sub-areas; drainage area “DON1”, drainage area “DON2”, and drainage area “DON3” consist of approximately 1.17 acres, 0.70 acres, and 0.13 acres, respectively.

These areas drain to landscaped swales at a minimum of 40 feet long. The proposed swales are rock-lined (d50=3-inches; thickness=6-inches) and treat 75 percent of the parking. Based on hydraulic analysis, these swales will convey, contain and treat the peak BMP discharge (QBMP) as well as facilitate the 100-year peak flow rate; these calculations are included in **Appendix D**. The proposed BMPs are shown on the grading plan included in **Appendix F**.

FINISHED FLOOR ELEVATION

The Clark County Regional Flood Control District requirement for the finish floor elevation (FFE) is that it must be 18 inches above the centerline grade of the adjacent street or be elevated to twice the depth of flow up to 18 inches above the water surface elevation (WSE). Additional criteria requires the finished floor elevation to be 6 inches above adjacent on-site flowline high point.

The finished floor elevation of the proposed building is **2747.25-feet** which does not meet the 18 inches above the centerline of Fort Apache Road, therefore **the project will apply for a finished floor waiver**. Despite this fact, however, the proposed building is set at least twice the depth of flow in Charleston Boulevard and Fort Apache Road, and the proposed driveways along Charleston Boulevard and Fort Apache Road are humped 6-inches above the WSE in the street. The proposed building is set more than 8-inches above the adjacent on-site high point. Please refer to the grading plan included in **Appendix F**.

CONCLUSIONS AND RECOMMENDATIONS

The proposed commercial development will not adversely impact downstream in both the 10-year and 100-year storm events. The development of this project site is in compliance with the CCRFCD *Hydrologic Criteria and Design Manual* and Clark County criteria.

1. This project is in compliance with the applicable drainage laws recognized by the State of Nevada.
2. This project is in compliance with the CCRFCD's "*Master Plan Update*", and will **not** conflict with any Master Planned Facilities.
3. This project is in compliance with the CCRFCD's "*Hydrologic Criteria and Drainage Design Manual*", with the exceptions noted in the study.
4. This project lies within a FEMA designated Flood **Zone X**.
5. The grading for this project has been designed to control and convey the on-site runoff from the 100-year storm safely around the site. In addition, they have been designed based upon generally accepted engineering practices and in accordance with local requirements.
6. A FFE waiver will be obtained where the FFE doesn't meet minimum criteria. However, the FFE's are elevated above the adjacent twice the depth of flow.

REFERENCES

1. Clark County Regional Flood Control District, "*Hydrologic Criteria and Drainage Design Manual*," August 1999, Revise September 2013.
2. Clark County Regional Flood Control District, "*2008/2013 Las Vegas Valley Flood Control Master Plan Update*," September 2008, 2013.
3. *TDS Odette Center; Pentacore*; December 2002 (DS-2832).

LIST OF APPENDICES

Appendix A – Documents & Figures

- EX-1 Existing Conditions Basin Map
- PR-1 Proposed Conditions Basin Map
- Assessor's Parcel Map
- FIRM Exhibit
- Figure F-30 Flood Control Facilities
- Figure H-30 Hydrologic Subareas, Land Use & Soils
- Entitlements – SDR-75332

Appendix B – Hydrologic Parameters & HEC-1 Analyses

- Figure 513 McCarran Airport Rainfall Area
- Table 503 Six-hour Storm Distributions
- Figure 503 Depth-Duration-Frequency Value 10-Year, 6-Hour
- Figure 506 Depth-Duration-Frequency Value 100-Year, 6-Hour
- Table 501 Precipitation Adjustment Ratios
- Table 502 Depth-Area Reduction Factors
- Table 602 page 1 of 4 Runoff Curve Numbers (Urban Areas)
- USDA NRCS Custom Soils Resource Report for Las Vegas Valley
- Existing Condition Standard Form 4
- Existing Condition HEC-1 Output
- Proposed Condition Standard Form 4
- Proposed Condition HEC-1 Output

Appendix C – Hydraulic Calculations

- FlowMaster Hydraulic Sections – Streets
- FlowMaster Hydraulic Sections – Onsite

Appendix D – Parking Lot LID Calculations

- LID LID Basin Map
- Parking Lot Data Calculations
- FlowMaster Hydraulic Sections – Swales
- Riprap Sizing Calculations

Appendix E – Reference Materials

- *Addendum #1 to the Technical Drainage Study for Odette Center; Pentacore.* December 2002

Appendix F – Plans

- C3.0 Grading Plans
- C3.1-C4.3 Detail Sheets



Technical Drainage Study
for

*Chick-fil-A @
Charleston & Fort Apache*

Date Prepared:
February 14, 2019

Prepared for:
Chick-fil-A
1535 Alston Parkway, Suite 350
Irvine, California 92618
404.305.4834

Prepared by:
Kimley-Horn and Associates, Inc.
6671 Las Vegas Boulevard South, Suite 320
Las Vegas, NV 89119
702.862.3600

Kimley»Horn



February 14, 2019

Mr. Albert Sung, P.E.
City of Las Vegas Flood Control
333 Rancho Drive
Las Vegas, NV 89106

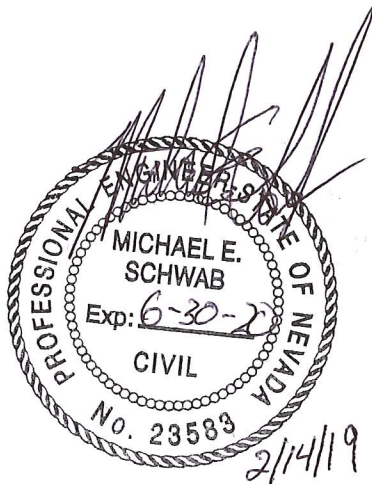
**RE: Technical Drainage Study for Chick-fil-A @ Charleston & Fort Apache
(APN: 163-05-101-002)**

Dear Mr. Sung,

Attached are one (1) copy and one (1) CD of the Technical Drainage Study for *Chick-fil-A @ Charleston & Fort Apache* for your review. The project site consists of a 5,011 sq. foot fast food development and a 4,000 sq. foot retail development. The site will also improve the existing parking lot to incorporate a drive-thru window.

With Kimley-Horn, you should expect more and will experience better. Please contact me at 702.790.0206 or michael.schwab@kimley-horn.com should you have any questions.

Sincerely,



Michael Schwab, P.E.

Adam Lo, E.I.T.

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: Chick-fil-A @ Charleston & Fort Apache Date: February 2019

Location of Development: a) Descriptive (Cross Streets) North/South: Fort Apache Road
East/West: Charleston Boulevard

b) Section: 5 Township: 21S Range: 60E

c) APN : 163-05-101-002

Name of Owner: Crossroads Commons LTD LLC/Chick-fil-A

Telephone No.: 404.305.4834 Fax No.: N/A E-Mail Address: N/A

Address: 851 S Rampart Las Vegas, Nevada 89128

Contact Person-Name: Michael Schwab Telephone No.: 702.790.0206

* E-Mail Address: michael.schwab@kimley-horn.com Fax No.: _____

Firm: KIMLEY-HORN

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

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	GRADING PERMIT

1. Total Owned Land Area: At Site: +/- 16.63 acres Being Developed/Disturbed: +/- 2.0 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

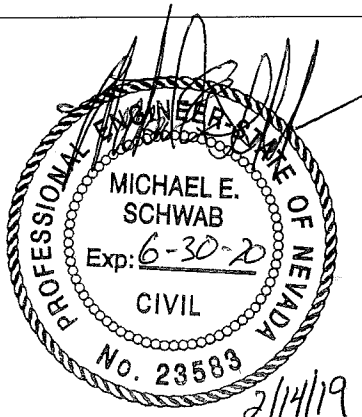
4. Proposed type of development (Residential, Commercial, Etc.): Commercial

5. Approximate upstream land area which drains to the subject site: N/A

6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Technical Drainage Study for Odette Center; Pentacore, February 2001

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Fort Apache Road storm drain to the west, Charleston Blvd to the north and the existing private drive aisle to the south

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.

Local Entity File No.	Revision	Date

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL			
DRAINAGE SUBMITTAL CHECKLIST			
Project Name:	Chick-fil-A @ Charleston/Ft. Apache	Map ID:	
Firm Name:	Kimley-Horn	Engineer:	Michael Schwab
Address:	6671 Las Vegas Boulevard South, Suite 320		
City:	Las Vegas	State:	Nevada
Phone No.:	(702) 862-3600	Zip:	89119
		Fax No.:	
Property Owner:	Crossroads Commons LTD, LLC		
Address:	851 S Rampart Boulevard		
City:	Las Vegas	State:	Nevada
		Zip:	89128
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 (CCRCD) 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 N/A

- | | | | |
|-------------------------------------|--------------------------|-------------------------------------|--|
| ☒ | ☐ | ☐ | Design Manual Standard Form 1 with the Engineer's seal and signature. |
| ☒ | ☐ | ☐ | Design Manual Standard Form 4 . |
| ☒ | ☐ | ☐ | 2 copies of the 24" x 36" Drainage Plan . |
| ☐ | ☐ | ☒ | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |

II. MAPS AND EXHIBITS

YES NO N/A

- | | | | |
|-------------------------------------|--------------------------|--------------------------|--|
| ☒ | ☐ | ☐ | A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated. |
| ☒ | ☐ | ☐ | A copy of the current CCRCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated. |
| ☒ | ☐ | ☐ | Off-site drainage basin maps for existing, interim, and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |

II. MAPS AND EXHIBITS (CONTINUED)

- | | | | |
|-------------------------------------|--------------------------|--------------------------|---|
| ☒ | ☐ | ☐ | Vicinity Map with local and major cross streets identified and a north arrow. |
|-------------------------------------|--------------------------|--------------------------|---|

III. DRAINAGE PLAN

YES	NO	N/A	
☒	☐	☐	Sheet size: 24"x36" 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.
☐	☐	☒	Streets with offset 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 peak flows at basin concentration points.
☒	☐	☐	Concentration points and drainage flow directions with Q_{100} and V_{100} and D_{100} in streets.
☒	☐	☐	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
☒	☐	☐	Location and cross-section of street capacity calculations.
☒	☐	☐	Cross-sectional detail for channels, including cutoff wall locations.

III. DRAINAGE PLAN (CONTINUED)

YES	NO	N/A	
☒	☐	☐	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk ditches, swales, storm drain systems, unimproved channels, and culverts, etc.) stating size, material shape, and slope with plan and profile and HGL calculations.
☐	☐	☒	Existing and proposed drainage easements and widths shown with sufficient detail. A cross-sectional detail must be provided that shows appropriate lining and reinforcement.
☐	☐	☒	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16"x48". Wrought iron gate is required for flows > 10 cfs.
☐	☐	☒	Location and detail of flood-wall(s) illustrating depth of flow, proposed grouting height, etc.
☒	☐	☐	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
☒	☐	☐	Building and/or lot numbers.
☒	☐	☐	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☐	☐	☒	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.
☐	☐	☒	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 the 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	N/A	
☒	☐	☐	Appropriate soil information and Soils Map for existing and future conditions with sub-basins 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 proposed 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 sub-basin 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.

IV. HYDROLOGIC ANALYSIS (CONTINUED)

- | | | | |
|-------------------------------------|--------------------------|--------------------------|--|
| ☒ | ☐ | ☐ | 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) |

V. HYDRAULIC ANALYSIS

YES NO N/A

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



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

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

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

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

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

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
✓		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.
✓		Finished floor elevations for buildings adjacent to public drainage easements must be a minimum of 18 inches above the Q100 weir of submerged weir elevation, whichever is greater.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

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

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

Technical Drainage Study

for

Chick-fil-A @ Charleston & Fort Apache

Date Prepared:

February 14, 2019

Prepared for:

Chick-fil-A

1535 Alston Parkway, Suite 350

Irvine, California 92618

404.305.4834

Prepared by:

Kimley-Horn and Associates, Inc.

6671 Las Vegas Boulevard South, Suite 320

Las Vegas, NV 89119

702.862.3600

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INTRODUCTION

Chick-fil-A @ Charleston & Fort Apache is a commercial development located on the southeast corner (SEC) of Charleston Boulevard and Fort Apache Road. Site improvements consist of a 5,011 sq. foot fast food development and a 4,000 sq. foot retail development. The site will also improve the existing parking lot to incorporate a drive-thru window for the fast food development.

The purpose of this study is as follows:

1. Determine the 10-year and 100-year on-site and off-site peak runoff for existing and developed conditions.
2. Determine the Finish Floor Elevation for the proposed building.
3. Determine the stormwater runoff generated by the 85th Percentile Rainfall for fully developed conditions and recommend on-site water quality structural Best Management Practices (BMP) to meet Parking Lot Low Impact Development (LID) requirements

LOCATION AND DEVELOPMENT DESCRIPTION

The site is located in Section 5, Township 21 South, Range 60 East, and M.D.M. Clark County, Nevada. The project site will develop approximately 2.00 acres at the SEC of Charleston Boulevard and Fort Apache Road. Refer to **Figure 1 – Vicinity Map**. The project site is composed of a portion of Assessor's Parcel Number 163-05-101-002. A copy of the *Assessor's Parcel Map* is included in **Appendix A**.

LAND USE CONDITIONS

The parcel currently has a zoning classification of General Commercial District (C-2). The proposed improvements are consistent with the current zoning. Preliminary Staff Conditions were issued by the Planning Commission on February 12, 2019 (SDR-75322). A copy of SDR-75322 is included in **Appendix A**. Final approval and conditions will be provided once they become available.

PREVIOUS DRAINAGE STUDIES

Previous hydrology studies that were reviewed and referenced as part of the preparation of this report:

1. *TDS Odette Center TDS*; Pentacore. December 2002 (DS-2832).

The *Odette Study*, addresses a retail/office building site downstream east of the project site south of Charleston Boulevard. Per the *Odette Study* all existing runoff west of Fort Apache Road is collected by the existing CCRFCD Facility APP1 0056 located in Fort Apache Road west of the project site.

Kimley-Horn has reviewed the reference studies listed above and is in agreement with the information included therein. The information referenced is for the purpose of determining the existing and future development patterns and quantities of flow adjacent to the proposed project site. Pertinent reference material is included in **Appendix E**.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (CCRFCD) MASTER PLAN FACILITIES

“The Las Vegas Valley Flood Control Master Plan Update”, Figure **F-30**, dated September 2013 (2013 MPU), as prepared by the Clark County Regional Flood Control District (CCRFCD) includes the existing and proposed master planned facilities adjacent to the project site in Fort Apache Road. Per the 2013 MPU, there is an existing CCRFCD Facility west of the project site. The Facility is identified as *APP1 0056*, which is dual (2) - 60” reinforced concrete pipe conveying offsite flows west of the project site and ultimately north and away from the project site. See **Appendix A**.

FLOOD HAZARD DESIGNATION

The Special Flood Hazard Areas for both the unincorporated and the incorporated portions of Clark County, Nevada, are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps. This subject site is located on FEMA Community Panel No. **32003C2145F** effective November 16, 2011. As shown on the *FEMA FIRM Exhibit* (see **Appendix A**), the subject site is located within a flood **Zone X**, which is not a FEMA designated SFHA. Zone X areas are determined to be outside the 0.2% annual flood chance floodplain (500-yr).

HYDROLOGIC METHODOLOGY

The hydrologic model and design of this site development are in compliance with local requirements, including Clark County (CC), the CCRFCD’s “*Hydrologic Criteria and Drainage Design Manual*”, and the CCRFCD’s “*Flood Control Master Plan Update*” (2013 MPU).

HYDROLOGIC MODEL

The hydrologic model utilized in this study is the **HEC-1** Flood Hydrograph Package developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. **HEC-1** is a rainfall runoff event simulation model utilizing an interconnected system of hydrologic and hydraulic components to simulate the surface runoff response of a drainage area to precipitation. The calculations of this study were performed using the SCS Unit Hydrograph of the **HEC-1** Flood Hydrograph Model. The detailed explanation of the theory and background is presented in Section 4 of the SCS National Engineering Handbook and the **HEC-1** User Manual.

PRECIPITATION

According to **Figure 513** of the CCRFCD Manual, the project is **outside** the McCarran Airport Rainfall Area. The precipitation depths used to determine the 10-year and 100-year, six-hour storm event discharges were obtained from **Figures 503** and **506** of the CCRFCD Manual, which can be found in **Appendix B**. Depth-Area-Reduction-Factors (DARF) have not been applied to the point precipitation values used for onsite basins in the HEC-1 analysis. The basin areas analyzed in this study are less than 8 square miles; therefore, the SDN3, six-hour storm distribution from HCDDM **Table 503** has been referenced. **Table 501** and **Table 502** were used to adjust the point rainfall values for the 10-year and 100-year, six-hour storm durations. The precipitation calculations resulted

in point rainfall values of **1.61** inches and **3.00** inches. Refer to **Appendix B** for all referenced Tables and Figures.

CURVE NUMBER

The soils information for the project watershed was referenced from the Soil Survey of Las Vegas Area, Nevada, Part of Clark County” prepared by the United States Department of Agriculture Natural Resources Conservation Services (USDA NRCS). A *Custom Soil Resource Report* for the project site is included in **Appendix B**. The report indicates that the project area is classified as Hydrologic Soil Group “D”. Group “D” is characterized as having high runoff potential. The report indicates that the project area is classified as Soil Type 152.

Onsite subbasins for both existing and proposed conditions referenced a CN value of 95 for a commercial landuse. Offsite streets use a CN of 98 for streets. Refer to **Table 602** in **Appendix B**.

A copy of The *Las Vegas Valley Flood Control Master Plan Update*”, Figure **H-30**, dated September 2008, as prepared by Post, Buckley, Schuh & Jernigan, Inc. (PBS&J), Parsons Brinckerhoff and Louis Berger Group for the CCRFCD is included in **Appendix A** for the purpose of illustrating the Regional’s hydrologic subareas, land use and soils in the area. The proposed project land uses and drainage areas are consistent with the 2013 MPU.

LAG TIME

The time between a brief, heavy rain and maximum runoff rate is called Lag Time. Lag Time can be estimated from historical hydrographs or it can be estimated from specific watershed characteristics such as watershed length, slope and flow impedance. Based on studies of many storm events for a range of watershed conditions, the following empirical relationship between Lag Time (T) and Time of Concentration (T_c) was derived:

$$T = 0.6T_c$$

The Time of Concentration (T_c) is defined as the time required for runoff to the flow from the most remote part of the drainage basin to the outlet or to a combination point. The procedure for calculating the T_c is outlined in **Section 602** of CCRFCD’s *“Hydrologic Criteria and Drainage Design Manual”*. Lag time calculations for this site are included in **Appendix B** as shown on Standard Form 4.

EXISTING HYDROLOGIC CONDITION

The existing condition drainage patterns are depicted on **EX-1**. Offsite drainage flows west of Fort Apache Road are captured by the existing dual (2) – 60" RCP CCRFCD Facility APP1 0056. An *Existing Condition Basin Map*, **EX-1**, depicting onsite and offsite drainage patterns, is included in **Appendix A**.

Flows generated onsite will be conveyed to Fort Apache Road, Charleston Boulevard, and the existing drive aisle south of the project site, and ultimately east of the project site.

Table 1 summarizes the results of the existing conditions from the HEC-1 model, which is located in **Appendix B**.

Table 1: Existing Flow Summary Table

BASIN ID/ COMB. PT.	BASIN AREA	10-YR FLOW	100-YR FLOW
	(ac)	(cfs)	(cfs)
EON1	0.65	1	2
CHAR1	0.48	1	2
CP1 EON1+CHAR1	-	2	5
EON2	1.13	2	4
EON3	0.22	<1	1
FORT1	0.55	1	2
CP2 EON3+FORT1	-	2	3

PROPOSED HYDROLOGIC CONDITION

The existing condition drainage patterns remain valid during the proposed condition. Reference material and basin maps can be found in **Appendix F**. A *Proposed Condition Basin Map*, **PR-1**, depicting onsite and offsite drainage patterns, is included in **Appendix F**.

Table 2 summarizes the results of the proposed conditions from the HEC-1 model, which is located in **Appendix B**.

Table 2: Proposed Flow Summary Table

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
DON1	1.17	2	4
DON2	0.70	1	3
DON3	0.13	<1	<1
CHAR1	0.48	1	2
FORT1	0.55	1	2
CP1 DON3+FORT1	-	1	3

The runoff generated from DON1 and DON2 has been prorated to determine onsite flows at specific locations. Prorated calculations were performed by taking the percentage of the total area and multiplying it by the total flowrate. The prorated flow rates are shown below in **Table 3**.

Table 3: Proposed Prorated Flow Summary Table

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
DON1A	0.65	1.11	2.22
DON1B	0.52	0.44	1.78
DON2A	0.06	0.09	0.26
DON2B	0.09	0.13	0.39
DON2C	0.11	0.16	0.47
DON2D	0.43	0.61	1.84
DON3	0.13	<1	<1
CHAR1	0.48	1	2
FORT1	0.55	1	2
CP1 DON3+FORT1	-	1	3

HYDRAULIC CALCULATIONS

STREETS

Table 4 below contains a summary of the hydraulic sections taken along Charleston Boulevard and Fort Apache Road. All street and cross section analyses are included in **Appendix C**; please refer to **PR-1** included in **Appendix A** for the location of each section. The results of the street analysis indicate that the product of depth and velocity are less than 6 for the 10-year storm, and less than 8 for the 100-year storm. Furthermore, the depth within the streets are less than 1 foot during a 10-year storm, and 2 feet during a 100-year storm.

Table 4: Existing Offsite Hydraulic Cross Sections

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D*V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D*V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	2	0.30	2.13	0.64	3	0.34	2.34	0.80	OK

Table 5: Proposed Offsite Hydraulic Cross Sections

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D*V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D*V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	1	0.25	1.83	0.46	3	0.34	2.34	0.80	OK

ONSITE

Appendix C includes seven onsite hydraulic normal depth calculations throughout the project site. The physical characteristics of each cross section were taken from the Grading Plan located in **Appendix F**. Runoff flow rates were obtained from the corresponding onsite basin. The resulting water surface elevation for each cross section was checked to confirm that the finished floor elevation of the proposed building is raised such that the building will be protected from onsite runoff. The finished floor check calculations for each onsite hydraulic section can be found in **Appendix C**. The results indicate that the finished floor elevation of the proposed building is adequately raised above more than twice the depth of flow during the 100-year storm event. **Table 6** below is a summary of hydraulic sections for the proposed condition.

Table 6: Hydraulic Section Summary

SECTION NAME	SLOPE	Q100 (CFS)	FLOW DEPTH (FT)	2*D (ft)	FLOW LINE (ft)	FLOW LINE + 2D	FFE BLDG (ft)	FFE CHECK
HS1	0.50	1.78	0.27	0.54	2745.39	2745.93	2747.25	OK
HS2	1.05	2.22	0.27	0.54	2744.15	2744.69	2747.25	OK
HS3	0.50	2.22	0.32	0.64	2745.79	2746.43	2747.25	OK

PARKING LOT LOW IMPACT DEVELOPMENT (LID)

Per Section 1502.2 of the CCRFCD "Hydrologic Criteria and Drainage Design Manual", this project is categorized as a Large Parking Lot since the size of the site is approximately +/-2.00 acres.

For the Large parking lot category, treatment BMPs are required to treat stormwater runoff from at least 75 percent of the parking lot. BMPs are sized for the 85th Percentile Rainfall. Please refer to **Appendix D** for all LID calculations and **Appendix F** for **Figure LID, Parking Lot LID Map**.

BMPs incorporated into the project design include landscaped swales. Due to site design and grading constraints, the project site was delineated into three (3) sub-areas; drainage area "DON1", drainage area "DON2", and drainage area "DON3" consist of approximately 1.17 acres, 0.70 acres, and 0.13 acres, respectively.

These areas drain to landscaped swales at a minimum of 40 feet long. The proposed swales are rock-lined (d50=3-inches; thickness=6-inches) and treat 75 percent of the parking. Based on hydraulic analysis, these swales will convey, contain and treat the peak BMP discharge (QBMP) as well as facilitate the 100-year peak flow rate; these calculations are included in **Appendix D**. The proposed BMPs are shown on the grading plan included in **Appendix F**.

FINISHED FLOOR ELEVATION

The Clark County Regional Flood Control District requirement for the finish floor elevation (FFE) is that it must be 18 inches above the centerline grade of the adjacent street or be elevated to twice the depth of flow up to 18 inches above the water surface elevation (WSE). Additional criteria requires the finished floor elevation to be 6 inches above adjacent on-site flowline high point.

The finished floor elevation of the proposed building is **2747.25-feet** which does not meet the 18 inches above the centerline of Fort Apache Road, therefore **the project will apply for a finished floor waiver**. Despite this fact, however, the proposed building is set at least twice the depth of flow in Charleston Boulevard and Fort Apache Road, and the proposed driveways along Charleston Boulevard and Fort Apache Road are humped 6-inches above the WSE in the street. The proposed building is set more than 8-inches above the adjacent on-site high point. Please refer to the grading plan included in **Appendix F**.

CONCLUSIONS AND RECOMMENDATIONS

The proposed commercial development will not adversely impact downstream in both the 10-year and 100-year storm events. The development of this project site is in compliance with the CCRFCD *Hydrologic Criteria and Design Manual* and Clark County criteria.

1. This project is in compliance with the applicable drainage laws recognized by the State of Nevada.
2. This project is in compliance with the CCRFCD's "*Master Plan Update*", and will **not** conflict with any Master Planned Facilities.
3. This project is in compliance with the CCRFCD's "*Hydrologic Criteria and Drainage Design Manual*", with the exceptions noted in the study.
4. This project lies within a FEMA designated Flood **Zone X**.
5. The grading for this project has been designed to control and convey the on-site runoff from the 100-year storm safely around the site. In addition, they have been designed based upon generally accepted engineering practices and in accordance with local requirements.
6. A FFE waiver will be obtained where the FFE doesn't meet minimum criteria. However, the FFE's are elevated above the adjacent twice the depth of flow.

REFERENCES

1. Clark County Regional Flood Control District, "*Hydrologic Criteria and Drainage Design Manual*," August 1999, Revise September 2013.
2. Clark County Regional Flood Control District, "*2008/2013 Las Vegas Valley Flood Control Master Plan Update*," September 2008, 2013.
3. *TDS Odette Center; Pentacore*; December 2002 (DS-2832).

LIST OF APPENDICES

Appendix A – Documents & Figures

- EX-1 Existing Conditions Basin Map
- PR-1 Proposed Conditions Basin Map
- Assessor's Parcel Map
- FIRM Exhibit
- Figure F-30 Flood Control Facilities
- Figure H-30 Hydrologic Subareas, Land Use & Soils
- Entitlements – SDR-75332

Appendix B – Hydrologic Parameters & HEC-1 Analyses

- Figure 513 McCarran Airport Rainfall Area
- Table 503 Six-hour Storm Distributions
- Figure 503 Depth-Duration-Frequency Value 10-Year, 6-Hour
- Figure 506 Depth-Duration-Frequency Value 100-Year, 6-Hour
- Table 501 Precipitation Adjustment Ratios
- Table 502 Depth-Area Reduction Factors
- Table 602 page 1 of 4 Runoff Curve Numbers (Urban Areas)
- USDA NRCS Custom Soils Resource Report for Las Vegas Valley
- Existing Condition Standard Form 4
- Existing Condition HEC-1 Output
- Proposed Condition Standard Form 4
- Proposed Condition HEC-1 Output

Appendix C – Hydraulic Calculations

- FlowMaster Hydraulic Sections – Streets
- FlowMaster Hydraulic Sections – Onsite

Appendix D – Parking Lot LID Calculations

- LID LID Basin Map
- Parking Lot Data Calculations
- FlowMaster Hydraulic Sections – Swales
- Riprap Sizing Calculations

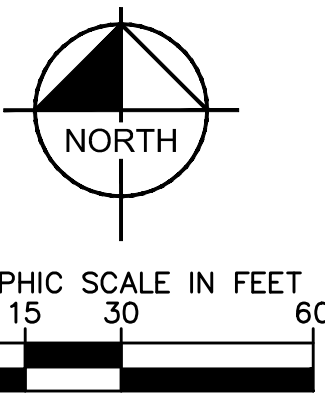
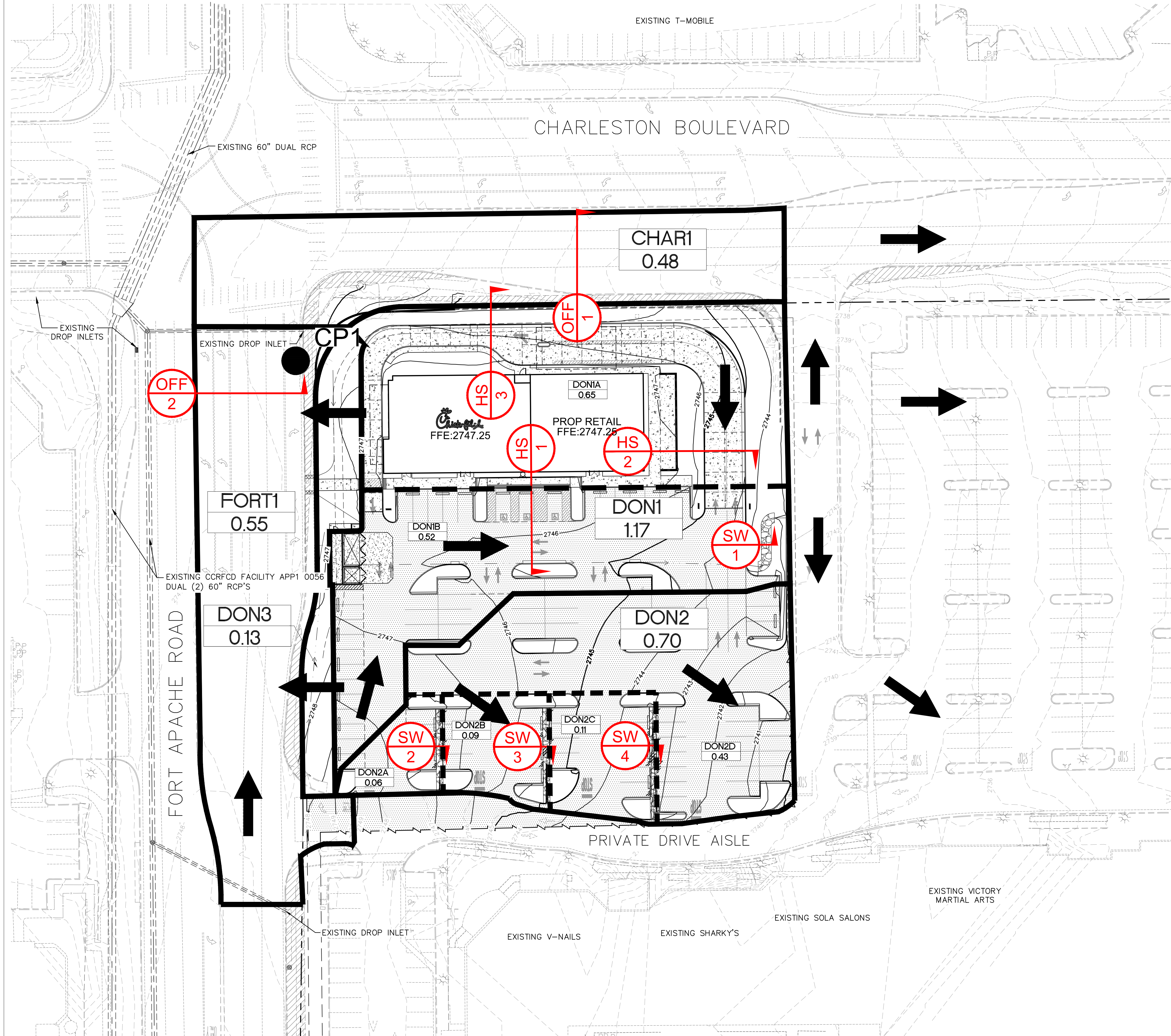
Appendix E – Reference Materials

- *Addendum #1 to the Technical Drainage Study for Odette Center; Pentacore.* December 2002

Appendix F – Plans

- C3.0 Grading Plans
- C3.1-C4.3 Detail Sheets

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LEGEND

SITE 1.20	BASIN ID BASIN AREA
	BASIN BOUNDARY
	PRORATED BASIN BOUNDARY
	FLOW ARROW
XX/XX CFS	10YR/100YR CFS
	SURFACE FLOW ARROW
	CONCENTRATION POINT
	SECTION ID

FLOW SUMMARY TABLE

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
DON1A	0.65	1.11	2.22
DON1B	0.52	0.44	1.78
DON2A	0.06	0.09	0.26
DON2B	0.09	0.13	0.39
DON2C	0.11	0.16	0.47
DON2D	0.43	0.61	1.84
DON3	0.13	<1	<1
CHAR1	0.48	1	2
FORT1	0.55	1	2
CP1	-	1	3
DON3+FORT1	-	1	3

OFFSITE HYDRAULIC SUMMARY TABLE

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D ² V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D ² V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	1	0.25	1.83	0.46	3	0.34	2.34	0.80	OK

ONSITE HYDRAULIC SUMMARY TABLE

SECTION NAME	SLOPE	Q100 (CFS)	FLOW DEPTH (FT)	2 ^D (ft)	FLOW LINE (ft)	FLOW LINE + 2D	FFE BLDG (ft)	FFE CHECK
HS1	1.50	1.78	0.27	0.54	2745.39	2745.93	2747.25	OK
HS2	1.05	2.22	0.27	0.54	2744.15	2744.69	2747.25	OK
HS3	0.50	2.22	0.32	0.64	2745.79	2746.43	2747.25	OK

PRORATED HYDRAULIC SUMMARY TABLE

BASIN ID	BASIN AREA (ac)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)	PRORATED BASIN ID	BASIN AREA (ac)	% OF TOTAL AREA	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
DON1	1.17	2	4	DON1A	0.65	56	1	2
				DON1B	0.52	44	1	2
DON2	0.70	1	3	DON2A	0.06	9	0.17	0.26
				DON2B	0.09	13	0.26	0.39
				DON2C	0.11	16	0.31	0.47
				DON2D	0.43	61	1	2



Chick-fil-A
5200 Buffington Road
Atlanta, Georgia
30349-2998

Kimley-Horn
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6671 LAS VEGAS BLVD S., SUITE 300, LAS VEGAS, NV 89119
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CHICK-FIL-A
CHARLESTON & FT. APACHE
8975 W CHARLESTON BLVD
LAS VEGAS, NV 89117

FSR# 4293

REVISION SCHEDULE
NO. DATE DESCRIPTION

AGENCY # CLV
PROJECT # 092908012
PRINTED FOR PRELIMINARY
DATE 01/21/19
DESIGN BY AL
DRAWN BY AL
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SHEET

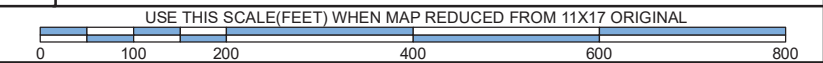
PR-1
SHEET NUMBER

NOTES

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

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

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



MAP LEGEND

- PARCEL BOUNDARY
- SUB BOUNDARY
- PM/LD BOUNDARY
- ROAD EASEMENT
- MATCH / LEADER LINE
- HISTORIC LOT LINE
- HISTORIC SUB BOUNDARY
- HISTORIC PM/LD BOUNDARY
- SECTION LINE
- CONDOMINIUM UNIT
- AIR SPACE PCL
- RIGHT OF WAY PCL
- SUB-SURFACE PCL
- 001 ROAD PARCEL NUMBER
- 001 PARCEL NUMBER
- 1.00 ACREAGE
- 202 PARCEL SUB/SEQ NUMBER
- PB 24-45 PLAT RECORDING NUMBER
- 5 BLOCK NUMBER
- 5 LOT NUMBER
- GL5 GOV. LOT NUMBER

BOOK T21S R60E

27	126	125	124
36	137	138	139
55	164	163	162
74	175	176	177

Scale: 1" = 200'

SEC. 5

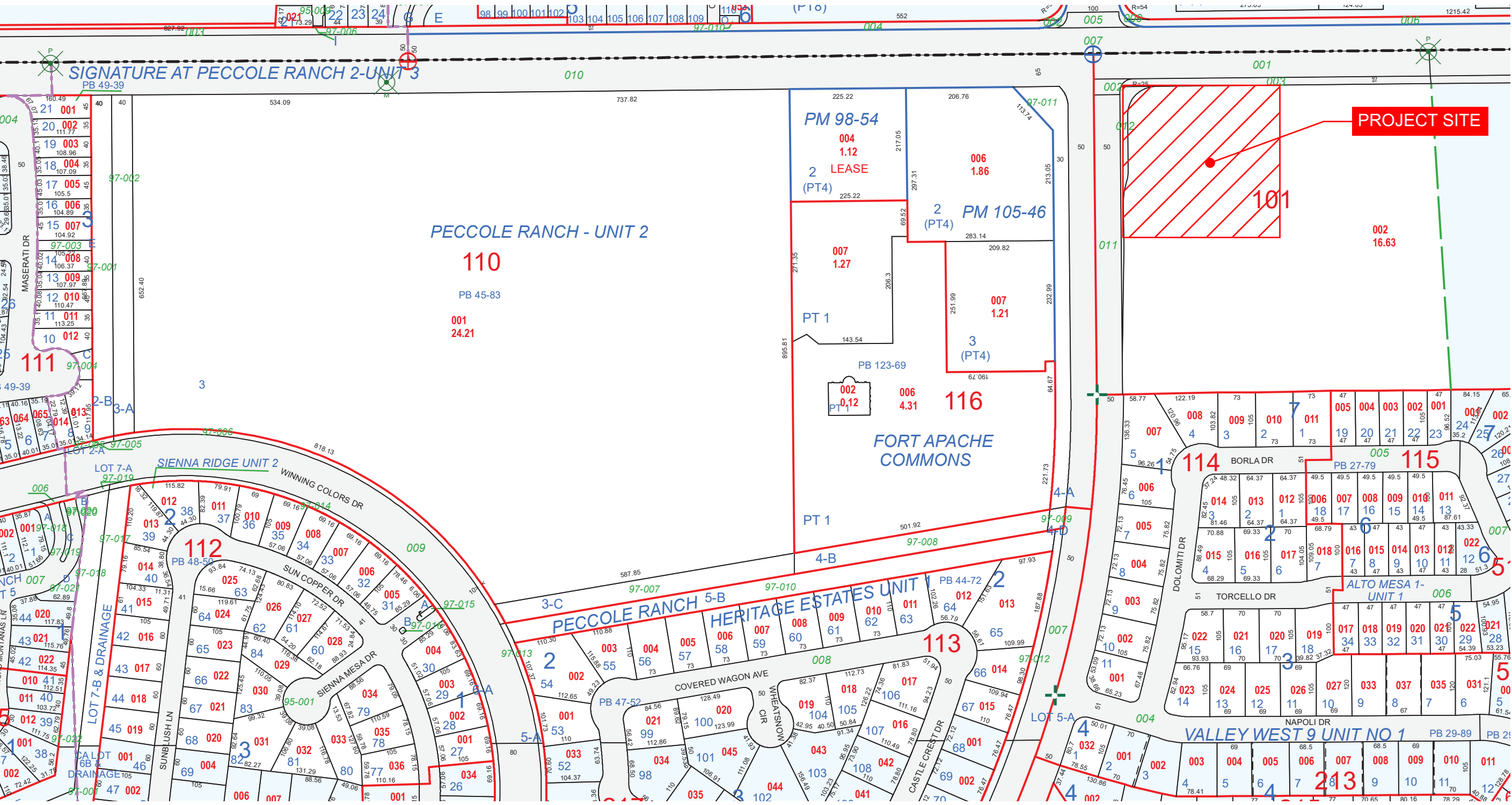
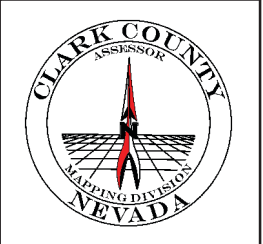
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Rev: 9/19/2018

MAP N 2 NW 4

8	4	8	4
5	1	5	1
6	2	6	2
7	3	7	3
8	4	8	4
5	1	5	1

163-05-1



NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRM for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NGS12
National Geodetic Survey
SSM-3, #R022
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov/>.

Base map information shown on this FIRM was provided in digital format by the Clark County GIS Management Office (GISMO).

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

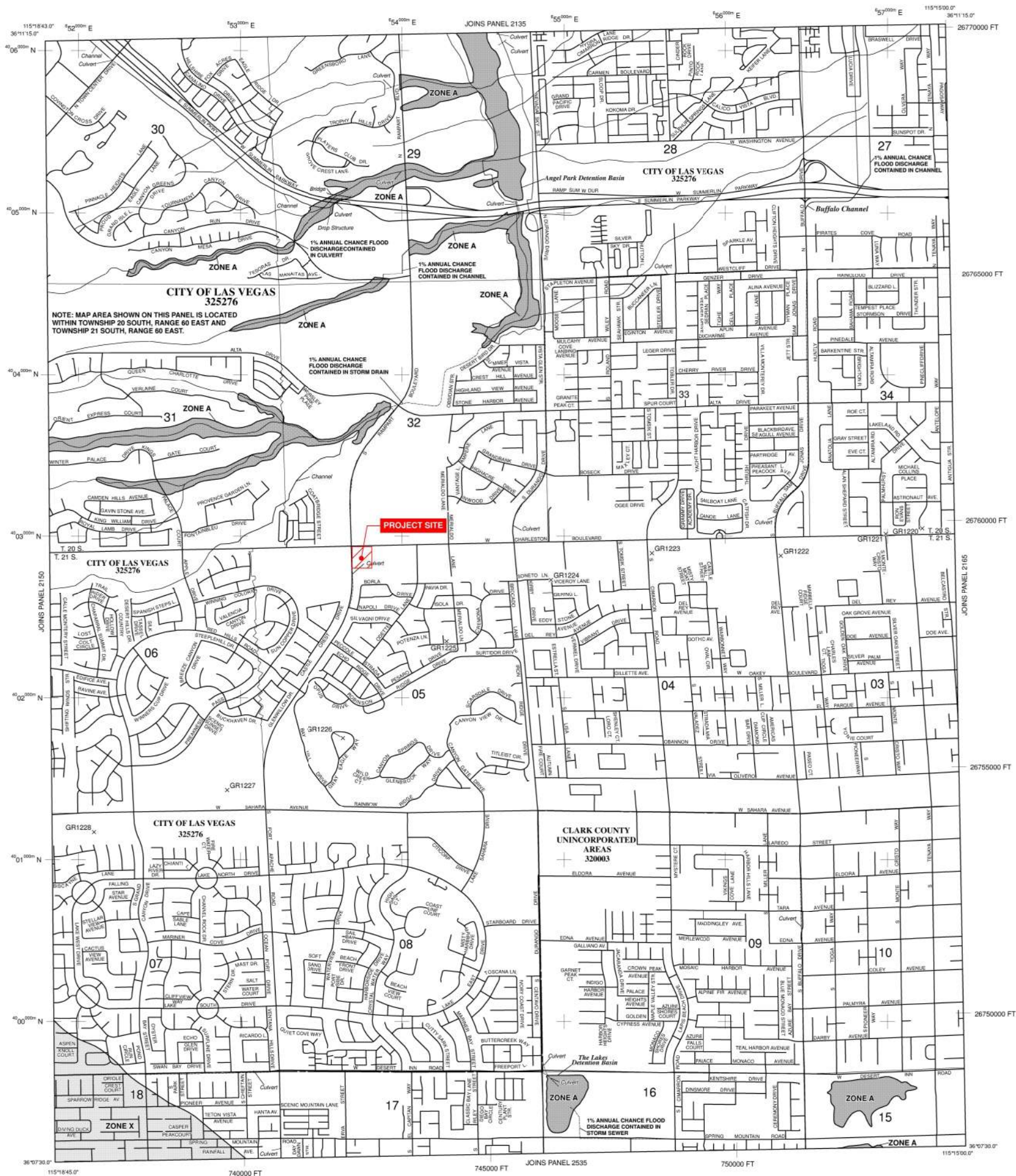
For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Service Center website at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

The Digital Flood Insurance Rate Map (DFIRM) was produced through a unique partnership between Clark County and the Federal Emergency Management Agency (FEMA). Clark County has developed a long-term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the Clark County commitment to share and maintain floodplain layers within their Geographic Information System Management Office (GISMO).

This DFIRM reflects several innovative features. These include:
+ Southern Nevada GIS-Cooperation among local government agencies throughout Clark County. The foundation of cooperation is the GIS Interlocal Agreements formed between fourteen regional participants. In part, the agreements specify that the Clark County GIS Management Office (GISMO) will be responsible for maintaining a GIS data warehouse and associated Southern Nevada GIS metadata.

+ The GISMO's responsibilities go beyond maintaining the GIS data warehouse. GISMO also maintains the Street Centerline Database used by 911 dispatch services. This centerline database serves as the basemap for this DFIRM.

DIGITAL DATA AVAILABILITY: <http://www.co.clark.nv.us/cgit/gismo/gismo.htm>



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

— Floodplain boundary

— Floodway boundary

— Zone D boundary

— CBRS and OPA boundary

— Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Base Flood Elevation line and value; elevation in feet*

Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

— Cross section line

— Transect line

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

1000-meter Universal Transverse Mercator grid ticks, zone 11

5000-foot grid ticks: Nevada State Plane coordinate system, east zone (FIPSZONE 2701), Transverse Mercator

Bench mark (see explanation in Notes to Users section of this FIRM panel)

— River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

August 16, 1995

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

September 27, 2002

November 16, 2011 - to reflect updated topographic information, to change floodway, to add Base Flood Elevations, to update corporate limits, to change Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to delete Special Flood Hazard Areas, to change zone designations, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

500 0 1000 2000 FEET

MAP SCALE 1" = 1000'

300 0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2145F

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

PANEL 2145 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
CLARK COUNTY 320003 2145 F
LAS VEGAS, CITY OF 325276 2145 F

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

MAP NUMBER
32003C2145F
MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
APDG		ANGEL PARK - DURANGO						
0000	E	84" RCP	2600	842	C38B	ALLGOW3	0.79	0.70
0060	E	72" RCP	1901	374	38A	ALLGOW3	0.35	0.96
APMD		ANGEL PARK - MIDDLE BRANCH						
0027	E	1: 12' X 10' and 2: 12' X 2' RCBC @ Canyon Run	170	6048	C11A-3*	ALLGOW4	11.31	3.00
0030	E	Natural Wash	7000	6048	C11A-3*	ALLGOW4	11.31	3.00
0132	E	2: 12"x10' RCBC @ Hualapai	120	6048	C11A-3*	ALLGOW4	11.31	1.00
0133	E	Natural Wash	3015	6048	C11A-3*	ALLGOW4	11.31	3.00
APNO		ANGEL PARK NORTH						
0001	E	1,512 ac-ft Angel Park Detention Basin		9199	ANGLPKIN	ALLGOW5	21.99	
APP1		ANGEL PARK - PECCOLE 1						
0000	E	72" RCP	2982	442	PIC-B	ALLGOW3	0.44	2.40
0056	E	2: 60" RCP	1385	442	PIC-B	ALLGOW3	0.44	2.40
APP2		ANGEL PARK - PECCOLE 2						
0000	E	Grass Chnl 10"W 5"D 2:1 SS	4793	2004	C57B-1	ALLGOW3	1.93	2.10
APSO		ANGEL PARK - SOUTH BRANCH						
0000	E	2: 12' X 12' RCB	2506	4628	CC57B-4	ALLGOW3	5.24	1.62
0020	E	2: 12' X 12' RCBC @ Rampart	350	4628	CC57B-4	ALLGOW3	5.24	1.80
0050	E	Natural Wash	209	4628	CC57B-4	ALLGOW3	5.24	1.84
0067	E	Natural Wash	8300	2384	C57B-2	ALLGOW3	2.67	2.10
0204	E	2: 8' X 8' RCBC @ Hualapai	326	2056	C12B	ALLGOW3	2.00	2.66
0205	E	Natural Wash	2380	2056	C12B	ALLGOW3	2.00	3.46
0254	E	2: 8' X 8' RCBC @ Town Center Dr.	190	1932	C12A	ALLGOW3	1.74	3.00
0255	E	24' X 12' RCAC @ Town Center Dr.	140	1932	C12A	ALLGOW3	1.74	3.00
FLBF		FLAMINGO WASH - BUFFALO						
0152	E	10' X 7' RCB	3460	814	CLF11	FLAM3A	4.29	0.32
0228	E	96" RCP	1330	746	CLF9	FLAM3A	0.94	1.00
0252	E	9' X 6' RCB	170	746	CLF9	FLAM3A	0.94	1.00
0258	E	96" RCP	1140	746	CLF9	FLAM3A	0.94	0.50
0278	E	90" RCP	2640	506	LF8	FLAM3A	0.51	0.50
0328	E	54" RCP	660	506	LF8	FLAM3A	0.51	0.30
FLDI		DESERT INN DRAIN						
0000	E	9' X 6' RCB	190	1145	CLF4	FLAM3A	1.38	2.71
0004	E	96" RCP	2670	1145	CLF4	FLAM3A	1.38	1.00
0050	E	90" RCP	1390	1145	CLF4	FLAM3A	1.38	1.65
0075	E	84" RCP	1010	874	CLF3	FLAM3A	0.94	1.87
0095	E	96" RCP	200	874	CLF3	FLAM3A	0.94	1.87
0100	E	72" RCP	190	277	LF1	FLAM3A	0.37	1.86
0105	E	60" RCP	2510	277	LF1	FLAM3A	0.37	1.85
FLDR		DURANGO COLLECTOR						
0179	E	60" RCP	1810	260	CUFS23	FLAM3A	0.45	1.21
FLDY		FLAMINGO WASH - DARBY STORM DRAIN						
0000	E	84" RCP	100	558	CLF24	FLAM3A	0.76	0.25
0002	E	10' X 3' RCB	50	558	CLF24	FLAM3A	0.76	0.25
0004	E	60" RCP	680	558	CLF24	FLAM3A	0.76	2.80
0013	E	78" RCP	560	558	CLF24	FLAM3A	0.76	1.79
FLLA		FLAMINGO WASH - LATERAL (FLAMINGO/RAINBOW)						
0227	E	93" RCP	1360	640	CLF28	FLAM3B	1.03	0.40
0254	E	90" RCP	2730	403	CLF27	FLAM3A	1.54	0.40
0305	E	1,556 cfs PMF Spillway		1556	CLF25	FLAM3A	1.03	
0306	E	30" RCP with 18" Orifice Outlet	160	29	DIDB	FLAM3A	1.03	0.43
0308	E	62 ac-ft Desert Inn Detention Basin		744	CLF25	FLAM3A	1.03	
0322	E	81" RCP	1370	224	LF25	FLAM3A	0.27	0.50
0345	E	81" RCP	1340	224	LF25	FLAM3A	0.27	0.50
0369	E	72" RCP	670					0.50
0379	E	66" RCP	1320					0.50

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
FLMN		FLAMINGO WASH - MONTESSOURI NORTH STORM DRAIN						
0000	E	78" RCP	1340	558	CLF24	FLAM3A	0.76	0.50
0025	E	72" RCP	1330	558	CLF24	FLAM3A	0.76	0.50
0050	E	66" RCP	500	372	LF23	FLAM3A	0.38	0.50
0060	E	54" RCP	800	372	LF23	FLAM3A	0.38	0.50
0075	E	48" RCP	30	372	LF23	FLAM3A	0.38	0.50
FLMS		FLAMINGO WASH - MONTESSOURI SOUTH STORM DRAIN						
0000	E	54" RCP	630					0.52
FLSM		SPRING MOUNTAIN DRAIN						
0000	E	60" RCP	4590	116	CLF10W	FLAM3A	2.84	2.50
0083	E	36" RCP	570	86	LAKEDB	FLAM3A	2.62	1.90
0086	E	36" RCP Outlet	90	86	LAKEDB	FLAM3A	2.62	
0087	E	143 ac-ft Lakes Detention Basin		1976	CLF7	FLAM3A	2.62	
0088	P1	Upgrade to 165 ac-ft Lakes Detention Basin		1976	CLF7	FLAM3A	2.62	
0100	E	12' X 8' RCB	310	1976	CLF7	FLAM3A	2.62	1.25
0125	E	96" RCP	3040	750	CLF6N	FLAM3A	0.87	0.80
0180	E	90" RCP	2350	526	LF5	FLAM3A	0.49	0.50
GOSO		GOWAN SOUTH FACILITIES						
0297	E	12' X 7' RCB	2124	1825	CW1BB-C	ALLGOW3	2.14	1.60
0336	E	12' X 7' RCB	602	1593	C1-WESTC	ALLGOW3	1.84	3.40
0352	E	2: 8' X 5' RCB	2740	1374	C1-DUCHC	ALLGOW3	1.60	0.73
0404	E	2: 8' X 4' RCB	2660	1125	C1-ALTAC	ALLGOW3	1.32	0.80
0455	E	2: 12' X 4' RCB	350	665	C1-HOLMC	ALLGOW3	0.81	0.30
0462	E	12' X 4' RCB	1330	665	C1-HOLMC	ALLGOW3	0.81	0.30
GOWC		GOWAN SOUTH FACILITIES - WEST CLIFF						
0000	E	24" RCP	5400	257	1-WEST-C	ALLGOW3	0.24	1.67
LCCH		LAS VEGAS CREEK CHANNEL						
0438	E	60" RCP	1090	162	CLC01-C	SW3	1.20	1.60
0458	E	60" RCP	1060	162	CLC01-C	SW3	1.20	1.60
0478	E	60" RCP	1110	162	CLC01-C	SW3	1.20	0.55
0499	E	42" RCP Outlet	660	85	RAINBWDB	SW3	1.11	1.88
0513	E	102 ac-ft Rainbow Detention Basin		970	RAINBWIN	SW3	1.11	
0518	E	60" RCP Connector Pipe Under Rainbow Blvd	670	970	RAINBWIN	SW3	1.11	1.85
LCLO		LAS VEGAS CREEK - LORENZI						
0000	E	7' X 6' RCB	445	265	DAL00A	SW3	0.41	3.37
0008	E	7' X 6' RCB	2415	265	DAL00A	SW3	0.41	0.40
0054	E	7' X 5' RCB	169	265	DAL00A	SW3	0.41	1.00
MEAL		MEADOWS ALTA						
0160	E	36" RCP	2600	331	CUS	SW3	0.56	1.25
0209	E	48" RCP	2500	150	DCR2	SW3	0.41	1.70
0256	E	38" X 60" HERCP	81	150	DCR2	SW3	0.41	1.48
0258	E	48" RCP	275	150	DCR2	SW3	0.41	4.07
MECH		EXTENSION OF MEADOWS / CHARLESTON						
0310	E	24" RCP	1000	32	OAKEYOT	SW3	1.88	1.43
0323	E	15" RCP Outlet	200	32	OAKEYDB	SW3	1.88	
0324	E	201 ac-ft Oakley Detention Basin		1652	OAKEYIN	SW3	1.88	
0334	E	11' X 6' RCB	200	573	C5-OAK-C	SW3	0.56	0.50
0337	E	9' X 6' RCB	520	573	C5-OAK-C	SW3	0.56	0.50
0338	E	10' X 8' RCB	2060	1131	C3A-OAKC	SW3	1.32	1.62
0351	E	90" RCP	1350	573	C5-OAK-C	SW3	0.56	0.50
0378	E	10' X 8' RCB	745	1131	C3A-OAKC	SW3	1.32	2.00
0380	E	66" RCP	385	352	3-HOLM-C	SW3	0.33	2.00
0387	E	66" RCP	300	403	3A-OAK-C	SW3	0.43	3.08
0390	E	83" X 53" RCP	50	352	3-HOLM-C	SW3	0.33	2.00
0400	E	10' X 6' RCB	1890	823	C3-ELP-C	SW3	0.88	1.43
0405	E	66" RCP	1390	403	3A-OAK-C	SW3	0.43	1.00
0410	E	66" RCP	182	352	3-HOLM-C	SW3	0.33	2.00
0420	E	66" RCP	1410	352	3-HOLM-C	SW3	0.33	2.00

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
MECN		MEADOWS - CHARLESTON						
0123	P1	8' X 6' RCB	5200	821	CCH09-C	SW3	0.72	1.64
0223	P1	6' X 5' RCB	2700	422	CCH05-C	SW3	0.34	2.04
RRFA		RED ROCK - FORT APACHE COLLECTOR						
0105	E	78" RCP	1330	463	CUFR22	FLAM3A	0.77	0.94
0130	E	66" RCP	690	331	UFR21	FLAM3A	0.51	0.93
0143	E	48" RCP	1330	331	UFR21	FLAM3A	0.51	2.54
RRHU		RED ROCK - HUALAPAI COLLECTOR						
0015	E	10' X 10' RCB	560	1199	CUFR13N	FLAM3A	1.52	1.30
0025	E	11' X 5.5' RCAP	3310	1199	CUFR13N	FLAM3A	1.52	1.30
0079	E	8' X 6' RCB	2650	981	CUFR11	FLAM3A	1.09	1.30
0129	E	7' X 6' RCB	2630	842	CUFR10	FLAM3A	0.82	1.20

* 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).



2013 LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FACILITY INVENTORY
FIGURE F - 30

LEGEND	ID (Facility Identifier)	AAB			
	Parent Stream Name				
	Stream Name				
	River Mile	0000			
	Distance Above Confluence with Parent Stream (Miles)				
	Miles in Hundredths				
Existing Facility..... E					
Proposed or Modified Facility..... P		Bottom Width..... W			
Contingency Level					
Category B..... P0		Depth..... D			
Master Plan..... P1					
Preliminary Design..... P2		Side Slope, H:V..... SS			
Design..... P3					
Construction Features					
Cast in Place Concrete Pipe..... CIPCP		Reinforced Concrete Arch Culvert..... RCAC			
Corrugated Metal Arch Pipe Culvert..... CMAP		Reinforced Concrete Box..... RCB			
Corrugated Metal Pipe Culvert..... CMPC		Reinforced Concrete Box Culvert..... RCBC			
High Density Polyethylene..... HDPE		Reinforced Concrete Pipe..... RCP			
Horizontal Elliptical Reinforced Concrete Pipe..... HERCP		Reinforced Concrete Pipe Culvert..... RCP			
Reinforced Concrete Arch Pipe..... RCAP		Storm Sewer Pipe..... SSP			



2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

**FIGURE F- 30
FLOOD CONTROL FACILITIES**

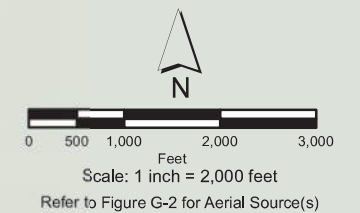
LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin

- 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 |



US95						I-15					
1	2	3				A1	A2				
4	5	6				A3	A4				
7	8	9	10			A5	A6				
11	12	13	14	15	16	17					
18	19	20	21	22	23						
24	25	26	27	28							
29	30	31	32	33	34						
35	36	37	38	39	40						
41	42	43	44	45	46						
47	48	49	50	51	52						
53	54	55	56								
57	58	59									



City of Las Vegas

AGENDA MEMO - PLANNING

PLANNING COMMISSION MEETING DATE: FEBRUARY 12, 2019

DEPARTMENT: PLANNING

ITEM DESCRIPTION: APPLICANT: CHICK-FIL-A, INC. - OWNER: CROSSROADS
COMMONS LTD, LLC

**** STAFF RECOMMENDATION(S) ****

CASE NUMBER	RECOMMENDATION	REQUIRED FOR APPROVAL
SDR-75322	Staff recommends DENIAL, if approved subject to conditions:	

**** NOTIFICATION ****

NEIGHBORHOOD ASSOCIATIONS NOTIFIED 24

NOTICES MAILED 704

PROTESTS 3

APPROVALS 2

**** CONDITIONS ****

SDR-75332 CONDITIONS

Planning

1. 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.
2. All development shall be in conformance with the site plan, landscape plan, and building elevations, date stamped 12/18/18, except as amended by conditions herein.
3. A Waiver from Title 19.08.040 is hereby approved, to not orient the building to the corner where such is required.
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.
6. 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.
7. 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.
8. All City Code requirements and design standards of all City Departments must be satisfied, except as modified herein.

Conditions Page Two
February 12, 2019 - Planning Commission Meeting

Public Works

9. Prior to the issuance of permits, grant a Bus Shelter Pad Easement for a double shelter at the existing bus stop on Charleston Boulevard adjacent to this site unless the Regional Transportation Commission (RTC) acknowledges in writing that this easement is not required.
- 10.. A Traffic Impact Analysis must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits, submittal of any construction drawings or the recordation of a Map subdividing this site, whichever may occur first. Comply with the recommendations of the approved Traffic Impact Analysis prior to occupancy of the site. No recommendation of the approved Traffic Impact Analysis, nor compliance therewith, shall be deemed to modify or eliminate any condition of approval imposed by the Planning Commission or the City Council on the development of this site.
11. An Update to the previously approved Drainage Plan and Technical Drainage Study must be submitted to and approved by the Department of Public Works prior to the issuance of any grading or building permits, submittal of construction drawings or the submittal of a Final Map for this site, whichever may occur first. Provide and improve all drainageways as recommended in the approved drainage plan/study.
12. Site development to comply with all applicable conditions of approval for Site Development Plan Review Z-34-81 and all other applicable site related actions.

Staff Report Page One
February 12, 2019 - Planning Commission Meeting

**** STAFF REPORT ****

PROJECT DESCRIPTION

This is a request for a Site Development Plan Review for a proposed Restaurant with a Drive-Through and General Retail building at 1100 South Fort Apache Road.

ISSUES

- A Waiver from Title 19.08.040 development standards has been requested to not orient the building to the corner where such is required. Staff does not support the request.

ANALYSIS

The subject site has a zoning designation of C-2 (General Commercial), which allows the proposed Restaurant and General Retail use as permitted uses and the Drive-Through as a conditional land use. The applicant proposes to construct a 9,011 square-foot Restaurant with a Drive-Through and General Retail building within the subject shopping center. The restaurant building that currently occupies the desired location of the new restaurant building will be demolished.

Drive Through Conditional Use Regulations:

1. A single-station drive-through shall have a stacking lane that will accommodate a minimum of six vehicles, including the vehicle at the station. A multiple-station drive-through shall have stacking lanes that will accommodate a minimum of three vehicles per station, including the vehicle at that station.

The submitted site plan indicates that the proposed drive through will be a double station drive-through and will provide stacking lanes which will accommodate 21 vehicles.

2. The drive-through shall be screened in accordance with LVMC 19.08.040(F).

The submitted landscaping plan indicates that the proposed development will keep the existing landscape buffer screening as previously approved through Site Development Plan Review [Z-0034-81(11)]. The existing landscaping consists of 15 perimeter trees adjacent to the proposed Restaurant with Drive Through and General Retail building. A large variety of shrubs are located within the landscape buffers. Staff finds this is adequate to provide thorough screening of the proposed drive through. In addition, there is also an existing retaining wall along the north perimeter which will remain.

Staff Report Page Two
February 12, 2019 - Planning Commission Meeting

The subject site is currently developed with a 178,679 square-foot commercial building area within the shopping center. With the proposed demolition of the existing restaurant building and the addition of the new Restaurant with Drive Through and General Retail Building, the total building area for the shopping center will decrease to 172,911 square feet. The submitted building elevations indicate that the proposed structure will have a maximum height of 22 feet with a stucco finish in neutral colors. The submitted floor plan depicts 5,011 square feet of the proposed building dedicated to the Restaurant use and the remaining 4,000 square feet dedicated for a general retail use. The Restaurant side shows a typical layout for a Restaurant with Drive-Through. The dining room seating area will be able to serve 104 patrons. The plan also shows a 305 square-foot play area.

The RTC (Regional Transportation Commission of Southern Nevada) has requested an easement be granted to allow a 5x50 double bus shelter be located behind the sidewalk along the north property line. A condition of approval has been added to address the proposal.

Title 19 requires proposed buildings on corner lots to be oriented to the corner and to the street fronts in order to maintain a strong street edge. The applicant requests to set the proposed building back from the minimum building setback line, separated by a double drive through lane. While the proposed Restaurant with Drive Through and General Retail building are appropriate for the subject site, staff recommends denial of the proposed Site Development Plan Review due to the associated Waiver to allow the proposed building to not orient to the corner. If approved, the entitlement will be subject to conditions.

FINDINGS (SDR-75332)

In order to approve a Site Development Plan Review application, per Title 19.16.100(E) the Planning Commission and/or City Council must affirm the following:

- 1. The proposed development is compatible with adjacent development and development in the area;**

The proposed Restaurant with Drive Through and General Retail building will be located within an existing shopping center development and is compatible with the existing commercial uses in the surrounding area.

- 2. The proposed development is consistent with the General Plan, this Title, and other duly-adopted city plans, policies and standards;**

SDR-75332 [PRJ-75235]

This project is consistent with the General Plan and the uses allowed in the C-2 (General Commercial) zoning district. However, it is not consistent with the building orientation requirement in Title 19.08.

Staff Report Page Three

February 12, 2019 - Planning Commission Meeting

3. **Site access and circulation do not negatively impact adjacent roadways or neighborhood traffic;**

Access to the site will remain from Charleston Boulevard and Fort Apache Road, both Primary Arterial roads, which are adequate in size to service the proposed Restaurant with Drive Through use.

4. **Building and landscape materials are appropriate for the area and for the City;**

The submitted elevations depict a building with a stucco finish in neutral colors, which is consistent with the development in the area. The applicant intends to keep the existing perimeter landscaping. The proposed interior parking lot trees are drought resistant and appropriate for the subject area.

5. **Building elevations, design characteristics and other architectural and aesthetic features are not unsightly, undesirable, or obnoxious in appearance; create an orderly and aesthetically pleasing environment; and are harmonious and compatible with development in the area;**

The submitted building elevations are consistent with the desert environment and surrounding commercial land uses.

6. **Appropriate measures are taken to secure and protect the public health, safety and general welfare.**

The proposed development is subject to permit review and inspection; therefore, appropriate measures will be taken to protect the health, safety and general welfare.

BACKGROUND INFORMATION

<i>Related Relevant City Actions by Planning, Fire, Bldg., etc.</i>	
05/20/81	The City Council approved a Rezoning (Z-0034-81) to C-2 (General Commercial) zoning on this site as part of the overall rezoning of 2,249 acres. The Planning Commission recommended approval.
01/17/01	The City Council approved the overall site development plan for this 152,500 square foot Shopping Center [Z-0034-81(11)]. The Planning Commission recommended approval.
07/16/03	The City Council approved Special Use Permit (SUP-2486) for a Liquor Establishment (Off-Premise Consumption, Beer and Wine) for a Grocery Store at 8855 W. Charleston Boulevard. The Planning Commission and staff recommended approval.

Staff Report Page Four
February 12, 2019 - Planning Commission Meeting

Related Relevant City Actions by Planning, Fire, Bldg., etc.	
12/11/12	The Planning Commission approved Special Use Permit (SUP-47304) for a Tattoo Parlor/Body Piercing Studio at 8975 West Charleston Boulevard, Suite #130. Staff recommended approval.
05/14/13	The Planning Commission approved Special Use Permit (SUP-48783) for a Beer/Wine/Cooler On-Sale Establishment use at 8975 West Charleston Boulevard, Suite #130. Staff recommended approval.

Most Recent Change of Ownership	
03/15/01	A deed was recorded for a change in ownership.

Related Building Permits/Business Licenses	
10/16/12	Building Permit (#C-221758) was issued for interior/exterior upgrades of the existing building at 1100 South Fort Apache. The permit was finalized on 12/03/15.

Pre-Application Meeting	
12/05/18	Staff conducted a pre-application meeting with the applicant where the submittal requirements and deadlines were reviewed for a proposed Site Development Plan Review.

Neighborhood Meeting	
A neighborhood meeting was not required, nor was one held.	

Field Check	
12/27/18	Staff conducted a routine field check and found an active shopping center. No issues were noted.

Details of Application Request	
Site Area	
Net Acres	16.63

Staff Report Page Five
February 12, 2019 - Planning Commission Meeting

<i>Surrounding Property</i>	<i>Existing Land Use Per Title 19.12</i>	<i>Planned or Special Land Use Designation</i>	<i>Existing Zoning District</i>
Subject Property	Shopping Center	SC (Service Commercial)	C-2 (General Commercial)
North	Shopping Center	SC (Service Commercial)	C-1 (Limited Commercial)
South	Single Family, Detached	L (Low Density Residential)	R-PD8 (Residential Planned Development – 8 Units per Acre)
East	Shopping Center	SC (Service Commercial)	C-1 (Limited Commercial)
West	Shopping Center	SC (Service Commercial)	C-1 (Limited Commercial)

<i>Master and Neighborhood Plan Areas</i>	<i>Compliance</i>
No Applicable Master Plan Area	N/A
<i>Special Area and Overlay Districts</i>	<i>Compliance</i>
No Applicable Special Area or Overlay Districts	N/A
<i>Other Plans or Special Requirements</i>	<i>Compliance</i>
Trails	N/A
Las Vegas Redevelopment Plan Area	N/A
Interlocal Agreement	N/A
Project of Significant Impact (Development Impact Notification Assessment)	N/A
Project of Regional Significance	N/A

Staff Report Page Six
February 12, 2019 - Planning Commission Meeting

DEVELOPMENT STANDARDS

Pursuant to Title 19.08, the following standards apply:

Standard	Required/Allowed	Provided	Compliance
Min. Setbacks • Front • Corner	10 Feet 10 Feet	41 Feet 36 Feet	Y Y
Max. Lot Coverage	50 %	24 %	Y
Max. Building Height	N/A	22 Feet	Y
Trash Enclosure	Screened, Gated, w/ a Roof or Trellis	Screened, Gated, w/ a Roof or Trellis	Y
Mech. Equipment	Screened	Screened	Y

Pursuant to Title 19.08 and Site Development Plan Review [Z-0034-81(11)], the following standards apply:

Landscaping and Open Space Standards				
Standards	Required		Provided	Compliance
	Ratio	Trees		
Buffer Trees: • North • West	1 Tree / 20 Linear Feet 1 Tree / 20 Linear Feet	7 Trees 8 Trees	7 Trees 8 Trees	Y Y
TOTAL PERIMETER TREES		15 Trees	15 Trees	Y
Parking Area Trees	1 Tree / 6 Uncovered Spaces, plus 1 tree at the end of each row of spaces	29 Trees	29 Trees	Y
LANDSCAPE BUFFER WIDTHS				
Min. Zone Width • North • West	15 Feet 15 Feet		13 Feet 28 Feet	Y* Y

*The applicant proposes to keep the existing perimeter landscaping as previously approved through Site Development Plan Review [Z-0034-81(11)].

Staff Report Page Seven
February 12, 2019 - Planning Commission Meeting

Street Name	Functional Classification of Street(s)	Governing Document	Actual Street Width (Feet)	Compliance with Street Section
Charleston Boulevard	Primary Arterial	Planned Streets and Highways Map	100	Y
Fort Apache Road	Primary Arterial	Planned Streets and Highways Map	100	Y

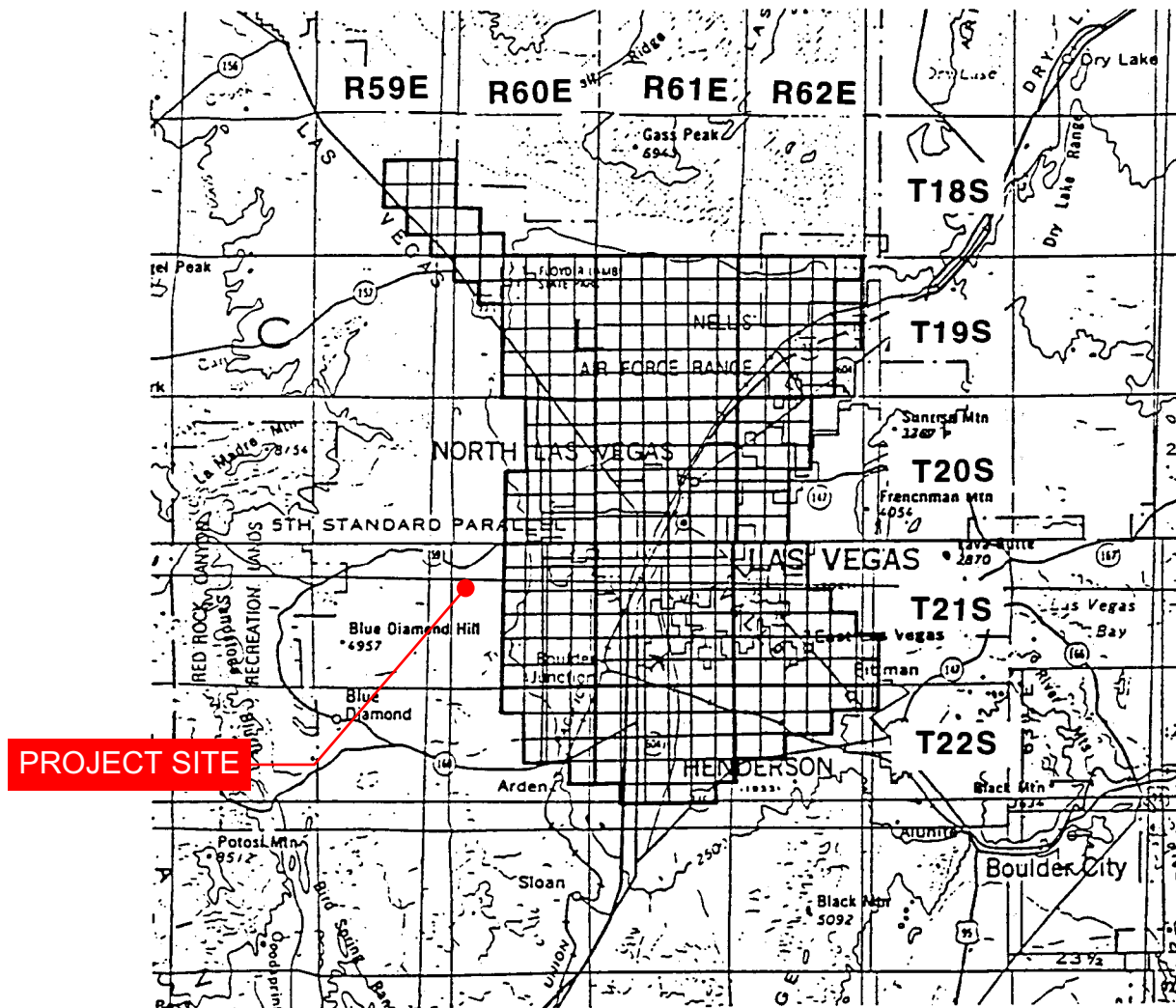
Pursuant to Title 19.08 and 19.12, the following parking standards apply:

Parking Requirement							
Use	Gross Floor Area or Number of Units	Required		Provided		Compliance	
		Parking Ratio	Parking		Parking		
			Regular	Handi-capped	Regular	Handi-capped	
Shopping Center	172,911 SF	1:250	692				
TOTAL SPACES REQUIRED			692		837		Y
Regular and Handicap Spaces Required			678	14	818	19	Y

Waivers		
Requirement	Request	Staff Recommendation
Buildings on corner lots should be oriented to the corner and to the street fronts.	To not orient the proposed buildings to the corner where such is required.	Denial

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



PROJECT SITE

TOWNSHIP	RANGE	SECTIONS	TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36	20 South	62 East	4-9,16-20,29-32
18 South	60 East	30-32	21 South	60 East	1-4,9-16,21-28,33-36
19 South	60 East	1-6,8-16,21-28,33-36	21 South	61 East	ALL SECTIONS
19 South	61 East	ALL SECTIONS	21 South	62 East	4-9,15-23, 25-36
19 South	62 East	2-11,14-23,27-34	22 South	60 East	1-4,10-15,24
20 South	60 East	1-3,10-15,21-28,33-36	22 South	61 East	1-24,26-29
20 South	61 East	ALL SECTIONS	22 South	62 East	1-10,17-18

Notes:

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

Revision	Date

**WRC
ENGINEERING**

REFERENCE:

USACE, Los Angeles District, 1988

FIGURE 513

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

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				

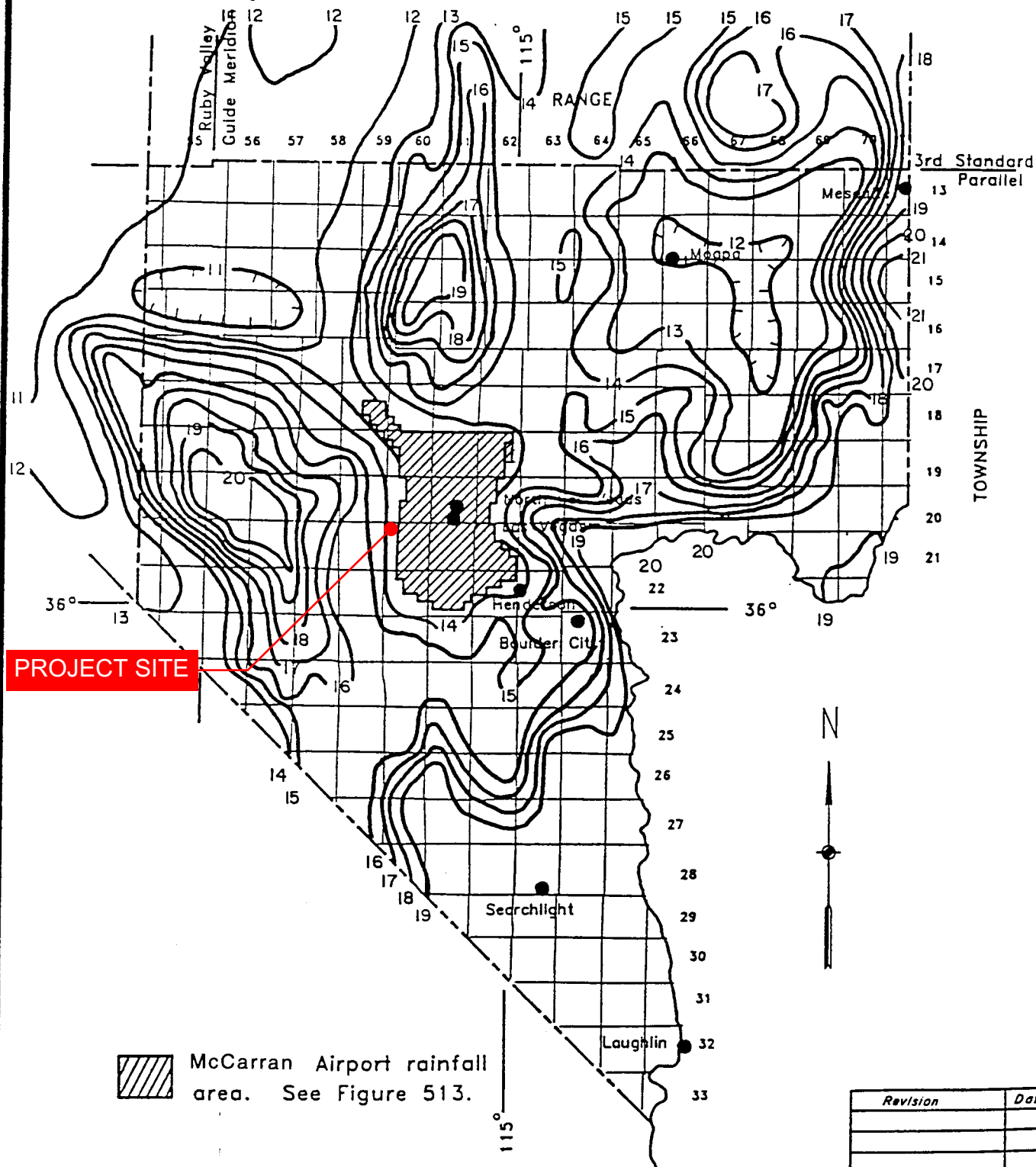
- Notes: 1. For drainage areas less than 8 square miles in size, use SDN 3.
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
 4. A graphical representation of these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

Revision	Date

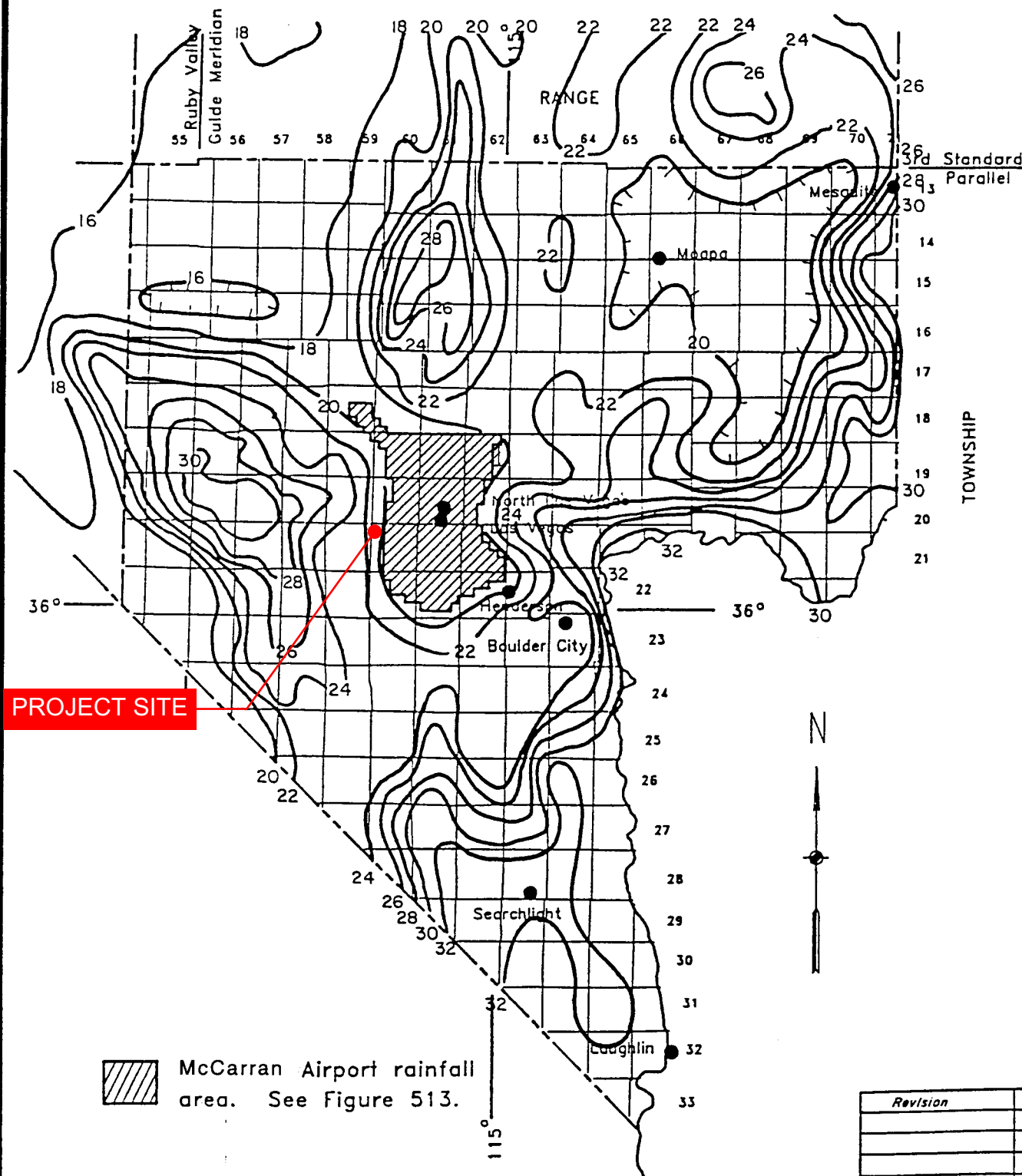
REFERENCE:

TABLE 503

RAINFALL DEPTH-DURATION-FREQUENCY 10-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



RAINFALL DEPTH-DURATION-FREQUENCY 100-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



PRECIPITATION ADJUSTMENT RATIOS

<u>Recurrence Interval</u>	<u>Ratio to NOAA Atlas 2</u>
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

- NOTE: 1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

<i>Revision</i>	<i>Date</i>

**PRECIPITATION DEPTH CALCULATIONS
FOR AREAS OUTSIDE MCCARRAN AIRPORT RAINFALL DATA**

Calculated by:	AL
Checked by:	MS
Project Name:	SUMMERLIN HOTEL
Date:	2/14/2019

10-YEAR STORM EVENT

PRECIPITATION DEPTH: REFERENCE (FIGURES & TABLES FROM CCRFCD MANUAL)
1.30 INCHES FIGURE 503

PRECIPITATION ADJUSTMENT:
1.24 TABLE 501

DEPTH-AREA REDUCTION FACTOR
1.00 TABLE 502

ADJUSTED POINT PRECIPITATION
= 1.60 X 1.24 X 1.00 = **1.61** TABLE 501, NOTE 1

100-YEAR STORM EVENT

PRECIPITATION DEPTH: REFERENCE (FIGURES & TABLES FROM CCRFCD MANUAL)
2.10 INCHES FIGURE 506

PRECIPITATION ADJUSTMENT:
1.43 TABLE 501

DEPTH-AREA REDUCTION FACTOR
1.00 TABLE 502

ADJUSTED POINT PRECIPITATION
= 1.75 X 1.43 X 1.00 = **3.00** TABLE 501, NOTE 1

HEC-1 10-YEAR RATIO

$$\frac{1.61}{3.00} = \mathbf{0.54}$$

HEC-1 100-YEAR RATIO

$$\frac{3.00}{3.00} = \mathbf{1.00}$$

SIX HOUR DEPTH-AREA REDUCTION FACTORS

<u>Drainage Area (Square Miles)</u>	<u>Six-Hour Depth-Area Reduction Factor</u>
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

- NOTES: 1. A graphical representation of these factors is presented in Figure 514.
2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

<i>Revision</i>	<i>Date</i>

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



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Las Vegas Valley Area, Nevada, Part of Clark County



January 8, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County
Survey Area Data: Version 13, Sep 14, 2018

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

Date(s) aerial images were photographed: Sep 26, 2013—Feb 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

Custom Soil Resource Report

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
152	Cave gravelly fine sandy loam, 0 to 4 percent slopes	3.4	100.0%
Totals for Area of Interest		3.4	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Las Vegas Valley Area, Nevada, Part of Clark County

152—Cave gravelly fine sandy loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: hr9v
Elevation: 2,000 to 4,800 feet
Mean annual precipitation: 4 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

Cave and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cave

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 12 inches: gravelly fine sandy loam
H2 - 12 to 36 inches: indurated
H3 - 36 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: 4 to 20 inches to petrocalcic
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)
Hydric soil rating: No

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Custom Soil Resource Report

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TIME OF CONCENTRATION / LAG TIME DETERMINATION - less than 1 mi²



CHICK-FIL-A CHARLESTON/FORT APACHE
SOUTHEAST CORNER OF CHARLESTON & FORT APACHE
EXISTING CONDITIONS

Project No: 092908012
Date: 2/14/19
Calculated by: AL

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)							T _{lag}	REMARKS
Basin ID	DEV./UNDEV. (D or U)	CN	K	AREA	AREA	INITIAL LENGTH	SLOPE	Ti	TRAVEL LENGTH	SLOPE	V ₁	V ₂	Tt	Tc	Tc Check	T _{lag}	
				Ac	Mi ²	Feet	%	Min	Feet	%	VELOCITY	VELOCITY	Min	Min	Min	0.6Tc/60	RAINFALL
				(5a)	(5b)	(6)	(7)	(8)	(9)	(10)	(10a)	(10b)	(11)	(12)	(13)	(14)	(15)
EON1	D	95.0	0.8640	0.65	0.0010	100	2.00	3.4	141	2.00	2.9	4.3	0.8	4.2	11.3	0.042	
EON2	D	95.0	0.8640	1.13	0.0018	46	1.11	2.8	242	3.13	3.6	5.4	1.1	3.9	11.6	0.039	
EON3	D	95.0	0.8640	0.22	0.0003	12	1.00	1.5	22	16.86	8.3	12.6	0.0	1.5	10.2	0.015	
CHAR1	D	98.0	0.9036	0.48	0.0008	82	2.00	2.5	277	2.00	2.9	4.3	1.6	4.2	12.0	0.042	
FORT1	D	98.0	0.9036	0.55	0.0009	37	2.00	1.7	340	2.00	2.9	4.3	2.0	3.7	12.1	0.037	

NOTE:

(1) Subbasin Name

(2) Developed or Undeveloped Subbasin

(3) Curve Number (See Subbasin CN Calculations)

(4) K = 0.0132 (CN) - 0.39

(5a) & (5b) Area

(6) Initial Length

(7) Initial Slope

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

(9) Travel Length

(10) Slope

(10a) Slope V_1 applies to the first 500 feet of travel distance;

Developed $V_1 = 20.2 (S/100)^{1/2}$

(10b) V_2 applies to the remaining travel distance;

Developed $V_2 = 30.6 (S/100)^{1/2}$

(11) $T_t = 500 / (V_1 * 60) + (Travel Length - 500) / (V_2 * 60)$

(12) $T_c = T_i + T_t$

(13) $T_c Check = L / 180 + 10$ (select smaller T_c)

(14) $T_{lag} = 0.6 T_c / 60$

(15) Rainfall in inches

REFERENCE: Calculations based on the Clark County Regional Flood Control District HCDDM

STANDARD FORM 4

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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 14FEB19 TIME 10:52:01
*
*****

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

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

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

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*** FREE ***
*DIAGRAM
1 ID
2 ID *****
3 ID * HYDROLOGIC ANALYSIS *
4 ID * FOR *
5 ID * CFA @ CHARLESTON & FORT APACHE *
6 ID * EXISTING CONDITION *
7 ID *
8 ID *****
9 ID
10 ID *****
11 ID * 10 & 100 YEAR *
12 ID * STORM EVENT *
13 ID *****
14 ID
*DIAGRAM
15 IT 5 0 0 300
16 IO 5 0 0
17 IN 5 0 0
18 JR PREC .54 1.0
19 KK EON1
20 KM ONSITE EXISTING AREA EON1
21 BA .0010
22 PB 3.00
23 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
24 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
25 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
26 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
27 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
28 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
29 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
30 PC .998 .999 1.00
31 LS 0 95
32 UD .042
*
33 KK CHAR1
34 KM OFFSITE ROADWAY CHARLESTON BOULEVARD
35 BA .0008
36 LS 0 98
37 UD .042
*
38 KK CP1
39 KM COMBINATION POINT OF CHAR1 & EON1
40 HC 2
*

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1 HEC-1 INPUT PAGE 2

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
41 KK EON2
42 KM ONSITE EXISTING AREA EON2
43 BA .0018
44 LS 0 95
45 UD .039
*

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46      KK      EON3
47      KM      ONSITE EXISTING AREA EON3
48      BA      .0003
49      LS      0      95
50      UD      .015
      *

51      KK      FORT1
52      KM      OFFSITE ROADWAY FORT APACHE ROAD
53      BA      .0009
54      LS      0      98
55      UD      .037
      *

56      KK      CP2
57      KM      COMBINATION POINT OF FORT1 & EON3
58      HC      2
      *
59      ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

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

19      EON1
      .
33      .      CHAR1
      .
38      CP1.....
      .
41      .      EON2
      .
46      .      .      EON3
      .
51      .      .      .      FORT1
      .
56      .      .      CP2.....

```

(*** RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*      FLOOD HYDROGRAPH PACKAGE (HEC-1)
*      JUN 1998
*      VERSION 4.1
*      RUN DATE 14FEB19 TIME 10:52:01
*
*****

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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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*****
*      HYDROLOGIC ANALYSIS
*      FOR
*      CFA @ CHARLESTON & FORT APACHE
*      EXISTING CONDITION
*
*****

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*****
*      10 & 100 YEAR
*      STORM EVENT
*
*****

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

IT      HYDROGRAPH TIME DATA
      NMIN      5      MINUTES IN COMPUTATION INTERVAL
      IDATE      1      0      STARTING DATE
      ITIME      0000      STARTING TIME
      NQ      300      NUMBER OF HYDROGRAPH ORDINATES
      NDDATE      2      0      ENDING DATE
      NDTIME      0055      ENDING TIME
      ICENT      19      CENTURY MARK

      COMPUTATION INTERVAL      .08 HOURS
      TOTAL TIME BASE      24.92 HOURS

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

```

SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.54 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 .54	RATIO 2 1.00
HYDROGRAPH AT +	EON1	.00	1 FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT +	CHAR1	.00	1 FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT +	CP1	.00	1 FLOW TIME	2. 3.50	5. 3.50
HYDROGRAPH AT +	EON2	.00	1 FLOW TIME	2. 3.50	4. 3.50
HYDROGRAPH AT +	EON3	.00	1 FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT +	FORT1	.00	1 FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT +	CP2	.00	1 FLOW TIME	2. 3.50	3. 3.50

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

TIME OF CONCENTRATION / LAG TIME DETERMINATION - less than 1 mi2



NORTHPOINT SELF-STORAGE SOUTHEAST CORNER OF RAINBOW BLVD & BUCKSKIN AVE PROPOSED CONDITIONS

Project No: 192016003
Date: 2/14/19
Calculated by: AL

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)							T _{lag}	REMARKS
Basin ID	DEV./UNDEV. (D or U)	CN	K	AREA	AREA	INITIAL LENGTH	SLOPE	Ti	TRAVEL LENGTH	SLOPE	V ₁	V ₂	Tt	Tc	Tc Check	T _{lag}	
				Ac	Mi ²	Feet	%	Min	Feet	%	VELOCITY	VELOCITY	Min	Min	Min	0.6Tc/60	RAINFALL
				(5a)	(5b)	(6)	(7)	(8)	(9)	(10)	(10a)	(10b)	(11)	(12)	(13)	(14)	(15)
DON1	D	95.0	0.8640	1.1700	0.0018	133	2.11	3.8	197	1.30	2.3	3.5	1.4	5.2	11.8	0.052	
DON2	D	95.0	0.8640	0.7000	0.0011	93	2.14	3.2	168	3.36	3.7	5.6	0.8	3.9	11.5	0.039	
DON3	D	95.0	0.8640	0.1300	0.0002	13	2.85	1.1	14	4.00	4.0	6.1	0.1	1.1	10.2	0.011	
CHAR1	D	98.0	0.9036	0.4800	0.0008	82	2.00	2.5	277	2.00	2.9	4.3	1.6	4.2	12.0	0.042	
FORT1	D	98.0	0.9036	0.5500	0.0009	37	2.00	1.7	340	2.00	2.9	4.3	2.0	3.7	12.1	0.037	

NOTE:

- | | | | |
|---|--|---|-------------------------|
| (1) Subbasin Name | (7) Initial Slope | (10b) V ₂ applies to the remaining travel distance; | (15) Rainfall in inches |
| (2) Developed or Undeveloped Subbasin | (8) $T_i = 1.8 (1.1 - K) L^{1/2} / S^{1/3}$ | Developed V ₂ = $30.6(S/100)^{1/2}$ | |
| (3) Curve Number (See Subbasin CN Calculations) | (9) Travel Length | (11) $T_t = 500/(V_1 \cdot 60) + (\text{Travel Length} - 500)/(V_2 \cdot 60)$ | |
| (4) K = 0.0132 (CN) - 0.39 | (10) Slope | (12) Tc = T _i + T _t | |
| (5a) & (5b) Area | (10a) Slope V ₁ applies to the first 500 feet of travel distance; | (13) Tc Check = L/180+10 (select smaller Tc) | |
| (6) Initial Length | Developed V ₁ = $20.2(S/100)^{1/2}$ | (14) Tlag = 0.6 Tc/60 | |

REFERENCE: Calculations based on the Clark County Regional Flood Control District HCDDM

STANDARD FORM 4

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 14FEB19 TIME 10:58:18
*
*****

```

```

*****
*
* 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
XXXXXXX XXXX X XXXXX 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
*** FREE ***
*DIAGRAM
1 ID
2 ID *****
3 ID * HYDROLOGIC ANALYSIS *
4 ID * FOR *
5 ID * CFA @ CHARLESTON & FORT APACHE *
6 ID * PROPOSED CONDITION *
7 ID *
8 ID *****
9 ID
10 ID *****
11 ID * 10 & 100 YEAR *
12 ID * STORM EVENT *
13 ID *****
14 ID
*DIAGRAM
15 IT 5 0 0 300
16 IO 5 0 0
17 IN 5 0 0
18 JR PREC .54 1.0
19 KK DON1
20 KM ONSITE DEVELOPED AREA DON1
21 BA .0018
22 PB 3.00
23 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
24 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
25 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
26 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
27 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
28 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
29 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
30 PC .998 .999 1.00
31 LS 0 95
32 UD .052
*
33 KK CHAR1
34 KM OFFSITE ROADWAY CHARLESTON BOULEVARD
35 BA .0008
36 LS 0 98
37 UD .042
*
38 KK DON2
39 KM ONSITE DEVELOPED AREA DON2
40 BA .0011
41 LS 0 95
42 UD .034
*

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
43 KK DON3
44 KM ONSITE EXISTING AREA EON3
45 BA .0002
46 LS 0 95
47 UD .018

```



```

*
48      KK  FORT1
49      KM  OFFSITE ROADWAY FORT APACHE ROAD
50      BA  .0009
51      LS  0      98
52      UD  .037
*
53      KK  CP1
54      KM  COMBINATION POINT OF FORT1 & EON3
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

19      DON1
.
.
33      .      CHAR1
.
.
38      .      .      DON2
.
.
43      .      .      DON3
.
.
48      .      .      .      FORT1
.
.
53      .      .      .      CP1.....

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 14FEB19 TIME 10:58:18
*
*****

```

```

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

```

```

*****
* HYDROLOGIC ANALYSIS
* FOR
* CFA @ CHARLESTON & FORT APACHE
* PROPOSED CONDITION
*
*****
*
* 10 & 100 YEAR
* STORM EVENT
*
*****

```

```

16 IO      OUTPUT CONTROL VARIABLES
          IPRT 5 PRINT CONTROL
          IPLOT 0 PLOT CONTROL
          QSCAL 0. HYDROGRAPH PLOT SCALE

IT      HYDROGRAPH TIME DATA
          NMIN 5 MINUTES IN COMPUTATION INTERVAL
          IDATE 1 0 STARTING DATE
          ITIME 0000 STARTING TIME
          NQ 300 NUMBER OF HYDROGRAPH ORDINATES
          NDDATE 2 0 ENDING DATE
          NDTIME 0055 ENDING TIME
          ICENT 19 CENTURY MARK

          COMPUTATION INTERVAL .08 HOURS
          TOTAL TIME BASE 24.92 HOURS

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

JP      MULTI-PLAN OPTION
          NPLAN 1 NUMBER OF PLANS

JR      MULTI-RATIO OPTION
          RATIOS OF PRECIPITATION

```

.54 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
				.54	1.00
HYDROGRAPH AT					
+	DON1	.00	1 FLOW	2.	4.
			TIME	3.50	3.50
HYDROGRAPH AT					
+	CHAR1	.00	1 FLOW	1.	2.
			TIME	3.50	3.50
HYDROGRAPH AT					
+	DON2	.00	1 FLOW	1.	3.
			TIME	3.50	3.50
HYDROGRAPH AT					
+	DON3	.00	1 FLOW	0.	0.
			TIME	3.50	3.50
HYDROGRAPH AT					
+	FORT1	.00	1 FLOW	1.	2.
			TIME	3.50	3.50
2 COMBINED AT					
+	CP1	.00	1 FLOW	1.	3.
			TIME	3.50	3.50

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

Worksheet for OFF1 Q10

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.03180 ft/ft
Discharge 1.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.21 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.33 ft²
Wetted Perimeter 4.65 ft
Hydraulic Radius 0.07 ft
Top Width 4.47 ft
Normal Depth 0.21 ft

Worksheet for OFF1 Q10

Results

Critical Depth	0.25	ft
Critical Slope	0.00759	ft/ft
Velocity	3.02	ft/s
Velocity Head	0.14	ft
Specific Energy	0.35	ft
Froude Number	1.96	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.25	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00759	ft/ft

Cross Section for OFF1 Q10

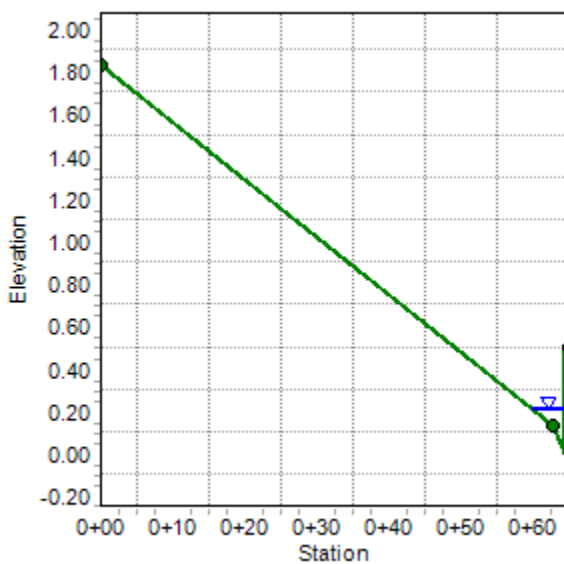
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.21	ft	
Discharge	1.00	ft ³ /s	CHAR1

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.21*(3.02) = 0.63 < 6 \quad \text{OK}$$

DRY LANE CHECK

$$\begin{aligned} WSE &= 0.0 + 0.21 = 0.21 \\ (1.83 - 0.21) / 0.0318 &= 51' > 12' \quad \text{OK} \end{aligned}$$

Worksheet for OFF2 Q10 EX

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.30 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.94 ft²
Wetted Perimeter 8.34 ft
Hydraulic Radius 0.11 ft
Top Width 8.07 ft
Normal Depth 0.30 ft

Worksheet for OFF2 Q10 EX

Results

Critical Depth	0.31	ft
Critical Slope	0.00732	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	0.37	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.31	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00732	ft/ft

Cross Section for OFF2 Q10 EX

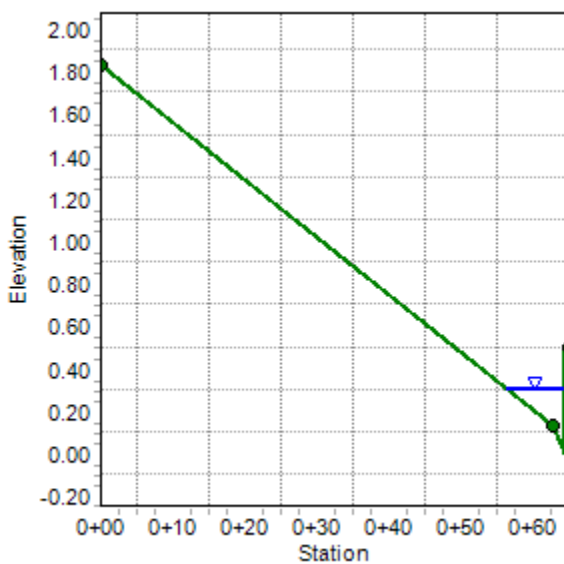
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.30	ft	
Discharge	2.00	ft ³ /s	FORT1+DON3

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.30*(2.13) = 0.64 < 6$$

OK

DRY LANE CHECK

$$WSE = 0.0 + 0.30 = 0.30$$

$$(1.83 - 0.30) / 0.009 = 170' > 12'$$

OK

Worksheet for OFF2 Q10 PR

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 1.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.25 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.55 ft²
Wetted Perimeter 6.23 ft
Hydraulic Radius 0.09 ft
Top Width 6.01 ft
Normal Depth 0.25 ft

Worksheet for OFF2 Q10 PR

Results

Critical Depth	0.25	ft
Critical Slope	0.00783	ft/ft
Velocity	1.83	ft/s
Velocity Head	0.05	ft
Specific Energy	0.30	ft
Froude Number	1.07	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.25	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00783	ft/ft

Worksheet for OFF1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03180	ft/ft
Discharge	2.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth	0.25	ft
Elevation Range	0.00 to 1.83 ft	
Flow Area	0.57	ft ²
Wetted Perimeter	6.40	ft
Hydraulic Radius	0.09	ft
Top Width	6.18	ft
Normal Depth	0.25	ft

Worksheet for OFF1

Results

Critical Depth	0.31	ft
Critical Slope	0.00717	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	0.44	ft
Froude Number	2.01	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.31	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00717	ft/ft

Cross Section for OFF1

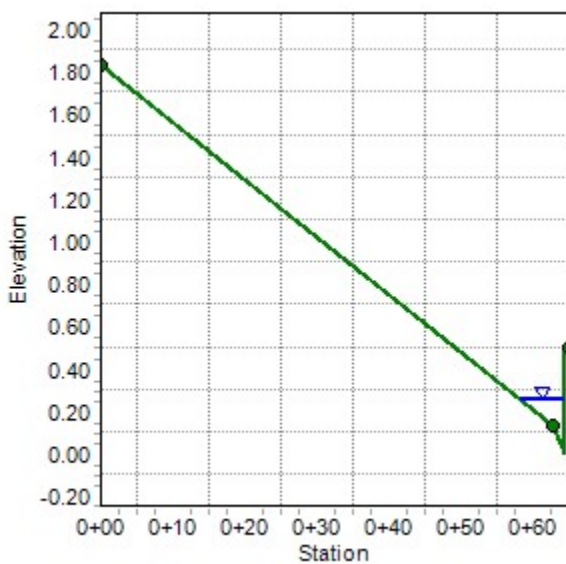
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.25	ft	
Discharge	2.00	ft ³ /s	CHAR1

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.25*(3.48) = 0.87 < 8$$

OK

Worksheet for OFF2 Q100 EX

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 3.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.34 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 1.28 ft²
Wetted Perimeter 9.83 ft
Hydraulic Radius 0.13 ft
Top Width 9.53 ft
Normal Depth 0.34 ft

Worksheet for OFF2 Q100 EX

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 EX

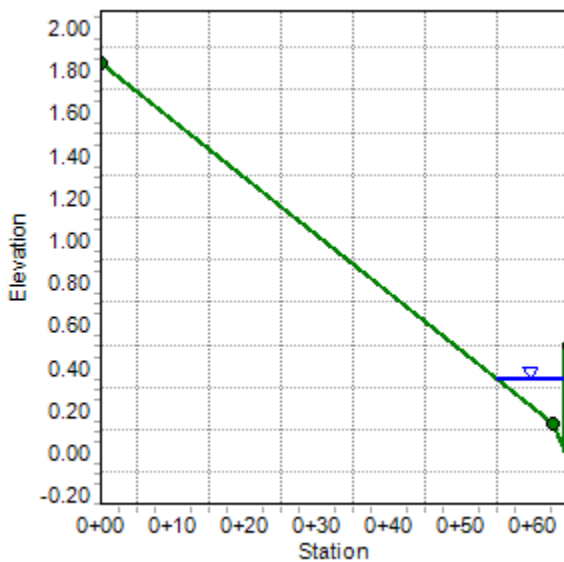
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK

Worksheet for OFF2 Q100 PR

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 3.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.34 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 1.28 ft²
Wetted Perimeter 9.83 ft
Hydraulic Radius 0.13 ft
Top Width 9.53 ft
Normal Depth 0.34 ft

Worksheet for OFF2 Q100 PR

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 PR

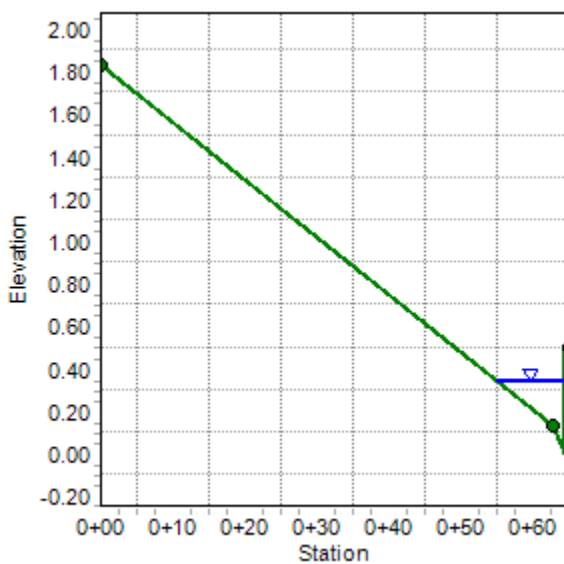
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK

Worksheet for HS1

Results

Hydraulic Radius	0.13	ft
Top Width	7.76	ft
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Critical Slope	0.00763	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.05	ft
Specific Energy	0.32	ft
Froude Number	0.82	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00763	ft/ft

Cross Section for HS1

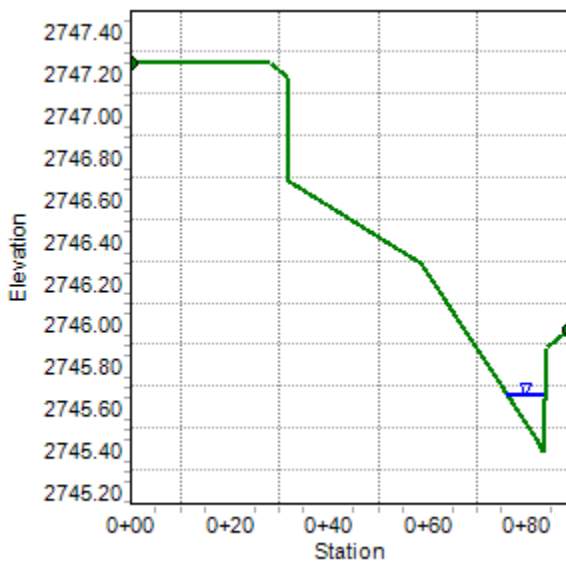
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.27	ft
Discharge	1.78	ft ³ /s

Cross Section Image



Worksheet for HS2

Results

Hydraulic Radius	0.10	ft
Top Width	10.64	ft
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Critical Slope	0.00819	ft/ft
Velocity	2.04	ft/s
Velocity Head	0.06	ft
Specific Energy	0.31	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Channel Slope	0.01050	ft/ft
Critical Slope	0.00819	ft/ft

Cross Section for HS2

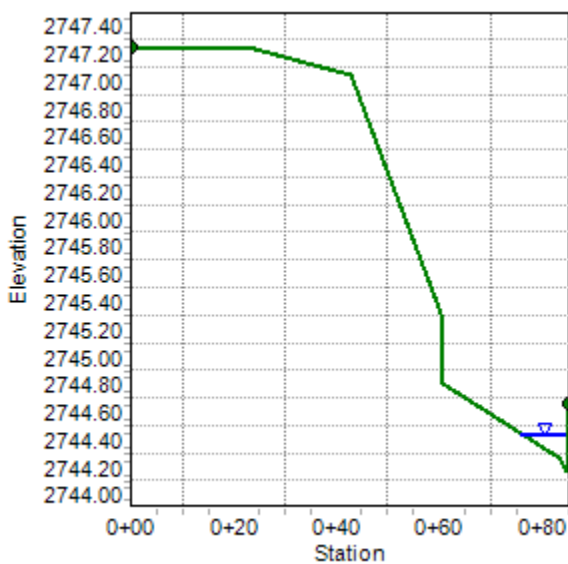
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01050	ft/ft
Normal Depth	0.27	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Worksheet for HS3

Results

Top Width	8.43	ft
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Critical Slope	0.00742	ft/ft
Velocity	1.80	ft/s
Velocity Head	0.05	ft
Specific Energy	0.37	ft
Froude Number	0.83	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00742	ft/ft

Cross Section for HS3

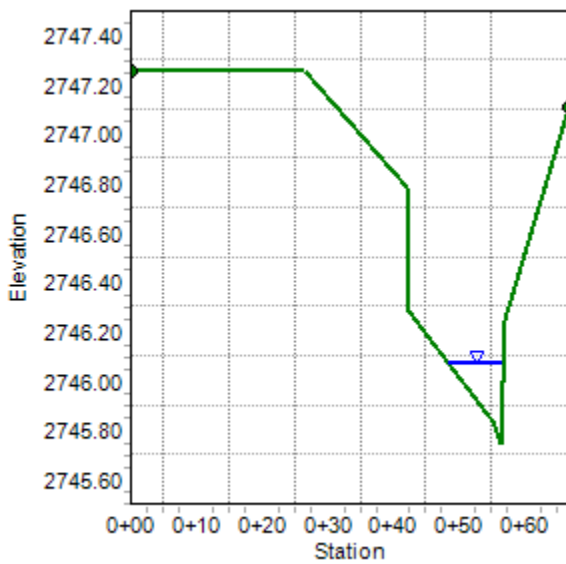
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.32	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Worksheet for HS1

Results

Hydraulic Radius	0.13	ft
Top Width	7.76	ft
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Critical Slope	0.00763	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.05	ft
Specific Energy	0.32	ft
Froude Number	0.82	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00763	ft/ft

Cross Section for HS1

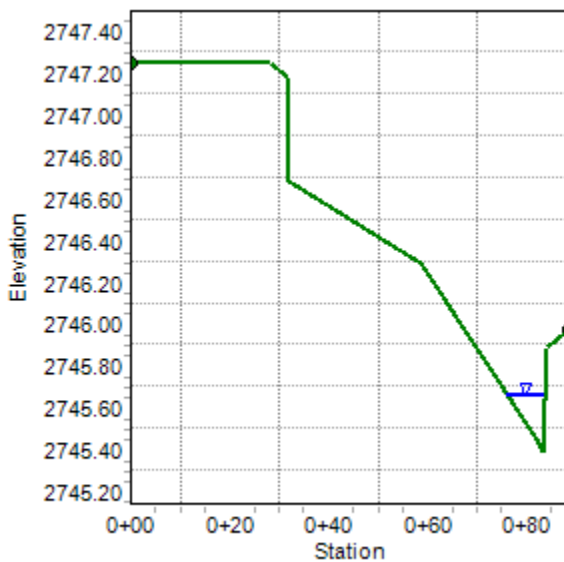
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.27	ft
Discharge	1.78	ft ³ /s

Cross Section Image



Worksheet for HS2

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.01050 ft/ft
Discharge 2.22 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2747.25
0+23.90	2747.23
0+42.89	2747.04
0+60.17	2745.31
0+60.67	2744.81
0+83.13	2744.26
0+84.67	2744.16
0+85.17	2744.66
0+91.23	2744.19

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2747.25)	(0+91.23, 2744.19)	0.016

Options

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

Results

Normal Depth 0.25 ft
Elevation Range 2744.16 to 2747.25 ft
Flow Area 1.09 ft²
Wetted Perimeter 10.97 ft

Worksheet for HS2

Results

Hydraulic Radius	0.10	ft
Top Width	10.64	ft
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Critical Slope	0.00819	ft/ft
Velocity	2.04	ft/s
Velocity Head	0.06	ft
Specific Energy	0.31	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Channel Slope	0.01050	ft/ft
Critical Slope	0.00819	ft/ft

Cross Section for HS2

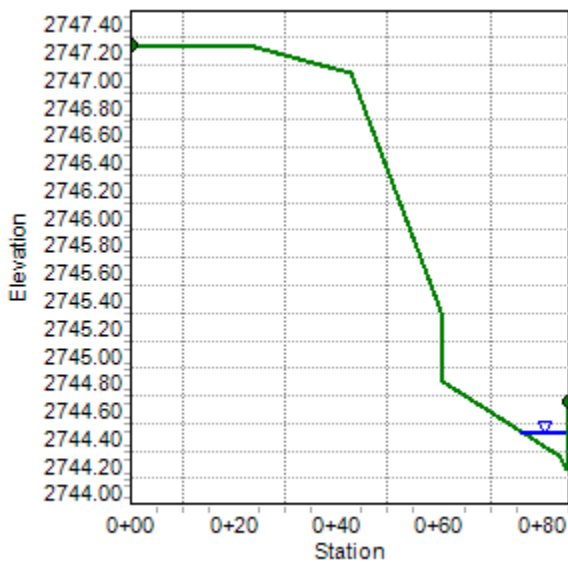
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01050	ft/ft
Normal Depth	0.27	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Worksheet for HS3

Results

Top Width	8.43	ft
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Critical Slope	0.00742	ft/ft
Velocity	1.80	ft/s
Velocity Head	0.05	ft
Specific Energy	0.37	ft
Froude Number	0.83	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00742	ft/ft

Cross Section for HS3

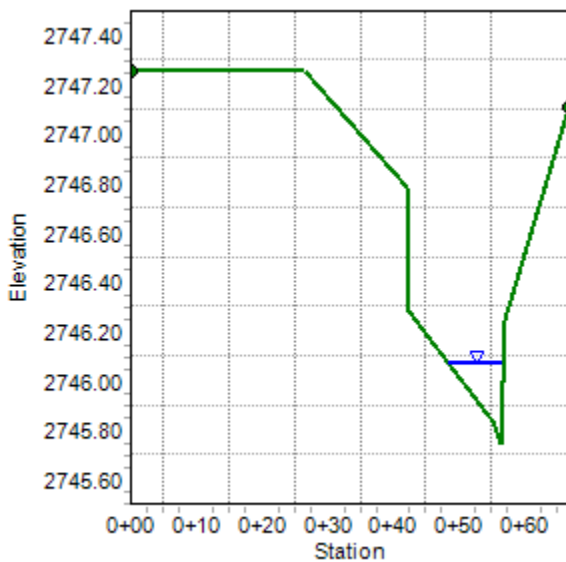
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.32	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Project Description

Input Data

Worksheet for OFF1 Q10

Results

Critical Depth	0.25	ft
Critical Slope	0.00759	ft/ft
Velocity	3.02	ft/s
Velocity Head	0.14	ft
Specific Energy	0.35	ft
Froude Number	1.96	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.25	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00759	ft/ft

Cross Section for OFF1 Q10

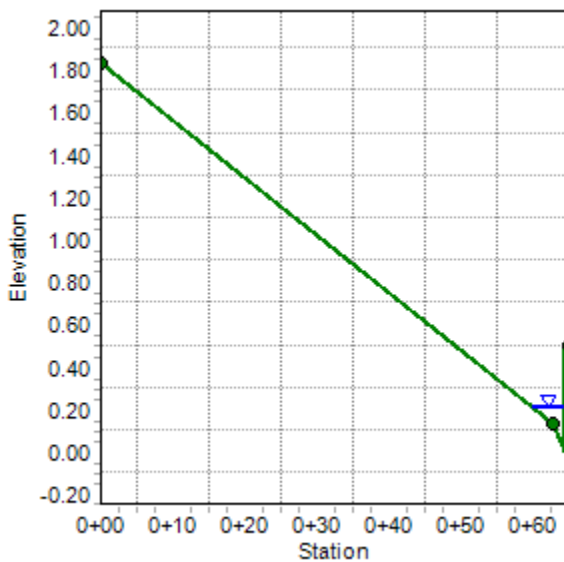
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.21	ft	
Discharge	1.00	ft ³ /s	CHAR1

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.21*(3.02) = 0.63 < 6 \quad \text{OK}$$

DRY LANE CHECK

$$\begin{aligned} WSE &= 0.0 + 0.21 = 0.21 \\ (1.83 - 0.21) / 0.0318 &= 51' > 12' \quad \text{OK} \end{aligned}$$

Worksheet for OFF2 Q10 EX

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.30 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.94 ft²
Wetted Perimeter 8.34 ft
Hydraulic Radius 0.11 ft
Top Width 8.07 ft
Normal Depth 0.30 ft

Worksheet for OFF2 Q10 EX

Results

Critical Depth	0.31	ft
Critical Slope	0.00732	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	0.37	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.31	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00732	ft/ft

Cross Section for OFF2 Q10 EX

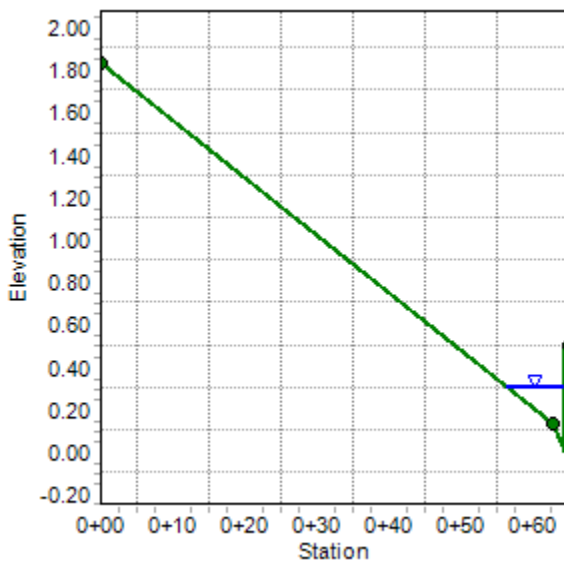
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.30	ft	
Discharge	2.00	ft ³ /s	FORT1+DON3

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.30*(2.13) = 0.64 < 6$$

OK

DRY LANE CHECK

$$WSE = 0.0 + 0.30 = 0.30$$

$$(1.83 - 0.30) / 0.009 = 170' > 12'$$

OK

Worksheet for OFF2 Q10 PR

Results

Critical Depth	0.25	ft
Critical Slope	0.00783	ft/ft
Velocity	1.83	ft/s
Velocity Head	0.05	ft
Specific Energy	0.30	ft
Froude Number	1.07	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.25	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00783	ft/ft

Worksheet for OFF1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03180	ft/ft
Discharge	2.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth	0.25	ft
Elevation Range	0.00 to 1.83 ft	
Flow Area	0.57	ft ²
Wetted Perimeter	6.40	ft
Hydraulic Radius	0.09	ft
Top Width	6.18	ft
Normal Depth	0.25	ft

Worksheet for OFF1

Results

Critical Depth	0.31	ft
Critical Slope	0.00717	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	0.44	ft
Froude Number	2.01	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.31	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00717	ft/ft

Cross Section for OFF1

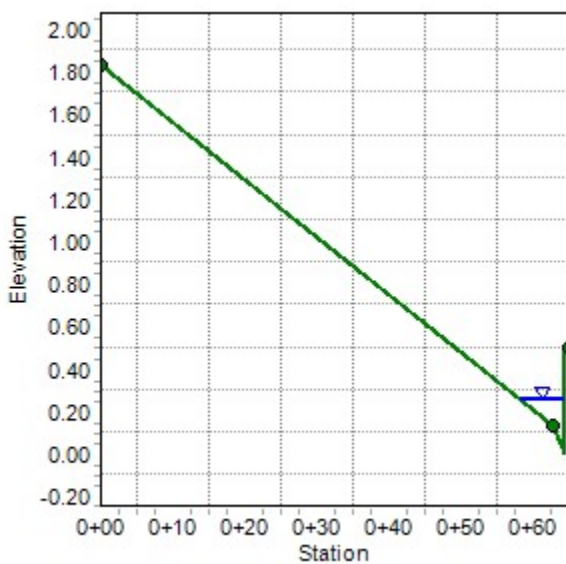
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.25	ft	
Discharge	2.00	ft ³ /s	CHAR1

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.25*(3.48) = 0.87 < 8$$

OK

Worksheet for OFF2 Q100 EX

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 3.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.34 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 1.28 ft²
Wetted Perimeter 9.83 ft
Hydraulic Radius 0.13 ft
Top Width 9.53 ft
Normal Depth 0.34 ft

Worksheet for OFF2 Q100 EX

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 EX

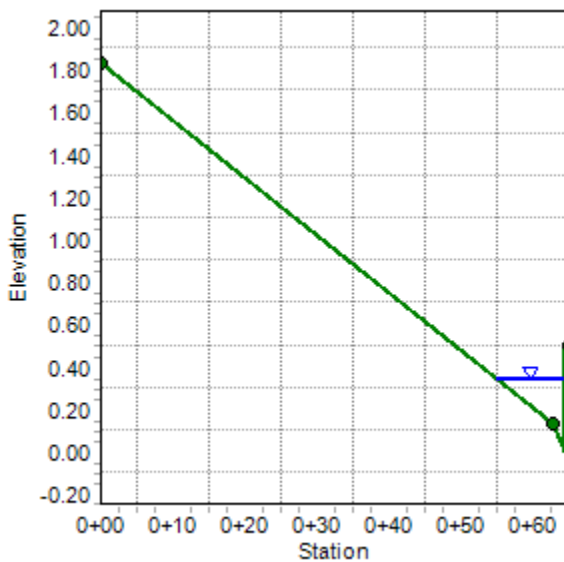
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK

Worksheet for OFF2 Q100 PR

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 PR

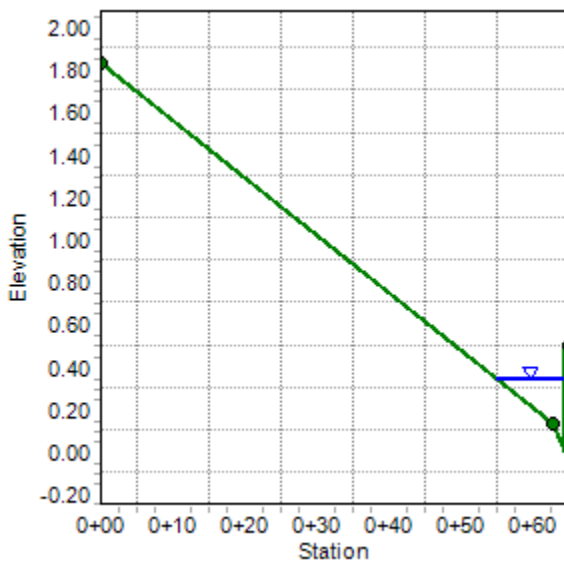
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

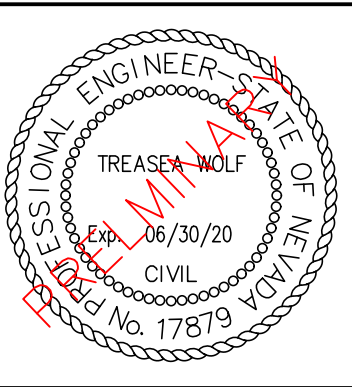
$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK



Chick-fil-A
5200 Buffington Road
Atlanta, Georgia
30349-2998

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6671 LAS VEGAS BLVD S., SUITE 320, LAS VEGAS, NV 89119
PHONE: 702-862-3600
WWW.KIMLEY-HORN.COM



CHICK-FIL-A
CHARLESTON & FT. APACHE
8975 W CHARLESTON BLVD
LAS VEGAS, NV 89147

FSR# 4293

REVISION SCHEDULE

<u>NO.</u>	<u>DATE</u>	<u>DESCRIPTION</u>
------------	-------------	--------------------

AGENCY # _____ CLV _____

PROJECT # 092908012

PRINTED FOR PRELIMINARY

DATE 01/21/15

DESIGN BY _____ AL

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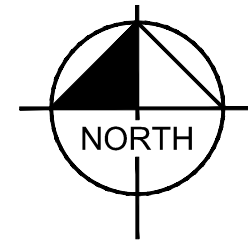
Express written or verbal consent from authorized project representatives.

MEET

1221

QUEST NUMBER

SHEET NUMBER

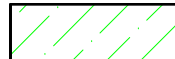


GRAPHIC SCALE IN FEET

A horizontal scale bar with tick marks at 0, 10, 20, and 40 feet. The bar is divided into segments: a white segment from 0 to 10, a black segment from 10 to 20, a white segment from 20 to 30, a black segment from 30 to 40, and a white segment from 40 to 50.

LEGEND

SITE	DRAINAGE MANAGEMENT AREA
1.20	BASIN AREA

	BASIN BOUNDARY
	FLOW ARROW
	IMPERVIOUS AREA
	PERVIOUS AREA
	BUILDING AREA

PARKING LOT DATA CALCULATIONS

PARKING LOT DATA CALCULATIONS			
Note: Stormwater Quality Design Volume calculated using steps from Section 1500 Figures 1501-1503 of the CCRFCD HCDDM, Revised 2013			
GIVEN:			
Project Description:	CHICK-FIL-A PARKING/DRIVE-THRU AREA		
Parking Lot Data		Acreage	
Property Size (PS)	=	1.99	
Building Area (BA)	=	0.21	
Total Pervious Area (TPA)	=	0.51	
Parking Lot Area (PLA) = (PLA = PS-BA-TPA)	=	1.27	
Minimum PLA to be treated = (PLA * 0.75)	=	0.95	acres
Area to be treated by the proposed LID BMPs			
Drainage Area A	=	0.79	
Drainage Area B	=	0.04	
Drainage Area C	=	0.06	
Drainage Area D	=	0.10	
Total	=	0.99	acres

K:\LAV_Civil\09208012-Chick-II-A-Charleston Fort Apache 04293\CAD\Exhibits\20190101-TDS Exhibit\ILD Basin Map.dwg Sheet No: KHA Saved by: adam.lo - Wednesday, February 13, 2019 5:02 PM Printed by: Lo, Adam - February 13, 2019 5:04 PM

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: EJ CHECKED BY: MS
 DATE: 2/12/19 KH No. 92908012

PARKING LOT DATA CALCULATIONS

Note: Stormwater Quality Design Volume calculated using steps from Section 1500 Figures 1501-1503 of the CCRFCD HCDDM, Revised 2013

GIVEN:

Project Description:	CHICK-FIL-A PARKING/DRIVE-THRU AREA		
Parking Lot Data		Acreage	
Property Size (PS)	=	1.99	
Building Area (BA)	=	0.21	
Total Pervious Area (TPA)	=	0.51	
Parking Lot Area (PLA) = (PLA = PS-BA-TPA)	=	1.27	
Minimum PLA to be treated = (PLA * 0.75)	=	0.95	acres
Area to be treated by the proposed LID BMPs			
Drainage Area A	=	0.79	
Drainage Area B	=	0.04	
Drainage Area C	=	0.06	
Drainage Area D	=	0.10	
Total	=	0.99	acres
Since 0.99 ac >= 0.95 ac then site satisfies Parking Lot LID criteria			

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 1/2/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "A"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013
 GIVEN:

Project Description: CHICK-FIL-A PARKING/DRIVE-THRU AREA
 Drainage Area = 0.79 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) **NO**

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1.25

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = 0.32 * **D2_{site}/D2_{McCarran}**
 = 0.40

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.60 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.62 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.49 cfs

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 1/2/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "B"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013
 GIVEN:

Project Description: PARKING AREA
 Drainage Area = 0.04 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) NO

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1.25

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = $0.32 * D2_{site} / D2_{McCarran}$
 = 0.40

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.60 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.62 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.02 cfs

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 2/12/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "C"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013

GIVEN:

Project Description: PARKING AREA
 Drainage Area = 0.06 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) **NO**

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = $0.32 * D2_{site} / D2_{McCarran}$
 = 0.32

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.47 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.50 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.03 cfs

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 2/12/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "D"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013

GIVEN:

Project Description: PARKING AREA
 Drainage Area = 0.10 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) **NO**

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = $0.32 * D2_{site} / D2_{McCarran}$
 = 0.32

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.47 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.50 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.05 cfs

Worksheet for SW1

Results

Top Width	11.89	ft
Normal Depth	0.58	ft
Critical Depth	0.53	ft
Critical Slope	0.01938	ft/ft
Velocity	1.79	ft/s
Velocity Head	0.05	ft
Specific Energy	0.63	ft
Froude Number	0.73	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.58	ft
Critical Depth	0.53	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01938	ft/ft

Cross Section for SW1

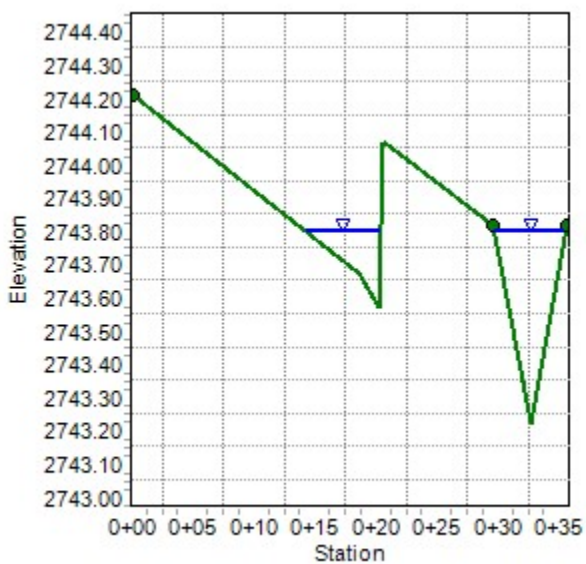
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	0.58	ft
Discharge	4.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Options

Results

Worksheet for SW2

Results

Top Width	2.61	ft
Normal Depth	0.26	ft
Critical Depth	0.18	ft
Critical Slope	0.04122	ft/ft
Velocity	0.76	ft/s
Velocity Head	0.01	ft
Specific Energy	0.27	ft
Froude Number	0.37	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.18	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.04122	ft/ft

Cross Section for SW2

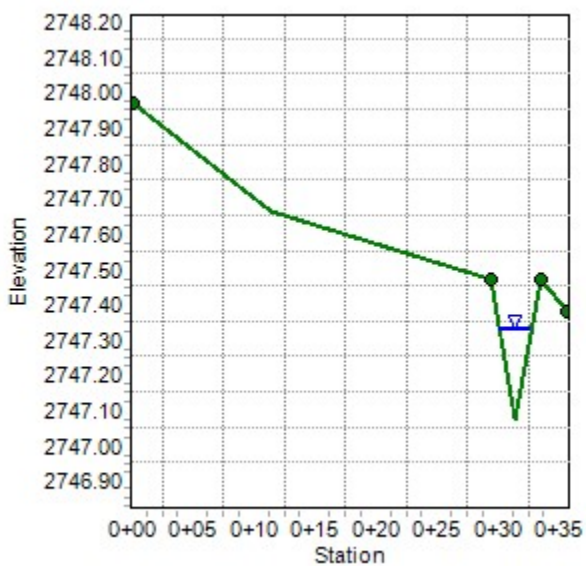
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.26	ft
Discharge	0.26	ft ³ /s

Cross Section Image



Worksheet for SW3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00640	ft/ft
Discharge	0.39	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2746.33
0+29.47	2745.47
0+31.52	2745.07
0+33.52	2745.47
0+35.60	2745.39

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2746.33)	(0+29.47, 2745.47)	0.016
(0+29.47, 2745.47)	(0+33.52, 2745.47)	0.035
(0+33.52, 2745.47)	(0+35.60, 2745.39)	0.016

Options

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

Results

Normal Depth	0.29	ft
Elevation Range	2745.07 to 2746.33 ft	
Flow Area	0.42	ft ²
Wetted Perimeter	2.98	ft
Hydraulic Radius	0.14	ft
Top Width	2.93	ft

Worksheet for SW3

Results

Normal Depth	0.29	ft
Critical Depth	0.21	ft
Critical Slope	0.03907	ft/ft
Velocity	0.92	ft/s
Velocity Head	0.01	ft
Specific Energy	0.30	ft
Froude Number	0.43	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.21	ft
Channel Slope	0.00640	ft/ft
Critical Slope	0.03907	ft/ft

Cross Section for SW3

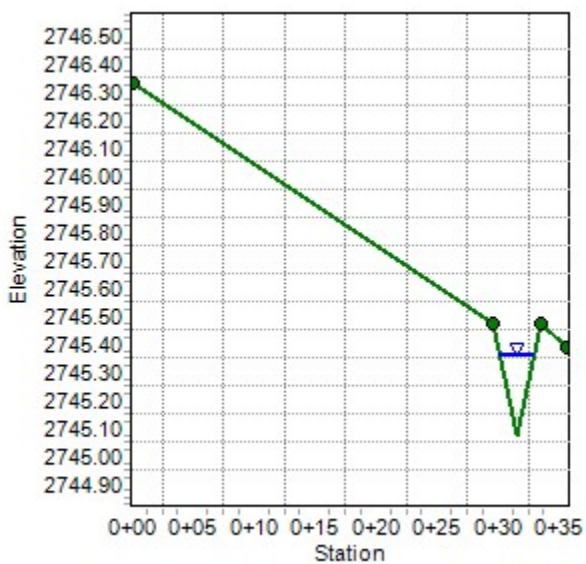
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00640	ft/ft
Normal Depth	0.29	ft
Discharge	0.39	ft ³ /s

Cross Section Image



Worksheet for SW4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00600	ft/ft
Discharge	0.47	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2744.30
0+28.93	2743.22
0+30.93	2742.91
0+32.93	2743.31
0+35.60	2743.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2744.30)	(0+28.93, 2743.22)	0.016
(0+28.93, 2743.22)	(0+32.93, 2743.31)	0.035
(0+32.93, 2743.31)	(0+35.60, 2743.21)	0.016

Options

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

Results

Normal Depth	0.30	ft
Elevation Range	2742.91 to 2744.30 ft	
Flow Area	0.51	ft ²
Wetted Perimeter	3.48	ft
Hydraulic Radius	0.15	ft
Top Width	3.43	ft

Worksheet for SW4

Results

Normal Depth	0.30	ft
Critical Depth	0.21	ft
Critical Slope	0.03856	ft/ft
Velocity	0.92	ft/s
Velocity Head	0.01	ft
Specific Energy	0.31	ft
Froude Number	0.42	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.21	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.03856	ft/ft

Cross Section for SW4

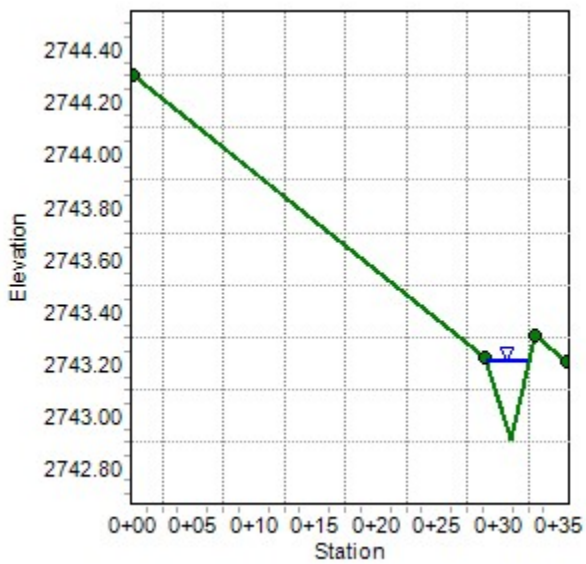
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00600	ft/ft
Normal Depth	0.30	ft
Discharge	0.47	ft ³ /s

Cross Section Image



Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

Riprap Sizing Calculation
Swale # 1

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

V = 1.79 ft/s

S = 0.01 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0273 = 0.0273 x 12in/ft = 0.33-inches → Use d₅₀ = 3-inches

Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

Riprap Sizing Calculation
Swale # 2

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

V = 0.69 ft/s

S = 0.005 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0032 = 0.0032 x 12in/ft = 0.04-inches → Use d₅₀ = 3-inches

Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

Riprap Sizing Calculation
Swale # 3

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

V = 0.92 ft/s

S = 0.006 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0062 = 0.0062 x 12in/ft = 0.07-inches → Use d₅₀ = 3-inches

Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

Riprap Sizing Calculation
Swale # 4

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

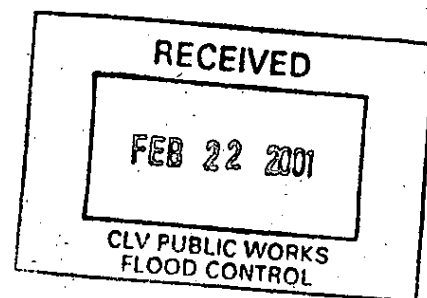
V = 0.92 ft/s

S = 0.006 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0061 = 0.0061 x 12in/ft = 0.07-inches → Use d₅₀ = 3-inches

2832
Q05



ADDENDUM NO. 1
TO THE
TECHNICAL DRAINAGE STUDY
FOR
ODETTE CENTER

February 22, 2001

Prepared for

Outback Steakhouse, Inc.
2202 N. Westshore Blvd.
5TH Floor
Tampa, FL 33607
(813) 2821225

Project No: 0050.0268

Prepared by:

PENTACORE



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		March 13, 2003
TO: Land Development Services Department of Public Works		FROM: Albert Surg, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
	Odette Center – Update for Barcelone	Dunnam Civil Engineer
Cross Streets:	SEC of Charleston Blvd. & Odette Lane	Micah Holding
File Number:	F:\Depot\DSMEMOS\DS2832D.doc	Bart Anderson, P.E., DEVCO
Parcel Number:	163-05-502-001	
Zoning Action:		
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID G.R. No.
1 st Submittal	1/24/2001	2/7/2001	Not Acceptable	\$250.00	---
2 nd Submittal	2/22/2001	3/8/2001	Not Acceptable	\$250.00	---
3 rd Submittal	3/27/2001	3/30/2001	Conditional acceptance	\$250.00	---
4 th Submittal	2/28/2003	3/13/2003	See Comments Below	\$250.00	100014: \$250
TOTAL FEES (LDDRS):				\$1,000.00	Balance: \$750

REMARKS:

4th Submittal (Update study)

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

X	is acceptable in concept subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	must have Clark County Regional Flood Control District concurrence.

- All elevations, shown on the grading plans, are not clear and must be revised to identify as either top of curb (TC), finish grade (FG) or flow line (FL).

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Amendment and accepted by the City of Las Vegas Flood Control Section. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the City reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

END OF REMARKS

ssn

T/R/S: T21S/R60E/05
AREA Q-05



PENTACORE

0050.0286

Civil Engineering
Surveying • GPS
Land Planning • GIS
Landscape
Architecture
Environmental and
Natural Resources
Management
Construction
Administration
Program
Management
ADA Consulting
Measurement
Technologies

February 22, 2001

**Mr. Albert Sung, P.E.
Flood Control Division
City of Las Vegas
731 South 4th Street
Las Vegas, Nevada 89101**

SUBJECT: Addendum No. 1 to the Technical Drainage Study for the Odette Center

Dear Mr. Sung:

The enclosed addendum is being provided in response to a memorandum dated February 7, 2001, from The City of Las Vegas. Twenty-One (21) comments were outlined in the Memorandum regarding the Technical Drainage Study for the Odette Center. Those comments are addressed within the following summarization:

Comment 1: On the offsite drainage map indicate the Q_{100}/Q_{10} flows and concentration points for all basins impacting the site. The drainage map must be in a scale not less than 1" equal to 60' and must be on a 24"x36" sheet. The study assumes flows on Odette drain into Charleston and neglects the flows from Fort Apache and further upstream. This must be addressed.

Response 1: The offsite basin map has been revised to show the Q_{100}/Q_{10} flows. A 24"x36" proposed drainage map is enclosed within this study. The City of Las Vegas – "City Wide Hydrology Study" shows that all flows in the area of the Odette Center are draining North. The "Conceptual Drainage Study for Fort Apache Commons" also determined that all flows on W. Charleston Blvd. and Fort Apache Road will be captured by drop inlets and conveyed in an existing storm drain system. Any flows that split from Fort Apache Road and Peccole Strada don't contribute to the project flows, since flows will continue down Peccole Strada in a Southeasterly direction past Odette Lane. Flows do not enter basin OFF-2 at Napoli from Fort Apache Road due to the high point in Napoli Dr. See the Offsite Drainage Map. Enclosed are Figure 12 from the Citywide Study and the grading plan and text excerpts from the Fort Apache Study. ✓

6763 West Charleston Boulevard • Las Vegas, Nevada 89146

Engineering
Tel. 702.258.0115 • Fax 258.4956

Surveying
Tel. 702.258.4110 • Fax 258.4790

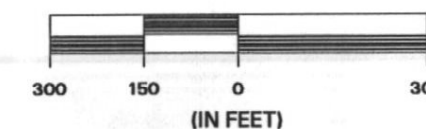
ADA Consulting
Tel. 702.258.0202 • Fax 258.0294



ODETTE CENTER OFF-SITE DRAINAGE MAP

*Q100 flow rates?
CC points*

Aerial Photo
March 2000



January 16, 2001
Scale: 1 inch = 300 feet

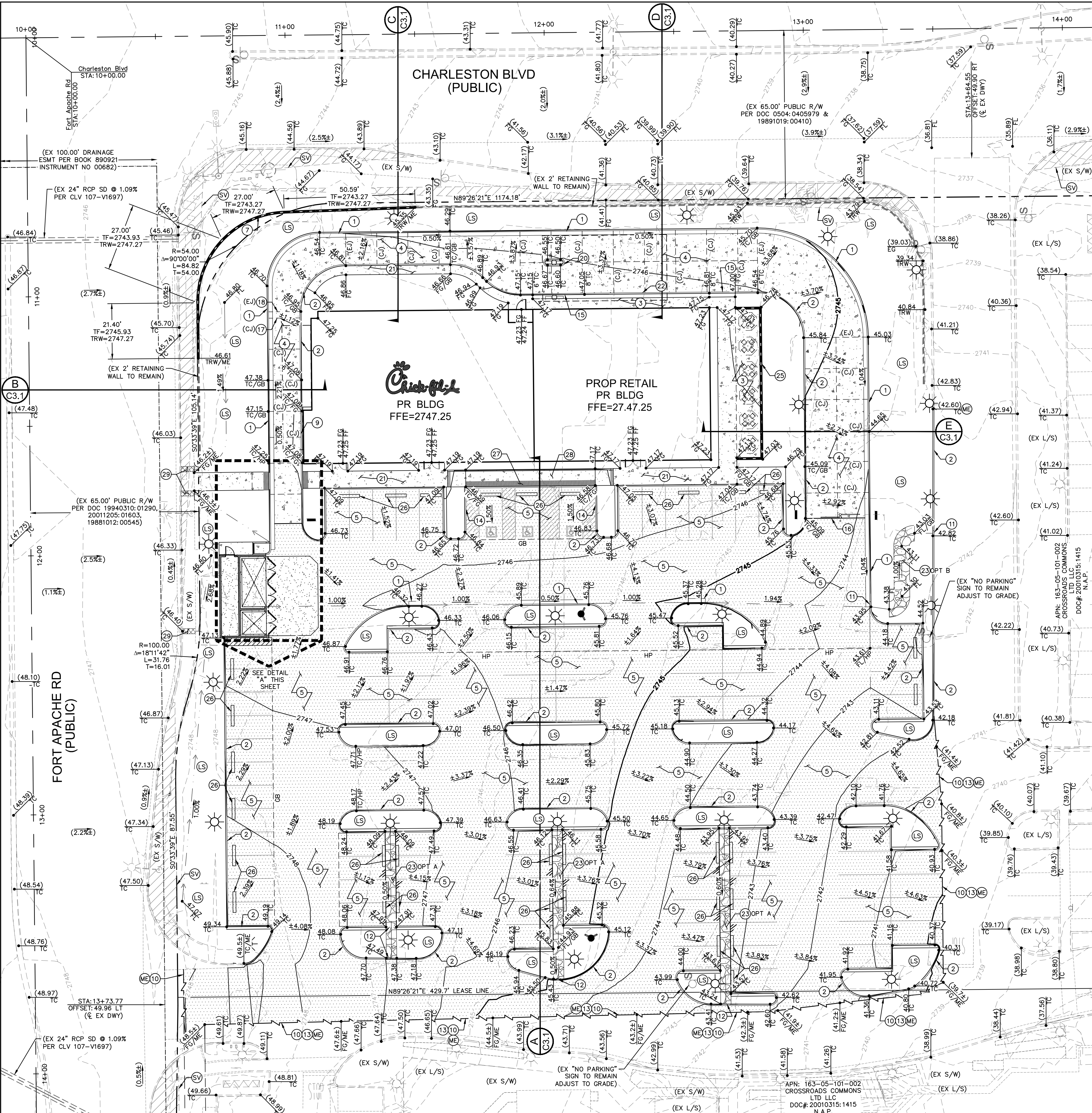


PENTACORE
Geographic Information
Systems

6763 West Charleston Blvd.
Las Vegas, Nevada 89146

For Reference only. Pentacore assumes no liability for the accuracy
of the data delineated hereon.

D.N.S.



LEGEND

- RIGHT-OF-WAY
- PROPERTY LINE
- LEASE LINE
- GRADE BREAK
- PR SAWCUT LINE
- PR RETAINING WALL
- PR SWALE/FLOW LINE
- PR TYPE 'L' CURB & GUTTER
- PR TYPE 'A' CURB
- EX STREETLIGHT
- EX SIGHT VISIBILITY ZONE (SVZ)
- PR PAVEMENT
- PR CONCRETE

GRAPHIC SCALE IN FEET
0 10 20 40
SCALE: 1" = 20'

NORTH

ENGINEER'S NOTES:

- ALL WORK SHALL CONFORM TO THE SOILS REPORT PREPARED BY XXXXXX, DATED MONTH DAY, 2019, NO. XXXXXXXX.
- ALL OFF-SITE IMPROVEMENT CONSTRUCTION SHALL CONFORM TO THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA" LATEST EDITION.
- FINAL ASPHALTIC CONCRETE (AC PAVEMENT SURFACES SHALL BE FLUSH WITH THE TOP OF GUTTER (INCLUDING OPEN GRADE).
- CONTRACTOR IS RESPONSIBLE FOR DUST AND EROSION CONTROL DURING CONSTRUCTION.
- THIS PLAN SHALL NOT, IN PART OR IN WHOLE, BE USED FOR CONSTRUCTION UNLESS APPROVED AND SIGNED BY ALL APPLICABLE GOVERNMENT AGENCIES.
- ENGINEER TO BE NOTIFIED OF ANY DISCREPANCIES IMMEDIATELY.
- MATCH ELEVATIONS SHOWN TO BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION.
- THIS PROJECT IS PART OF A PROPOSED COMMERCIAL SUBDIVISION.
- ALL SITE STORM DRAINS AND THE ASSOCIATED STORM WATER FACILITIES ARE PRIVATELY OWNED AND PRIVATELY MAINTAINED.

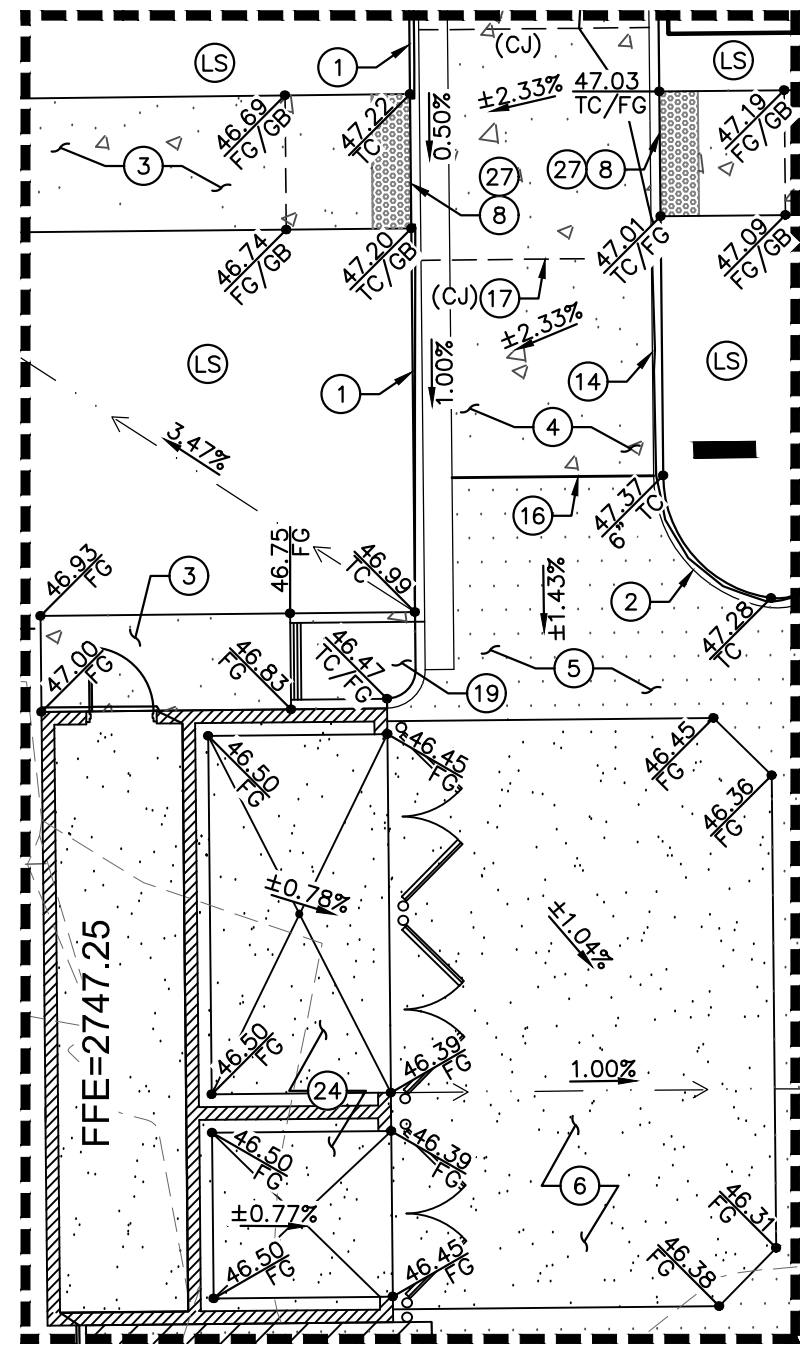
STORMWATER MANAGEMENT NOTES

- THE OWNER, SITE DEVELOPER, CONTRACTOR, AND/OR THEIR AUTHORIZED AGENTS SHALL EACH DAY REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN DISCHARGED, OR ACCUMULATED IN, THE PUBLIC RIGHTS OF WAY OF THE CITY OF LAS VEGAS AS A RESULT OF CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS SITE DEVELOPMENT OR CONSTRUCTION PROJECT. SUCH MATERIALS SHALL BE PREVENTED FROM ENTERING THE STORM SEWER SYSTEM.
- ADDITIONAL CONSTRUCTION SITE DISCHARGE BEST MANAGEMENT PRACTICES MAY BE REQUIRED OF THE OWNER AND HIS OR HER AGENTS DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT MEET THE PERFORMANCE STANDARDS SPECIFIED IN THE CITY OF LAS VEGAS BUILDING ADMINISTRATIVE CODE 24.40 AND THE LAS VEGAS VALLEY CONSTRUCTION SITE BMP GUIDANCE MANUAL.
- TEMPORARY OR PERMANENT STABILIZATION PRACTICES WILL BE INSTALLED ON DISTURBED AREAS AS SOON AS PRACTICABLE AND NO LATER THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. SOME EXCEPTIONS MAY APPLY; REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVRI00000, SECTION III.A.5.
- AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL DISTURBED AREAS, AREAS USED FOR STORAGE OF MATERIALS AND EQUIPMENT THAT ARE EXPOSED TO PRECIPITATION, VEHICLE ENTRANCE AND EXIT LOCATIONS, AND ALL BMPs WEEKLY, AND WITHIN 24 HOURS AFTER ANY RAIN EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR OR HIS AGENT SHALL UPDATE OR MODIFY THE STORMWATER POLLUTION PREVENTION PLAN AS NECESSARY. SOME EXCEPTIONS TO WEEKLY INSPECTIONS MAY APPLY, SUCH AS SUSPENSION OF LAND DISTURBANCE ACTIVITIES. REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVRI00000, SECTION III.A.12.
- ACCUMULATED SEDIMENT IN BMPs SHALL BE REMOVED WITHIN SEVEN DAYS AFTER A STORMWATER RUNOFF EVENT OR PRIOR TO THE NEXT ANTICIPATED STORM EVENT, WHICHEVER IS EARLIER. SEDIMENT MUST BE REMOVED WHEN BMP DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT OR MORE.

SIGHT VISIBILITY ZONES NOTE

NO WALLS, FENCES, SHRUBS, UTILITY APPURTENANCES OR ANY OTHER OBJECT, OTHER THAN TRAFFIC CONTROL DEVICES, FIRE HYDRANTS, TREES, AND STREET LIGHT POLES MAY BE CONSTRUCTED OR INSTALLED WITHIN THE SIGHT VISIBILITY ZONE UNLESS SAID OBJECT IS MAINTAINED LESS THAN 24 INCHES IN HEIGHT MEASURED FROM TOP OF CURB, OR WHERE NO CURB EXISTS, A HEIGHT OF 27 INCHES MEASURED FROM THE TOP OF ADJACENT ASPHALT, GRAVEL, OR PAVEMENT STREET SURFACE. THIS RESTRICTION EXTENDS ALONG THE SIGHT VISIBILITY LINE THROUGH LANDSCAPED MEDIANS.

- CONSTRUCTION NOTES**
- CONSTRUCT "L" TYPE CURB & GUTTER PER DETAIL 17, SHEET C4.2
 - CONSTRUCT "A" TYPE CURB PER DETAIL 8, SHEET C4.1
 - CONSTRUCT SIDEWALK PER DETAIL 11, SHEET C4.1
 - CONSTRUCT CONCRETE PAVING DRIVE-THRU LANE PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 25, SHEET C4.3
 - CONSTRUCT STANDARD AC PAVEMENT PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 21, SHEET C4.2
 - CONSTRUCT CONCRETE APRON @ TRASH ENCLOSURE PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 24, SHEET C4.3
 - CONSTRUCT 4' MAX RETAINING WALL PER SEPARATE ARCHITECTURAL PLANS AND DETAILS BY OTHERS
 - CONSTRUCT 0" CURB PER DETAIL 17, SHEET C4.2
 - DRIVE-THRU ISOMETRIC PLAN VIEW PER DETAILS 13 & 14, SHEET C4.2
 - SAWOUT NEAT & MATCH EXISTING
 - CONSTRUCT 2.0' WIDE CURB OPENING PER DETAIL 16A, SHEET C4.2
 - CONSTRUCT 4.0' WIDE CURB OPENING PER DETAIL 16B, SHEET C4.2
 - CONSTRUCT TRANSVERSE AND LONGITUDINAL DOWELED CONSTRUCTION JOINT PER DETAIL 23, AND BUTT JOINT PER DETAIL 23A, SHEET C4.3
 - CONSTRUCT 0" TO 6" TRANSITION PER DETAIL 15A, SHEET C4.2
 - CONSTRUCT 6" TO 8" TRANSITION PER DETAIL 15B, SHEET C4.2
 - CONSTRUCT CONCRETE/AC EDGE PER DETAIL 21A, SHEET C4.2
 - CONSTRUCT CONTRACTION JOINT (CJ) PER DETAIL 22, SHEET C4.3
 - CONSTRUCT EXPANSION JOINT (EJ) PER DETAIL 26, SHEET C4.3
 - CONSTRUCT RETURNED CURB ACCESSIBLE RAMP PER DETAIL 33, SHEET C4.3
 - DRIVE-THRU ISLAND CURB PER DETAIL 30, SHEET C4.3
 - CONSTRUCT SIDEWALK WITH 6" CURB SECTION PER DETAIL 12, SHEET C4.2
 - CONSTRUCT 8" "A" TYPE CURB PER DETAIL 7, SHEET C4.1
 - INSTALL RIP-RAP (D50=3", T=6") LINED SWALE PER DETAIL 32, SHEET C4.3
 - CONSTRUCT TRASH ENCLOSURE FOUNDATION PER ARCHITECTURAL PLANS AND DETAILS BY OTHERS
 - CONSTRUCT SCREEN WALL WITH WEEP HOLES PER ARCHITECTURAL PLANS AND DETAILS BY OTHERS
 - CONSTRUCT PRECAST CONCRETE WHEEL STOP PER CCAUSD DWG NO. 238-SEE DETAIL 27, SHEET C4.3
 - CONSTRUCT TRUNCATED DOMES PER DETAIL 10, SHEET C4.1
 - CONSTRUCT ACCESSIBLE CURB RAMP PER DETAIL 9, SHEET C4.1
 - INSTALL SIDEWALK UNDERDRAIN PER CCAUSD DWG NO. 236
 - PROPOSED LANDSCAPING PER SEPARATE LANDSCAPE PLANS
 - MATCH EXISTING
 - EXISTING SIGHT VISIBILITY ZONE



DETAIL "A"
SCALE: 1"=10'

EARTHWORK QUANTITIES

CUT	FILL	NET
3,842 CY	186 CY	3,656 CY (CUT)*

*RAW NUMBERS; HAVE NOT BEEN ADJUSTED FOR SOIL TYPE

LEGEND & ABBREVIATIONS

SEE SHEET C0.3 FOR MASTER LEGEND AND ABBREVIATIONS.

LEGAL DESCRIPTION

SEE COVER SHEET FOR FULL LEGAL DESCRIPTION

NOTES:

ALL DIMENSIONS ARE TO BACK OF CURB UNLESS OTHERWISE NOTED.

OWNER RESPONSIBLE TO PROVIDE SURVEY MONUMENTATION AS SHOWN AND TO REPLACE ALL SURVEY MONUMENTATION DAMAGED, DISTURBED, DESTROYED, OR OBTUSCURED DURING CONSTRUCTION.

GRADING NOTE:

PER THE SOILS REPORT, POSITIVE DRAINAGE OF 5% MINIMUM IN LANDSCAPE AREAS AND 2% MINIMUM ELSEWHERE SHALL BE MAINTAINED FOR AREAS ADJACENT TO STRUCTURES. THE 2% SHOULD BE MAINTAINED A DISTANCE OF 10' IN AREAS WHERE ADA IS ADJACENT TO THE BUILDING, SLOPES LESS THAN 2% ARE ACCEPTABLE.

ELEVATION NOTE:

ADD 2700 FEET TO ALL SPOT ELEVATIONS, EXCEPT FINISHED FLOOR ELEVATIONS AND CONTOURS.



BENCHMARK

7LV00 325SW6: A RIVET AND PLATE IN THE TOP OF CURB AT THE NORTHWEST CORNER OF RAMFORD BOULEVARD AND CHARLESTON BOULEVARD = 837.425m = 2,747.45ft (NAVD88).

BASIS OF BEARING

NORTH 89°26'21" EAST, BEING THE SOUTH LINE OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 32, TOWNSHIP 20 SOUTH, RANGE 60 EAST, M.D.M., CITY OF LAS VEGAS, STATE OF NEVADA, AS SHOWN BY THE MAP RECORDED IN FILE 36 OF SURVEYS, PAGE 89 IN THE OFFICE OF THE COUNTY RECORDER, CLARK COUNTY, NEVADA.

FLOOD ZONE NOTE

THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) PANEL NUMBER 32003C2145F, EFFECTIVE NOVEMBER 16, 2011, INDICATE THAT THE PROJECT SITE IS LOCATED IN ZONE "X". ZONE "X" IS DEFINED BY FEMA AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN."

DRAINAGE CERTIFICATION

I CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE WITH CITY OF LAS VEGAS FOR THIS PROJECT, DS-XXXX

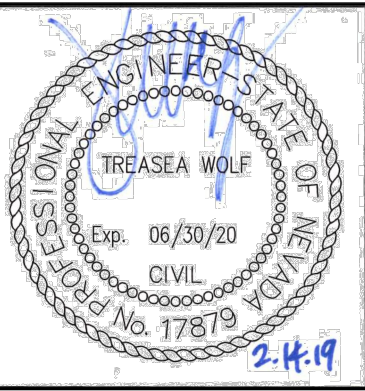
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PROJECT # 092908012

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DRAWN BY CT

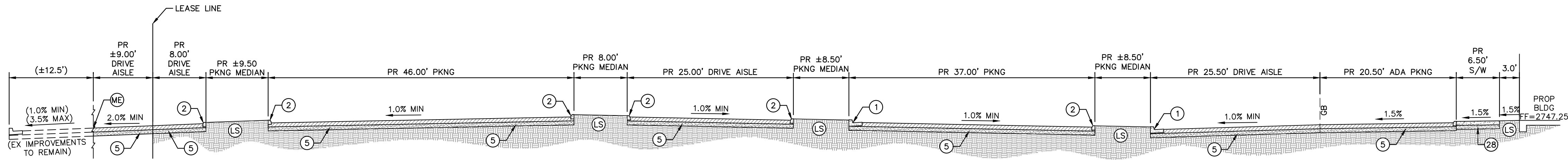
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SHEET GRADING PLAN

SHEET NUMBER

C3.0

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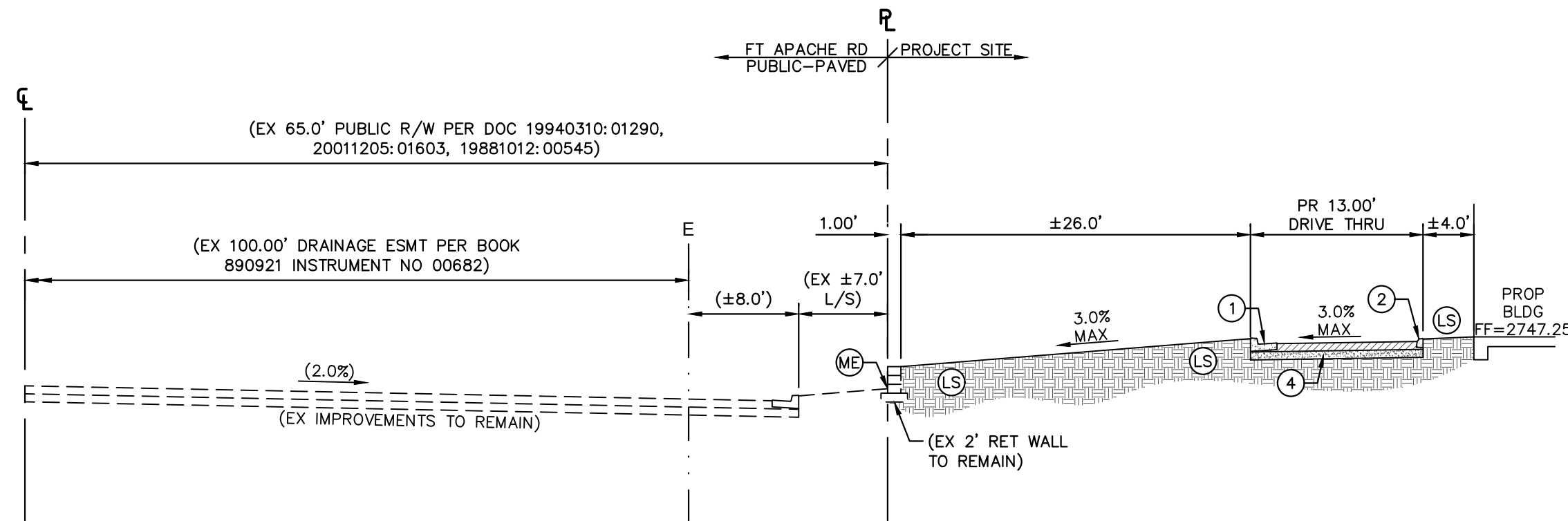
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C3.1

SECTION A -SOUTH OF BLDG

NTS

CONSTRUCTION NOTES

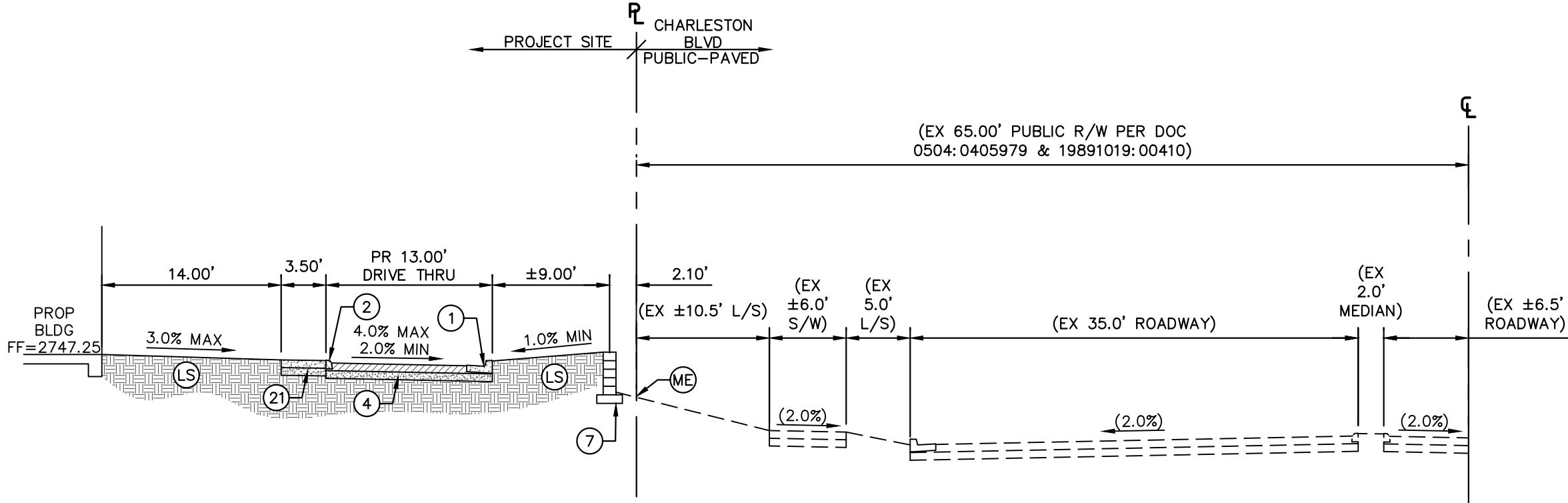
- 1 CONSTRUCT "L" TYPE CURB & GUTTER PER DETAIL 17, SHEET C4.2
- 2 CONSTRUCT "A" TYPE CURB PER DETAIL 8, SHEET C4.1
- 3 CONSTRUCT SIDEWALK PER DETAIL 11, SHEET C4.1
- 4 CONSTRUCT CONCRETE PAVING DRIVE-THRU LANE PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 25, SHEET C4.3
- 5 CONSTRUCT STANDARD AC PAVEMENT PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 25, SHEET C4.2
- 7 CONSTRUCT 4' MAX RETAINING WALL PER SEPERATE ARCHITECTURAL PLANS AND DETAILS BY OTHERS
- 21 CONSTRUCT SIDEWALK WITH 6" CURB SECTION PER DETAIL 12, SHEET C4.2
- 25 CONSTRUCT SCREEN WALL WITH WEEP HOLES PER ARCHITECTURAL PLANS AND DETAILS BY OTHERS
- 28 CONSTRUCT ACCESSIBLE CURB RAMP PER DETAIL 15, SHEET C4.2
- LS PROPOSED LANDSCAPING PER SEPARATE LANDSCAPE PLANS
- ME MATCH EXISTING



B
C3.1

SECTION B -WEST PROPERTY LINE

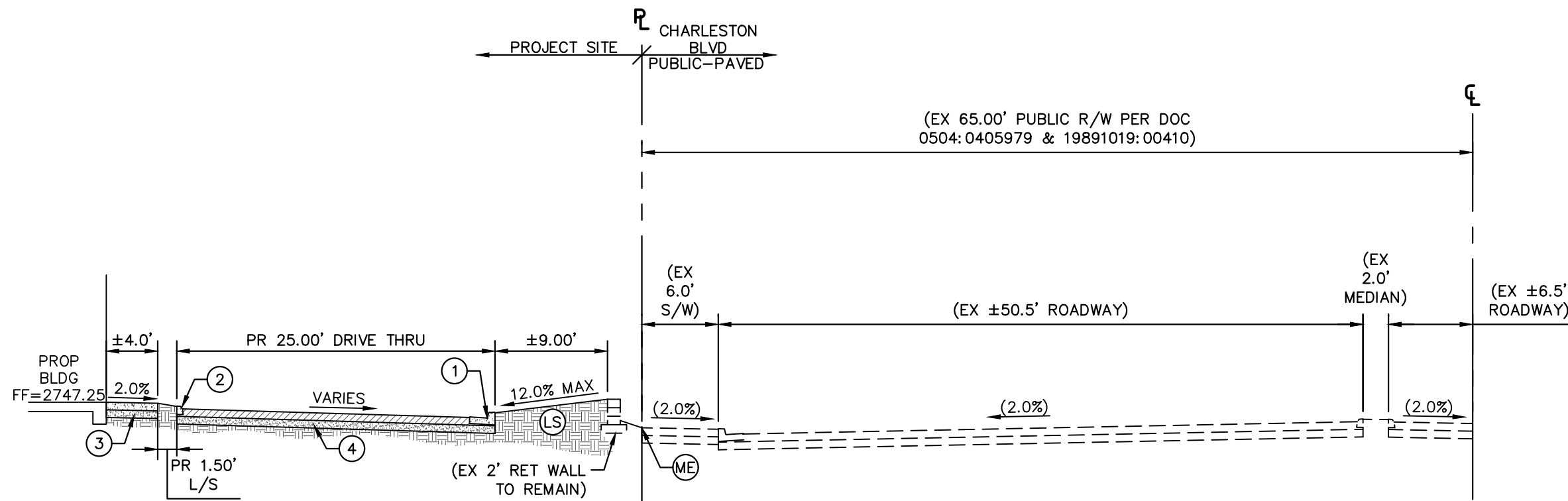
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C
C3.1

SECTION C -NORTH PROPERTY LINE

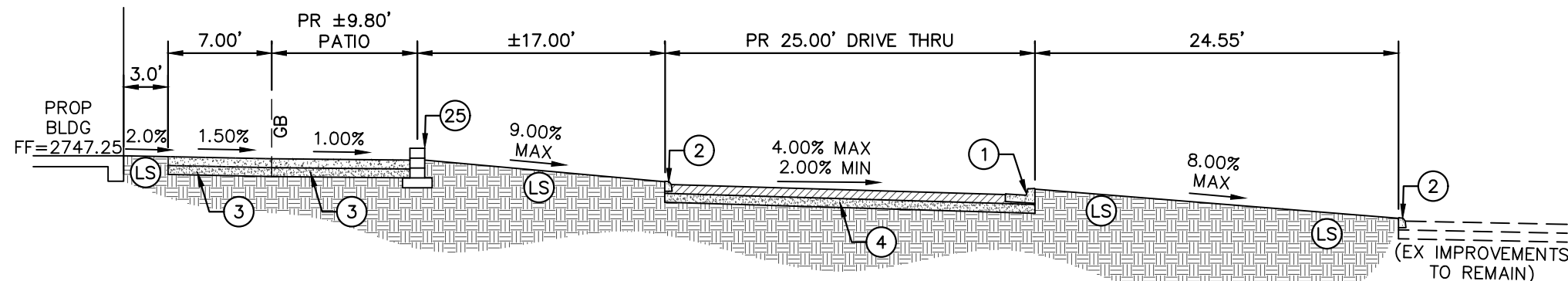
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D
C3.1

SECTION D -NORTH PROPERTY LINE

NTS



E
C3.1

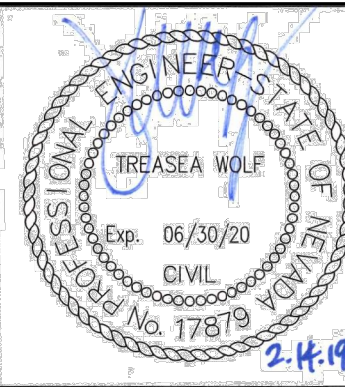
SECTION E -EAST PROPERTY LINE

NTS



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SHEET
TYPICAL SECTIONS

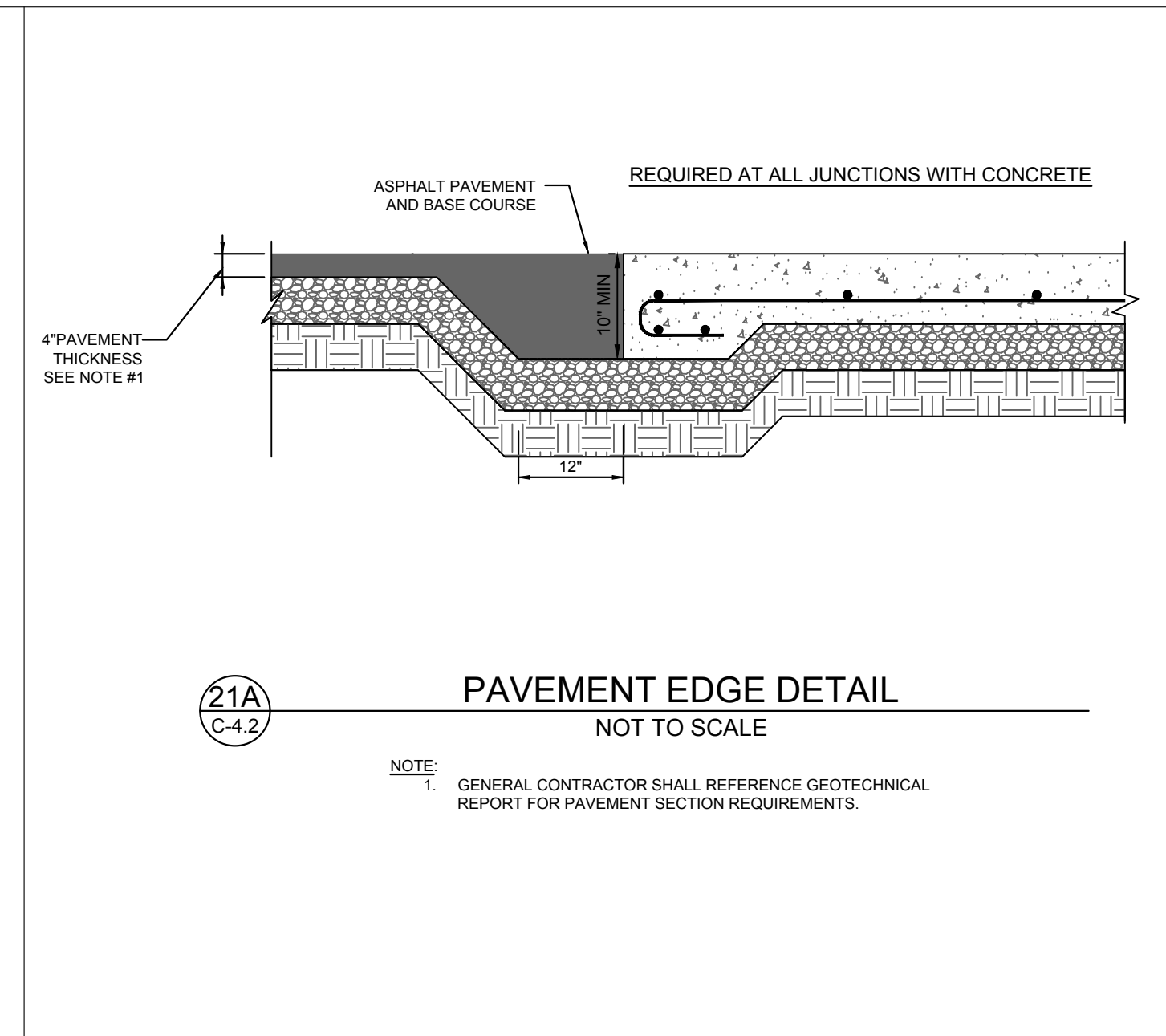
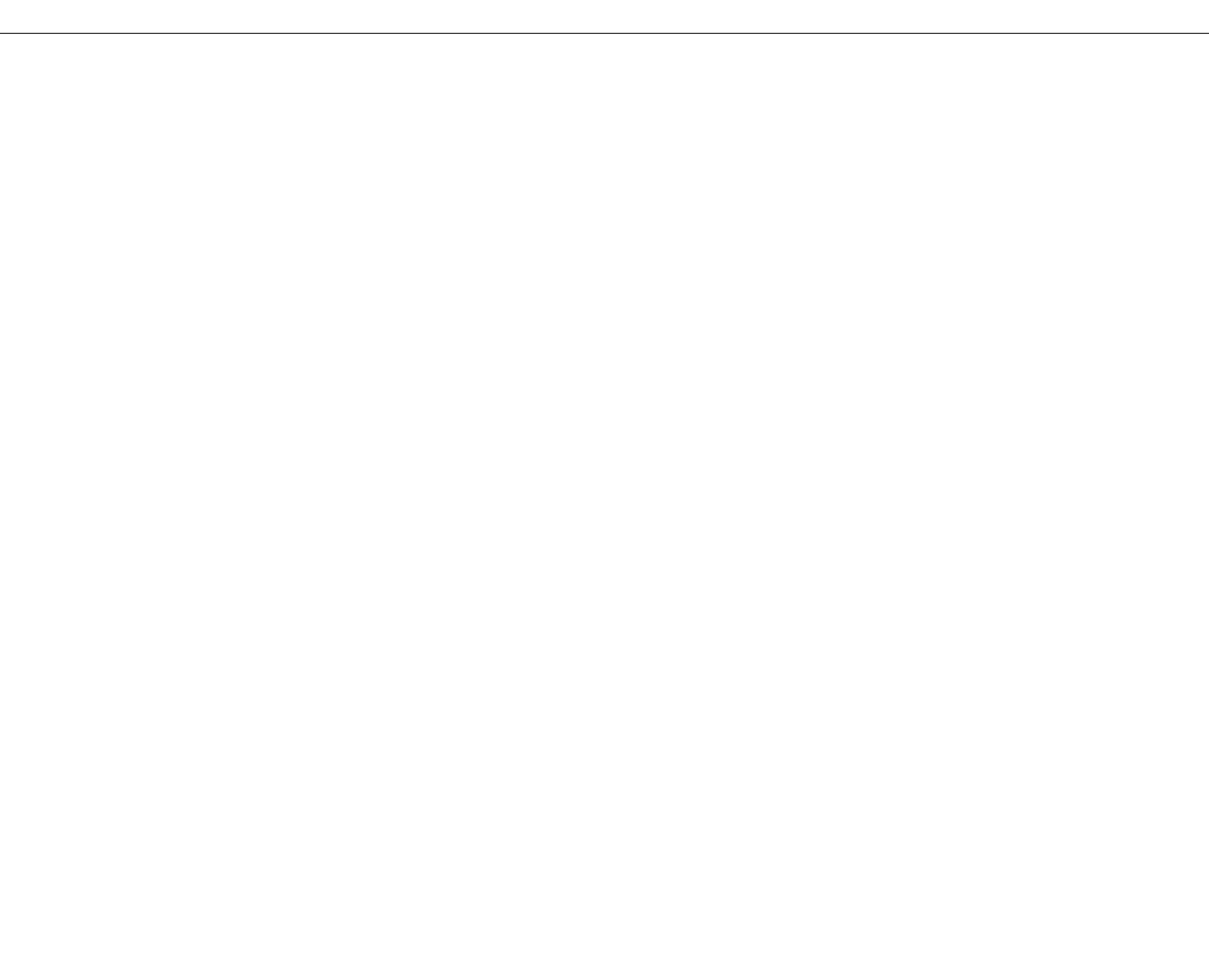
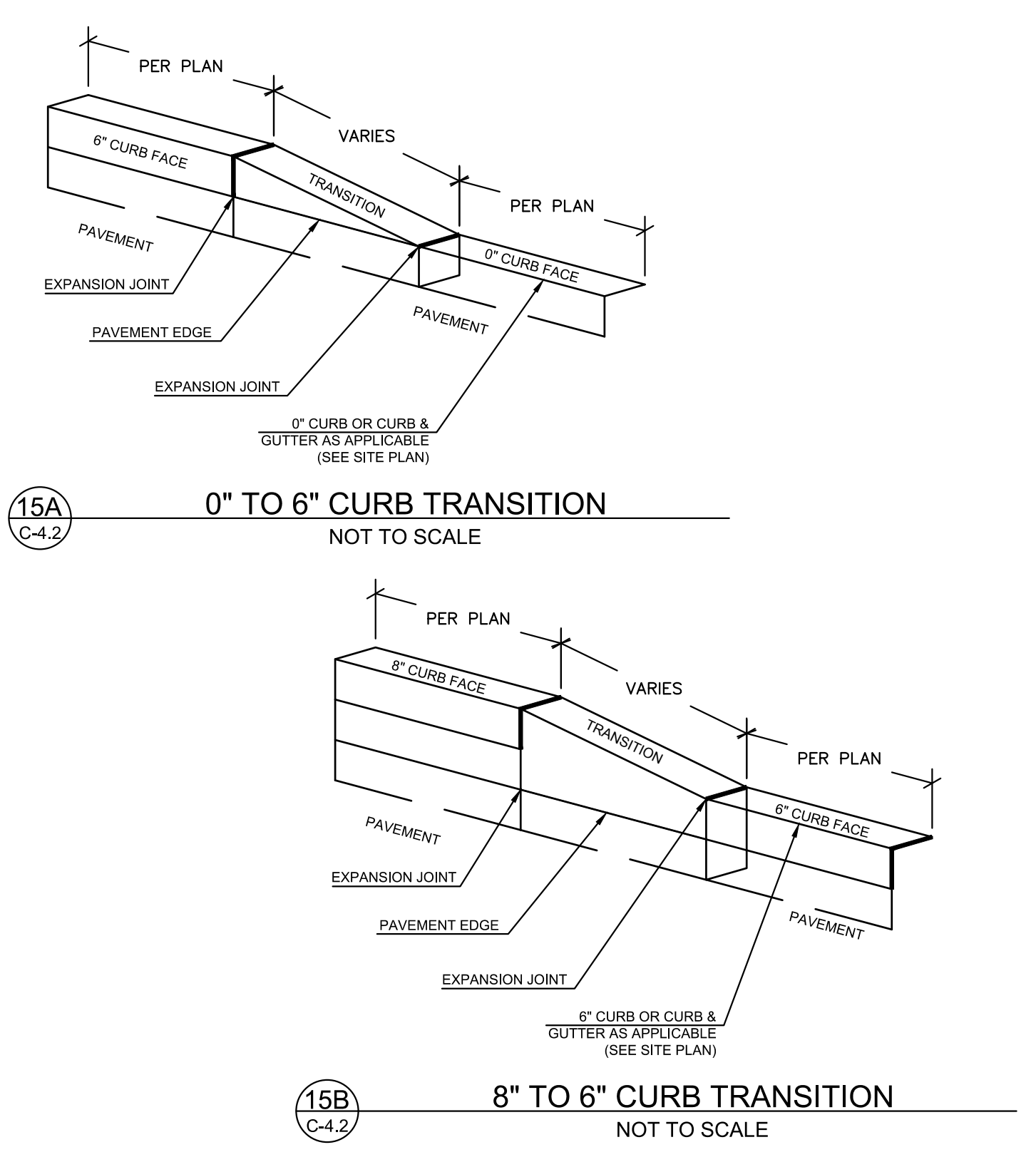
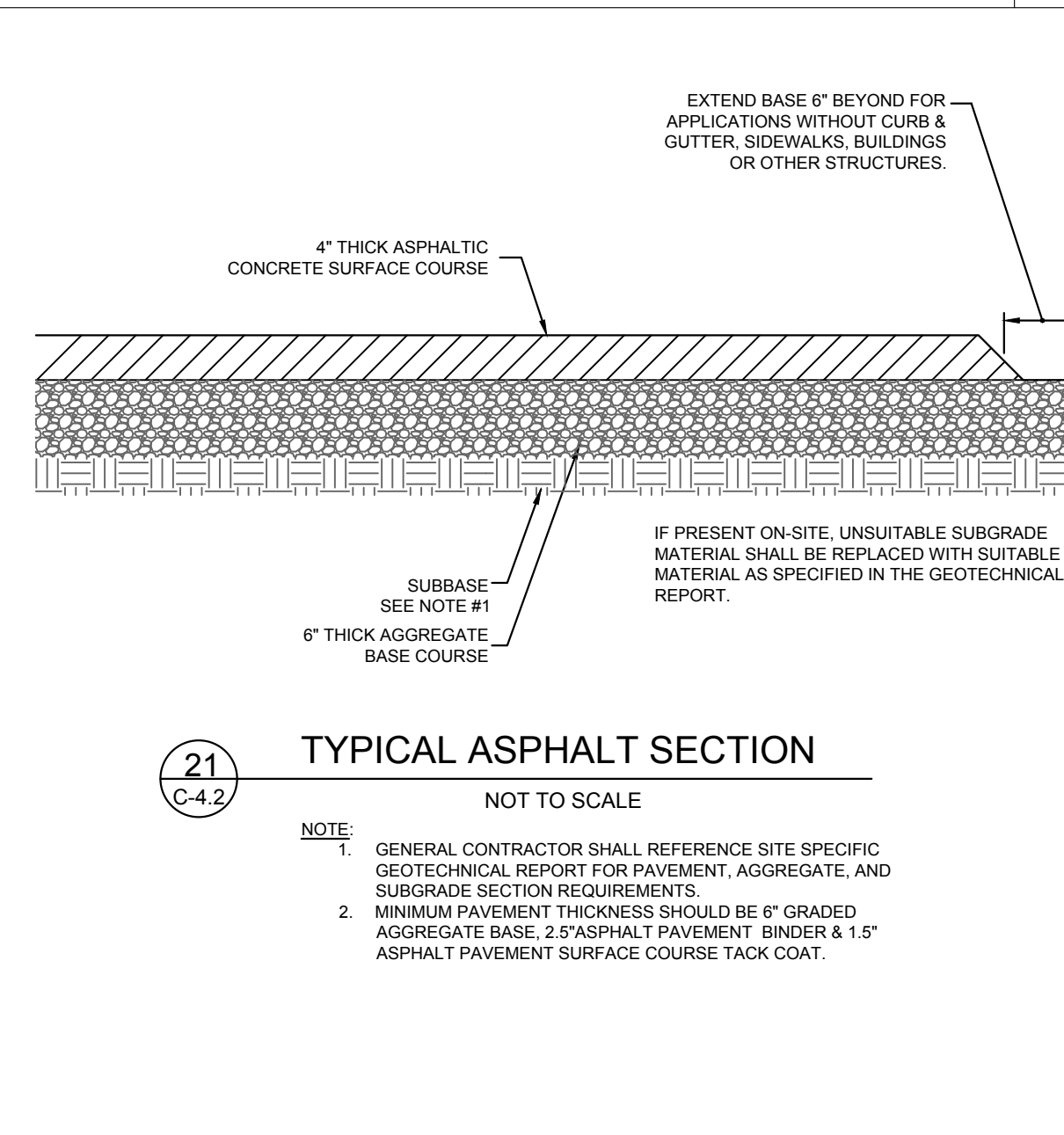
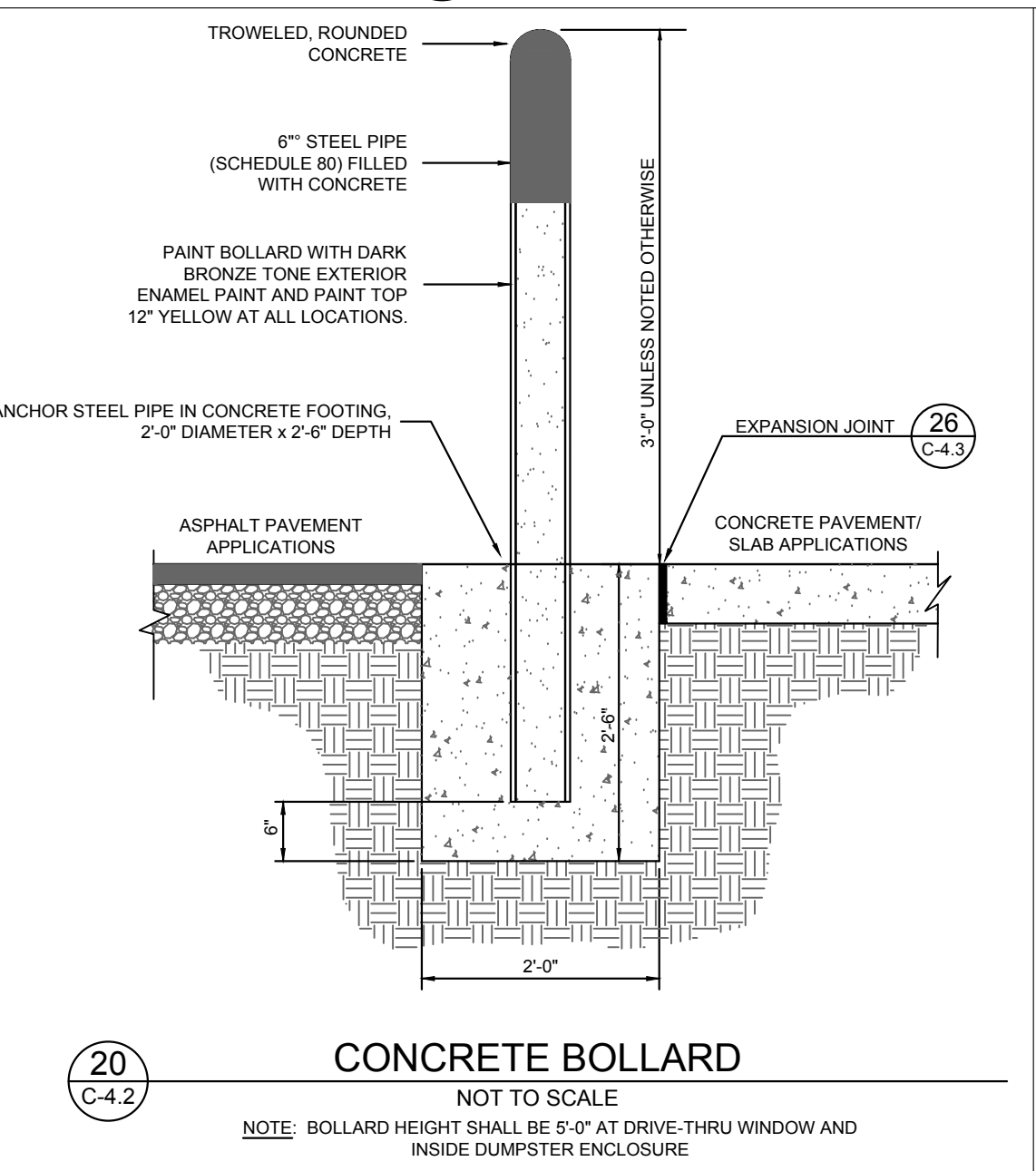
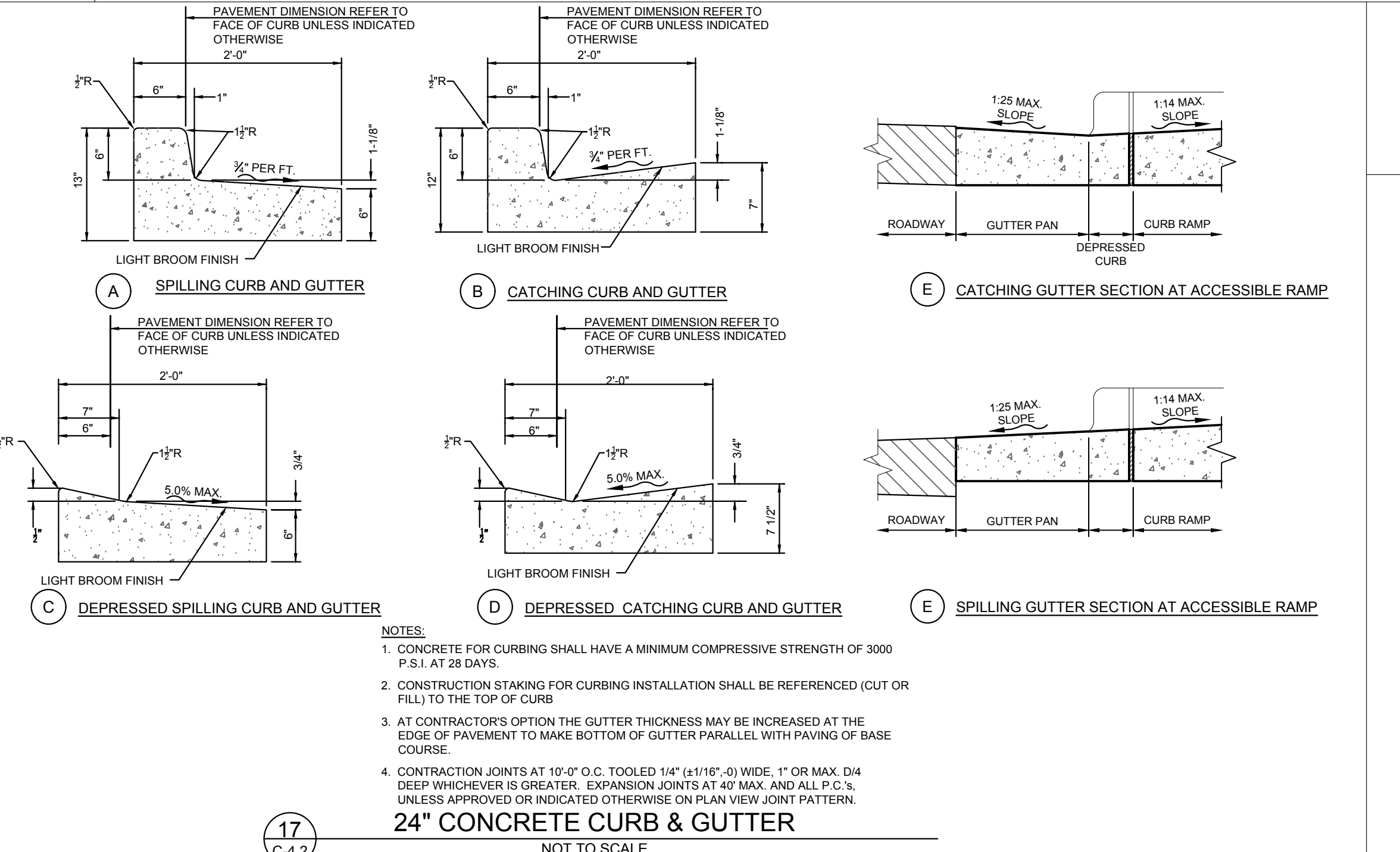
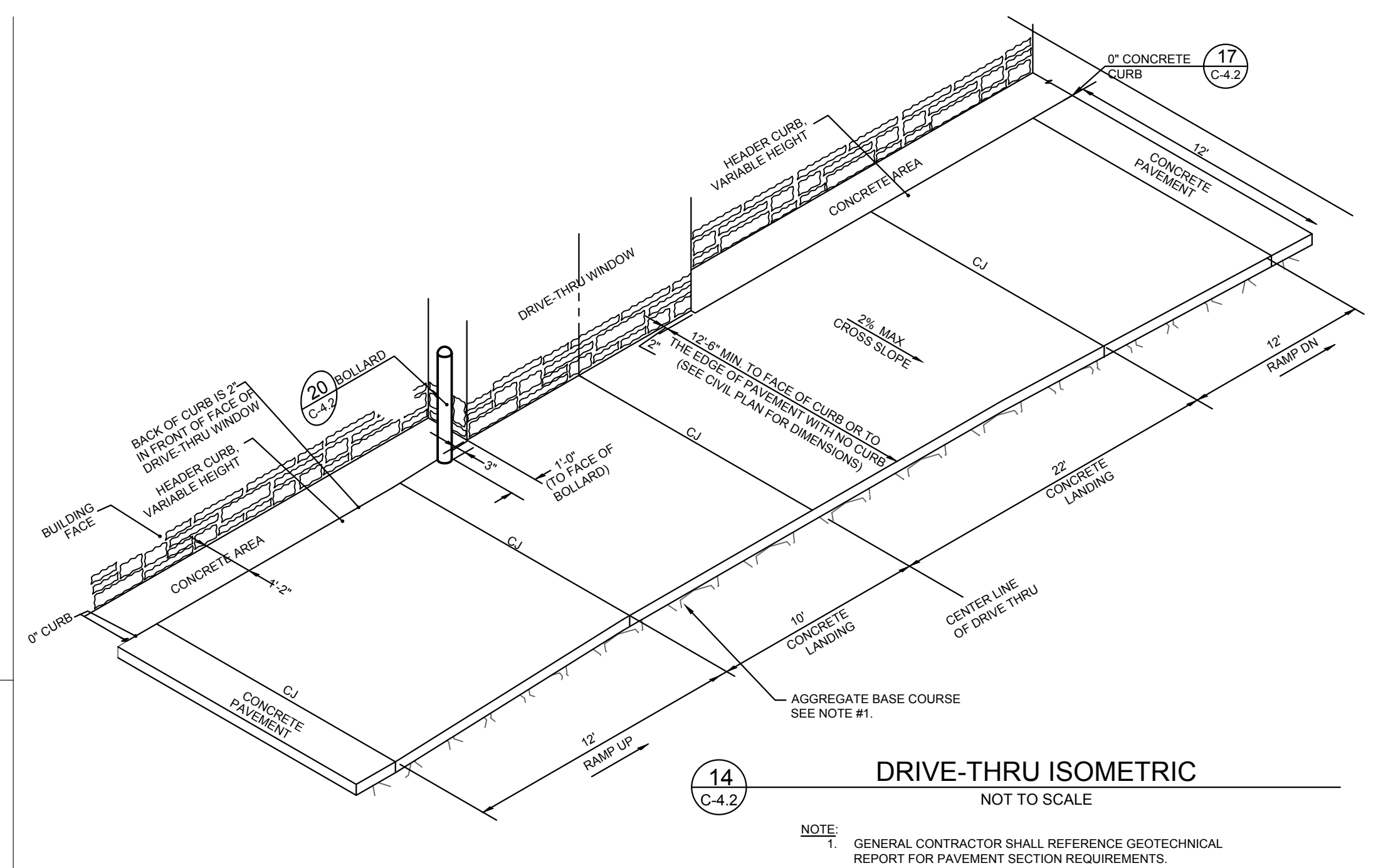
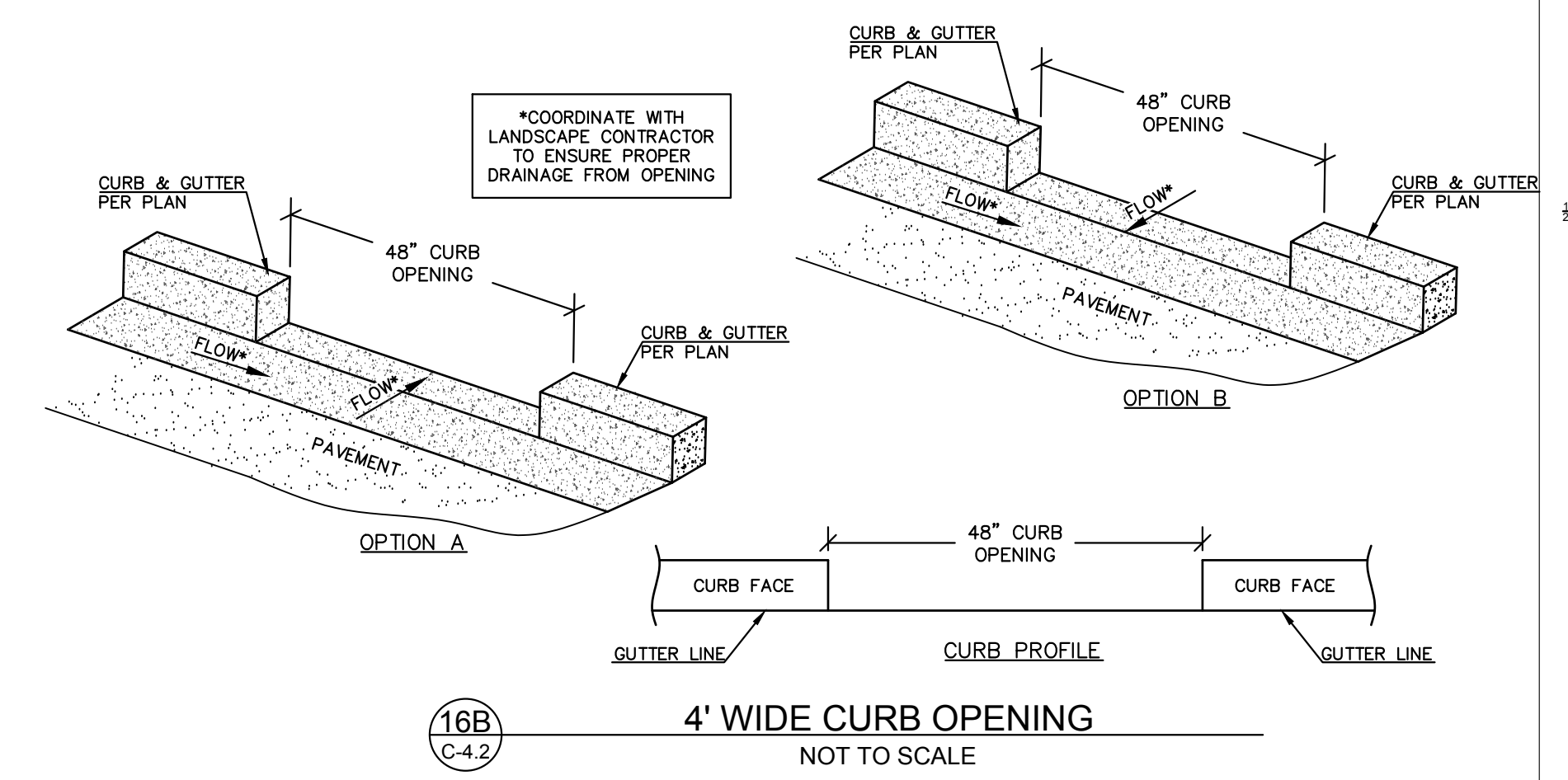
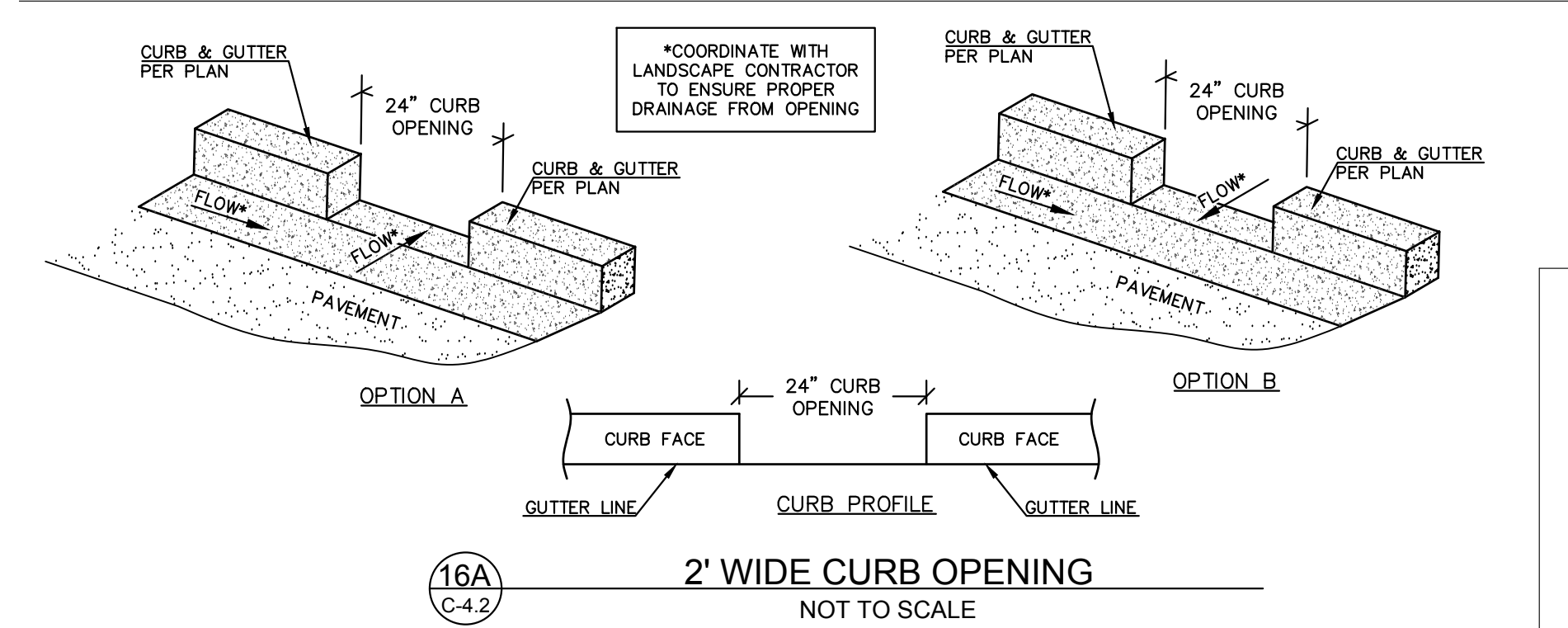
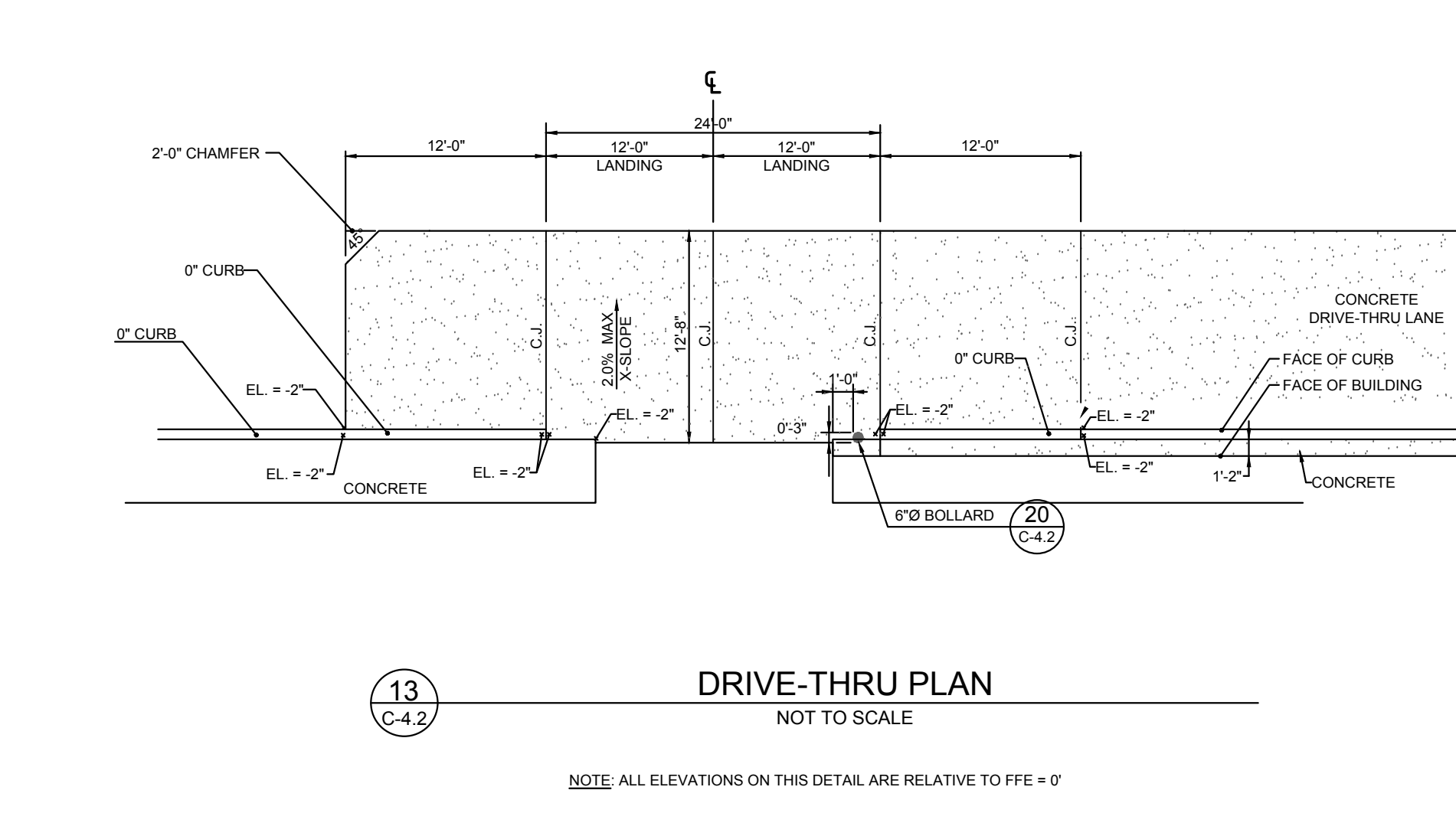
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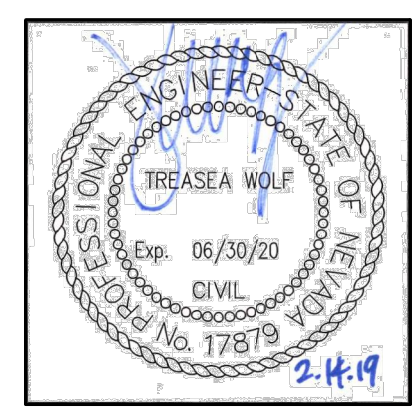
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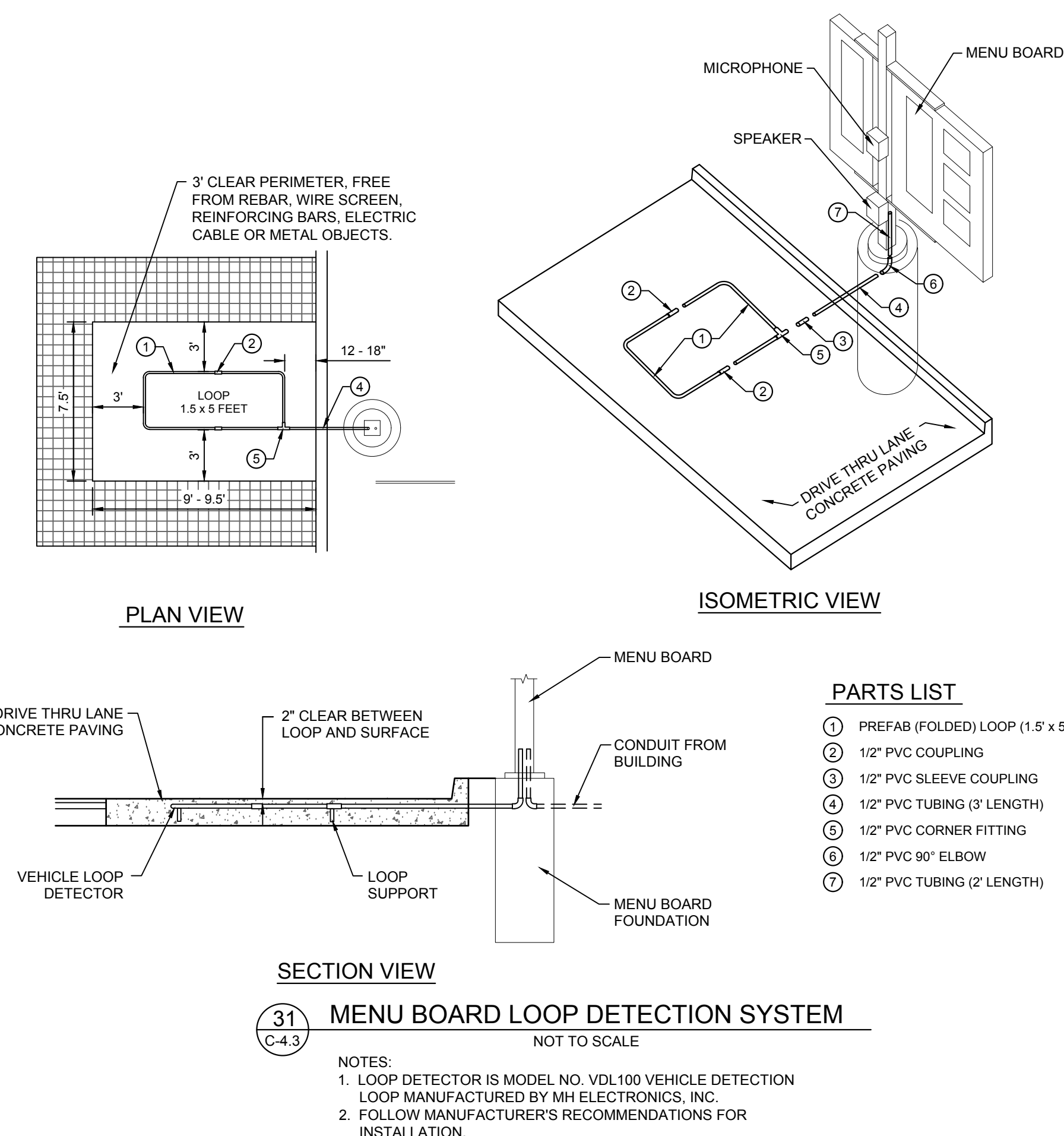
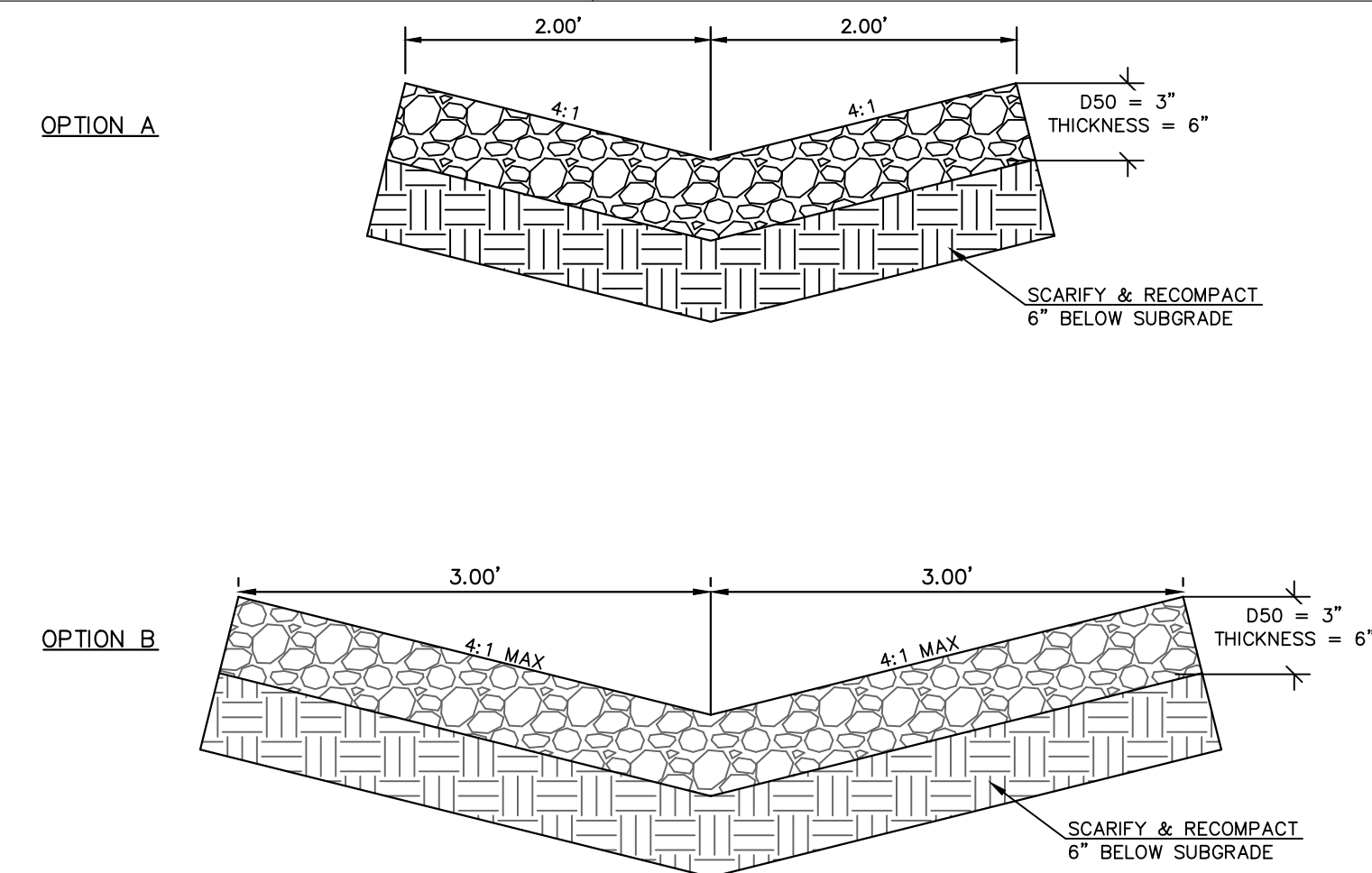
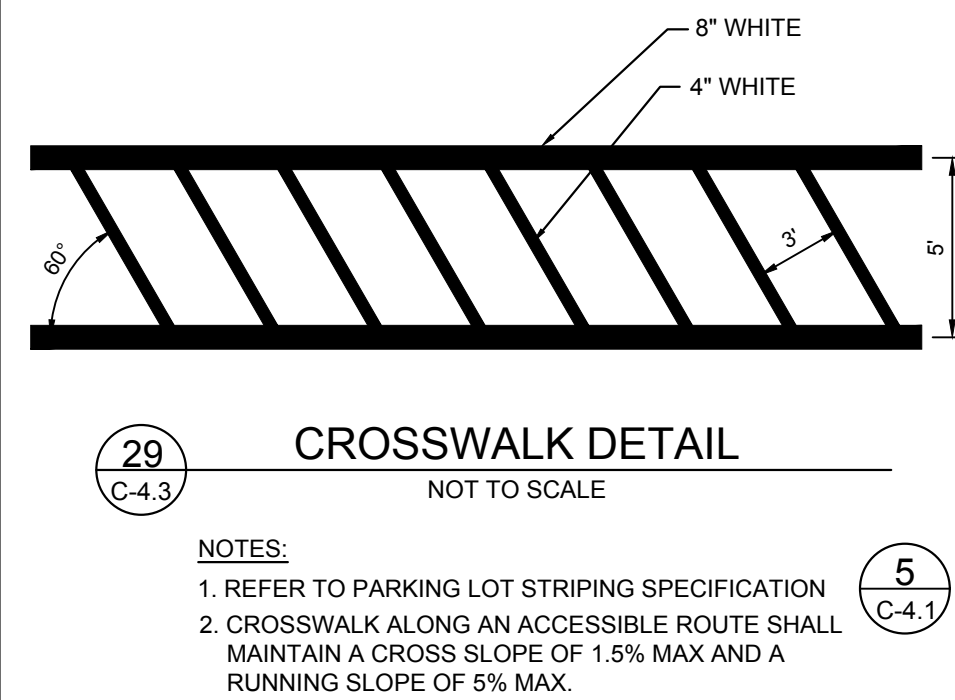
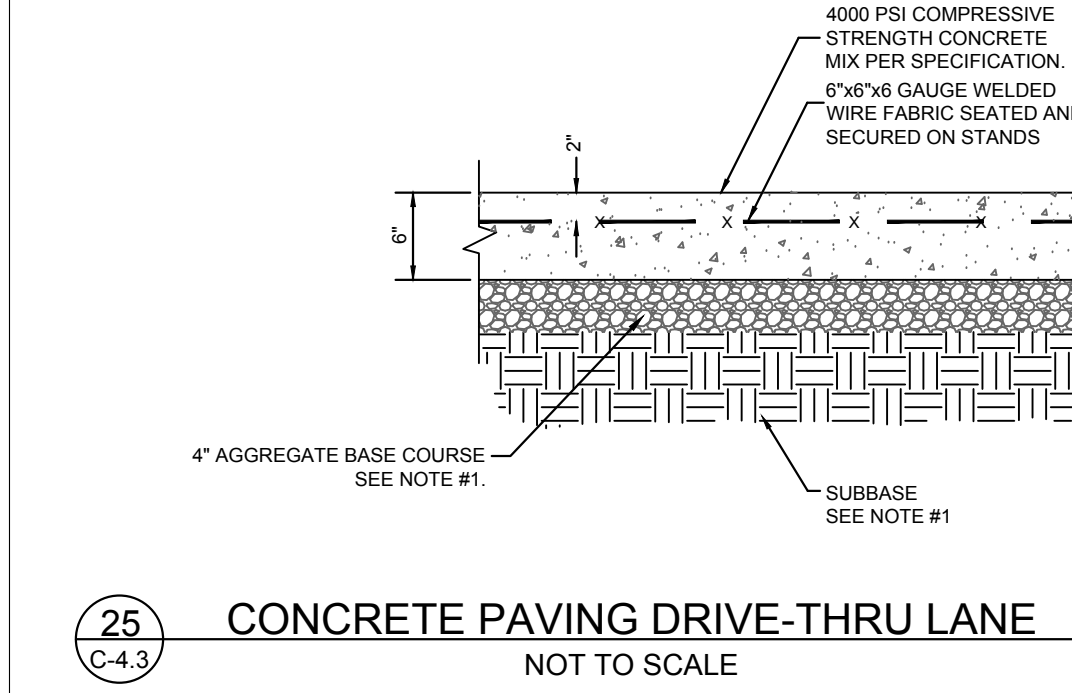
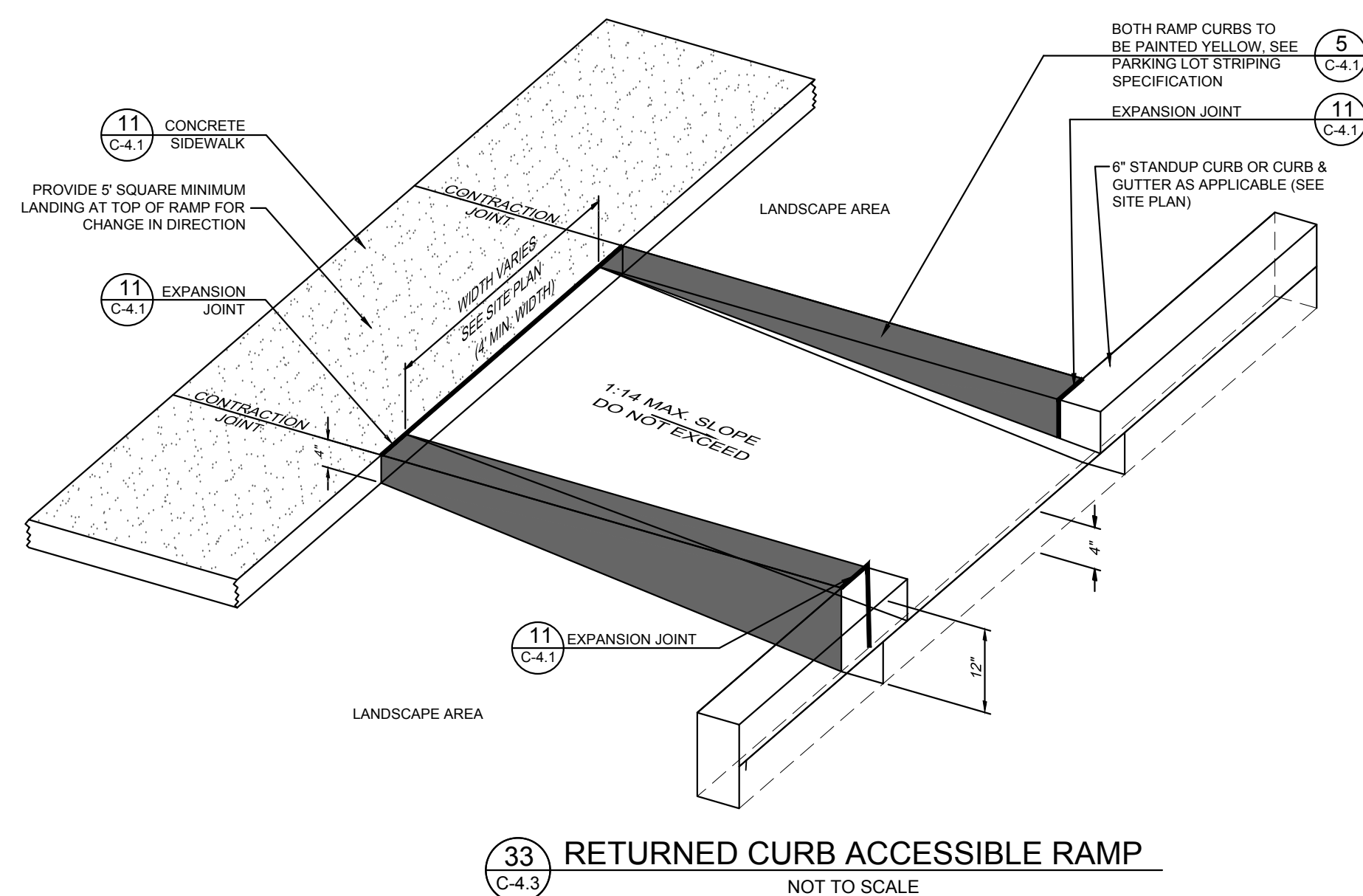
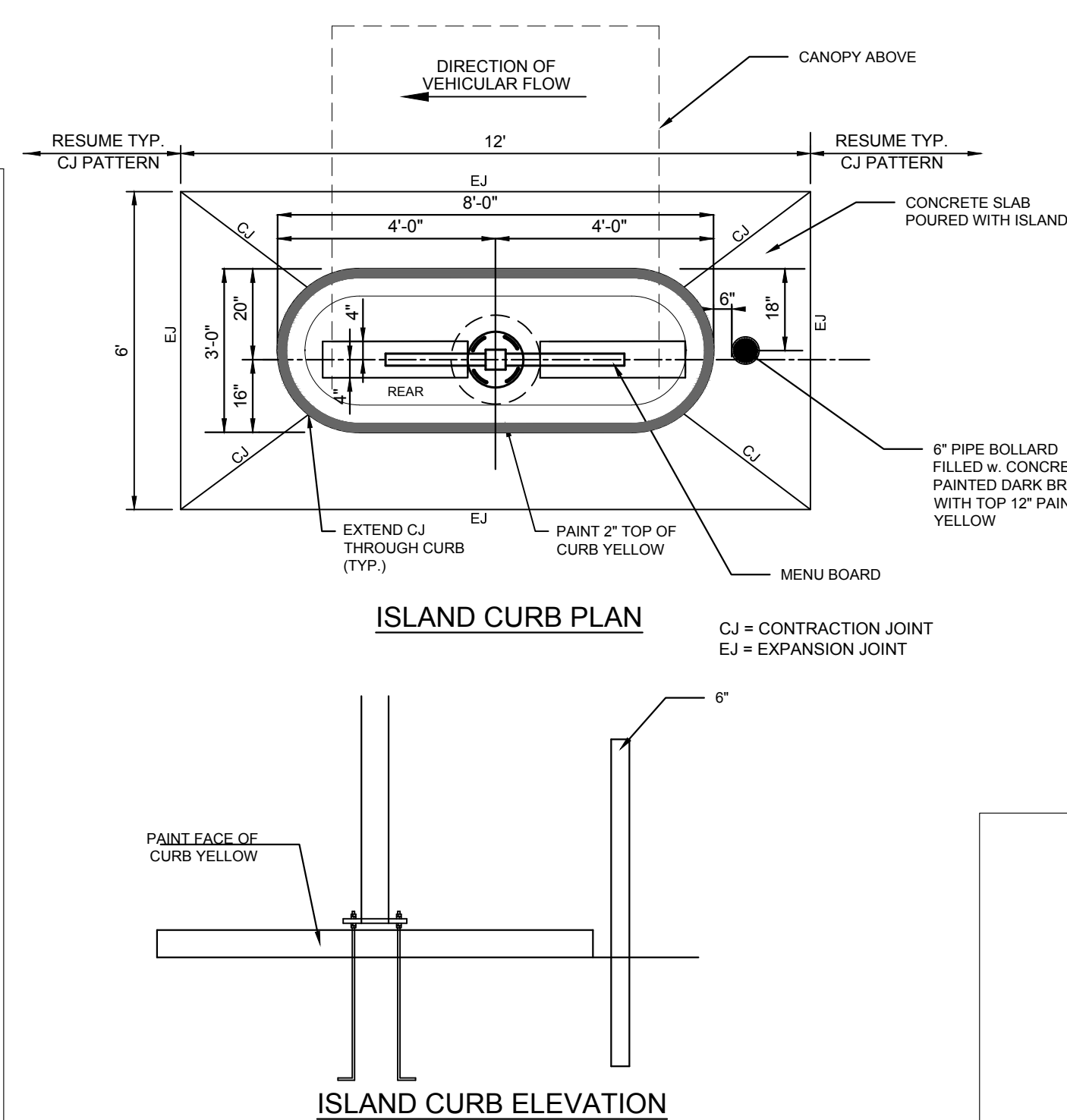
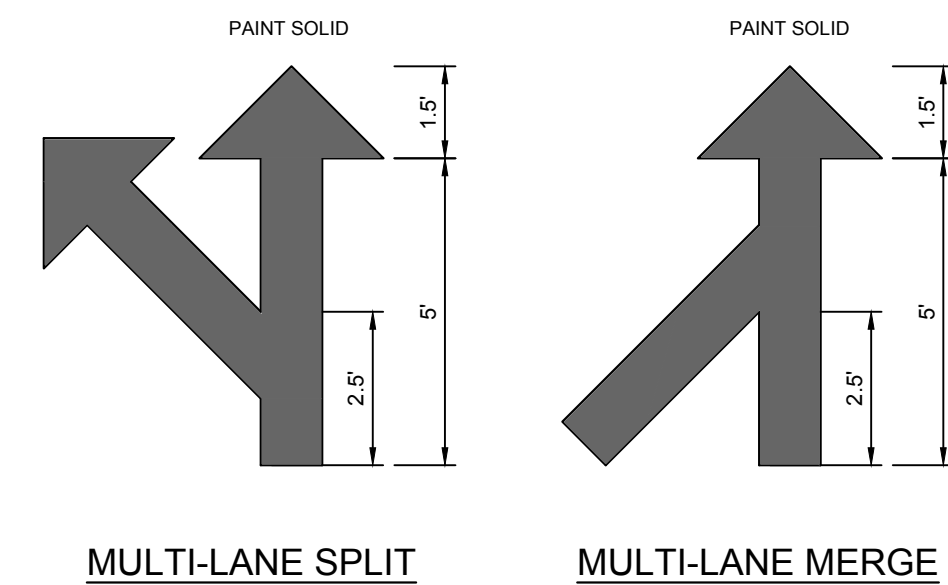
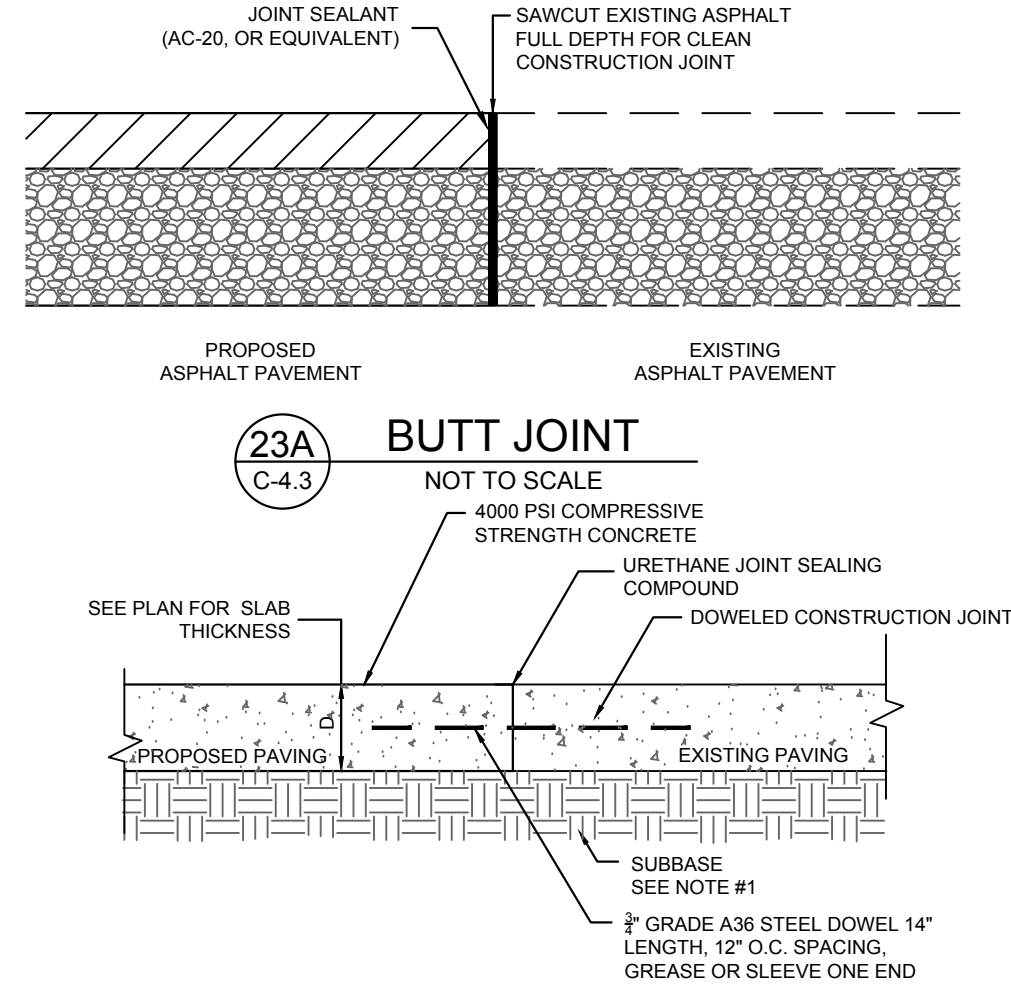
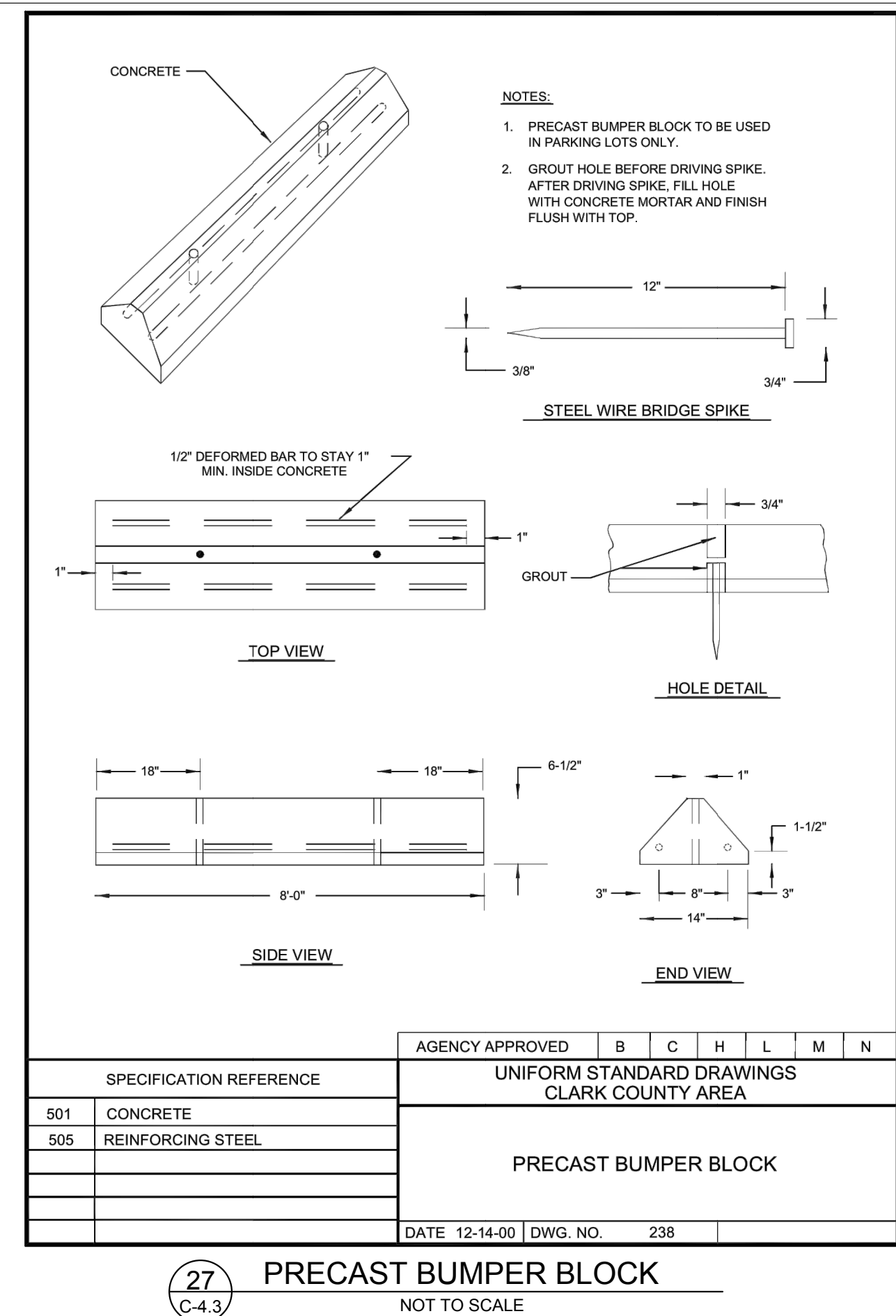
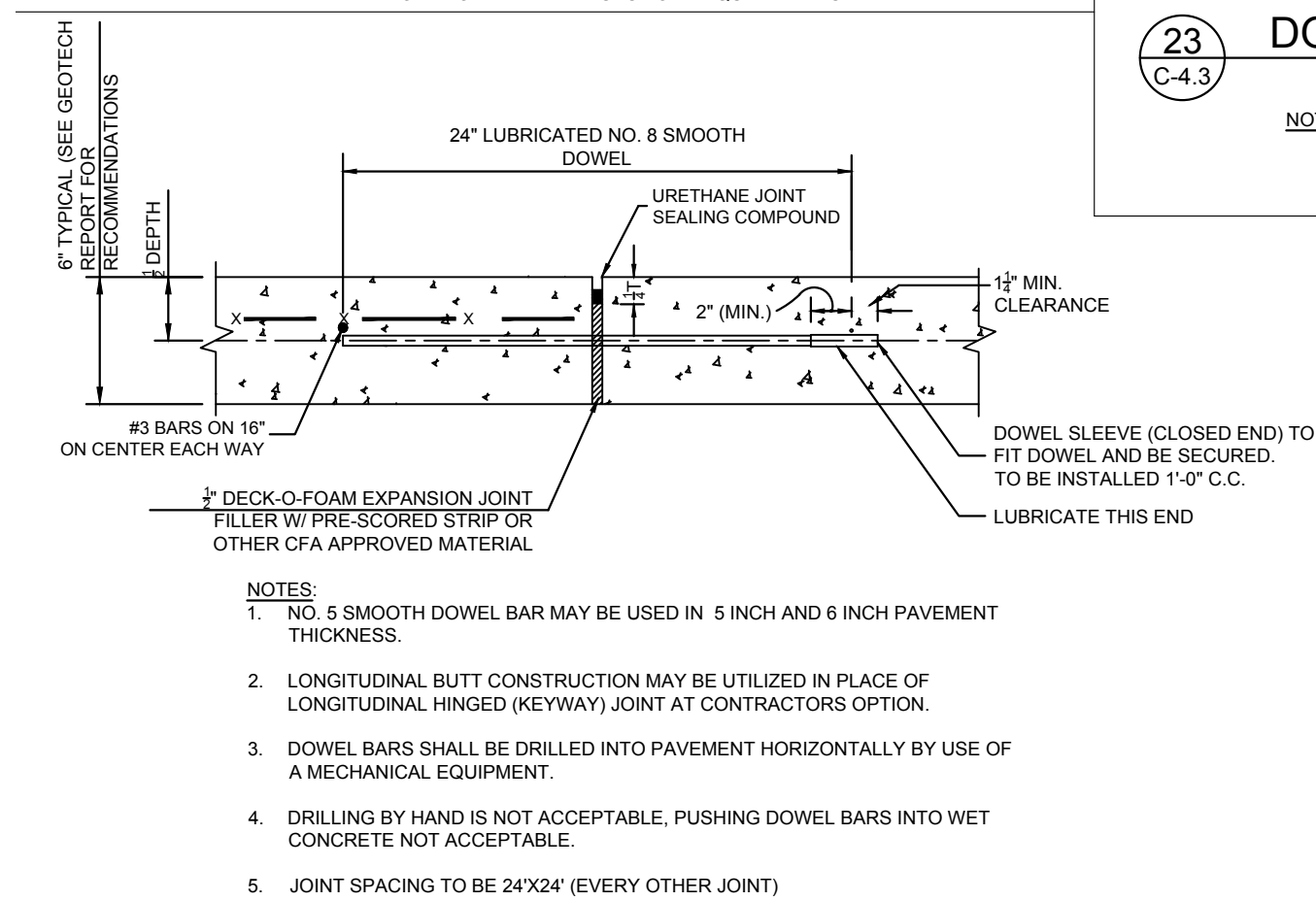
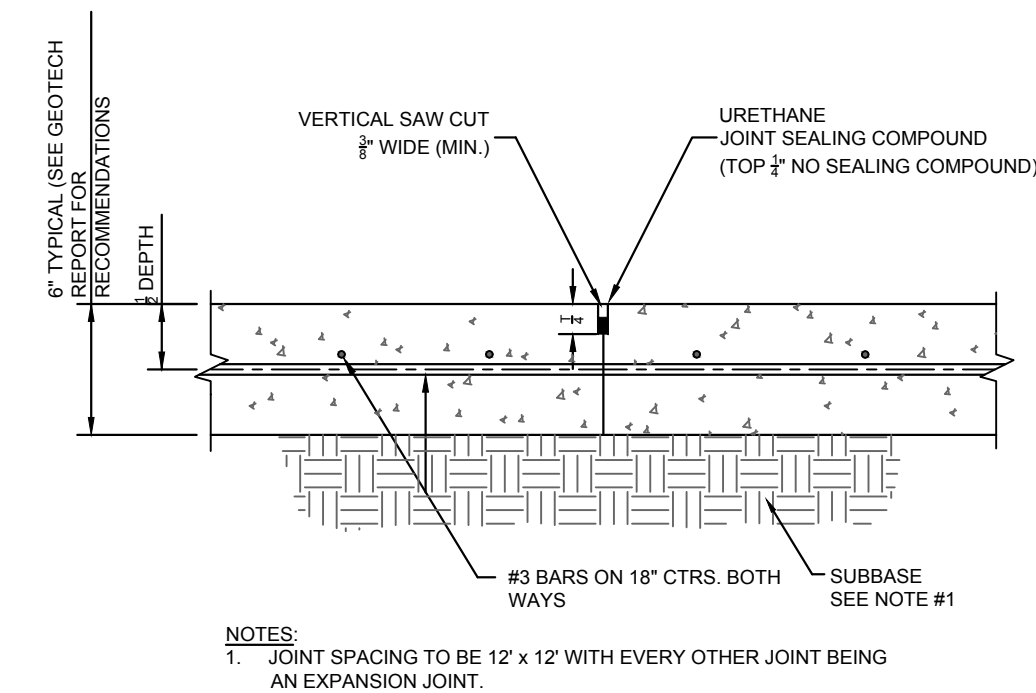
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SHEET
TYPICAL DETAILS 2

SHEET NUMBER

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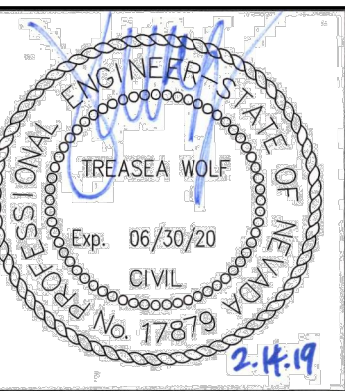
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C4.2



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FSR# 4293

PAYROLL SCHEDULE

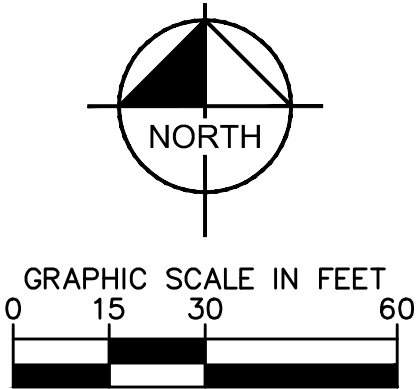
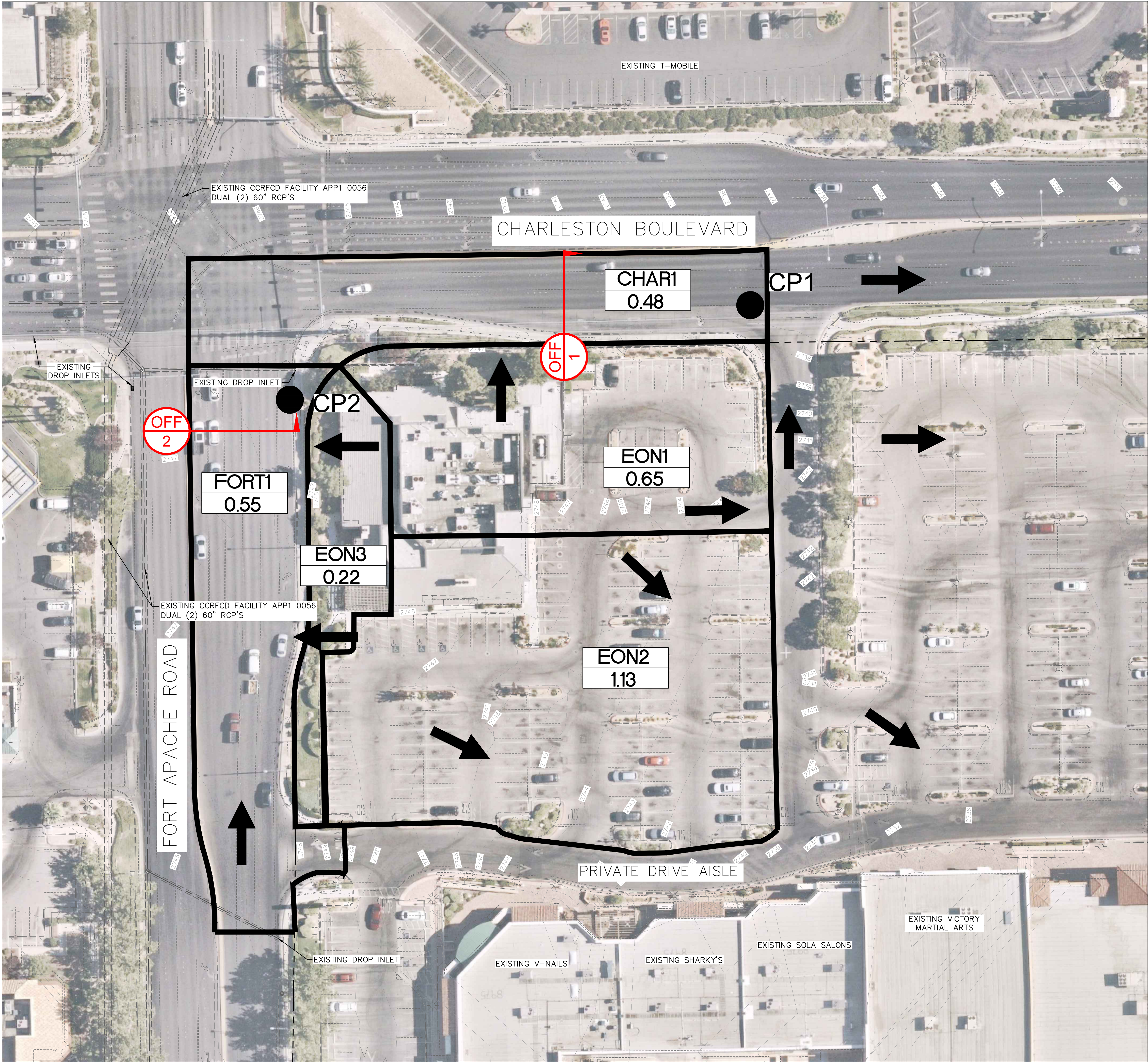
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DESIGNED FOR	DRAINAGE
EFFECTIVE DATE	02/14/19
DRAWN BY	JZ
CHECKED BY	CT

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SPECIAL DETAILS 3

SHEET NUMBER

C4.3



LEGEND

- SITE 1.20** BASIN ID
- BASIN AREA
- BASIN BOUNDARY
- FLOW ARROW
- XX/XX CFS** 10YR/100YR CFS
- SURFACE FLOW ARROW
- CPX** CONCENTRATION POINT
- ⊗ XX** SECTION ID

FLOW SUMMARY TABLE

BASIN ID/ COMB. PT.	BASIN AREA	10-YR FLOW	100-YR FLOW
	(ac)	(cfs)	(cfs)
EON1	0.65	1	2
CHAR1	0.48	1	2
CP1	-	2	5
EON1+CHAR1	-	2	5
EON2	1.13	2	4
EON3	0.22	<1	1
FORT1	0.55	1	2
CP2	-	2	3
EON3+FORT1	-	2	3

OFFSITE HYDRAULIC SUMMARY TABLE

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D+V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D+V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	2	0.30	2.13	0.64	3	0.34	2.34	0.80	OK



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LAS VEGAS, NV 89117

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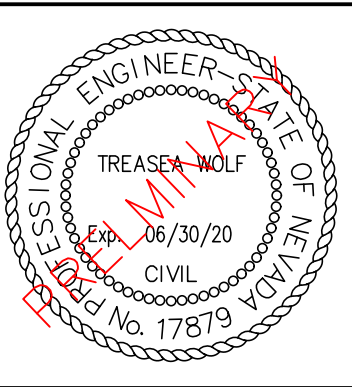
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SHEET

EX-1
SHEET NUMBER



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LASCORCA, NV 89447

FSR# 4293

REVISION SCHEDULE

<u>NO.</u>	<u>DATE</u>	<u>DESCRIPTION</u>
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PROJECT # 092908012

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DESIGN BY _____ AL

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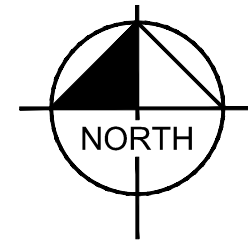
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MEET

1121

QUEST NUMBER

SHEET NUMBER



GRAPHIC SCALE IN FEET

A horizontal scale bar with tick marks at 0, 10, 20, and 40 feet. The bar is divided into alternating black and white segments: black from 0 to 10, white from 10 to 20, black from 20 to 30, white from 30 to 40.

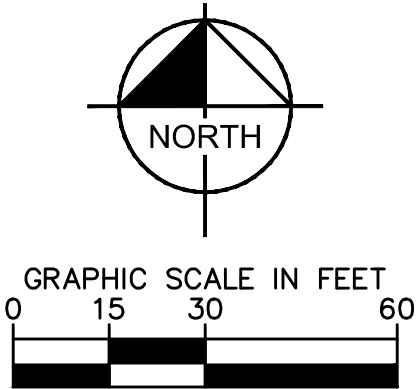
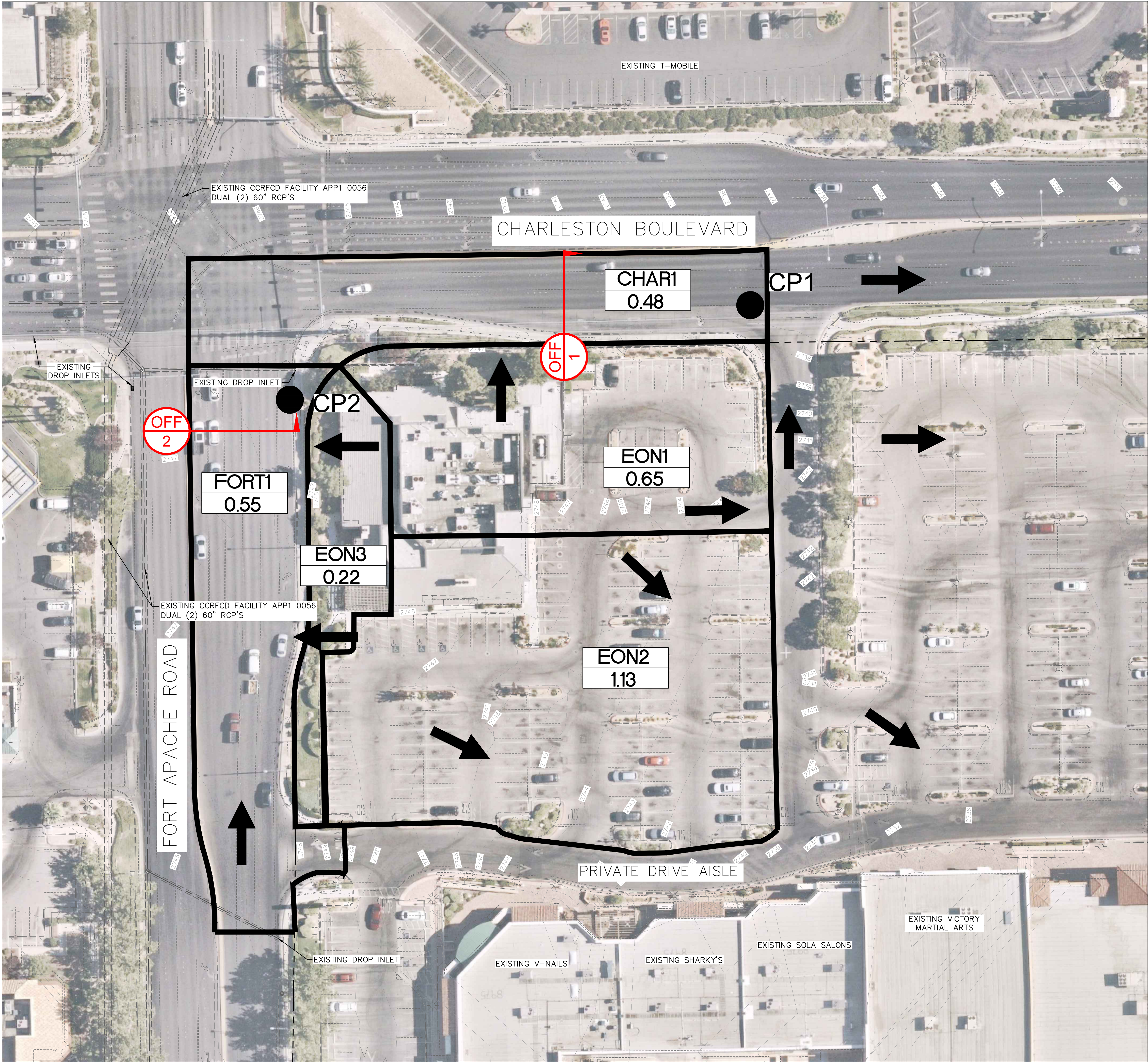
LEGEND

SITE 1.20	DRAINAGE MANAGEMENT AREA
	BASIN AREA
	BASIN BOUNDARY
	FLOW ARROW
	IMPERVIOUS AREA
	PERVIOUS AREA
	BUILDING AREA

PARKING LOT DATA CALCULATIONS

PARKING LOT DATA CALCULATIONS			
Note: Stormwater Quality Design Volume calculated using steps from Section 1500 Figures 1501-1503 of the CCRFCD HCDDM, Revised 2013			
GIVEN:			
Project Description:	CHICK-FIL-A PARKING/DRIVE-THRU AREA		
Parking Lot Data		Acreeage	
Property Size (PS)	=	1.99	
Building Area (BA)	=	0.21	
Total Pervious Area (TPA)	=	0.51	
Parking Lot Area (PLA) = (PLA = PS-BA-TPA)	=	1.27	
Minimum PLA to be treated = (PLA * 0.75)	=	0.95	acres
Area to be treated by the proposed LID BMPs			
Drainage Area A	=	0.79	
Drainage Area B	=	0.04	
Drainage Area C	=	0.06	
Drainage Area D	=	0.10	
Total	=	0.99	acres
<u>Since, 0.99 ac >= 0.95 ac then site satisfies Parking Lot LID criteria</u>			

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LEGEND

- SITE**
1.20
- BASIN ID**
BASIN AREA
- BASIN BOUNDARY**
- FLOW ARROW**
- XX/XX CFS**
SURFACE FLOW ARROW
- CPX**
CONCENTRATION POINT
- SECTION ID**

FLOW SUMMARY TABLE

BASIN ID/ COMB. PT.	BASIN AREA	10-YR FLOW	100-YR FLOW
	(ac)	(cfs)	(cfs)
EON1	0.65	1	2
CHAR1	0.48	1	2
CP1	-	2	5
EON1+CHAR1	-	2	5
EON2	1.13	2	4
EON3	0.22	<1	1
FORT1	0.55	1	2
CP2	-	2	3
EON3+FORT1	-	2	3

OFFSITE HYDRAULIC SUMMARY TABLE

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D ² V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D ² V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	2	0.30	2.13	0.64	3	0.34	2.34	0.80	OK



Chick-fil-A
5200 Buffington Road
Atlanta, Georgia
30349-2998

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LAS VEGAS, NV 89117

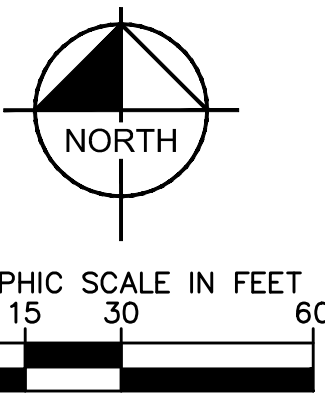
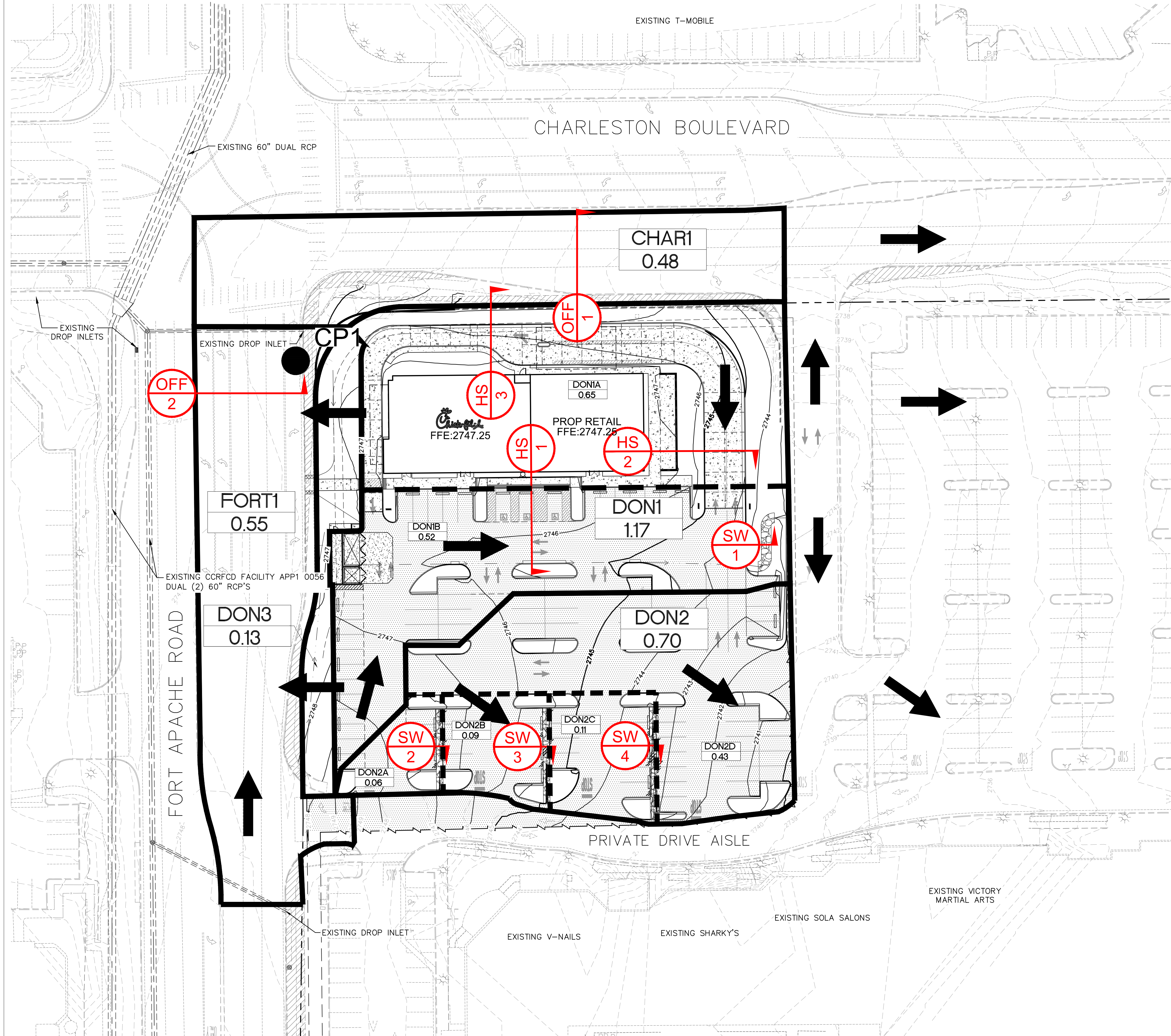
FSR# 4293

REVISION SCHEDULE
NO. DATE DESCRIPTION

AGENCY # CLV
PROJECT # 092908012
PRINTED FOR PRELIMINARY
DATE 01/21/19
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SHEET

EX-1
SHEET NUMBER

K:\AU_Civil\2019\01-12-Chick-fil-A\Drawings\Fort Apache\20190112-Chick-fil-A-Fort Apache.dwg Sheet No. 001A Printed by: jkennedy Thursday, February 14, 2019 9:49 AM



LEGEND

SITE 1.20	BASIN ID BASIN AREA
	BASIN BOUNDARY
	PRORATED BASIN BOUNDARY
	FLOW ARROW
XX/XX CFS 	10YR/100YR CFS SURFACE FLOW ARROW
	CONCENTRATION POINT
	SECTION ID

FLOW SUMMARY TABLE

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
DON1A	0.65	1.11	2.22
DON1B	0.52	0.44	1.78
DON2A	0.06	0.09	0.26
DON2B	0.09	0.13	0.39
DON2C	0.11	0.16	0.47
DON2D	0.43	0.61	1.84
DON3	0.13	<1	<1
CHAR1	0.48	1	2
FORT1	0.55	1	2
CP1	-	1	3
DON3+FORT1	-	1	3

OFFSITE HYDRAULIC SUMMARY TABLE

SECTION NAME	SLOPE	Q10 (CFS)	FLOW DEPTH (FT)	V10 (FPS)	D ² V	Q100 (CFS)	FLOW DEPTH (FT)	V100 (FPS)	D ² V	DRY LANE
OFF1	3.18	1	0.21	3.02	0.63	2	0.25	3.48	0.87	OK
OFF2	0.90	1	0.25	1.83	0.46	3	0.34	2.34	0.80	OK

ONSITE HYDRAULIC SUMMARY TABLE

SECTION NAME	SLOPE	Q100 (CFS)	FLOW DEPTH (FT)	2 ^D (ft)	FLOW LINE (ft)	FLOW LINE + 2D (ft)	FFE BLDG (ft)	FFE CHECK
HS1	1.50	1.78	0.27	0.54	2745.39	2745.93	2747.25	OK
HS2	1.05	2.22	0.27	0.54	2744.15	2744.69	2747.25	OK
HS3	0.50	2.22	0.32	0.64	2745.79	2746.43	2747.25	OK

PRORATED HYDRAULIC SUMMARY TABLE

BASIN ID	BASIN AREA (ac)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)	PRORATED BASIN ID	BASIN AREA (ac)	% OF TOTAL AREA	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
DON1	1.17	2	4	DON1A	0.65	56	1	2
				DON1B	0.52	44	1	2
DON2	0.70	1	3	DON2A	0.06	9	0.17	0.26
				DON2B	0.09	13	0.26	0.39
				DON2C	0.11	16	0.31	0.47
				DON2D	0.43	61	1	2



Chick-fil-A
5200 Buffington Road
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6671 LAS VEGAS BLVD S., SUITE 300, LAS VEGAS, NV 89119
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PR-1
SHEET NUMBER

NOTES

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

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

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

MAP LEGEND

PARCEL BOUNDARY

SUB BOUNDARY

PM/LD BOUNDARY

ROAD EASEMENT

MATCH / LEADER LINE

HISTORIC LOT LINE

HISTORIC SUB BOUNDARY

HISTORIC PM/LD BOUNDARY

SECTION LINE

CONDOMINIUM UNIT

AIR SPACE PCL

RIGHT OF WAY PCL

SUB-SURFACE PCL

001

ROAD PARCEL NUMBER

001

PARCEL NUMBER

1.00

ACREAGE

202

PARCEL SUB/SEQ NUMBER

PB 24-45

PLAT RECORDING NUMBER

5

BLOCK NUMBER

5

LOT NUMBER

GL5

GOV. LOT NUMBER

BOOK

T21S R60E

SEC.

5

MAP

N 2 NW 4

163-05-1

Scale: 1" = 200'

Rev: 9/19/2018

8

4

8

4

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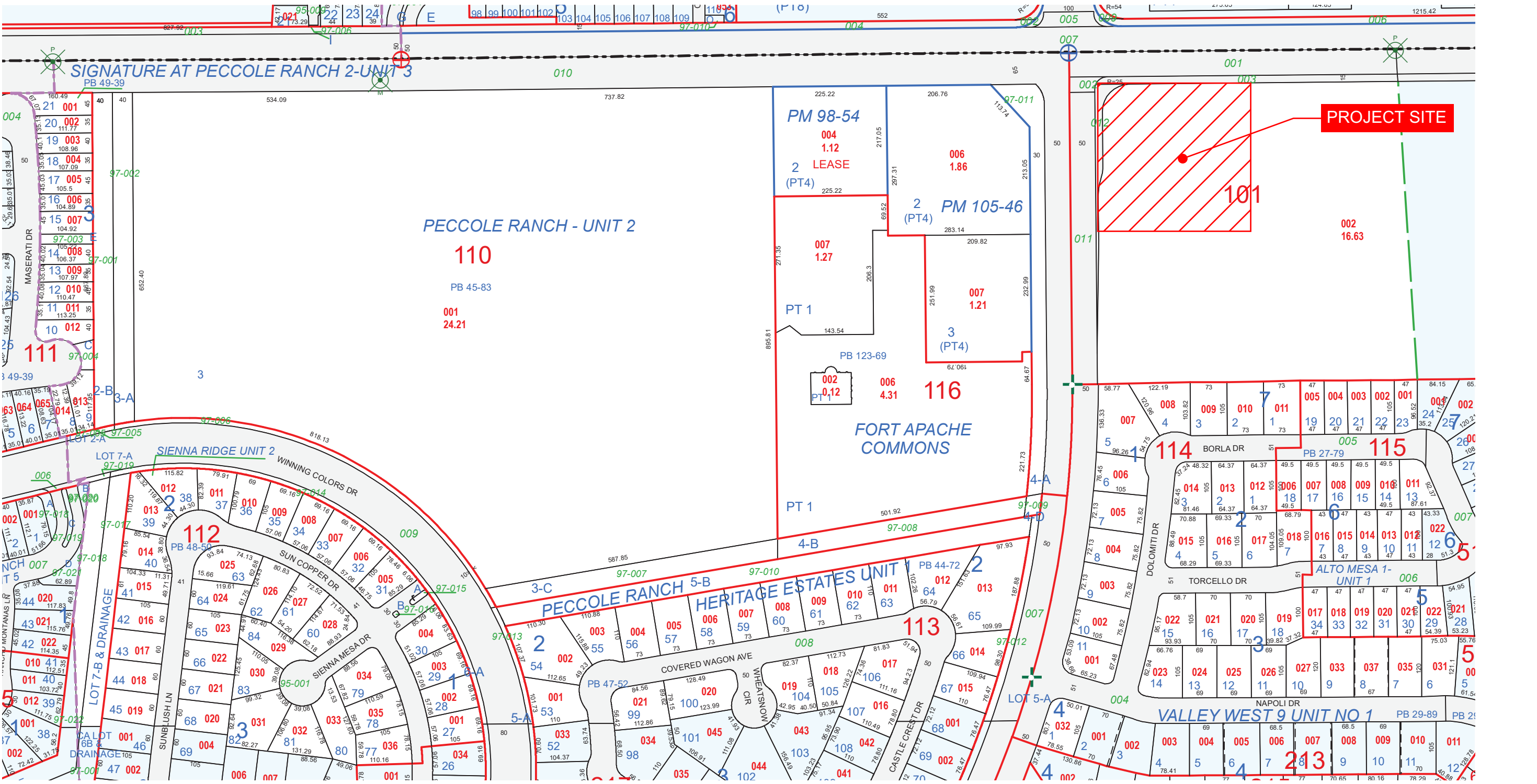
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1

CLARK COUNTY

ASSESSOR

NEVADA



NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRM for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NGS12
National Geodetic Survey
SSM-3, #R022
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov/>.

Base map information shown on this FIRM was provided in digital format by the Clark County GIS Management Office (GISMO).

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

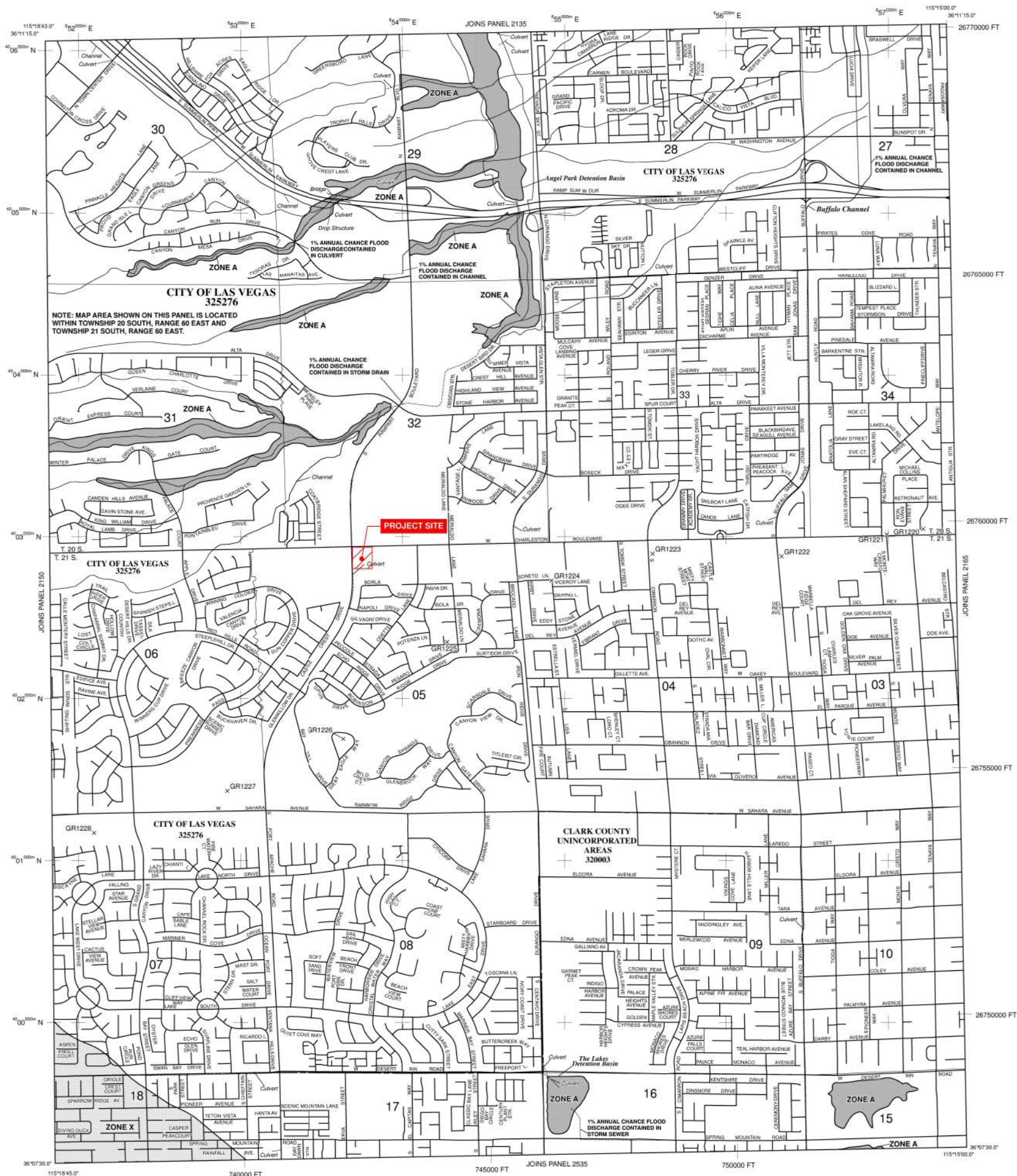
For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Service Center website at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

The Digital Flood Insurance Rate Map (DFIRM) was produced through a unique partnership between Clark County and the Federal Emergency Management Agency (FEMA). Clark County has developed a long-term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the Clark County commitment to share and maintain floodplain layers within their Geographic Information System Management Office (GISMO).

This DFIRM reflects several innovative features. These include:
+ Southern Nevada GIS-Cooperation among local government agencies throughout Clark County. The foundation of cooperation is the GIS Interlocal Agreements formed between fourteen regional participants. In part, the agreements specify that the Clark County GIS Management Office (GISMO) will be responsible for maintaining a GIS data warehouse and associated Southern Nevada GIS metadata.

+ The GISMO's responsibilities go beyond maintaining the GIS data warehouse. GISMO also maintains the Street Centerline Database used by 911 dispatch services. This centerline database serves as the basemap for this DFIRM.

DIGITAL DATA AVAILABILITY: <http://www.co.clark.nv.us/cglt/gismo/gismo.htm>



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, AV, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE AR9** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

— Floodplain boundary

— Floodway boundary

— Zone D boundary

— CBRS and OPA boundary

— Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Base Flood Elevation line and value; elevation in feet*

Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

— Cross section line

— Transect line

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

1000-meter Universal Transverse Mercator grid ticks, zone 11

5000-foot grid ticks: Nevada State Plane coordinate system, east zone (FIPSZONE 2701), Transverse Mercator

Bench mark (see explanation in Notes to Users section of this FIRM panel)

— River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

August 16, 1995

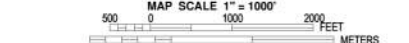
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

September 27, 2002

November 16, 2011 - to reflect updated topographic information, to change floodway, to add Base Flood Elevations, to update corporate limits, to change Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to delete Special Flood Hazard Areas, to change zone designations, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



PANEL 2145F

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY,

NEVADA

AND INCORPORATED AREAS

PANEL 2145 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NUMBER PANEL SUFFIX

CLARK COUNTY 320003 2145 F

LAS VEGAS, CITY OF 325276 2145 F

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

MAP NUMBER 32003C2145F

MAP REVISED NOVEMBER 16, 2011

Federal Emergency Management Agency

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
APDG		ANGEL PARK - DURANGO						
0000	E	84" RCP	2600	842	C38B	ALLGOW3	0.79	0.70
0060	E	72" RCP	1901	374	38A	ALLGOW3	0.35	0.96
APMD		ANGEL PARK - MIDDLE BRANCH						
0027	E	1: 12' X 10' and 2: 12' X 2' RCBC @ Canyon Run	170	6048	C11A-3*	ALLGOW4	11.31	3.00
0030	E	Natural Wash	7000	6048	C11A-3*	ALLGOW4	11.31	3.00
0132	E	2: 12"x10' RCBC @ Hualapai	120	6048	C11A-3*	ALLGOW4	11.31	1.00
0133	E	Natural Wash	3015	6048	C11A-3*	ALLGOW4	11.31	3.00
APNO		ANGEL PARK NORTH						
0001	E	1,512 ac-ft Angel Park Detention Basin		9199	ANGLPKIN	ALLGOW5	21.99	
APP1		ANGEL PARK - PECCOLE 1						
0000	E	72" RCP	2982	442	PIC-B	ALLGOW3	0.44	2.40
0056	E	2: 60" RCP	1385	442	PIC-B	ALLGOW3	0.44	2.40
APP2		ANGEL PARK - PECCOLE 2						
0000	E	Grass Chnl 10"W 5"D 2:1 SS	4793	2004	C57B-1	ALLGOW3	1.93	2.10
APSO		ANGEL PARK - SOUTH BRANCH						
0000	E	2: 12' X 12' RCB	2506	4628	CC57B-4	ALLGOW3	5.24	1.62
0020	E	2: 12' X 12' RCBC @ Rampart	350	4628	CC57B-4	ALLGOW3	5.24	1.80
0050	E	Natural Wash	209	4628	CC57B-4	ALLGOW3	5.24	1.84
0067	E	Natural Wash	8300	2384	C57B-2	ALLGOW3	2.67	2.10
0204	E	2: 8' X 8' RCBC @ Hualapai	326	2056	C12B	ALLGOW3	2.00	2.66
0205	E	Natural Wash	2380	2056	C12B	ALLGOW3	2.00	3.46
0254	E	2: 8' X 8' RCBC @ Town Center Dr.	190	1932	C12A	ALLGOW3	1.74	3.00
0255	E	24' X 12' RCAC @ Town Center Dr.	140	1932	C12A	ALLGOW3	1.74	3.00
FLBF		FLAMINGO WASH - BUFFALO						
0152	E	10' X 7' RCB	3460	814	CLF11	FLAM3A	4.29	0.32
0228	E	96" RCP	1330	746	CLF9	FLAM3A	0.94	1.00
0252	E	9' X 6' RCB	170	746	CLF9	FLAM3A	0.94	1.00
0258	E	96" RCP	1140	746	CLF9	FLAM3A	0.94	0.50
0278	E	90" RCP	2640	506	LF8	FLAM3A	0.51	0.50
0328	E	54" RCP	660	506	LF8	FLAM3A	0.51	0.30
FLDI		DESERT INN DRAIN						
0000	E	9' X 6' RCB	190	1145	CLF4	FLAM3A	1.38	2.71
0004	E	96" RCP	2670	1145	CLF4	FLAM3A	1.38	1.00
0050	E	90" RCP	1390	1145	CLF4	FLAM3A	1.38	1.65
0075	E	84" RCP	1010	874	CLF3	FLAM3A	0.94	1.87
0095	E	96" RCP	200	874	CLF3	FLAM3A	0.94	1.87
0100	E	72" RCP	190	277	LF1	FLAM3A	0.37	1.86
0105	E	60" RCP	2510	277	LF1	FLAM3A	0.37	1.85
FLDR		DURANGO COLLECTOR						
0179	E	60" RCP	1810	260	CUFS23	FLAM3A	0.45	1.21
FLDY		FLAMINGO WASH - DARBY STORM DRAIN						
0000	E	84" RCP	100	558	CLF24	FLAM3A	0.76	0.25
0002	E	10' X 3' RCB	50	558	CLF24	FLAM3A	0.76	0.25
0004	E	60" RCP	680	558	CLF24	FLAM3A	0.76	2.80
0013	E	78" RCP	560	558	CLF24	FLAM3A	0.76	1.79
FLLA		FLAMINGO WASH - LATERAL (FLAMINGO/RAINBOW)						
0227	E	93" RCP	1360	640	CLF28	FLAM3B	1.03	0.40
0254	E	90" RCP	2730	403	CLF27	FLAM3A	1.54	0.40
0305	E	1,556 cfs PMF Spillway		1556	CLF25	FLAM3A	1.03	
0306	E	30" RCP with 18" Orifice Outlet	160	29	DIDB	FLAM3A	1.03	0.43
0308	E	62 ac-ft Desert Inn Detention Basin		744	CLF25	FLAM3A	1.03	
0322	E	81" RCP	1370	224	LF25	FLAM3A	0.27	0.50
0345	E	81" RCP	1340	224	LF25	FLAM3A	0.27	0.50
0369	E	72" RCP	670					0.50
0379	E	66" RCP	1320					0.50

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
FLMN		FLAMINGO WASH - MONTESSOURI NORTH STORM DRAIN						
0000	E	78" RCP	1340	558	CLF24	FLAM3A	0.76	0.50
0025	E	72" RCP	1330	558	CLF24	FLAM3A	0.76	0.50
0050	E	66" RCP	500	372	LF23	FLAM3A	0.38	0.50
0060	E	54" RCP	800	372	LF23	FLAM3A	0.38	0.50
0075	E	48" RCP	30	372	LF23	FLAM3A	0.38	0.50
FLMS		FLAMINGO WASH - MONTESSOURI SOUTH STORM DRAIN						
0000	E	54" RCP	630					0.52
FLSM		SPRING MOUNTAIN DRAIN						
0000	E	60" RCP	4590	116	CLF10W	FLAM3A	2.84	2.50
0083	E	36" RCP	570	86	LAKEDB	FLAM3A	2.62	1.90
0086	E	36" RCP Outlet	90	86	LAKEDB	FLAM3A	2.62	
0087	E	143 ac-ft Lakes Detention Basin		1976	CLF7	FLAM3A	2.62	
0088	P1	Upgrade to 165 ac-ft Lakes Detention Basin		1976	CLF7	FLAM3A	2.62	
0100	E	12' X 8' RCB	310	1976	CLF7	FLAM3A	2.62	1.25
0125	E	96" RCP	3040	750	CLF6N	FLAM3A	0.87	0.80
0180	E	90" RCP	2350	526	LF5	FLAM3A	0.49	0.50
GOSO		GOWAN SOUTH FACILITIES						
0297	E	12' X 7' RCB	2124	1825	CW1BB-C	ALLGOW3	2.14	1.60
0336	E	12' X 7' RCB	602	1593	C1-WESTC	ALLGOW3	1.84	3.40
0352	E	2: 8' X 5' RCB	2740	1374	C1-DUCHC	ALLGOW3	1.60	0.73
0404	E	2: 8' X 4' RCB	2660	1125	C1-ALTAC	ALLGOW3	1.32	0.80
0455	E	2: 12' X 4' RCB	350	665	C1-HOLMC	ALLGOW3	0.81	0.30
0462	E	12' X 4' RCB	1330	665	C1-HOLMC	ALLGOW3	0.81	0.30
GOWC		GOWAN SOUTH FACILITIES - WEST CLIFF						
0000	E	24" RCP	5400	257	1-WEST-C	ALLGOW3	0.24	1.67
LCCH		LAS VEGAS CREEK CHANNEL						
0438	E	60" RCP	1090	162	CLC01-C	SW3	1.20	1.60
0458	E	60" RCP	1060	162	CLC01-C	SW3	1.20	1.60
0478	E	60" RCP	1110	162	CLC01-C	SW3	1.20	0.55
0499	E	42" RCP Outlet	660	85	RAINBWDB	SW3	1.11	1.88
0513	E	102 ac-ft Rainbow Detention Basin		970	RAINBWIN	SW3	1.11	
0518	E	60" RCP Connector Pipe Under Rainbow Blvd	670	970	RAINBWIN	SW3	1.11	1.85
LCLO		LAS VEGAS CREEK - LORENZI						
0000	E	7' X 6' RCB	445	265	DAL00A	SW3	0.41	3.37
0008	E	7' X 6' RCB	2415	265	DAL00A	SW3	0.41	0.40
0054	E	7' X 5' RCB	169	265	DAL00A	SW3	0.41	1.00
MEAL		MEADOWS ALTA						
0160	E	36" RCP	2600	331	CUS	SW3	0.56	1.25
0209	E	48" RCP	2500	150	DCR2	SW3	0.41	1.70
0256	E	38" X 60" HERCP	81	150	DCR2	SW3	0.41	1.48
0258	E	48" RCP	275	150	DCR2	SW3	0.41	4.07
MECH		EXTENSION OF MEADOWS / CHARLESTON						
0310	E	24" RCP	1000	32	OAKEYOT	SW3	1.88	1.43
0323	E	15" RCP Outlet	200	32	OAKEYDB	SW3	1.88	
0324	E	201 ac-ft Oakley Detention Basin		1652	OAKEYIN	SW3	1.88	
0334	E	11' X 6' RCB	200	573	C5-OAK-C	SW3	0.56	0.50
0337	E	9' X 6' RCB	520	573	C5-OAK-C	SW3	0.56	0.50
0338	E	10' X 8' RCB	2060	1131	C3A-OAKC	SW3	1.32	1.62
0351	E	90" RCP	1350	573	C5-OAK-C	SW3	0.56	0.50
0378	E	10' X 8' RCB	745	1131	C3A-OAKC	SW3	1.32	2.00
0380	E	66" RCP	385	352	3-HOLM-C	SW3	0.33	2.00
0387	E	66" RCP	300	403	3A-OAK-C	SW3	0.43	3.08
0390	E	83" X 53" RCP	50	352	3-HOLM-C	SW3	0.33	2.00
0400	E	10' X 6' RCB	1890	823	C3-ELP-C	SW3	0.88	1.43
0405	E	66" RCP	1390	403	3A-OAK-C	SW3	0.43	1.00
0410	E	66" RCP	182	352	3-HOLM-C	SW3	0.33	2.00
0420	E	66" RCP	1410	352	3-HOLM-C	SW3	0.33	2.00

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
MECN		MEADOWS - CHARLESTON						
0123	P1	8' X 6' RCB	5200	821	CCH09-C	SW3	0.72	1.64
0223	P1	6' X 5' RCB	2700	422	CCH05-C	SW3	0.34	2.04
RRFA		RED ROCK - FORT APACHE COLLECTOR						
0105	E	78" RCP	1330	463	CUFR22	FLAM3A	0.77	0.94
0130	E	66" RCP	690	331	UFR21	FLAM3A	0.51	0.93
0143	E	48" RCP	1330	331	UFR21	FLAM3A	0.51	2.54
RRHU		RED ROCK - HUALAPAI COLLECTOR						
0015	E	10' X 10' RCB	560	1199	CUFR13N	FLAM3A	1.52	1.30
0025	E	11' X 5.5' RCAP	3310	1199	CUFR13N	FLAM3A	1.52	1.30
0079	E	8' X 6' RCB	2650	981	CUFR11	FLAM3A	1.09	1.30
0129	E	7' X 6' RCB	2630	842	CUFR10	FLAM3A	0.82	1.20

* 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).



2013 LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FACILITY INVENTORY
FIGURE F - 30

L E G E N D	ID (Facility Identifier)	AAB	
	Parent Stream Name		
	Stream Name		
	River Mile	0000	
	Distance Above Confluence with Parent Stream (Miles)		
	Miles in Hundredths		
Existing Facility.....E			
Proposed or Modified Facility.....P		Bottom Width.....W	
Contingency Level		Depth.....D	
Category B.....P0		Side Slope, H:V.....SS	
Master Plan.....P1			
Preliminary Design.....P2			
Design.....P3			
Construction Features			
Cast in Place Concrete Pipe.....		CIPCP	Reinforced Concrete Arch Culvert.....RCAC
Corrugated Metal Arch Pipe Culvert.....		CMAF	Reinforced Concrete Box.....RCB
Corrugated Metal Pipe Culvert.....		CMPC	Reinforced Concrete Box Culvert.....RCBC
High Density Polyethylene.....		HDPE	Reinforced Concrete Pipe.....RCP
Horizontal Elliptical Reinforced Concrete Pipe.....		HERCP	Reinforced Concrete Pipe Culvert.....RCPC
Reinforced Concrete Arch Pipe.....		RCAP	Storm Sewer Pipe.....SSP



2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

**FIGURE F- 30
FLOOD CONTROL FACILITIES**

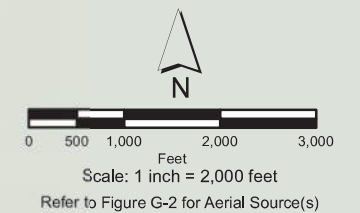
LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin

- 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 |



US95						I-15							
1	2	3				A1	A2						
4	5	6				A3	A4						
7	8	9	10	A5	A6								
11	12	13	14	15	16	17							
18	19	20	21	22	23								
24	25	26	27	28									
29	30	31	32	33	34								
35	36	37	38	39	40								
41	42	43	44	45	46								
47	48	49	50	51	52								
53	54	55	56										
57	58	59											



*City of Las Vegas***AGENDA MEMO - PLANNING**

PLANNING COMMISSION MEETING DATE: FEBRUARY 12, 2019

DEPARTMENT: PLANNING

ITEM DESCRIPTION: APPLICANT: CHICK-FIL-A, INC. - OWNER: CROSSROADS
COMMONS LTD, LLC**** STAFF RECOMMENDATION(S) ****

CASE NUMBER	RECOMMENDATION	REQUIRED FOR APPROVAL
SDR-75322	Staff recommends DENIAL, if approved subject to conditions:	

**** NOTIFICATION ******NEIGHBORHOOD ASSOCIATIONS NOTIFIED** 24**NOTICES MAILED** 704**PROTESTS** 3**APPROVALS** 2

**** CONDITIONS ****

SDR-75332 CONDITIONS

Planning

1. 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.
2. All development shall be in conformance with the site plan, landscape plan, and building elevations, date stamped 12/18/18, except as amended by conditions herein.
3. A Waiver from Title 19.08.040 is hereby approved, to not orient the building to the corner where such is required.
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.
6. 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.
7. 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.
8. All City Code requirements and design standards of all City Departments must be satisfied, except as modified herein.

Conditions Page Two
February 12, 2019 - Planning Commission Meeting

Public Works

9. Prior to the issuance of permits, grant a Bus Shelter Pad Easement for a double shelter at the existing bus stop on Charleston Boulevard adjacent to this site unless the Regional Transportation Commission (RTC) acknowledges in writing that this easement is not required.
- 10.. A Traffic Impact Analysis must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits, submittal of any construction drawings or the recordation of a Map subdividing this site, whichever may occur first. Comply with the recommendations of the approved Traffic Impact Analysis prior to occupancy of the site. No recommendation of the approved Traffic Impact Analysis, nor compliance therewith, shall be deemed to modify or eliminate any condition of approval imposed by the Planning Commission or the City Council on the development of this site.
11. An Update to the previously approved Drainage Plan and Technical Drainage Study must be submitted to and approved by the Department of Public Works prior to the issuance of any grading or building permits, submittal of construction drawings or the submittal of a Final Map for this site, whichever may occur first. Provide and improve all drainageways as recommended in the approved drainage plan/study.
12. Site development to comply with all applicable conditions of approval for Site Development Plan Review Z-34-81 and all other applicable site related actions.

Staff Report Page One
February 12, 2019 - Planning Commission Meeting

**** STAFF REPORT ****

PROJECT DESCRIPTION

This is a request for a Site Development Plan Review for a proposed Restaurant with a Drive-Through and General Retail building at 1100 South Fort Apache Road.

ISSUES

- A Waiver from Title 19.08.040 development standards has been requested to not orient the building to the corner where such is required. Staff does not support the request.

ANALYSIS

The subject site has a zoning designation of C-2 (General Commercial), which allows the proposed Restaurant and General Retail use as permitted uses and the Drive-Through as a conditional land use. The applicant proposes to construct a 9,011 square-foot Restaurant with a Drive-Through and General Retail building within the subject shopping center. The restaurant building that currently occupies the desired location of the new restaurant building will be demolished.

Drive Through Conditional Use Regulations:

1. A single-station drive-through shall have a stacking lane that will accommodate a minimum of six vehicles, including the vehicle at the station. A multiple-station drive-through shall have stacking lanes that will accommodate a minimum of three vehicles per station, including the vehicle at that station.

The submitted site plan indicates that the proposed drive through will be a double station drive-through and will provide stacking lanes which will accommodate 21 vehicles.

2. The drive-through shall be screened in accordance with LVMC 19.08.040(F).

The submitted landscaping plan indicates that the proposed development will keep the existing landscape buffer screening as previously approved through Site Development Plan Review [Z-0034-81(11)]. The existing landscaping consists of 15 perimeter trees adjacent to the proposed Restaurant with Drive Through and General Retail building. A large variety of shrubs are located within the landscape buffers. Staff finds this is adequate to provide thorough screening of the proposed drive through. In addition, there is also an existing retaining wall along the north perimeter which will remain.

Staff Report Page Two
February 12, 2019 - Planning Commission Meeting

The subject site is currently developed with a 178,679 square-foot commercial building area within the shopping center. With the proposed demolition of the existing restaurant building and the addition of the new Restaurant with Drive Through and General Retail Building, the total building area for the shopping center will decrease to 172,911 square feet. The submitted building elevations indicate that the proposed structure will have a maximum height of 22 feet with a stucco finish in neutral colors. The submitted floor plan depicts 5,011 square feet of the proposed building dedicated to the Restaurant use and the remaining 4,000 square feet dedicated for a general retail use. The Restaurant side shows a typical layout for a Restaurant with Drive-Through. The dining room seating area will be able to serve 104 patrons. The plan also shows a 305 square-foot play area.

The RTC (Regional Transportation Commission of Southern Nevada) has requested an easement be granted to allow a 5x50 double bus shelter be located behind the sidewalk along the north property line. A condition of approval has been added to address the proposal.

Title 19 requires proposed buildings on corner lots to be oriented to the corner and to the street fronts in order to maintain a strong street edge. The applicant requests to set the proposed building back from the minimum building setback line, separated by a double drive through lane. While the proposed Restaurant with Drive Through and General Retail building are appropriate for the subject site, staff recommends denial of the proposed Site Development Plan Review due to the associated Waiver to allow the proposed building to not orient to the corner. If approved, the entitlement will be subject to conditions.

FINDINGS (SDR-75332)

In order to approve a Site Development Plan Review application, per Title 19.16.100(E) the Planning Commission and/or City Council must affirm the following:

- 1. The proposed development is compatible with adjacent development and development in the area;**

The proposed Restaurant with Drive Through and General Retail building will be located within an existing shopping center development and is compatible with the existing commercial uses in the surrounding area.

- 2. The proposed development is consistent with the General Plan, this Title, and other duly-adopted city plans, policies and standards;**

SDR-75332 [PRJ-75235]

This project is consistent with the General Plan and the uses allowed in the C-2 (General Commercial) zoning district. However, it is not consistent with the building orientation requirement in Title 19.08.

Staff Report Page Three

February 12, 2019 - Planning Commission Meeting

3. **Site access and circulation do not negatively impact adjacent roadways or neighborhood traffic;**

Access to the site will remain from Charleston Boulevard and Fort Apache Road, both Primary Arterial roads, which are adequate in size to service the proposed Restaurant with Drive Through use.

4. **Building and landscape materials are appropriate for the area and for the City;**

The submitted elevations depict a building with a stucco finish in neutral colors, which is consistent with the development in the area. The applicant intends to keep the existing perimeter landscaping. The proposed interior parking lot trees are drought resistant and appropriate for the subject area.

5. **Building elevations, design characteristics and other architectural and aesthetic features are not unsightly, undesirable, or obnoxious in appearance; create an orderly and aesthetically pleasing environment; and are harmonious and compatible with development in the area;**

The submitted building elevations are consistent with the desert environment and surrounding commercial land uses.

6. **Appropriate measures are taken to secure and protect the public health, safety and general welfare.**

The proposed development is subject to permit review and inspection; therefore, appropriate measures will be taken to protect the health, safety and general welfare.

BACKGROUND INFORMATION

<i>Related Relevant City Actions by Planning, Fire, Bldg., etc.</i>	
05/20/81	The City Council approved a Rezoning (Z-0034-81) to C-2 (General Commercial) zoning on this site as part of the overall rezoning of 2,249 acres. The Planning Commission recommended approval.
01/17/01	The City Council approved the overall site development plan for this 152,500 square foot Shopping Center [Z-0034-81(11)]. The Planning Commission recommended approval.
07/16/03	The City Council approved Special Use Permit (SUP-2486) for a Liquor Establishment (Off-Premise Consumption, Beer and Wine) for a Grocery Store at 8855 W. Charleston Boulevard. The Planning Commission and staff recommended approval.

Staff Report Page Four
February 12, 2019 - Planning Commission Meeting

Related Relevant City Actions by Planning, Fire, Bldg., etc.	
12/11/12	The Planning Commission approved Special Use Permit (SUP-47304) for a Tattoo Parlor/Body Piercing Studio at 8975 West Charleston Boulevard, Suite #130. Staff recommended approval.
05/14/13	The Planning Commission approved Special Use Permit (SUP-48783) for a Beer/Wine/Cooler On-Sale Establishment use at 8975 West Charleston Boulevard, Suite #130. Staff recommended approval.

Most Recent Change of Ownership	
03/15/01	A deed was recorded for a change in ownership.

Related Building Permits/Business Licenses	
10/16/12	Building Permit (#C-221758) was issued for interior/exterior upgrades of the existing building at 1100 South Fort Apache. The permit was finalized on 12/03/15.

Pre-Application Meeting	
12/05/18	Staff conducted a pre-application meeting with the applicant where the submittal requirements and deadlines were reviewed for a proposed Site Development Plan Review.

Neighborhood Meeting	
A neighborhood meeting was not required, nor was one held.	

Field Check	
12/27/18	Staff conducted a routine field check and found an active shopping center. No issues were noted.

Details of Application Request	
Site Area	
Net Acres	16.63

Staff Report Page Five
February 12, 2019 - Planning Commission Meeting

<i>Surrounding Property</i>	<i>Existing Land Use Per Title 19.12</i>	<i>Planned or Special Land Use Designation</i>	<i>Existing Zoning District</i>
Subject Property	Shopping Center	SC (Service Commercial)	C-2 (General Commercial)
North	Shopping Center	SC (Service Commercial)	C-1 (Limited Commercial)
South	Single Family, Detached	L (Low Density Residential)	R-PD8 (Residential Planned Development – 8 Units per Acre)
East	Shopping Center	SC (Service Commercial)	C-1 (Limited Commercial)
West	Shopping Center	SC (Service Commercial)	C-1 (Limited Commercial)

<i>Master and Neighborhood Plan Areas</i>	<i>Compliance</i>
No Applicable Master Plan Area	N/A
<i>Special Area and Overlay Districts</i>	<i>Compliance</i>
No Applicable Special Area or Overlay Districts	N/A
<i>Other Plans or Special Requirements</i>	<i>Compliance</i>
Trails	N/A
Las Vegas Redevelopment Plan Area	N/A
Interlocal Agreement	N/A
Project of Significant Impact (Development Impact Notification Assessment)	N/A
Project of Regional Significance	N/A

Staff Report Page Six
February 12, 2019 - Planning Commission Meeting

DEVELOPMENT STANDARDS

Pursuant to Title 19.08, the following standards apply:

Standard	Required/Allowed	Provided	Compliance
Min. Setbacks • Front • Corner	10 Feet 10 Feet	41 Feet 36 Feet	Y Y
Max. Lot Coverage	50 %	24 %	Y
Max. Building Height	N/A	22 Feet	Y
Trash Enclosure	Screened, Gated, w/ a Roof or Trellis	Screened, Gated, w/ a Roof or Trellis	Y
Mech. Equipment	Screened	Screened	Y

Pursuant to Title 19.08 and Site Development Plan Review [Z-0034-81(11)], the following standards apply:

Landscaping and Open Space Standards				
Standards	Required		Provided	Compliance
	Ratio	Trees		
Buffer Trees: • North • West	1 Tree / 20 Linear Feet 1 Tree / 20 Linear Feet	7 Trees 8 Trees	7 Trees 8 Trees	Y Y
TOTAL PERIMETER TREES		15 Trees	15 Trees	Y
Parking Area Trees	1 Tree / 6 Uncovered Spaces, plus 1 tree at the end of each row of spaces	29 Trees	29 Trees	Y
LANDSCAPE BUFFER WIDTHS				
Min. Zone Width • North • West	15 Feet 15 Feet		13 Feet 28 Feet	Y* Y

*The applicant proposes to keep the existing perimeter landscaping as previously approved through Site Development Plan Review [Z-0034-81(11)].

Staff Report Page Seven
February 12, 2019 - Planning Commission Meeting

Street Name	Functional Classification of Street(s)	Governing Document	Actual Street Width (Feet)	Compliance with Street Section
Charleston Boulevard	Primary Arterial	Planned Streets and Highways Map	100	Y
Fort Apache Road	Primary Arterial	Planned Streets and Highways Map	100	Y

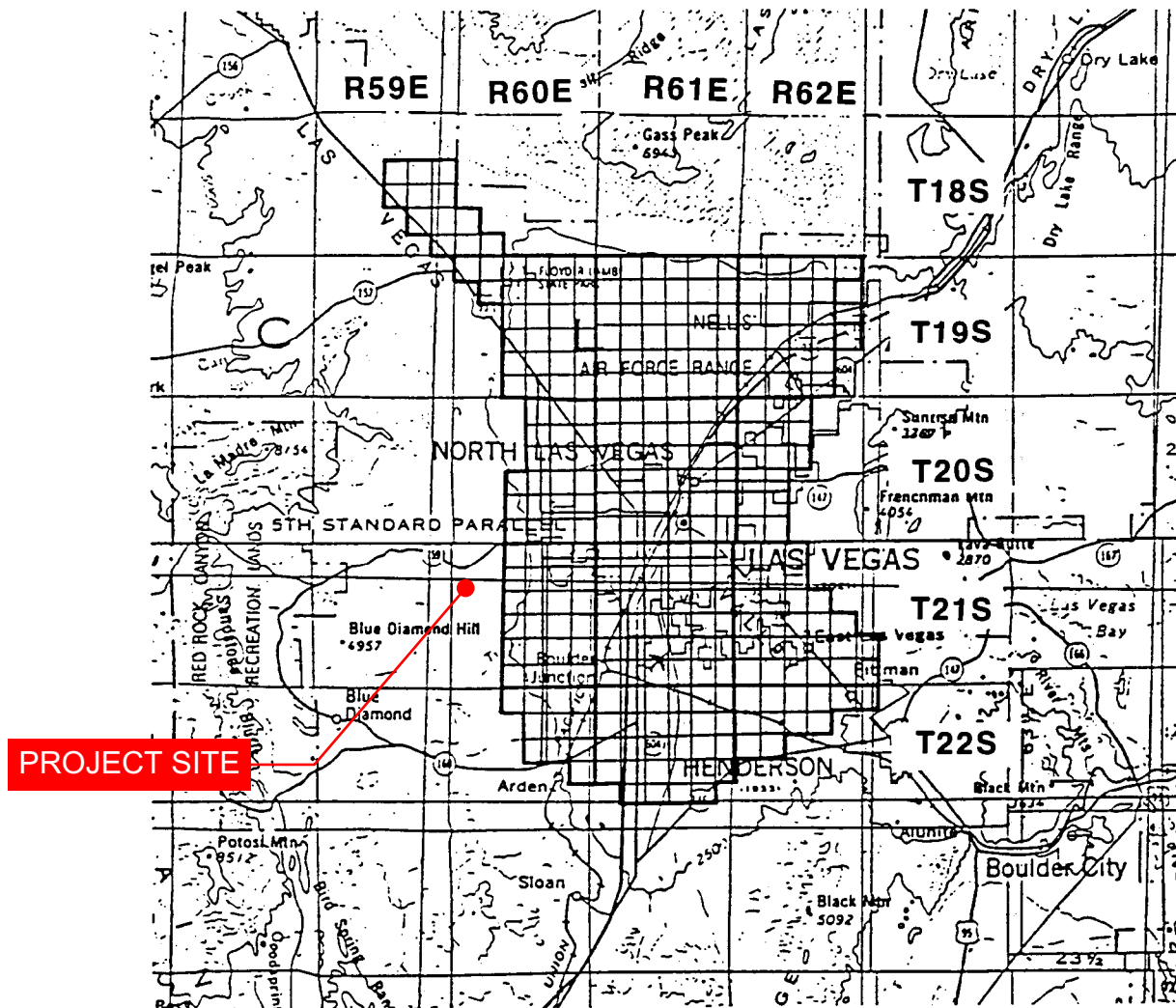
Pursuant to Title 19.08 and 19.12, the following parking standards apply:

Parking Requirement							
Use	Gross Floor Area or Number of Units	Required		Provided		Compliance	
		Parking Ratio	Parking		Parking		
			Regular	Handi-capped	Regular	Handi-capped	
Shopping Center	172,911 SF	1:250	692				
TOTAL SPACES REQUIRED			692		837		Y
Regular and Handicap Spaces Required			678	14	818	19	Y

Waivers		
Requirement	Request	Staff Recommendation
Buildings on corner lots should be oriented to the corner and to the street fronts.	To not orient the proposed buildings to the corner where such is required.	Denial

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP RANGE SECTIONS

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

TOWNSHIP RANGE SECTIONS

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

Notes:

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

Revision	Date

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				

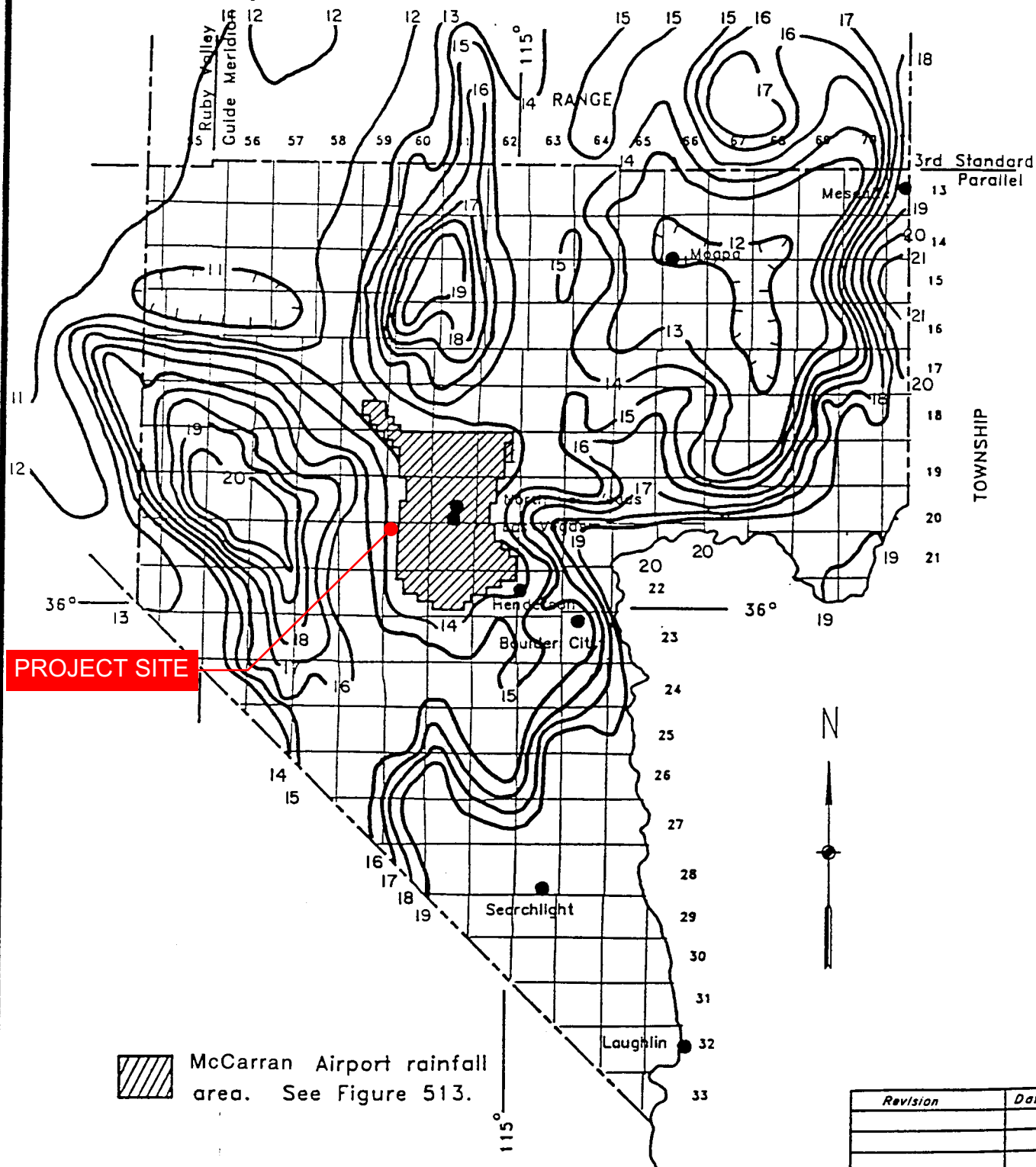
- Notes: 1. For drainage areas less than 8 square miles in size, use SDN 3.
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
 4. A graphical representation of these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

Revision	Date

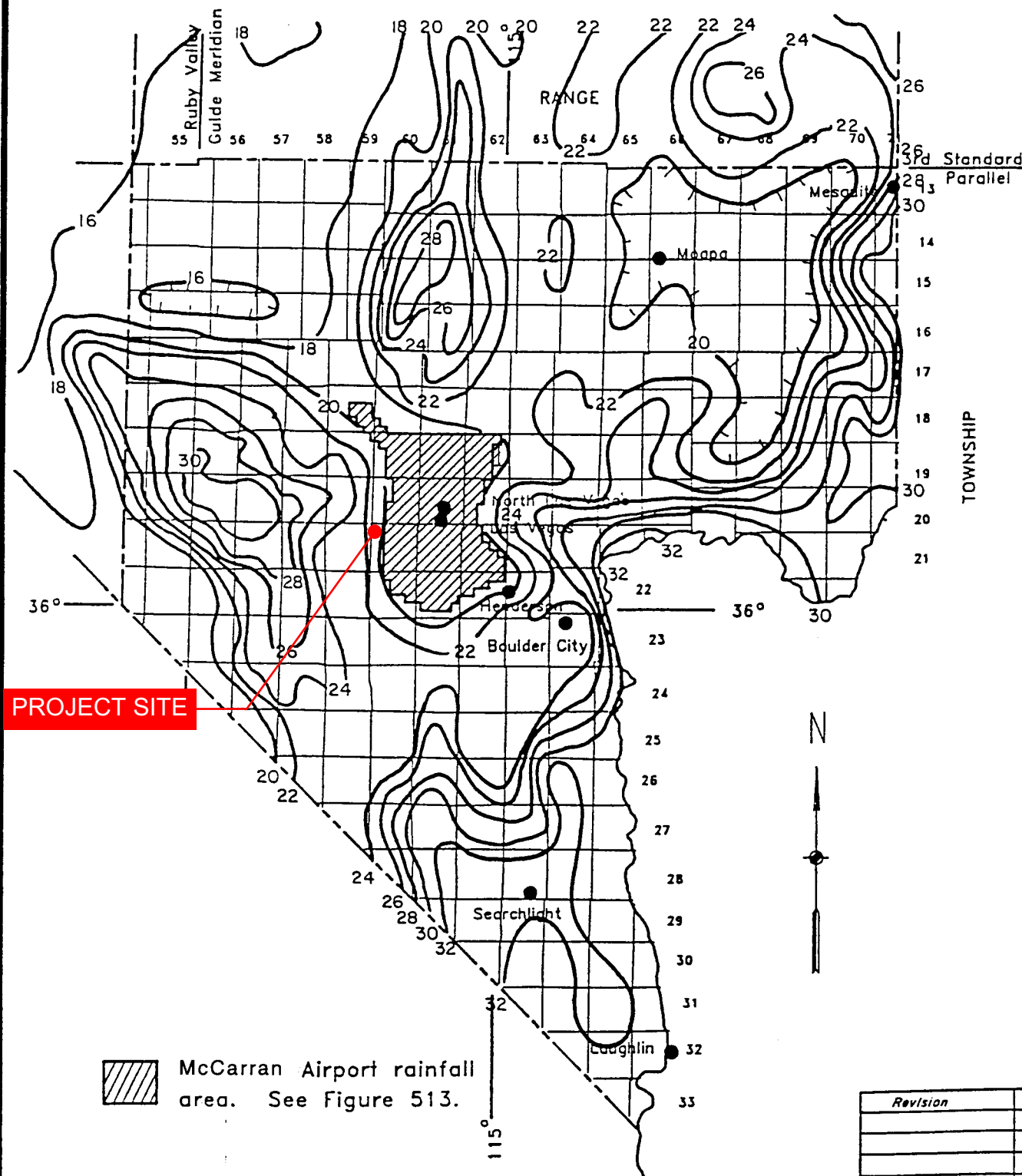
REFERENCE:

TABLE 503

RAINFALL DEPTH-DURATION-FREQUENCY 10-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



RAINFALL DEPTH-DURATION-FREQUENCY 100-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



PRECIPITATION ADJUSTMENT RATIOS

<u>Recurrence Interval</u>	<u>Ratio to NOAA Atlas 2</u>
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

- NOTE: 1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

<i>Revision</i>	<i>Date</i>

**PRECIPITATION DEPTH CALCULATIONS
FOR AREAS OUTSIDE MCCARRAN AIRPORT RAINFALL DATA**

Calculated by:	AL
Checked by:	MS
Project Name:	SUMMERLIN HOTEL
Date:	2/14/2019

10-YEAR STORM EVENT

PRECIPITATION DEPTH: REFERENCE (FIGURES & TABLES FROM CCRFCD MANUAL)
1.30 INCHES FIGURE 503

PRECIPITATION ADJUSTMENT:
1.24 TABLE 501

DEPTH-AREA REDUCTION FACTOR
1.00 TABLE 502

ADJUSTED POINT PRECIPITATION
= 1.60 X 1.24 X 1.00 = **1.61** TABLE 501, NOTE 1

100-YEAR STORM EVENT

PRECIPITATION DEPTH: REFERENCE (FIGURES & TABLES FROM CCRFCD MANUAL)
2.10 INCHES FIGURE 506

PRECIPITATION ADJUSTMENT:
1.43 TABLE 501

DEPTH-AREA REDUCTION FACTOR
1.00 TABLE 502

ADJUSTED POINT PRECIPITATION
= 1.75 X 1.43 X 1.00 = **3.00** TABLE 501, NOTE 1

HEC-1 10-YEAR RATIO

$$\frac{1.61}{3.00} = \mathbf{0.54}$$

HEC-1 100-YEAR RATIO

$$\frac{3.00}{3.00} = \mathbf{1.00}$$

SIX HOUR DEPTH-AREA REDUCTION FACTORS

<u>Drainage Area (Square Miles)</u>	<u>Six-Hour Depth-Area Reduction Factor</u>
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

- NOTES: 1. A graphical representation of these factors is presented in Figure 514.
2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

<i>Revision</i>	<i>Date</i>

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 $I_p = 0.2S$.

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

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

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

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

Revision	Date



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Las Vegas Valley Area, Nevada, Part of Clark County



January 8, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County
Survey Area Data: Version 13, Sep 14, 2018

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

Date(s) aerial images were photographed: Sep 26, 2013—Feb 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

Custom Soil Resource Report

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
152	Cave gravelly fine sandy loam, 0 to 4 percent slopes	3.4	100.0%
Totals for Area of Interest		3.4	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Las Vegas Valley Area, Nevada, Part of Clark County

152—Cave gravelly fine sandy loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: hr9v
Elevation: 2,000 to 4,800 feet
Mean annual precipitation: 4 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

Cave and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cave

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 12 inches: gravelly fine sandy loam
H2 - 12 to 36 inches: indurated
H3 - 36 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: 4 to 20 inches to petrocalcic
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)
Hydric soil rating: No

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Custom Soil Resource Report

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TIME OF CONCENTRATION / LAG TIME DETERMINATION - less than 1 mi2



CHICK-FIL-A CHARLESTON/FORT APACHE
SOUTHEAST CORNER OF CHARLESTON & FORT APACHE
EXISTING CONDITIONS

Project No: 092908012
Date: 2/14/19
Calculated by: AL

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)							T _{lag}	REMARKS
Basin ID	DEV./UNDEV. (D or U)	CN	K	AREA	AREA	INITIAL LENGTH	SLOPE	Ti	TRAVEL LENGTH	SLOPE	V ₁	V ₂	Tt	Tc	Tc Check	T _{lag}	
				Ac	Mi ²	Feet	%	Min	Feet	%	VELOCITY	VELOCITY	Min	Min	Min	0.6Tc/60	RAINFALL
				(5a)	(5b)	(6)	(7)	(8)	(9)	(10)	(10a)	(10b)	(11)	(12)	(13)	(14)	(15)
EON1	D	95.0	0.8640	0.65	0.0010	100	2.00	3.4	141	2.00	2.9	4.3	0.8	4.2	11.3	0.042	
EON2	D	95.0	0.8640	1.13	0.0018	46	1.11	2.8	242	3.13	3.6	5.4	1.1	3.9	11.6	0.039	
EON3	D	95.0	0.8640	0.22	0.0003	12	1.00	1.5	22	16.86	8.3	12.6	0.0	1.5	10.2	0.015	
CHAR1	D	98.0	0.9036	0.48	0.0008	82	2.00	2.5	277	2.00	2.9	4.3	1.6	4.2	12.0	0.042	
FORT1	D	98.0	0.9036	0.55	0.0009	37	2.00	1.7	340	2.00	2.9	4.3	2.0	3.7	12.1	0.037	

NOTE:

(1) Subbasin Name

(2) Developed or Undeveloped Subbasin

(3) Curve Number (See Subbasin CN Calculations)

(4) K = 0.0132 (CN) - 0.39

(5a) & (5b) Area

(6) Initial Length

(7) Initial Slope

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

(9) Travel Length

(10) Slope

(10a) Slope V_1 applies to the first 500 feet of travel distance;

Developed $V_1 = 20.2 (S/100)^{1/2}$

(10b) V_2 applies to the remaining travel distance;

Developed $V_2 = 30.6 (S/100)^{1/2}$

(11) $T_t = 500 / (V_1 * 60) + (Travel Length - 500) / (V_2 * 60)$

(12) $T_c = T_i + T_t$

(13) $T_c Check = L / 180 + 10$ (select smaller T_c)

(14) $T_{lag} = 0.6 T_c / 60$

(15) Rainfall in inches

REFERENCE: Calculations based on the Clark County Regional Flood Control District HCDDM

STANDARD FORM 4

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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 14FEB19 TIME 10:52:01
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*****

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

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

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

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*** FREE ***
*DIAGRAM
1 ID
2 ID *****
3 ID * HYDROLOGIC ANALYSIS *
4 ID * FOR *
5 ID * CFA @ CHARLESTON & FORT APACHE *
6 ID * EXISTING CONDITION *
7 ID *
8 ID *****
9 ID
10 ID *****
11 ID * 10 & 100 YEAR *
12 ID * STORM EVENT *
13 ID *****
14 ID
*DIAGRAM
15 IT 5 0 0 300
16 IO 5 0 0
17 IN 5 0 0
18 JR PREC .54 1.0
19 KK EON1
20 KM ONSITE EXISTING AREA EON1
21 BA .0010
22 PB 3.00
23 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
24 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
25 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
26 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
27 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
28 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
29 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
30 PC .998 .999 1.00
31 LS 0 95
32 UD .042
*
33 KK CHAR1
34 KM OFFSITE ROADWAY CHARLESTON BOULEVARD
35 BA .0008
36 LS 0 98
37 UD .042
*
38 KK CP1
39 KM COMBINATION POINT OF CHAR1 & EON1
40 HC 2
*

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
41 KK EON2
42 KM ONSITE EXISTING AREA EON2
43 BA .0018
44 LS 0 95
45 UD .039
*

```

```

46      KK      EON3
47      KM      ONSITE EXISTING AREA EON3
48      BA      .0003
49      LS      0      95
50      UD      .015
      *

51      KK      FORT1
52      KM      OFFSITE ROADWAY FORT APACHE ROAD
53      BA      .0009
54      LS      0      98
55      UD      .037
      *

56      KK      CP2
57      KM      COMBINATION POINT OF FORT1 & EON3
58      HC      2
      *
59      ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

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

19      EON1
      .
33      .      CHAR1
      .
38      CP1.....
      .
41      .      EON2
      .
46      .      .      EON3
      .
51      .      .      .      FORT1
      .
56      .      .      CP2.....

```

(*** RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*      FLOOD HYDROGRAPH PACKAGE (HEC-1)
*      JUN 1998
*      VERSION 4.1
*      RUN DATE 14FEB19 TIME 10:52:01
*
*****

```

```

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

```

```

*****
*      HYDROLOGIC ANALYSIS
*      FOR
*      CFA @ CHARLESTON & FORT APACHE
*      EXISTING CONDITION
*
*****

```

```

*****
*      10 & 100 YEAR
*      STORM EVENT
*
*****

```

```

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

IT      HYDROGRAPH TIME DATA
      NMIN      5      MINUTES IN COMPUTATION INTERVAL
      IDATE      1      0      STARTING DATE
      ITIME      0000      STARTING TIME
      NQ      300      NUMBER OF HYDROGRAPH ORDINATES
      NDDATE      2      0      ENDING DATE
      NDTIME      0055      ENDING TIME
      ICENT      19      CENTURY MARK

      COMPUTATION INTERVAL      .08 HOURS
      TOTAL TIME BASE      24.92 HOURS

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

```


SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.54 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 .54	RATIO 2 1.00
HYDROGRAPH AT +	EON1	.00	1 FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT +	CHAR1	.00	1 FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT +	CP1	.00	1 FLOW TIME	2. 3.50	5. 3.50
HYDROGRAPH AT +	EON2	.00	1 FLOW TIME	2. 3.50	4. 3.50
HYDROGRAPH AT +	EON3	.00	1 FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT +	FORT1	.00	1 FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT +	CP2	.00	1 FLOW TIME	2. 3.50	3. 3.50

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

TIME OF CONCENTRATION / LAG TIME DETERMINATION - less than 1 mi²



NORTHPOINT SELF-STORAGE SOUTHEAST CORNER OF RAINBOW BLVD & BUCKSKIN AVE PROPOSED CONDITIONS

Project No: 192016003
Date: 2/14/19
Calculated by: AL

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)							T _{lag}	REMARKS
Basin ID	DEV./UNDEV. (D or U)	CN	K	AREA	AREA	INITIAL LENGTH	SLOPE	Ti	TRAVEL LENGTH	SLOPE	V ₁	V ₂	Tt	Tc	Tc Check	T _{lag}	
				Ac	Mi ²	Feet	%	Min	Feet	%	VELOCITY FPS	VELOCITY FPS	Min	Min	Min	0.6Tc/60 Hours	RAINFALL INCHES
(1)	(2)	(3)	(4)	(5a)	(5b)	(6)	(7)	(8)	(9)	(10)	(10a)	(10b)	(11)	(12)	(13)	(14)	(15)
DON1	D	95.0	0.8640	1.1700	0.0018	133	2.11	3.8	197	1.30	2.3	3.5	1.4	5.2	11.8	0.052	
DON2	D	95.0	0.8640	0.7000	0.0011	93	2.14	3.2	168	3.36	3.7	5.6	0.8	3.9	11.5	0.039	
DON3	D	95.0	0.8640	0.1300	0.0002	13	2.85	1.1	14	4.00	4.0	6.1	0.1	1.1	10.2	0.011	
CHAR1	D	98.0	0.9036	0.4800	0.0008	82	2.00	2.5	277	2.00	2.9	4.3	1.6	4.2	12.0	0.042	
FORT1	D	98.0	0.9036	0.5500	0.0009	37	2.00	1.7	340	2.00	2.9	4.3	2.0	3.7	12.1	0.037	

NOTE:

- | | | | |
|---|--|---|-------------------------|
| (1) Subbasin Name | (7) Initial Slope | (10b) V ₂ applies to the remaining travel distance; | (15) Rainfall in inches |
| (2) Developed or Undeveloped Subbasin | (8) $T_i = 1.8 (1.1 - K) L^{1/2} / S^{1/3}$ | Developed V ₂ = $30.6(S/100)^{1/2}$ | |
| (3) Curve Number (See Subbasin CN Calculations) | (9) Travel Length | (11) $T_t = 500/(V_1 \cdot 60) + (\text{Travel Length} - 500)/(V_2 \cdot 60)$ | |
| (4) K = 0.0132 (CN) - 0.39 | (10) Slope | (12) Tc = T _i + T _t | |
| (5a) & (5b) Area | (10a) Slope V ₁ applies to the first 500 feet of travel distance; | (13) Tc Check = L/180+10 (select smaller Tc) | |
| (6) Initial Length | Developed V ₁ = $20.2(S/100)^{1/2}$ | (14) Tlag = 0.6 Tc/60 | |

REFERENCE: Calculations based on the Clark County Regional Flood Control District HCDDM

STANDARD FORM 4

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 14FEB19 TIME 10:58:18
*
*****

```

```

*****
*
* 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
XXXXXXX XXXX X XXXXX 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

*** FREE ***
*DIAGRAM
1 ID
2 ID *****
3 ID * HYDROLOGIC ANALYSIS *
4 ID * FOR *
5 ID * CFA @ CHARLESTON & FORT APACHE *
6 ID * PROPOSED CONDITION *
7 ID *
8 ID *****
9 ID
10 ID *****
11 ID * 10 & 100 YEAR *
12 ID * STORM EVENT *
13 ID *****
14 ID
*DIAGRAM
15 IT 5 0 0 300
16 IO 5 0 0
17 IN 5 0 0
18 JR PREC .54 1.0

19 KK DON1
20 KM ONSITE DEVELOPED AREA DON1
21 BA .0018
22 PB 3.00
23 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
24 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
25 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
26 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
27 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
28 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
29 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
30 PC .998 .999 1.00
31 LS 0 95
32 UD .052
*

33 KK CHAR1
34 KM OFFSITE ROADWAY CHARLESTON BOULEVARD
35 BA .0008
36 LS 0 98
37 UD .042
*

38 KK DON2
39 KM ONSITE DEVELOPED AREA DON2
40 BA .0011
41 LS 0 95
42 UD .034
*

```

1 HEC-1 INPUT PAGE 2

```

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

43 KK DON3
44 KM ONSITE EXISTING AREA EON3
45 BA .0002
46 LS 0 95
47 UD .018

```

```

*
48      KK  FORT1
49      KM  OFFSITE ROADWAY FORT APACHE ROAD
50      BA  .0009
51      LS  0      98
52      UD  .037
*
53      KK  CP1
54      KM  COMBINATION POINT OF FORT1 & EON3
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

19      DON1
.
.
33      .      CHAR1
.
.
38      .      .      DON2
.
.
43      .      .      DON3
.
.
48      .      .      .      FORT1
.
.
53      .      .      .      CP1.....

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 14FEB19 TIME 10:58:18
*
*****

```

```

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

```

```

*****
* HYDROLOGIC ANALYSIS
* FOR
* CFA @ CHARLESTON & FORT APACHE
* PROPOSED CONDITION
*
*****
*
* 10 & 100 YEAR
* STORM EVENT
*
*****

```

```

16 IO      OUTPUT CONTROL VARIABLES
          IPRT 5 PRINT CONTROL
          IPLOT 0 PLOT CONTROL
          QSCAL 0. HYDROGRAPH PLOT SCALE

IT      HYDROGRAPH TIME DATA
          NMIN 5 MINUTES IN COMPUTATION INTERVAL
          IDATE 1 0 STARTING DATE
          ITIME 0000 STARTING TIME
          NQ 300 NUMBER OF HYDROGRAPH ORDINATES
          NDDATE 2 0 ENDING DATE
          NDTIME 0055 ENDING TIME
          ICENT 19 CENTURY MARK

          COMPUTATION INTERVAL .08 HOURS
          TOTAL TIME BASE 24.92 HOURS

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

JP      MULTI-PLAN OPTION
          NPLAN 1 NUMBER OF PLANS

JR      MULTI-RATIO OPTION
          RATIOS OF PRECIPITATION

```


.54 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 .54	RATIO 2 1.00
HYDROGRAPH AT +	DON1	.00	1 FLOW TIME	2. 3.50	4. 3.50
HYDROGRAPH AT +	CHAR1	.00	1 FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT +	DON2	.00	1 FLOW TIME	1. 3.50	3. 3.50
HYDROGRAPH AT +	DON3	.00	1 FLOW TIME	0. 3.50	0. 3.50
HYDROGRAPH AT +	FORT1	.00	1 FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT +	CP1	.00	1 FLOW TIME	1. 3.50	3. 3.50

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

Worksheet for OFF1 Q10

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.03180 ft/ft
Discharge 1.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.21 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.33 ft²
Wetted Perimeter 4.65 ft
Hydraulic Radius 0.07 ft
Top Width 4.47 ft
Normal Depth 0.21 ft

Worksheet for OFF1 Q10

Results

Critical Depth	0.25	ft
Critical Slope	0.00759	ft/ft
Velocity	3.02	ft/s
Velocity Head	0.14	ft
Specific Energy	0.35	ft
Froude Number	1.96	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.25	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00759	ft/ft

Cross Section for OFF1 Q10

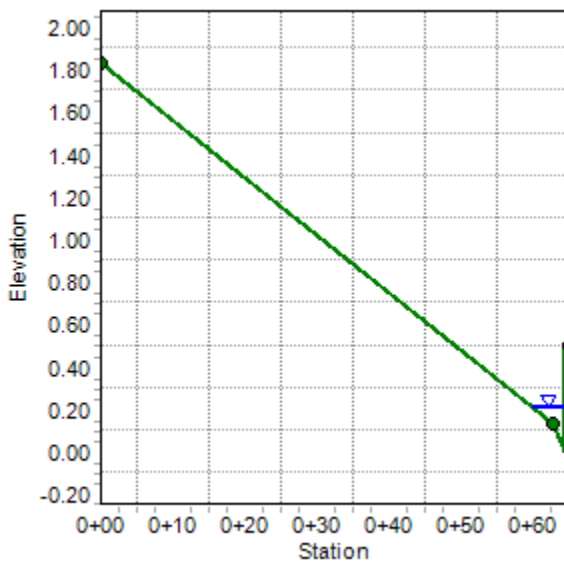
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.21	ft	
Discharge	1.00	ft ³ /s	CHAR1

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.21*(3.02) = 0.63 < 6$$

OK

DRY LANE CHECK

$$WSE=0.0+0.21=0.21$$

$$(1.83-0.21)/0.0318 = 51' > 12'$$

OK

Worksheet for OFF2 Q10 EX

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.30 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.94 ft²
Wetted Perimeter 8.34 ft
Hydraulic Radius 0.11 ft
Top Width 8.07 ft
Normal Depth 0.30 ft

Worksheet for OFF2 Q10 EX

Results

Critical Depth	0.31	ft
Critical Slope	0.00732	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	0.37	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.31	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00732	ft/ft

Cross Section for OFF2 Q10 EX

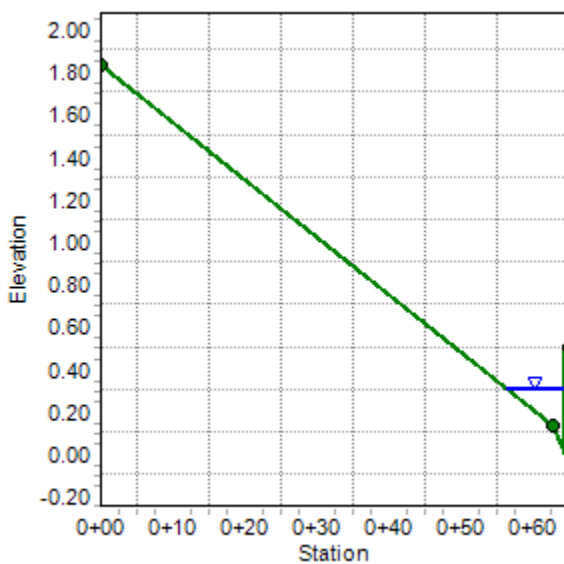
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.30	ft	
Discharge	2.00	ft ³ /s	FORT1+DON3

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.30*(2.13) = 0.64 < 6$$

OK

DRY LANE CHECK

$$WSE=0.0+0.30=0.30$$

$$(1.83-0.30)/0.009 = 170' > 12'$$

OK

Worksheet for OFF2 Q10 PR

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 1.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.25 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.55 ft²
Wetted Perimeter 6.23 ft
Hydraulic Radius 0.09 ft
Top Width 6.01 ft
Normal Depth 0.25 ft

Worksheet for OFF2 Q10 PR

Results

Critical Depth	0.25	ft
Critical Slope	0.00783	ft/ft
Velocity	1.83	ft/s
Velocity Head	0.05	ft
Specific Energy	0.30	ft
Froude Number	1.07	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.25	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00783	ft/ft

Worksheet for OFF1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.03180 ft/ft
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.25 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.57 ft²
Wetted Perimeter 6.40 ft
Hydraulic Radius 0.09 ft
Top Width 6.18 ft
Normal Depth 0.25 ft

Worksheet for OFF1

Results

Critical Depth	0.31	ft
Critical Slope	0.00717	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	0.44	ft
Froude Number	2.01	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.31	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00717	ft/ft

Cross Section for OFF1

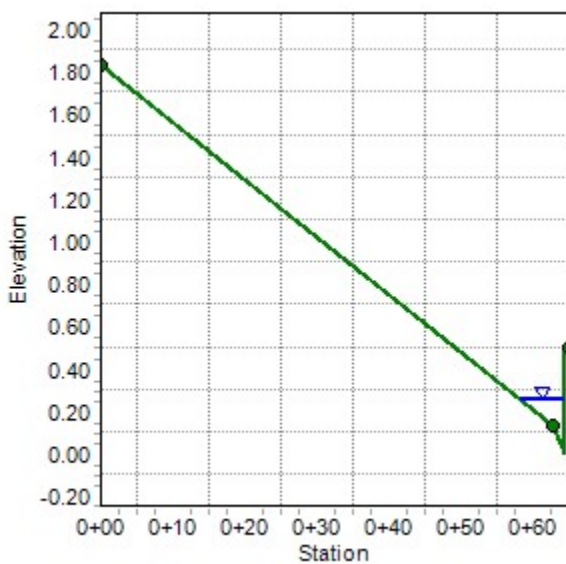
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.25	ft	
Discharge	2.00	ft ³ /s	CHAR1

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.25*(3.48) = 0.87 < 8$$

OK

Worksheet for OFF2 Q100 EX

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 3.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.34 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 1.28 ft²
Wetted Perimeter 9.83 ft
Hydraulic Radius 0.13 ft
Top Width 9.53 ft
Normal Depth 0.34 ft

Worksheet for OFF2 Q100 EX

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 EX

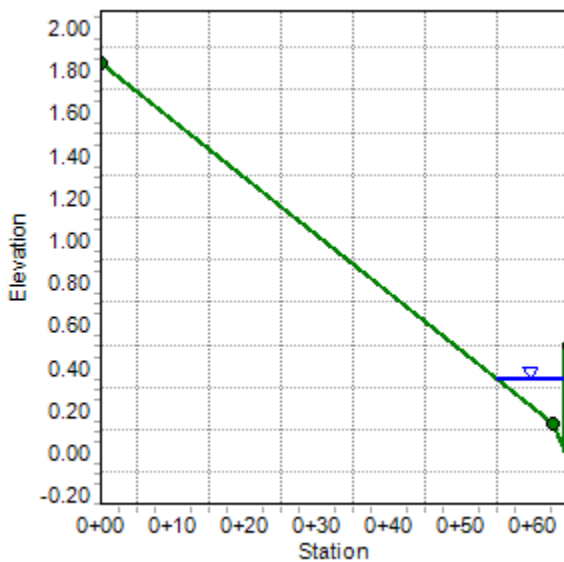
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK

Worksheet for OFF2 Q100 PR

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 3.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.34 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 1.28 ft²
Wetted Perimeter 9.83 ft
Hydraulic Radius 0.13 ft
Top Width 9.53 ft
Normal Depth 0.34 ft

Worksheet for OFF2 Q100 PR

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 PR

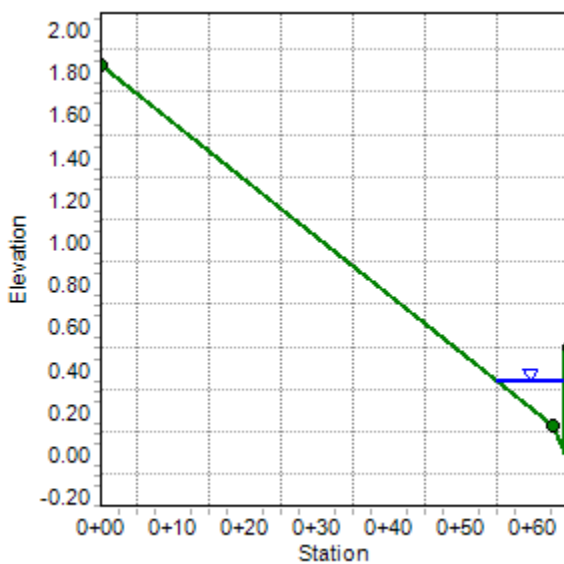
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK

Worksheet for HS1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00500 ft/ft
Discharge 1.78 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2747.25
0+28.30	2747.25
0+31.35	2747.18
0+31.85	2746.68
0+58.35	2746.29
0+81.85	2745.45
0+83.35	2745.39
0+83.85	2745.89
0+88.39	2745.98

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2747.25)	(0+88.39, 2745.98)	0.016

Options

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

Results

Normal Depth 0.27 ft
Elevation Range 2745.39 to 2747.25 ft
Flow Area 1.04 ft²
Wetted Perimeter 7.88 ft

Worksheet for HS1

Results

Hydraulic Radius	0.13	ft
Top Width	7.76	ft
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Critical Slope	0.00763	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.05	ft
Specific Energy	0.32	ft
Froude Number	0.82	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00763	ft/ft

Cross Section for HS1

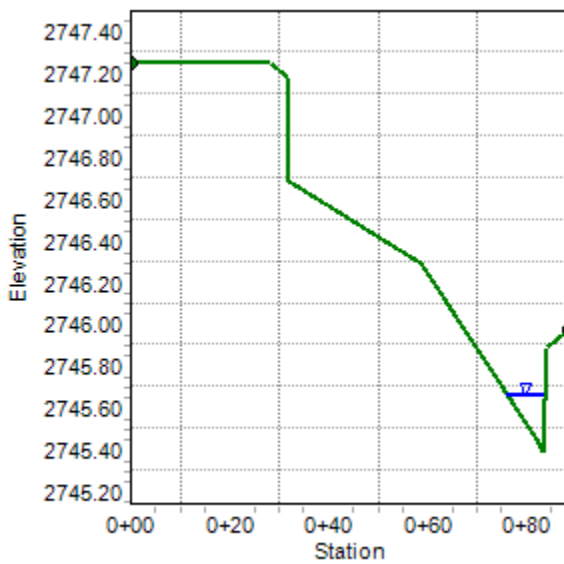
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.27	ft
Discharge	1.78	ft ³ /s

Cross Section Image



Worksheet for HS2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01050	ft/ft
Discharge	2.22	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2747.25
0+23.90	2747.23
0+42.89	2747.04
0+60.17	2745.31
0+60.67	2744.81
0+83.13	2744.26
0+84.67	2744.16
0+85.17	2744.66
0+91.23	2744.19

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2747.25)	(0+91.23, 2744.19)	0.016

Options

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

Results

Normal Depth	0.25	ft
Elevation Range	2744.16 to 2747.25 ft	
Flow Area	1.09	ft²
Wetted Perimeter	10.97	ft

Worksheet for HS2

Results

Hydraulic Radius	0.10	ft
Top Width	10.64	ft
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Critical Slope	0.00819	ft/ft
Velocity	2.04	ft/s
Velocity Head	0.06	ft
Specific Energy	0.31	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Channel Slope	0.01050	ft/ft
Critical Slope	0.00819	ft/ft

Cross Section for HS2

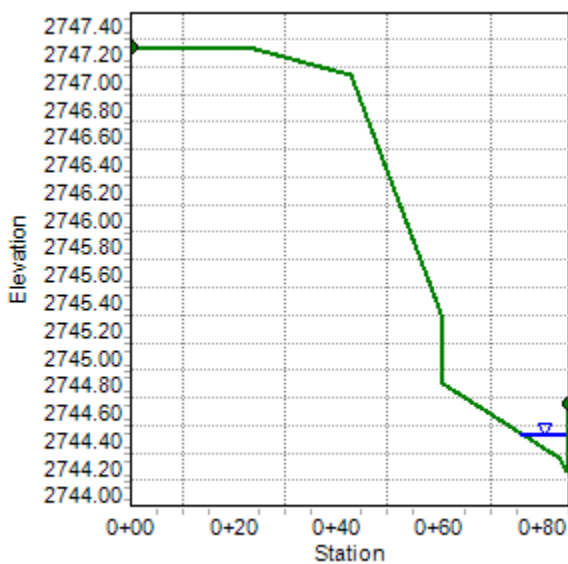
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01050	ft/ft
Normal Depth	0.27	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Worksheet for HS3

Results

Top Width	8.43	ft
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Critical Slope	0.00742	ft/ft
Velocity	1.80	ft/s
Velocity Head	0.05	ft
Specific Energy	0.37	ft
Froude Number	0.83	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00742	ft/ft

Cross Section for HS3

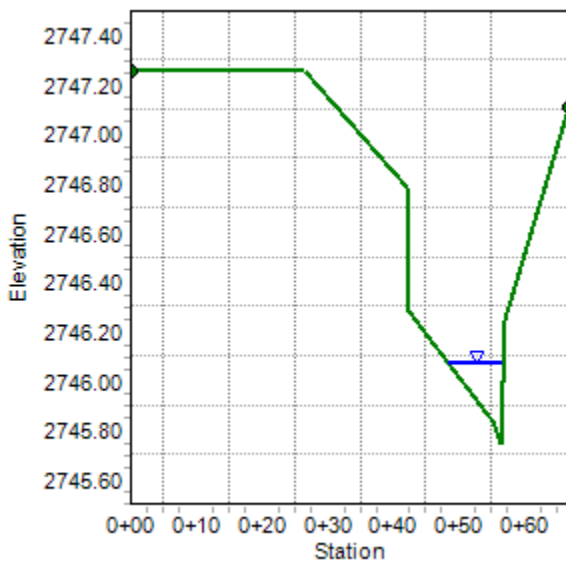
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.32	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Worksheet for HS1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00500 ft/ft
Discharge 1.78 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2747.25
0+28.30	2747.25
0+31.35	2747.18
0+31.85	2746.68
0+58.35	2746.29
0+81.85	2745.45
0+83.35	2745.39
0+83.85	2745.89
0+88.39	2745.98

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2747.25)	(0+88.39, 2745.98)	0.016

Options

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

Results

Normal Depth 0.27 ft
Elevation Range 2745.39 to 2747.25 ft
Flow Area 1.04 ft²
Wetted Perimeter 7.88 ft

Worksheet for HS1

Results

Hydraulic Radius	0.13	ft
Top Width	7.76	ft
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Critical Slope	0.00763	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.05	ft
Specific Energy	0.32	ft
Froude Number	0.82	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.25	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00763	ft/ft

Cross Section for HS1

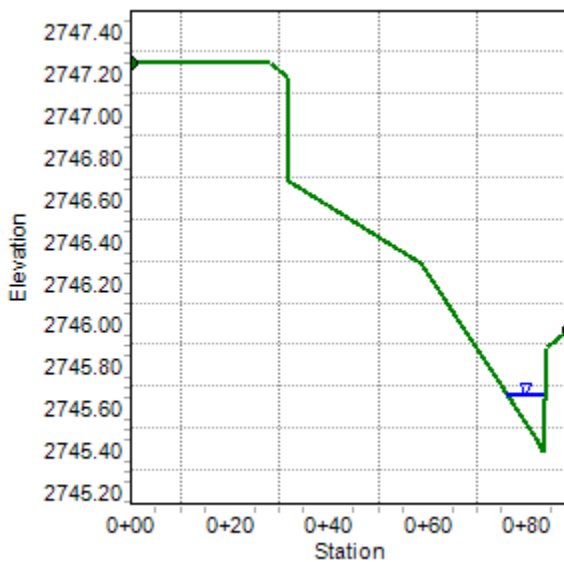
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.27	ft
Discharge	1.78	ft ³ /s

Cross Section Image



Worksheet for HS2

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.01050 ft/ft
Discharge 2.22 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2747.25
0+23.90	2747.23
0+42.89	2747.04
0+60.17	2745.31
0+60.67	2744.81
0+83.13	2744.26
0+84.67	2744.16
0+85.17	2744.66
0+91.23	2744.19

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2747.25)	(0+91.23, 2744.19)	0.016

Options

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

Results

Normal Depth 0.25 ft
Elevation Range 2744.16 to 2747.25 ft
Flow Area 1.09 ft²
Wetted Perimeter 10.97 ft

Worksheet for HS2

Results

Hydraulic Radius	0.10	ft
Top Width	10.64	ft
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Critical Slope	0.00819	ft/ft
Velocity	2.04	ft/s
Velocity Head	0.06	ft
Specific Energy	0.31	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.26	ft
Channel Slope	0.01050	ft/ft
Critical Slope	0.00819	ft/ft

Cross Section for HS2

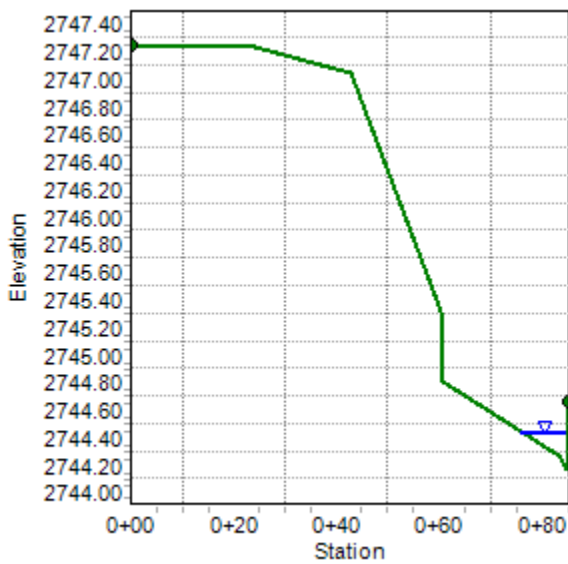
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01050	ft/ft
Normal Depth	0.27	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Worksheet for HS3

Results

Top Width	8.43	ft
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Critical Slope	0.00742	ft/ft
Velocity	1.80	ft/s
Velocity Head	0.05	ft
Specific Energy	0.37	ft
Froude Number	0.83	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.30	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00742	ft/ft

Cross Section for HS3

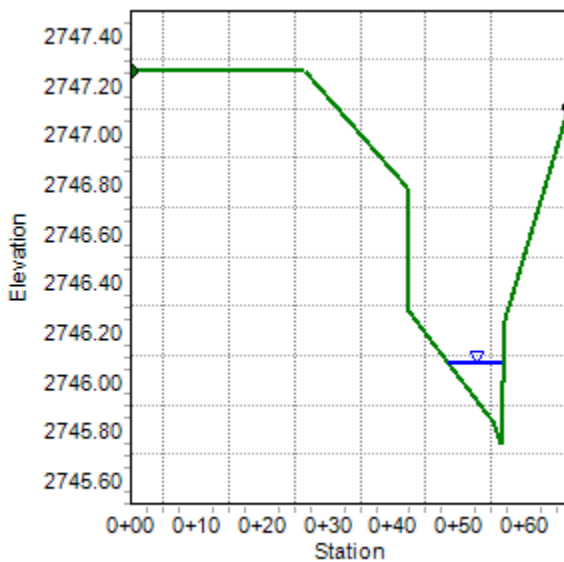
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.32	ft
Discharge	2.22	ft ³ /s

Cross Section Image



Worksheet for OFF1 Q10

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.03180 ft/ft
Discharge 1.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.21 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.33 ft²
Wetted Perimeter 4.65 ft
Hydraulic Radius 0.07 ft
Top Width 4.47 ft
Normal Depth 0.21 ft

Worksheet for OFF1 Q10

Results

Critical Depth	0.25	ft
Critical Slope	0.00759	ft/ft
Velocity	3.02	ft/s
Velocity Head	0.14	ft
Specific Energy	0.35	ft
Froude Number	1.96	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.25	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00759	ft/ft

Cross Section for OFF1 Q10

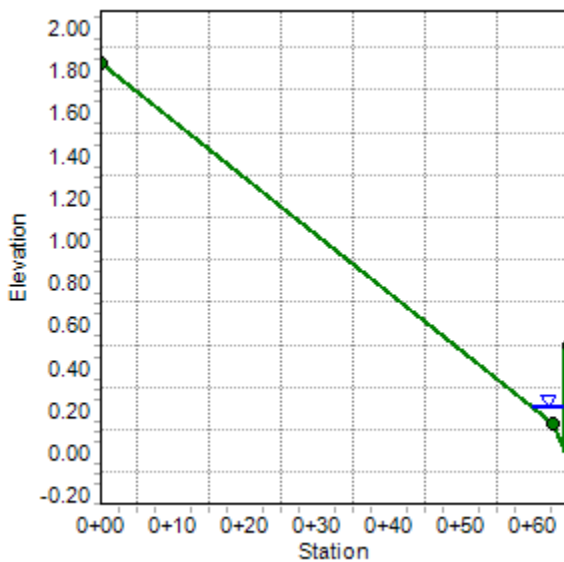
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.21	ft	
Discharge	1.00	ft ³ /s	CHAR1

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.21*(3.02) = 0.63 < 6$$

OK

DRY LANE CHECK

$$WSE=0.0+0.21=0.21$$

$$(1.83-0.21)/0.0318 = 51' > 12'$$

OK

Worksheet for OFF2 Q10 EX

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.30 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.94 ft²
Wetted Perimeter 8.34 ft
Hydraulic Radius 0.11 ft
Top Width 8.07 ft
Normal Depth 0.30 ft

Worksheet for OFF2 Q10 EX

Results

Critical Depth	0.31	ft
Critical Slope	0.00732	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	0.37	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.31	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00732	ft/ft

Cross Section for OFF2 Q10 EX

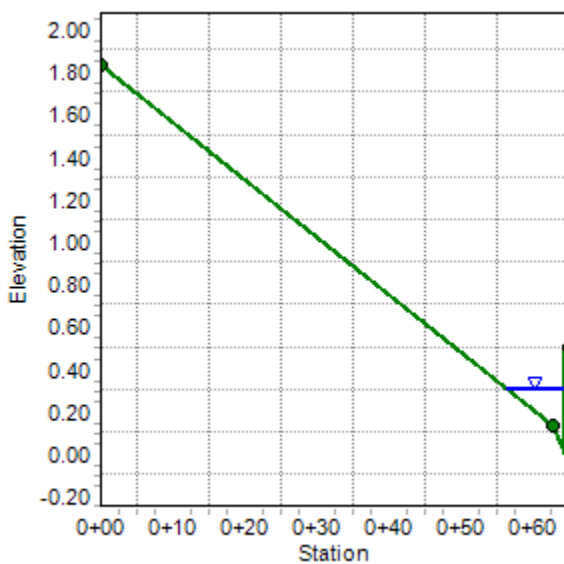
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.30	ft	
Discharge	2.00	ft ³ /s	FORT1+DON3

Cross Section Image



MINOR STORM CHECK

$$D*V = 0.30*(2.13) = 0.64 < 6$$

OK

DRY LANE CHECK

$$WSE = 0.0 + 0.30 = 0.30$$

$$(1.83 - 0.30) / 0.009 = 170' > 12'$$

OK

Worksheet for OFF2 Q10 PR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft
Discharge	1.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
--------------	----------------

0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth	0.25	ft
Elevation Range	0.00 to 1.83	ft
Flow Area	0.55	ft²
Wetted Perimeter	6.23	ft
Hydraulic Radius	0.09	ft
Top Width	6.01	ft
Normal Depth	0.25	ft

Worksheet for OFF2 Q10 PR

Results

Critical Depth	0.25	ft
Critical Slope	0.00783	ft/ft
Velocity	1.83	ft/s
Velocity Head	0.05	ft
Specific Energy	0.30	ft
Froude Number	1.07	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.25	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00783	ft/ft

Worksheet for OFF1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.03180 ft/ft
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.25 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 0.57 ft²
Wetted Perimeter 6.40 ft
Hydraulic Radius 0.09 ft
Top Width 6.18 ft
Normal Depth 0.25 ft

Worksheet for OFF1

Results

Critical Depth	0.31	ft
Critical Slope	0.00717	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	0.44	ft
Froude Number	2.01	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.31	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.00717	ft/ft

Cross Section for OFF1

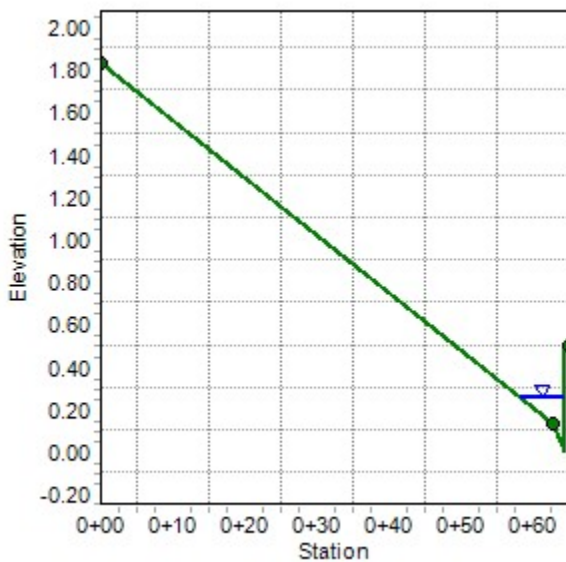
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.03180	ft/ft	
Normal Depth	0.25	ft	
Discharge	2.00	ft ³ /s	CHAR1

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.25*(3.48) = 0.87 < 8$$

OK

Project Description

Input Data

Worksheet for OFF2 Q100 EX

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 EX

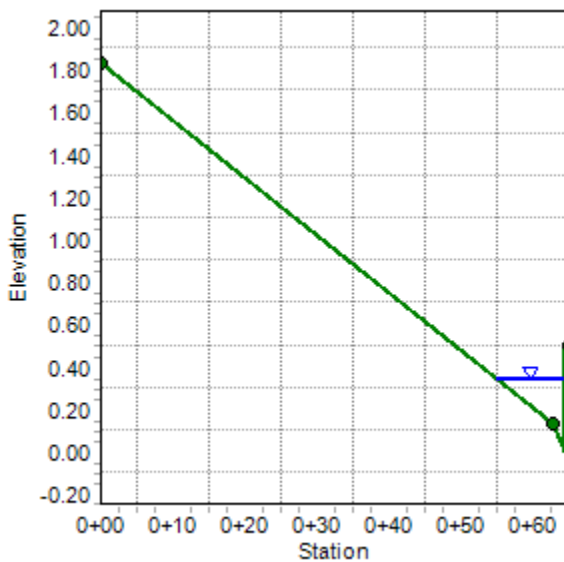
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK

Worksheet for OFF2 Q100 PR

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00900 ft/ft
Discharge 3.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.83
0+63.00	0.13
0+64.42	0.00
0+64.50	0.48
0+65.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.83)	(0+63.00, 0.13)	0.016
(0+63.00, 0.13)	(0+65.00, 0.50)	0.013

Options

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

Results

Normal Depth 0.34 ft
Elevation Range 0.00 to 1.83 ft
Flow Area 1.28 ft²
Wetted Perimeter 9.83 ft
Hydraulic Radius 0.13 ft
Top Width 9.53 ft
Normal Depth 0.34 ft

Worksheet for OFF2 Q100 PR

Results

Critical Depth	0.36	ft
Critical Slope	0.00701	ft/ft
Velocity	2.34	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00701	ft/ft

Cross Section for OFF2 Q100 PR

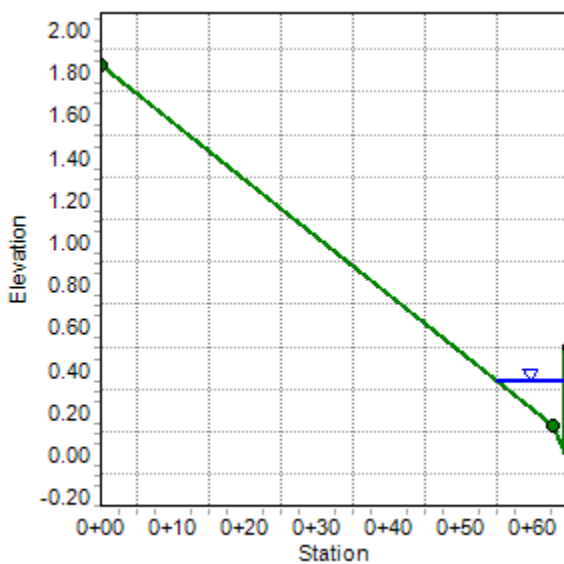
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.00900	ft/ft	
Normal Depth	0.34	ft	
Discharge	3.00	ft ³ /s	FORT1+DON3

Cross Section Image



MAJOR STORM CHECK

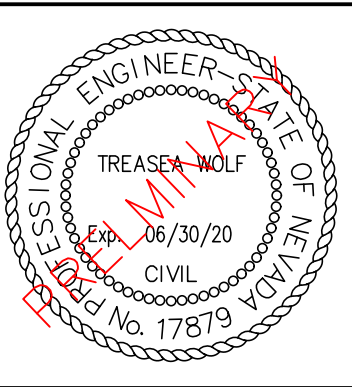
$$D*V = 0.34*(2.34) = 0.80 < 8$$

OK



Chick-fil-A
5200 Buffington Road
Atlanta, Georgia
30349-2998

Kimley»Horn
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6671 LAS VEGAS BLVD S., SUITE 320, LAS VEGAS, NV 89119
PHONE: 702-862-3600
WWW.KIMLEY-HORN.COM



CHICK-FIL-A
CHARLESTON & FT. APACHE
8975 W CHARLESTON BLVD
LASC VEGAS, NV 89047

FSR# 4293

REVISION SCHEDULE

<u>NO.</u>	<u>DATE</u>	<u>DESCRIPTION</u>
------------	-------------	--------------------

AGENCY # _____ CLV _____

PROJECT # 092908012

PRINTED FOR PRELIMINARY

DATE 01/21/15

DESIGN BY _____ AL

Information contained on this drawing and in all

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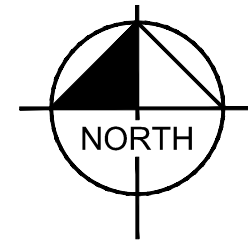
Express written or verbal consent from authorized project representatives.

MEET

1221

QUEST NUMBER

SHEET NUMBER



GRAPHIC SCALE IN FEET

A horizontal scale bar with tick marks at 0, 10, 20, and 40 feet. The bar is divided into segments: a white segment from 0 to 10, a black segment from 10 to 20, a white segment from 20 to 30, a black segment from 30 to 40, and a white segment from 40 to 50.

LEGEND

SITE 1.20	DRAINAGE MANAGEMENT AREA
	BASIN AREA
	BASIN BOUNDARY
	FLOW ARROW
	IMPERVIOUS AREA
	PERVIOUS AREA
	BUILDING AREA

PARKING LOT DATA CALCULATIONS

PARKING LOT DATA CALCULATIONS			
Note: Stormwater Quality Design Volume calculated using steps from Section 1500 Figures 1501-1503 of the CCRFD HCDDM, Revised 2013			
GIVEN:			
Project Description:	CHICK-FIL-A PARKING/DRIVE-THRU AREA		
Parking Lot Data		Acreage	
Property Size (PS)	=	1.99	
Building Area (BA)	=	0.21	
Total Pervious Area (TPA)	=	0.51	
Parking Lot Area (PLA) = (PLA = PS-BA-TPA)	=	1.27	
Minimum PLA to be treated = (PLA * 0.75)	=	0.95	acres
Area to be treated by the proposed LID BMPs			
Drainage Area A	=	0.79	
Drainage Area B	=	0.04	
Drainage Area C	=	0.06	
Drainage Area D	=	0.10	
Total	=	0.99	acres

K:\LAV_Civil\09208012-Chick-II-A-Charleston_Fort Apache 04293\CAD\Exhibits\20190101-TDS Exhibit\ILD Basin Map.dwg Sheet No: KHA Saved by: adam.lo - Wednesday, February 13, 2019 5:02 PM Printed by: Lo, Adam - February 13, 2019 5:04 PM

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: EJ CHECKED BY: MS
 DATE: 2/12/19 KH No. 92908012

PARKING LOT DATA CALCULATIONS

Note: Stormwater Quality Design Volume calculated using steps from Section 1500 Figures 1501-1503 of the CCRFCD HCDDM, Revised 2013

GIVEN:

Project Description:	CHICK-FIL-A PARKING/DRIVE-THRU AREA		
Parking Lot Data		Acreage	
Property Size (PS)	=	1.99	
Building Area (BA)	=	0.21	
Total Pervious Area (TPA)	=	0.51	
Parking Lot Area (PLA) = (PLA = PS-BA-TPA)	=	1.27	
Minimum PLA to be treated = (PLA * 0.75)	=	0.95	acres
Area to be treated by the proposed LID BMPs			
Drainage Area A	=	0.79	
Drainage Area B	=	0.04	
Drainage Area C	=	0.06	
Drainage Area D	=	0.10	
Total	=	0.99	acres
Since 0.99 ac >= 0.95 ac then site satisfies Parking Lot LID criteria			

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 1/2/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "A"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013
 GIVEN:

Project Description: CHICK-FIL-A PARKING/DRIVE-THRU AREA
 Drainage Area = 0.79 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) **NO**

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1.25

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = 0.32 * **D2_{site}/D2_{McCarran}**
 = 0.40

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.60 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.62 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.49 cfs

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 1/2/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "B"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013
 GIVEN:

Project Description: PARKING AREA
 Drainage Area = 0.04 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) NO

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1.25

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = $0.32 * D2_{site} / D2_{McCarran}$
 = 0.40

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.60 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.62 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.02 cfs

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 2/12/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "C"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013

GIVEN:

Project Description: PARKING AREA
 Drainage Area = 0.06 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) **NO**

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = $0.32 * D2_{site} / D2_{McCarran}$
 = 0.32

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.47 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.50 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.03 cfs

PROJECT NAME: CFA CHARLESTON & FORT APACHE
 CALC'D BY: AL CHECKED BY: MS
 DATE: 2/12/19 KH No. 92908012

PARKING LOT LID CALCULATIONS - Peak QBMP FOR DRAINAGE AREA "D"

Note: Stormwater Quality Design Volume calculated using steps from Section 1502.3 of the CCRFCD HCDDM, Revised 2013

GIVEN:

Project Description: PARKING AREA
 Drainage Area = 0.10 acres
 Avg % Impervious = 98 %

Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

Is site located within McCarran Airport Rainfall Area? (Yes/No?) NO

If yes, use Table 505 to obtain 2-year 6-hour rainfall depth; this is your **D2**

If no, use Figure 501 to obtain 2-year 6-hour rainfall depth; this is your **D2**

D2 = 0.9

Compute ratio of D2 of site to D2 for the McCarran Area

D2_{site}/D2_{McCarran} = 1

Compute 85th Percentile Rainfall depth **D₈₅** using following equation

D₈₅ = $0.32 * D2_{site} / D2_{McCarran}$
 = 0.32

Calculate BMP Design Peak Discharge, **QBMP**

Use the following regression equation to calculate the unit discharge (**Qp/A**) for the 90 percent average percent impervious area condition based on **D₈₅** value

$$Y = 1.5042X - 0.0066$$

where, **Y** = Average **Qp/A** in cfs/ac

X = **D₈₅** in inches

Qp/A = 0.47 cfs/ac

Adjust the **Qp/A** for site based on actual percent impervious using the following regression equation

$$Y = 0.0059X + 0.4688$$

where, **Y** = Ratio **Qp/A** to 90% Impervious Value (unitless)

X = Percent Impervious

Y = 1.05

Qp/A (adjusted) = 0.50 cfs/ac

QBMP = **Qp/A (adjusted) * Area**

= 0.05 cfs

Worksheet for SW1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.01000 ft/ft
Discharge 4.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2744.21
0+18.62	2743.67
0+20.12	2743.57
0+20.61	2744.07
0+29.64	2743.82
0+32.64	2743.22
0+35.64	2743.82

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2744.21)	(0+29.64, 2743.82)	0.016
(0+29.64, 2743.82)	(0+35.64, 2743.82)	0.035

Options

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

Results

Normal Depth 0.58 ft
Elevation Range 2743.22 to 2744.21 ft
Flow Area 2.24 ft²
Wetted Perimeter 12.10 ft
Hydraulic Radius 0.18 ft

Worksheet for SW1

Results

Top Width	11.89	ft
Normal Depth	0.58	ft
Critical Depth	0.53	ft
Critical Slope	0.01938	ft/ft
Velocity	1.79	ft/s
Velocity Head	0.05	ft
Specific Energy	0.63	ft
Froude Number	0.73	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.58	ft
Critical Depth	0.53	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01938	ft/ft

Cross Section for SW1

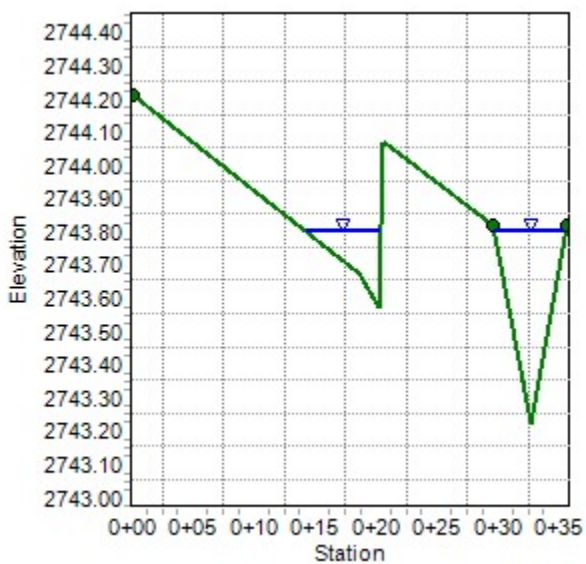
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	0.58	ft
Discharge	4.00	ft ³ /s

Cross Section Image



Worksheet for SW2

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00500 ft/ft
Discharge 0.26 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2747.97
0+11.39	2747.66
0+29.40	2747.47
0+31.40	2747.07
0+33.40	2747.47
0+35.60	2747.38

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2747.97)	(0+29.40, 2747.47)	0.016
(0+29.40, 2747.47)	(0+33.40, 2747.47)	0.035
(0+33.40, 2747.47)	(0+35.60, 2747.38)	0.016

Options

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

Results

Normal Depth 0.26 ft
Elevation Range 2747.07 to 2747.97 ft
Flow Area 0.34 ft²
Wetted Perimeter 2.66 ft
Hydraulic Radius 0.13 ft

Worksheet for SW2

Results

Top Width	2.61	ft
Normal Depth	0.26	ft
Critical Depth	0.18	ft
Critical Slope	0.04122	ft/ft
Velocity	0.76	ft/s
Velocity Head	0.01	ft
Specific Energy	0.27	ft
Froude Number	0.37	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.18	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.04122	ft/ft

Cross Section for SW2

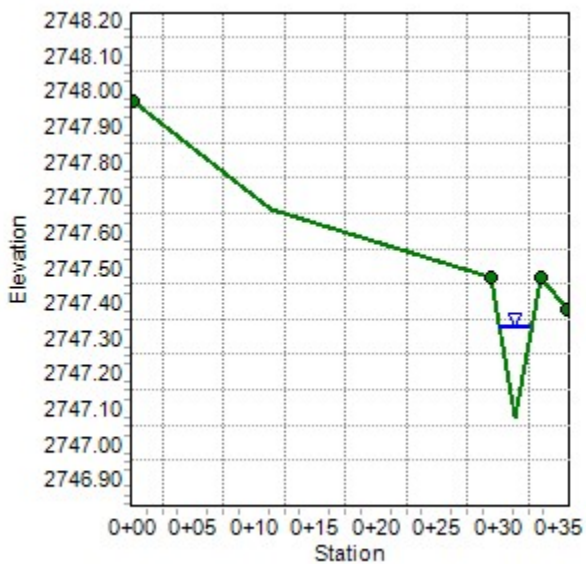
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.26	ft
Discharge	0.26	ft ³ /s

Cross Section Image



Worksheet for SW3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00640	ft/ft
Discharge	0.39	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2746.33
0+29.47	2745.47
0+31.52	2745.07
0+33.52	2745.47
0+35.60	2745.39

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2746.33)	(0+29.47, 2745.47)	0.016
(0+29.47, 2745.47)	(0+33.52, 2745.47)	0.035
(0+33.52, 2745.47)	(0+35.60, 2745.39)	0.016

Options

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

Results

Normal Depth	0.29	ft
Elevation Range	2745.07 to 2746.33 ft	
Flow Area	0.42	ft ²
Wetted Perimeter	2.98	ft
Hydraulic Radius	0.14	ft
Top Width	2.93	ft

Worksheet for SW3

Results

Normal Depth	0.29	ft
Critical Depth	0.21	ft
Critical Slope	0.03907	ft/ft
Velocity	0.92	ft/s
Velocity Head	0.01	ft
Specific Energy	0.30	ft
Froude Number	0.43	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.21	ft
Channel Slope	0.00640	ft/ft
Critical Slope	0.03907	ft/ft

Cross Section for SW3

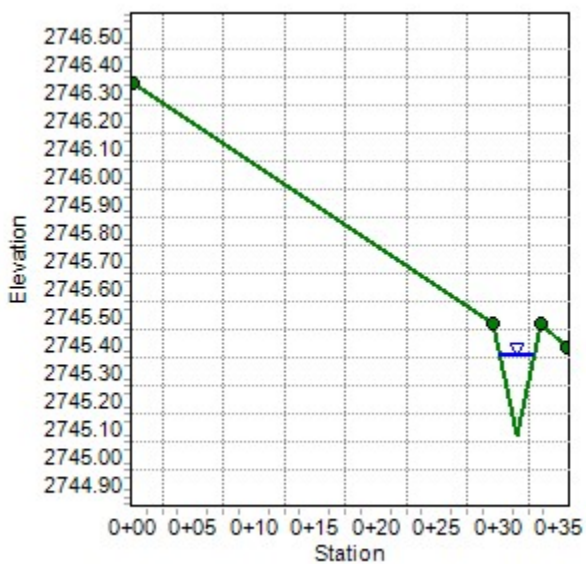
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00640	ft/ft
Normal Depth	0.29	ft
Discharge	0.39	ft ³ /s

Cross Section Image



Worksheet for SW4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00600	ft/ft
Discharge	0.47	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2744.30
0+28.93	2743.22
0+30.93	2742.91
0+32.93	2743.31
0+35.60	2743.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2744.30)	(0+28.93, 2743.22)	0.016
(0+28.93, 2743.22)	(0+32.93, 2743.31)	0.035
(0+32.93, 2743.31)	(0+35.60, 2743.21)	0.016

Options

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

Results

Normal Depth	0.30	ft
Elevation Range	2742.91 to 2744.30 ft	
Flow Area	0.51	ft ²
Wetted Perimeter	3.48	ft
Hydraulic Radius	0.15	ft
Top Width	3.43	ft

Worksheet for SW4

Results

Normal Depth	0.30	ft
Critical Depth	0.21	ft
Critical Slope	0.03856	ft/ft
Velocity	0.92	ft/s
Velocity Head	0.01	ft
Specific Energy	0.31	ft
Froude Number	0.42	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.21	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.03856	ft/ft

Cross Section for SW4

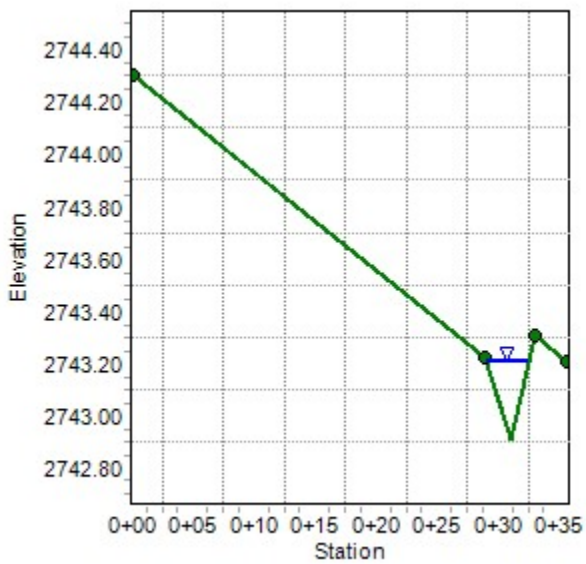
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00600	ft/ft
Normal Depth	0.30	ft
Discharge	0.47	ft ³ /s

Cross Section Image



Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

Riprap Sizing Calculation
Swale # 1

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

V = 1.79 ft/s

S = 0.01 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0273 = 0.0273 x 12in/ft = 0.33-inches → Use d₅₀ = 3-inches

Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

**Riprap Sizing Calculation
Swale # 2**

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

V = 0.69 ft/s

S = 0.005 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0032 = 0.0032 x 12in/ft = 0.04-inches → Use d₅₀ = 3-inches

Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

Riprap Sizing Calculation
Swale # 3

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

V = 0.92 ft/s

S = 0.006 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0062 = 0.0062 x 12in/ft = 0.07-inches → Use d₅₀ = 3-inches

Date 02/12/19 Project CHICK-FIL-A @ CHARLESTON AND FORT APACHE ROAD

Calc'd by EJ

Riprap Sizing Calculation
Swale # 4

$$d_{50} = (3V^* (S^{0.17}/S_s - 1))^2$$

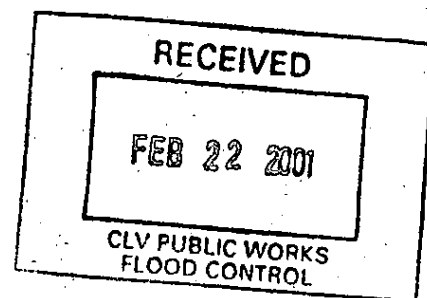
V = 0.92 ft/s

S = 0.006 ft/ft

S_s = 2.65 Specific Gravity

d₅₀ = 0.0061 = 0.0061 x 12in/ft = 0.07-inches → Use d₅₀ = 3-inches

2832
Q05



ADDENDUM NO. 1
TO THE
TECHNICAL DRAINAGE STUDY
FOR
ODETTE CENTER

February 22, 2001

Prepared for

Outback Steakhouse, Inc.
2202 N. Westshore Blvd.
5TH Floor
Tampa, FL 33607
(813) 2821225

Project No: 0050.0268

Prepared by:

PENTACORE



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		March 13, 2003
TO: Land Development Services Department of Public Works		FROM: Albert Surg, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
	Odette Center – Update for Barcelone	Dunnam Civil Engineer
Cross Streets:	SEC of Charleston Blvd. & Odette Lane	Micah Holding
File Number:	F:\Depot\DSMEMOS\DS2832D.doc	Bart Anderson, P.E., DEVCO
Parcel Number:	163-05-502-001	
Zoning Action:		
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID G.R. No.
1 st Submittal	1/24/2001	2/7/2001	Not Acceptable	\$250.00	---
2 nd Submittal	2/22/2001	3/8/2001	Not Acceptable	\$250.00	---
3 rd Submittal	3/27/2001	3/30/2001	Conditional acceptance	\$250.00	---
4 th Submittal	2/28/2003	3/13/2003	See Comments Below	\$250.00	100014: \$250
TOTAL FEES (LDDRS):				\$1,000.00	Balance: \$750

REMARKS:

4th Submittal (Update study)

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

X	is acceptable in concept subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	must have Clark County Regional Flood Control District concurrence.

- All elevations, shown on the grading plans, are not clear and must be revised to identify as either top of curb (TC), finish grade (FG) or flow line (FL).

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Amendment and accepted by the City of Las Vegas Flood Control Section. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the City reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

END OF REMARKS

ssn

T/R/S: T21S/R60E/05
AREA Q-05



PENTACORE

0050.0286

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Technologies

February 22, 2001

**Mr. Albert Sung, P.E.
Flood Control Division
City of Las Vegas
731 South 4th Street
Las Vegas, Nevada 89101**

SUBJECT: Addendum No. 1 to the Technical Drainage Study for the Odette Center

Dear Mr. Sung:

The enclosed addendum is being provided in response to a memorandum dated February 7, 2001, from The City of Las Vegas. Twenty-One (21) comments were outlined in the Memorandum regarding the Technical Drainage Study for the Odette Center. Those comments are addressed within the following summarization:

Comment 1: On the offsite drainage map indicate the Q_{100}/Q_{10} flows and concentration points for all basins impacting the site. The drainage map must be in a scale not less than 1" equal to 60' and must be on a 24"x36" sheet. The study assumes flows on Odette drain into Charleston and neglects the flows from Fort Apache and further upstream. This must be addressed.

Response 1: The offsite basin map has been revised to show the Q_{100}/Q_{10} flows. A 24"x36" proposed drainage map is enclosed within this study. The City of Las Vegas – "City Wide Hydrology Study" shows that all flows in the area of the Odette Center are draining North. The "Conceptual Drainage Study for Fort Apache Commons" also determined that all flows on W. Charleston Blvd. and Fort Apache Road will be captured by drop inlets and conveyed in an existing storm drain system. Any flows that split from Fort Apache Road and Peccole Strada don't contribute to the project flows, since flows will continue down Peccole Strada in a Southeasterly direction past Odette Lane. Flows do not enter basin OFF-2 at Napoli from Fort Apache Road due to the high point in Napoli Dr. See the Offsite Drainage Map. Enclosed are Figure 12 from the Citywide Study and the grading plan and text excerpts from the Fort Apache Study. ✓

6763 West Charleston Boulevard • Las Vegas, Nevada 89146

Engineering
Tel. 702.258.0115 • Fax 258.4956

Surveying
Tel. 702.258.4110 • Fax 258.4790

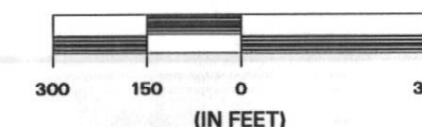
ADA Consulting
Tel. 702.258.0202 • Fax 258.0294



ODETTE CENTER OFF-SITE DRAINAGE MAP

*Q100 flow rates?
CC points*

Aerial Photo
March 2000



January 16, 2001
Scale: 1 inch = 300 feet

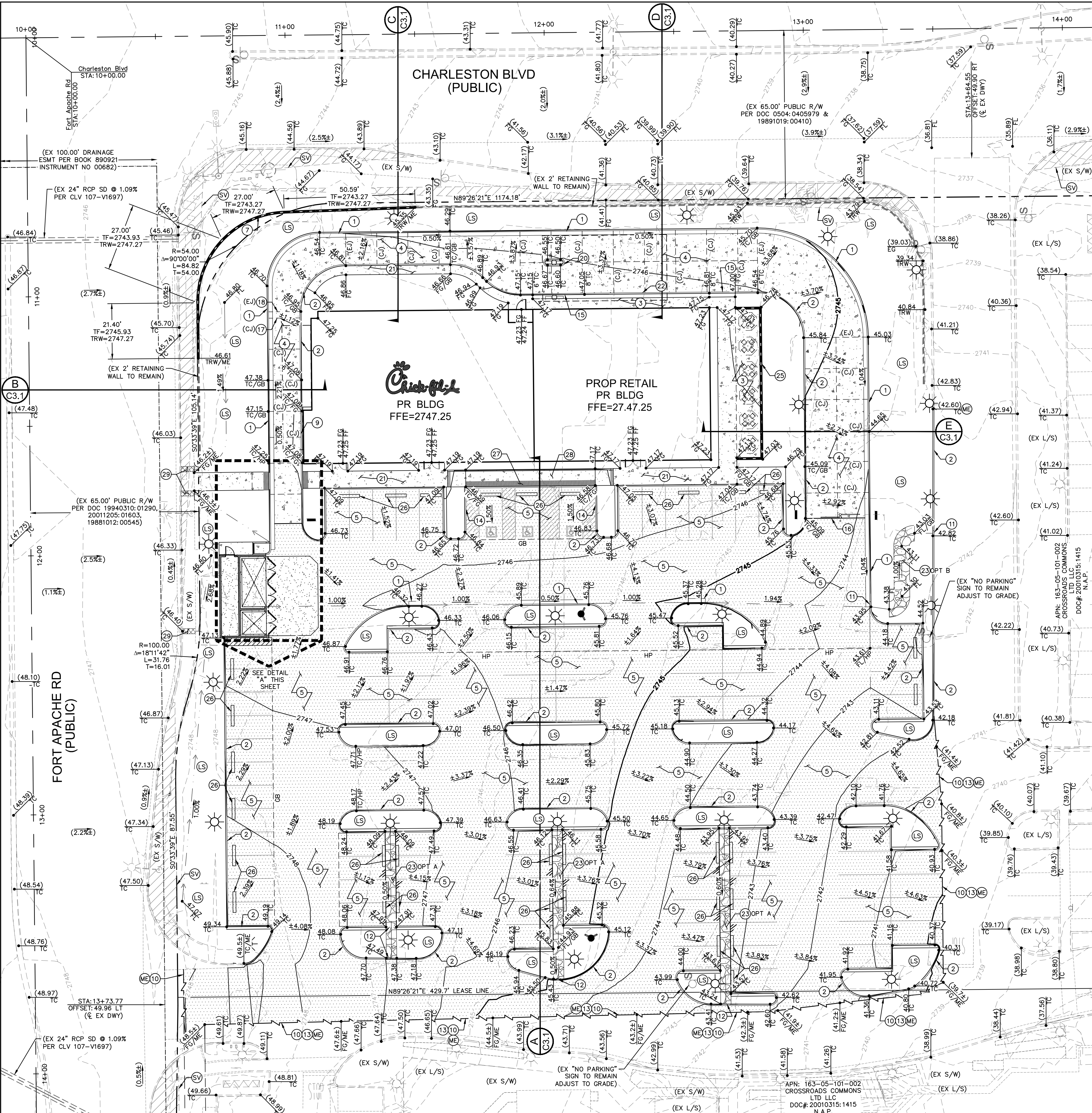


PENTACORE
Geographic Information
Systems

6763 West Charleston Blvd.
Las Vegas, Nevada 89146

For Reference only. Pentacore assumes no liability for the accuracy
of the data delineated hereon.

D.N.S.



LEGEND

- RIGHT-OF-WAY
- PROPERTY LINE
- LEASE LINE
- GRADE BREAK
- PR SAWCUT LINE
- PR RETAINING WALL
- PR SWALE/FLOW LINE
- PR TYPE 'L' CURB & GUTTER
- PR TYPE 'A' CURB
- EX STREETLIGHT
- EX SIGHT VISIBILITY ZONE (SVZ)
- PR PAVEMENT
- PR CONCRETE

GRAPHIC SCALE IN FEET
0 10 20 40
SCALE: 1" = 20'

NORTH

ENGINEER'S NOTES:

- ALL WORK SHALL CONFORM TO THE SOILS REPORT PREPARED BY XXXXXX, DATED MONTH DAY, 2019, NO. XXXXXXXX.
- ALL OFF-SITE IMPROVEMENT CONSTRUCTION SHALL CONFORM TO THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA" LATEST EDITION.
- FINAL ASPHALTIC CONCRETE (AC PAVEMENT SURFACES) SHALL BE FLUSH WITH THE TOP OF GUTTER (INCLUDING OPEN GRADE).
- CONTRACTOR IS RESPONSIBLE FOR DUST AND EROSION CONTROL DURING CONSTRUCTION.
- THIS PLAN SHALL NOT, IN PART OR IN WHOLE, BE USED FOR CONSTRUCTION UNLESS APPROVED AND SIGNED BY ALL APPLICABLE GOVERNMENT AGENCIES.
- ENGINEER TO BE NOTIFIED OF ANY DISCREPANCIES IMMEDIATELY.
- MATCH ELEVATIONS SHOWN TO BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION.
- THIS PROJECT IS PART OF A PROPOSED COMMERCIAL SUBDIVISION.
- ALL SITE STORM DRAINS AND THE ASSOCIATED STORM WATER FACILITIES ARE PRIVATELY OWNED AND PRIVATELY MAINTAINED.

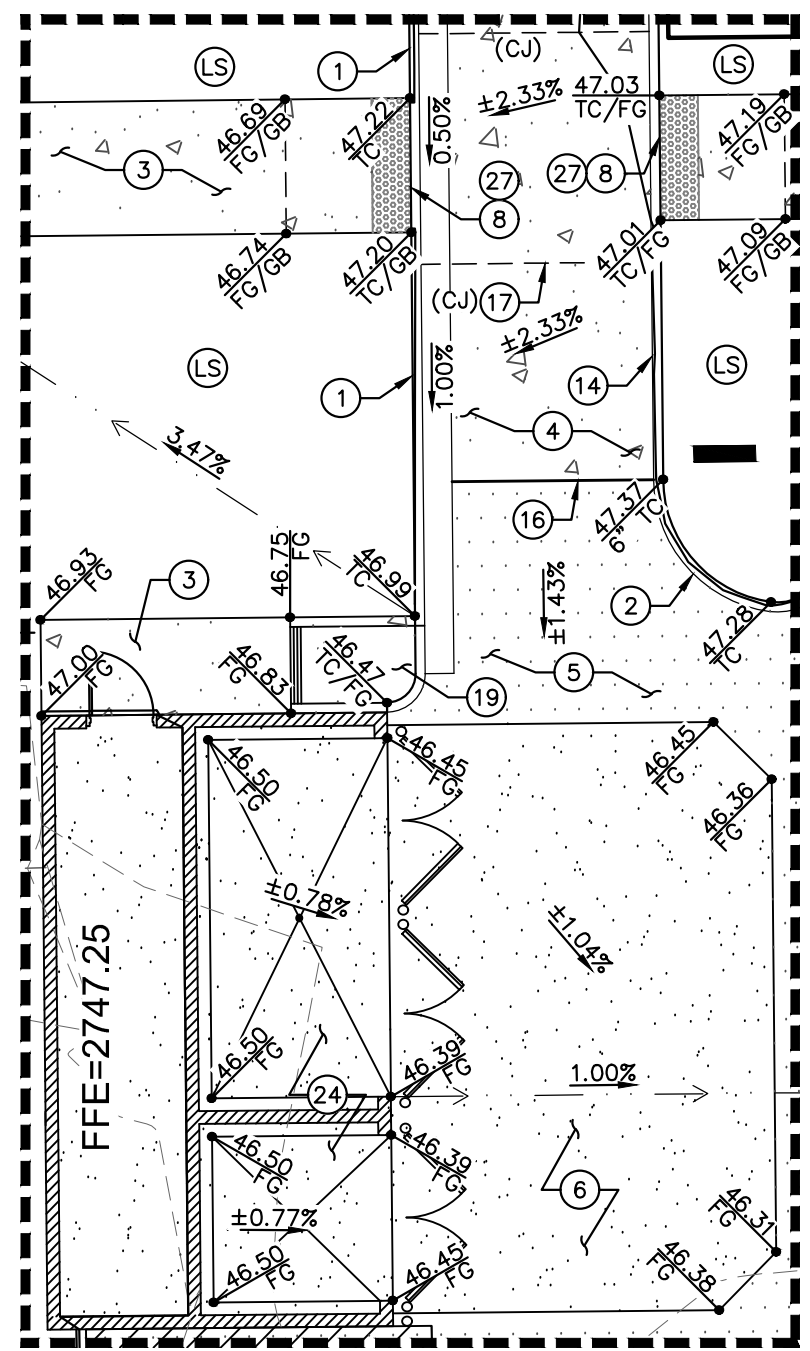
STORMWATER MANAGEMENT NOTES

- THE OWNER, SITE DEVELOPER, CONTRACTOR, AND/OR THEIR AUTHORIZED AGENTS SHALL EACH DAY REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN DISCHARGED, OR ACCUMULATED IN, THE PUBLIC RIGHTS OF WAY OF THE CITY OF LAS VEGAS AS A RESULT OF CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS SITE DEVELOPMENT OR CONSTRUCTION PROJECT. SUCH MATERIALS SHALL BE PREVENTED FROM ENTERING THE STORM SEWER SYSTEM.
- ADDITIONAL CONSTRUCTION SITE DISCHARGE BEST MANAGEMENT PRACTICES MAY BE REQUIRED OF THE OWNER AND HIS OR HER AGENTS DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT MEET THE PERFORMANCE STANDARDS SPECIFIED IN THE CITY OF LAS VEGAS BUILDING ADMINISTRATIVE CODE 24.40 AND THE LAS VEGAS VALLEY CONSTRUCTION SITE BMP GUIDANCE MANUAL.
- TEMPORARY OR PERMANENT STABILIZATION PRACTICES WILL BE INSTALLED ON DISTURBED AREAS AS SOON AS PRACTICABLE AND NO LATER THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. SOME EXCEPTIONS MAY APPLY; REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVRI00000, SECTION III.A.5.
- AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL DISTURBED AREAS, AREAS USED FOR STORAGE OF MATERIALS AND EQUIPMENT THAT ARE EXPOSED TO PRECIPITATION, VEHICLE ENTRANCE AND EXIT LOCATIONS, AND ALL BMPs WEEKLY, AND WITHIN 24 HOURS AFTER ANY RAIN EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR OR HIS AGENT SHALL UPDATE OR MODIFY THE STORMWATER POLLUTION PREVENTION PLAN AS NECESSARY. SOME EXCEPTIONS TO WEEKLY INSPECTIONS MAY APPLY, SUCH AS SUSPENSION OF LAND DISTURBANCE ACTIVITIES. REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVRI00000, SECTION III.A.12.
- ACCUMULATED SEDIMENT IN BMPs SHALL BE REMOVED WITHIN SEVEN DAYS AFTER A STORMWATER RUNOFF EVENT OR PRIOR TO THE NEXT ANTICIPATED STORM EVENT, WHICHEVER IS EARLIER. SEDIMENT MUST BE REMOVED WHEN BMP DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT OR MORE.

SIGHT VISIBILITY ZONES NOTE

NO WALLS, FENCES, SHRUBS, UTILITY APPURTENANCES OR ANY OTHER OBJECT, OTHER THAN TRAFFIC CONTROL DEVICES, FIRE HYDRANTS, TREES, AND STREET LIGHT POLES MAY BE CONSTRUCTED OR INSTALLED WITHIN THE SIGHT VISIBILITY ZONE UNLESS SAID OBJECT IS MAINTAINED LESS THAN 24 INCHES IN HEIGHT MEASURED FROM TOP OF CURB, OR WHERE NO CURB EXISTS, A HEIGHT OF 27 INCHES MEASURED FROM THE TOP OF ADJACENT ASPHALT, GRAVEL, OR PAVEMENT STREET SURFACE. THIS RESTRICTION EXTENDS ALONG THE SIGHT VISIBILITY LINE THROUGH LANDSCAPED MEDIANS.

- CONSTRUCTION NOTES**
- CONSTRUCT "L" TYPE CURB & GUTTER PER DETAIL 17, SHEET C4.2
 - CONSTRUCT "A" TYPE CURB PER DETAIL 8, SHEET C4.1
 - CONSTRUCT SIDEWALK PER DETAIL 11, SHEET C4.1
 - CONSTRUCT CONCRETE PAVING DRIVE-THRU LANE PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 25, SHEET C4.3
 - CONSTRUCT STANDARD AC PAVEMENT PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 21, SHEET C4.2
 - CONSTRUCT CONCRETE APRON @ TRASH ENCLOSURE PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 24, SHEET C4.3
 - CONSTRUCT 4' MAX RETAINING WALL PER SEPARATE ARCHITECTURAL PLANS AND DETAILS BY OTHERS
 - CONSTRUCT 0" CURB PER DETAIL 17, SHEET C4.2
 - DRIVE-THRU ISOMETRIC PLAN VIEW PER DETAILS 13 & 14, SHEET C4.2
 - SAWOUT NEAT & MATCH EXISTING
 - CONSTRUCT 2.0' WIDE CURB OPENING PER DETAIL 16A, SHEET C4.2
 - CONSTRUCT 4.0' WIDE CURB OPENING PER DETAIL 16B, SHEET C4.2
 - CONSTRUCT TRANSVERSE AND LONGITUDINAL DOWELED CONSTRUCTION JOINT PER DETAIL 23, AND BUTT JOINT PER DETAIL 23A, SHEET C4.3
 - CONSTRUCT 0" TO 6" TRANSITION PER DETAIL 15A, SHEET C4.2
 - CONSTRUCT 6" TO 8" TRANSITION PER DETAIL 15B, SHEET C4.2
 - CONSTRUCT CONCRETE/AC EDGE PER DETAIL 21A, SHEET C4.2
 - CONSTRUCT CONTRACTION JOINT (CJ) PER DETAIL 22, SHEET C4.3
 - CONSTRUCT EXPANSION JOINT (EJ) PER DETAIL 26, SHEET C4.3
 - CONSTRUCT RETURNED CURB ACCESSIBLE RAMP PER DETAIL 33, SHEET C4.3
 - DRIVE-THRU ISLAND CURB PER DETAIL 30, SHEET C4.3
 - CONSTRUCT SIDEWALK WITH 6" CURB SECTION PER DETAIL 12, SHEET C4.2
 - CONSTRUCT 8" "A" TYPE CURB PER DETAIL 7, SHEET C4.1
 - INSTALL RIP-RAP (D50=3", T=6") LINED SWALE PER DETAIL 32, SHEET C4.3
 - CONSTRUCT TRASH ENCLOSURE FOUNDATION PER ARCHITECTURAL PLANS AND DETAILS BY OTHERS
 - CONSTRUCT SCREEN WALL WITH WEEP HOLES PER ARCHITECTURAL PLANS AND DETAILS BY OTHERS
 - CONSTRUCT PRECAST CONCRETE WHEEL STOP PER CCAUSD DWG NO. 238-SEE DETAIL 27, SHEET C4.3
 - CONSTRUCT TRUNCATED DOMES PER DETAIL 10, SHEET C4.1
 - CONSTRUCT ACCESSIBLE CURB RAMP PER DETAIL 9, SHEET C4.1
 - INSTALL SIDEWALK UNDERDRAIN PER CCAUSD DWG NO. 236
 - PROPOSED LANDSCAPING PER SEPARATE LANDSCAPE PLANS
 - MATCH EXISTING
 - EXISTING SIGHT VISIBILITY ZONE



DETAIL "A"
SCALE: 1"=10'

EARTHWORK QUANTITIES

CUT	FILL	NET
3,842 CY	186 CY	3,656 CY (CUT)*

*RAW NUMBERS; HAVE NOT BEEN ADJUSTED FOR SOIL TYPE

LEGEND & ABBREVIATIONS
SEE SHEET C0.3 FOR MASTER LEGEND AND ABBREVIATIONS.

LEGAL DESCRIPTION
SEE COVER SHEET FOR FULL LEGAL DESCRIPTION

NOTES:
ALL DIMENSIONS ARE TO BACK OF CURB UNLESS OTHERWISE NOTED.

GRADING NOTE:
PER THE SOILS REPORT, POSITIVE DRAINAGE OF 5% MINIMUM IN LANDSCAPE AREAS AND 2% MINIMUM ELSEWHERE SHALL BE MAINTAINED FOR AREAS ADJACENT TO STRUCTURES. THE 2% SHOULD BE MAINTAINED A DISTANCE OF 10' IN AREAS WHERE ADA IS ADJACENT TO THE BUILDING, SLOPES LESS THAN 2% ARE ACCEPTABLE.

ELEVATION NOTE:
ADD 2700 FEET TO ALL SPOT ELEVATIONS, EXCEPT FINISHED FLOOR ELEVATIONS AND CONTOURS.

Call before you Dig
811
OR
1-800-227-2600

FAST
Call before you UnderGround
1-800-432-5300

CALL BEFORE YOU OVERHEAD
1-702-227-2929

BENCHMARK
7LV00 325SW6: A RIVET AND PLATE IN THE TOP OF CURB AT THE NORTHWEST CORNER OF RAMFORD BOULEVARD AND CHARLESTON BOULEVARD = 837.425m = 2,747.45ft (NAVD88).

BASIS OF BEARING
NORTH 89°26'21" EAST, BEING THE SOUTH LINE OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 32, TOWNSHIP 20 SOUTH, RANGE 60 EAST, M.D.M., CITY OF LAS VEGAS, STATE OF NEVADA, AS SHOWN BY THE MAP RECORDED IN FILE 36 OF SURVEYS, PAGE 89 IN THE OFFICE OF THE COUNTY RECORDER, CLARK COUNTY, NEVADA.

FLOOD ZONE NOTE
THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) PANEL NUMBER 32003C2145F, EFFECTIVE NOVEMBER 16, 2011, INDICATE THAT THE PROJECT SITE IS LOCATED IN ZONE "X". ZONE "X" IS DEFINED BY FEMA AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN."

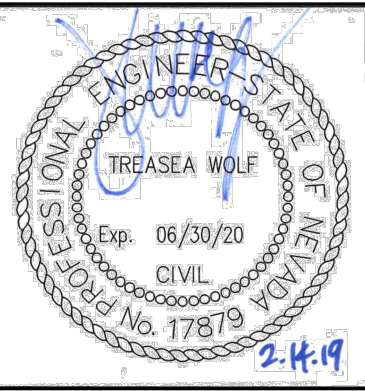
DRAINAGE CERTIFICATION
I CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE WITH CITY OF LAS VEGAS FOR THIS PROJECT, DS-XXXX

TREASEA WOLF, PE No. 17879
DATE: _____
CLV #: TBD
H #: TBD



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Atlanta, Georgia
30349-2998

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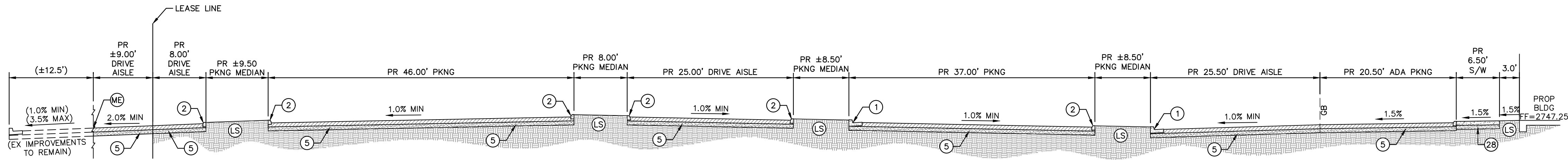
FSR# 4293

REVISION SCHEDULE
NO. DATE DESCRIPTION

AGENCY #	TBD
PROJECT #	092908012
PRINTED FOR	DRAINAGE
DATE	02/14/19
DESIGN BY	JZ
DRAWN BY	CT
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SHEET	
GRADING PLAN	
SHEET NUMBER	

C3.0

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Sheet No. C3.1 Saved by: caryn.jiajun - Friday, February 01, 2019 9:40 AM
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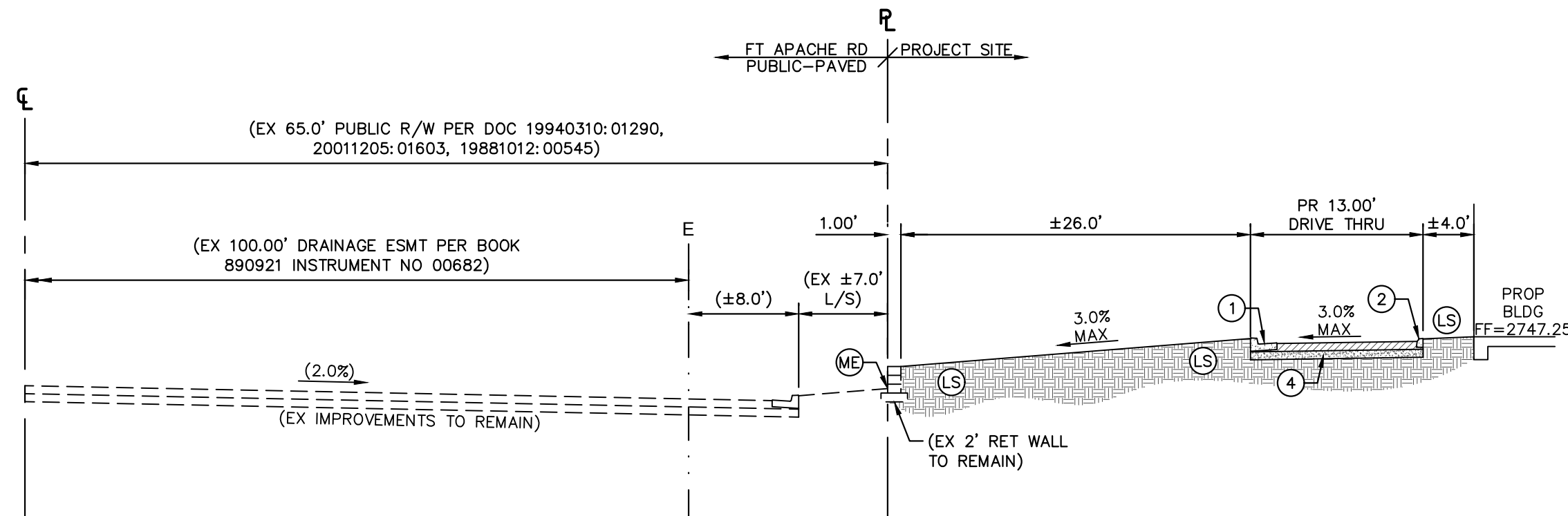
A
C3.1

SECTION A -SOUTH OF BLDG

NTS

CONSTRUCTION NOTES

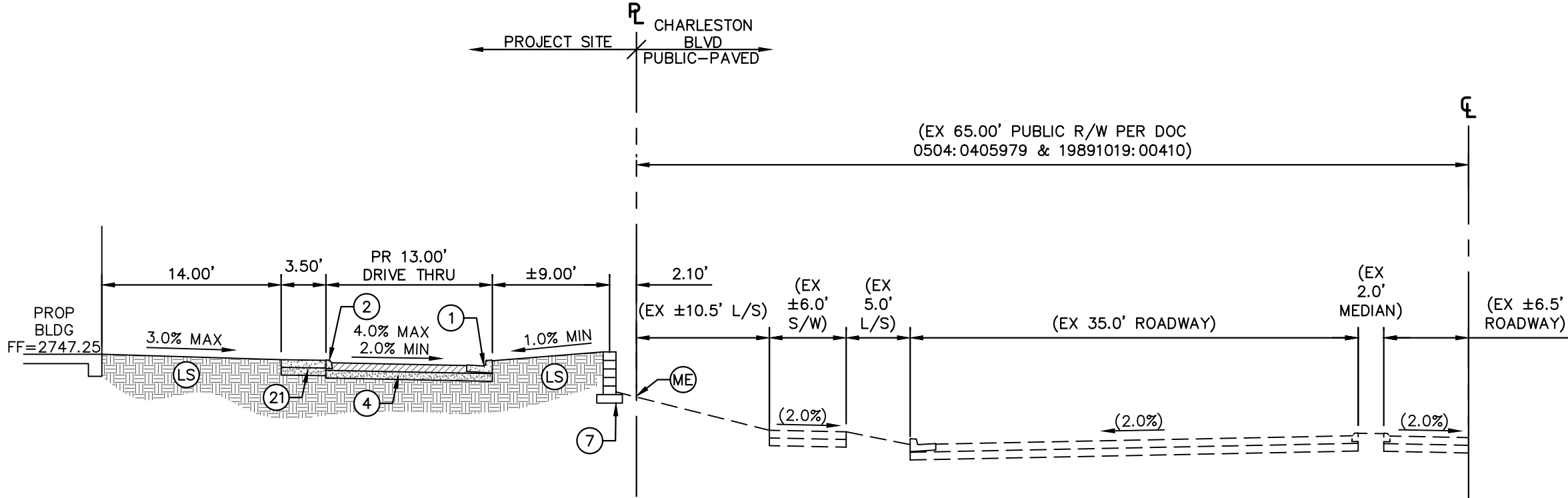
- ① CONSTRUCT "L" TYPE CURB & GUTTER PER DETAIL 17, SHEET C4.2
- ② CONSTRUCT "A" TYPE CURB PER DETAIL 8, SHEET C4.1
- ③ CONSTRUCT SIDEWALK PER DETAIL 11, SHEET C4.1
- ④ CONSTRUCT CONCRETE PAVING DRIVE-THRU LANE PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 25, SHEET C4.3
- ⑤ CONSTRUCT STANDARD AC PAVEMENT PER SOILS REPORT BY TERRACON CONSULTANTS. SEE DETAIL 25, SHEET C4.2
- ⑦ CONSTRUCT 4' MAX RETAINING WALL PER SEPERATE ARCHITECTURAL PLANS AND DETAILS BY OTHERS
- ⑫ CONSTRUCT SIDEWALK WITH 6" CURB SECTION PER DETAIL 12, SHEET C4.2
- ⑳ CONSTRUCT SCREEN WALL WITH WEEP HOLES PER ARCHITECTURAL PLANS AND DETAILS BY OTHERS
- ㉔ CONSTRUCT ACCESSIBLE CURB RAMP PER DETAIL 15, SHEET C4.2
- ㉕ PROPOSED LANDSCAPING PER SEPARATE LANDSCAPE PLANS
- ME MATCH EXISTING



B
C3.1

SECTION B -WEST PROPERTY LINE

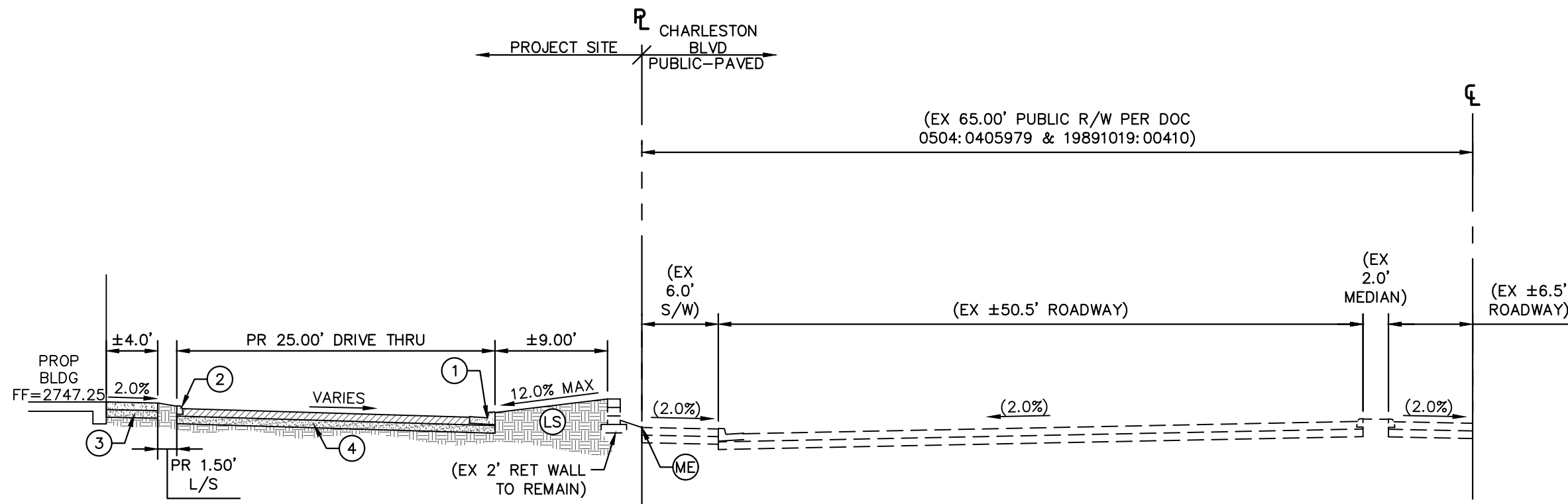
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C
C3.1

SECTION C -NORTH PROPERTY LINE

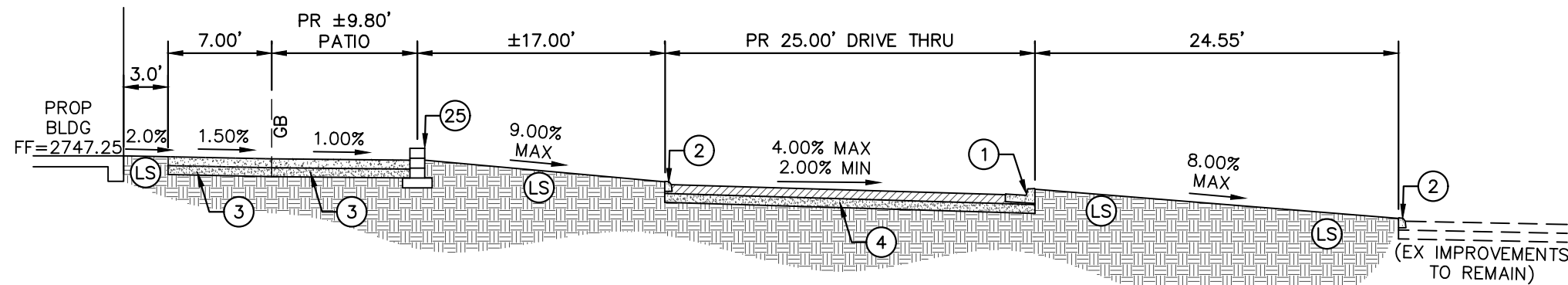
NTS



D
C3.1

SECTION D -NORTH PROPERTY LINE

NTS



E
C3.1

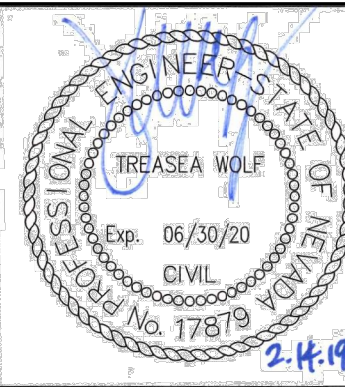
SECTION E -EAST PROPERTY LINE

NTS



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FSR# 4293

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PROJECT # 092908012
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SHEET
TYPICAL SECTIONS

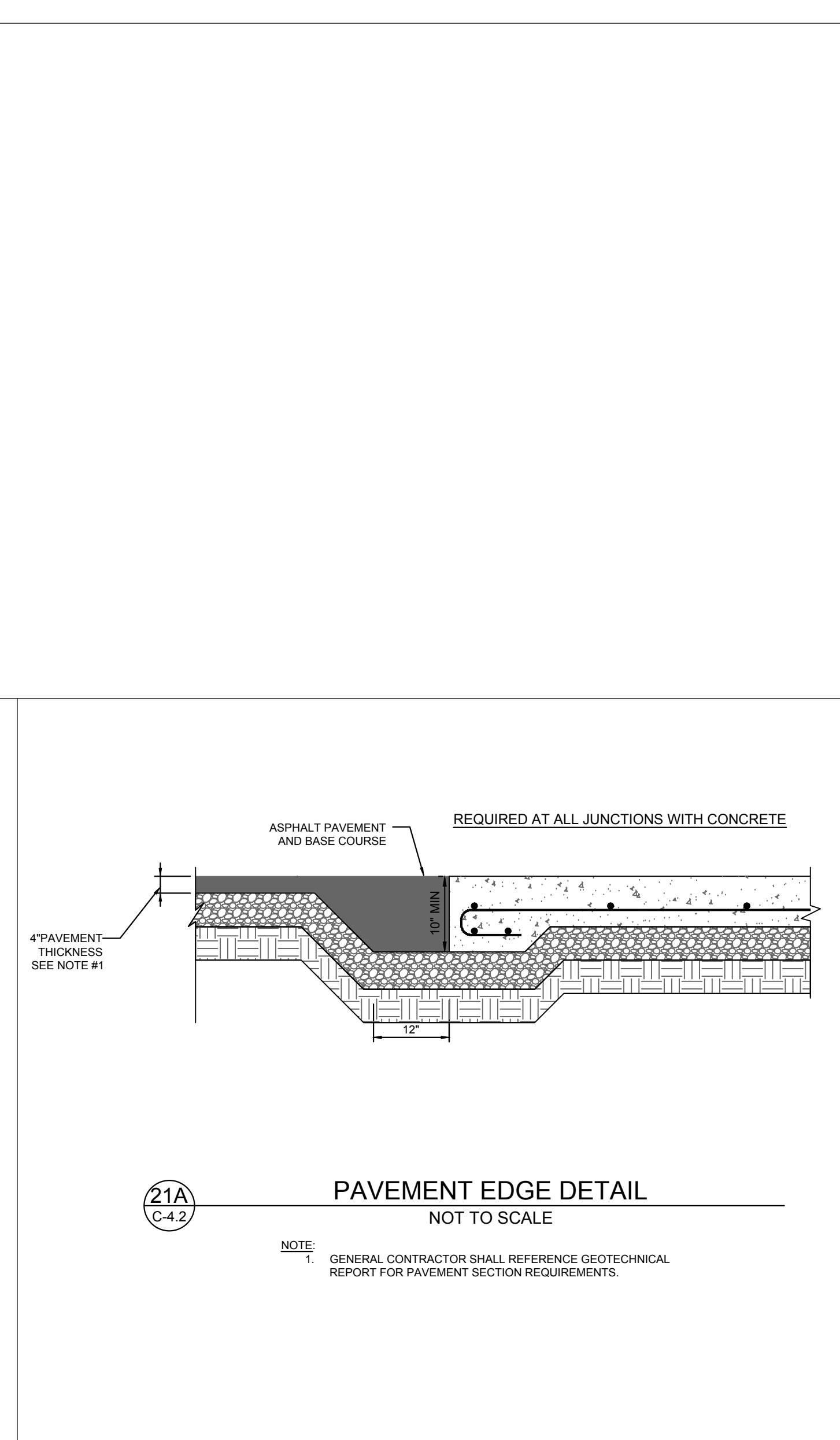
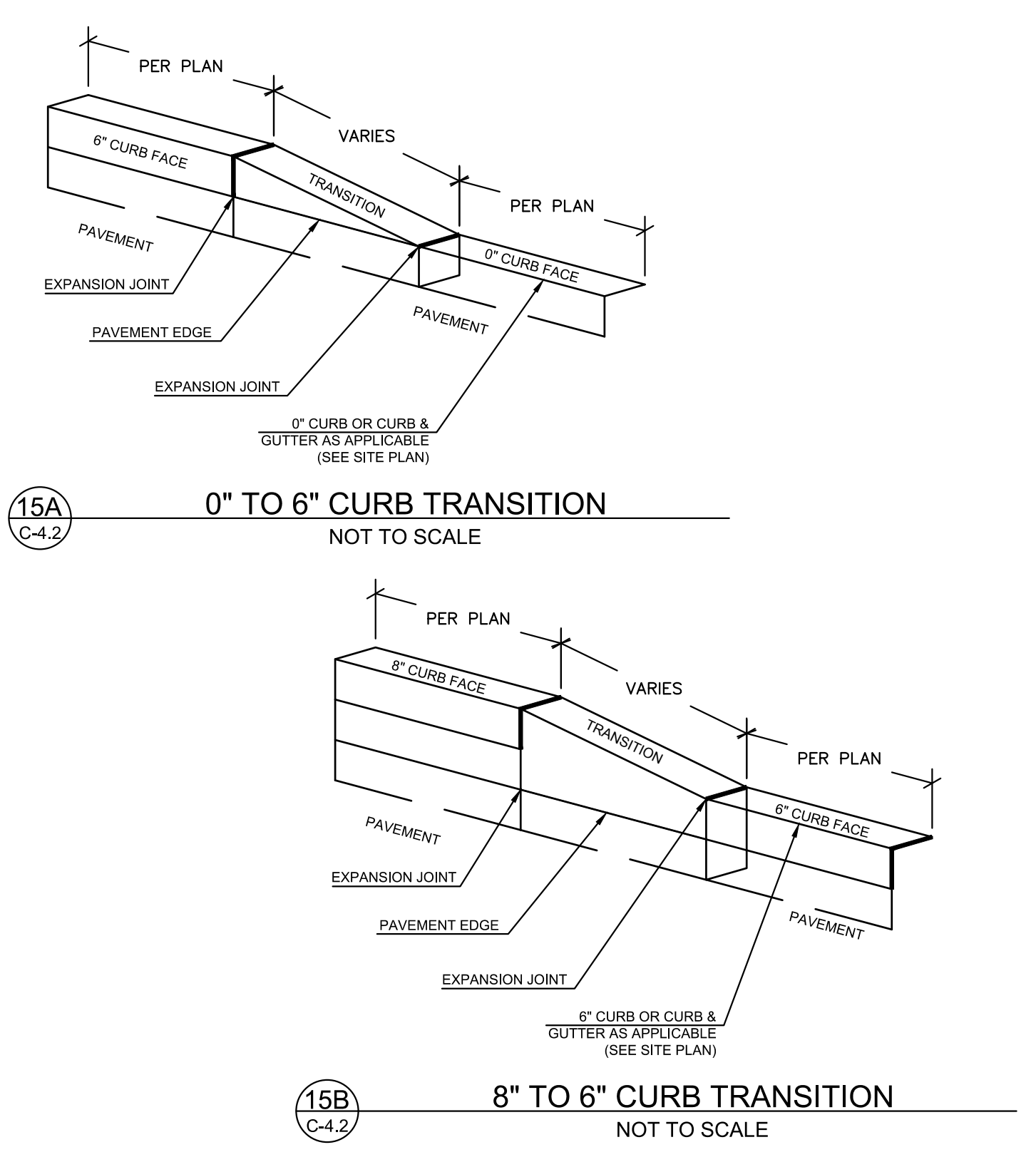
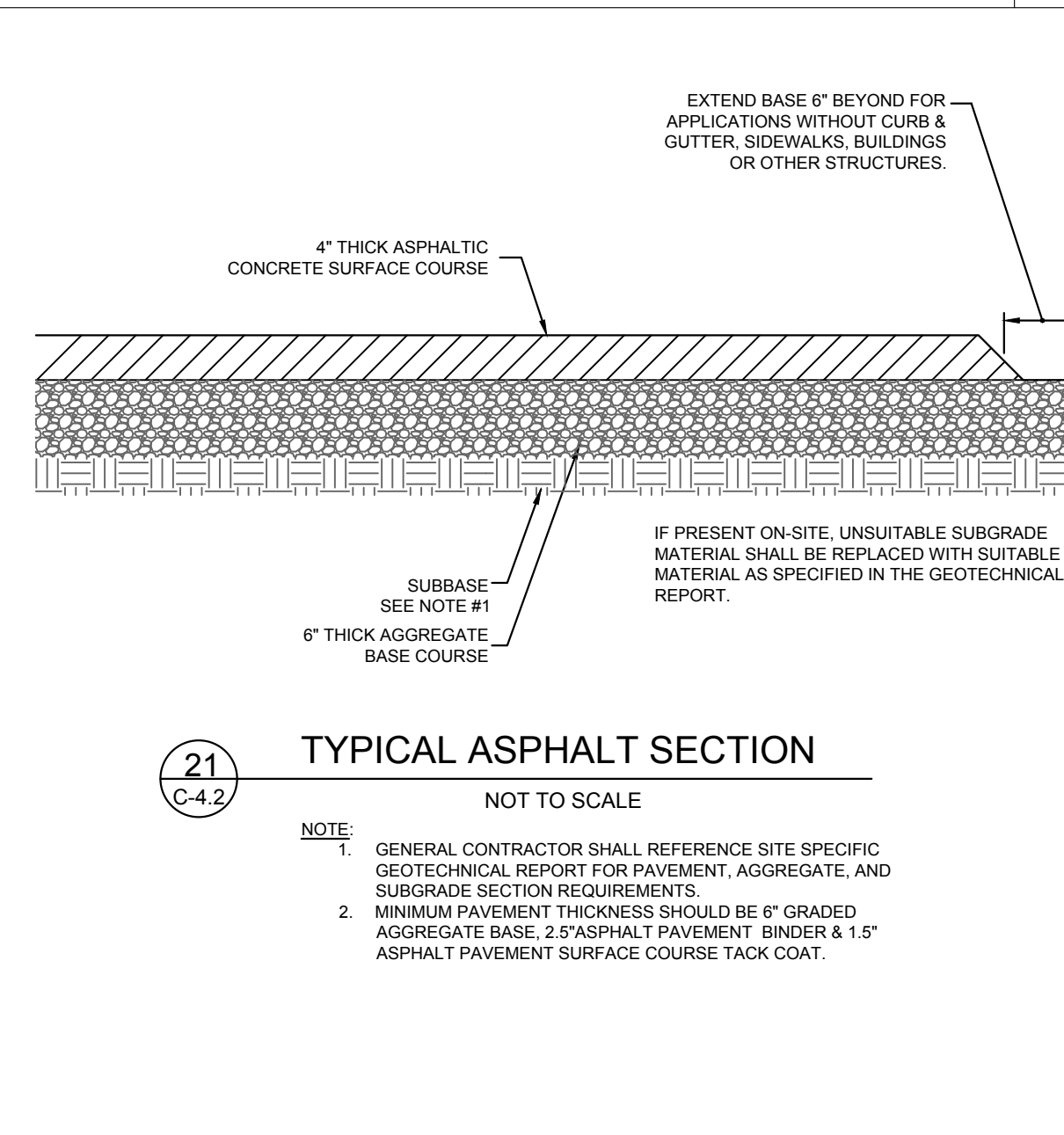
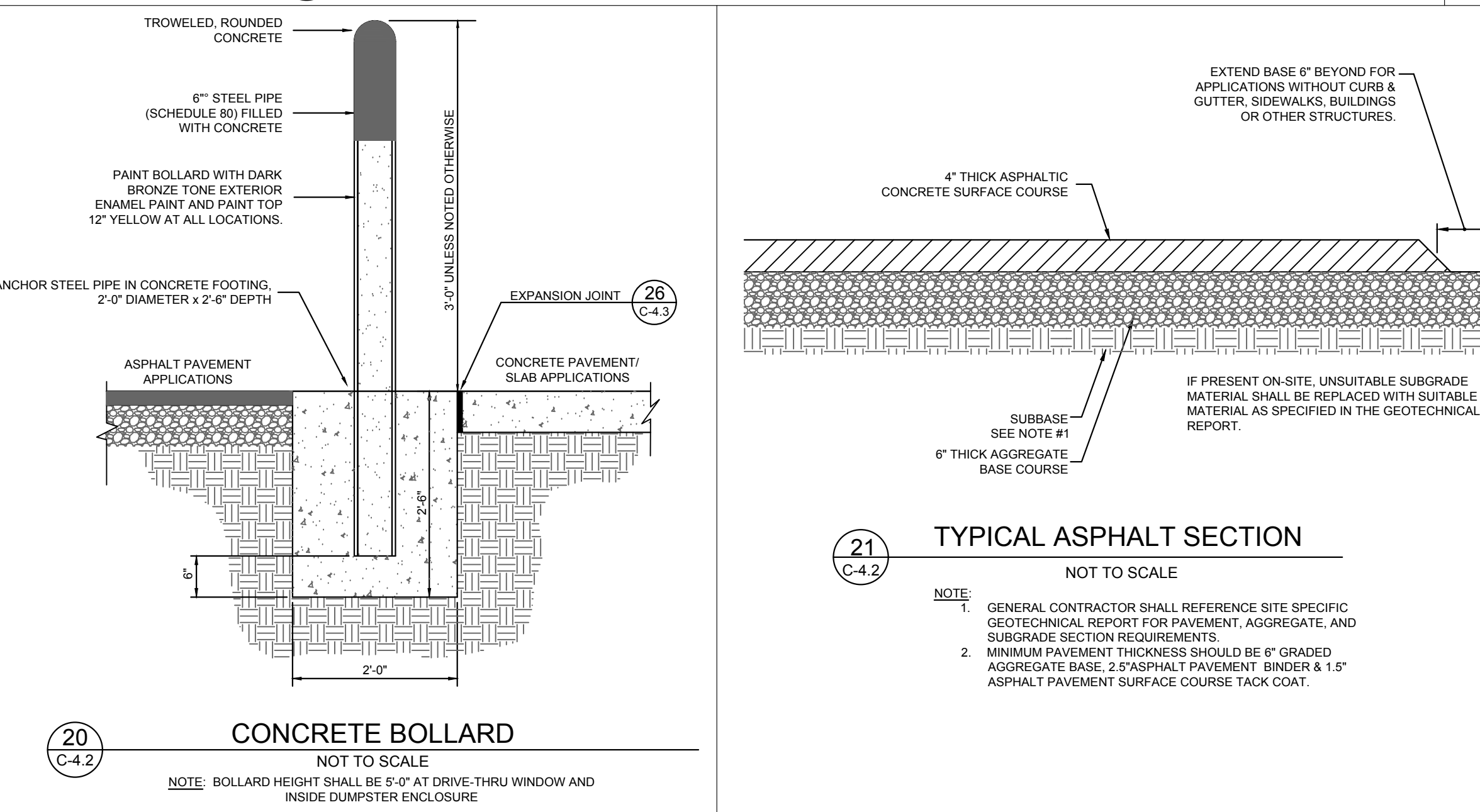
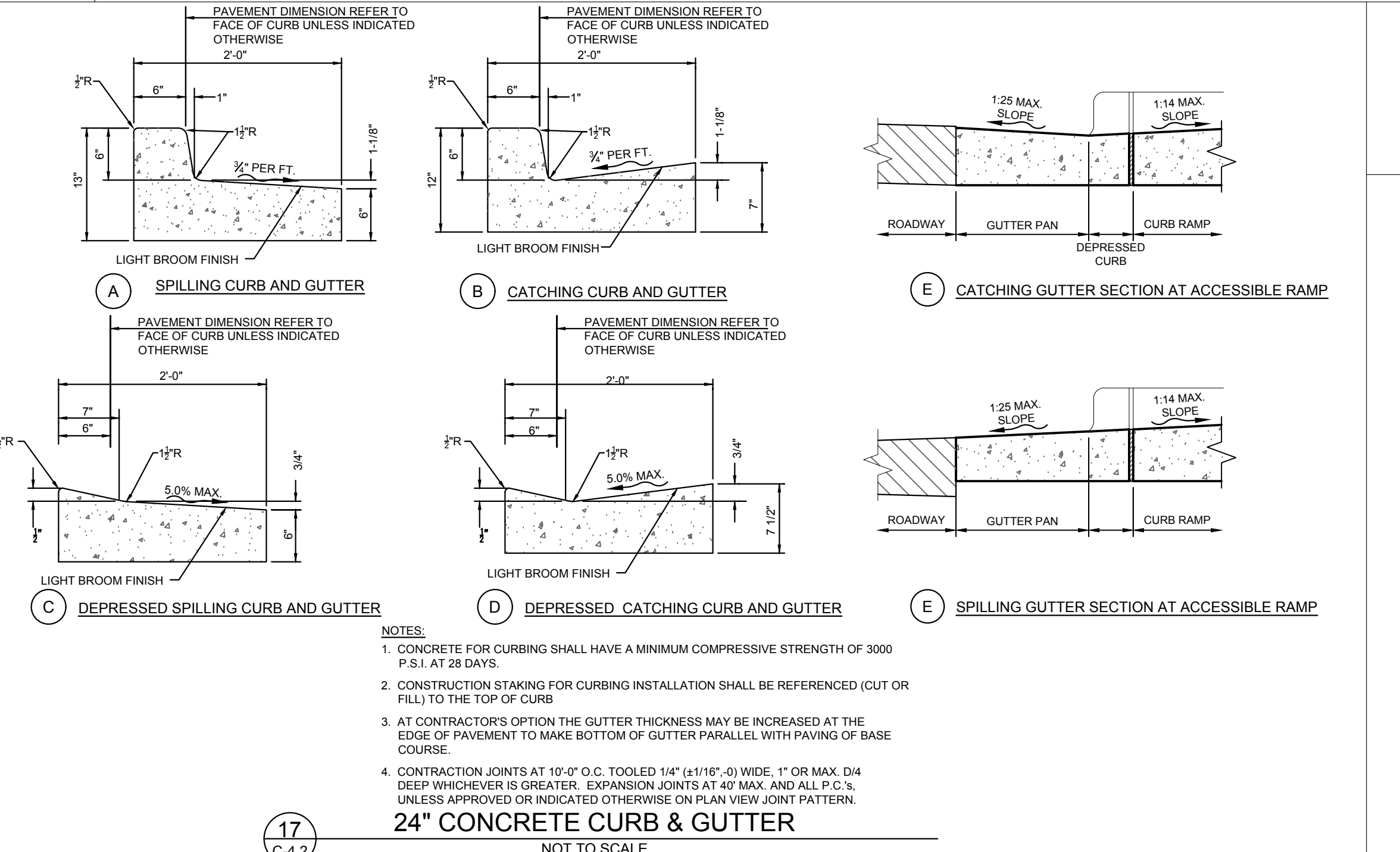
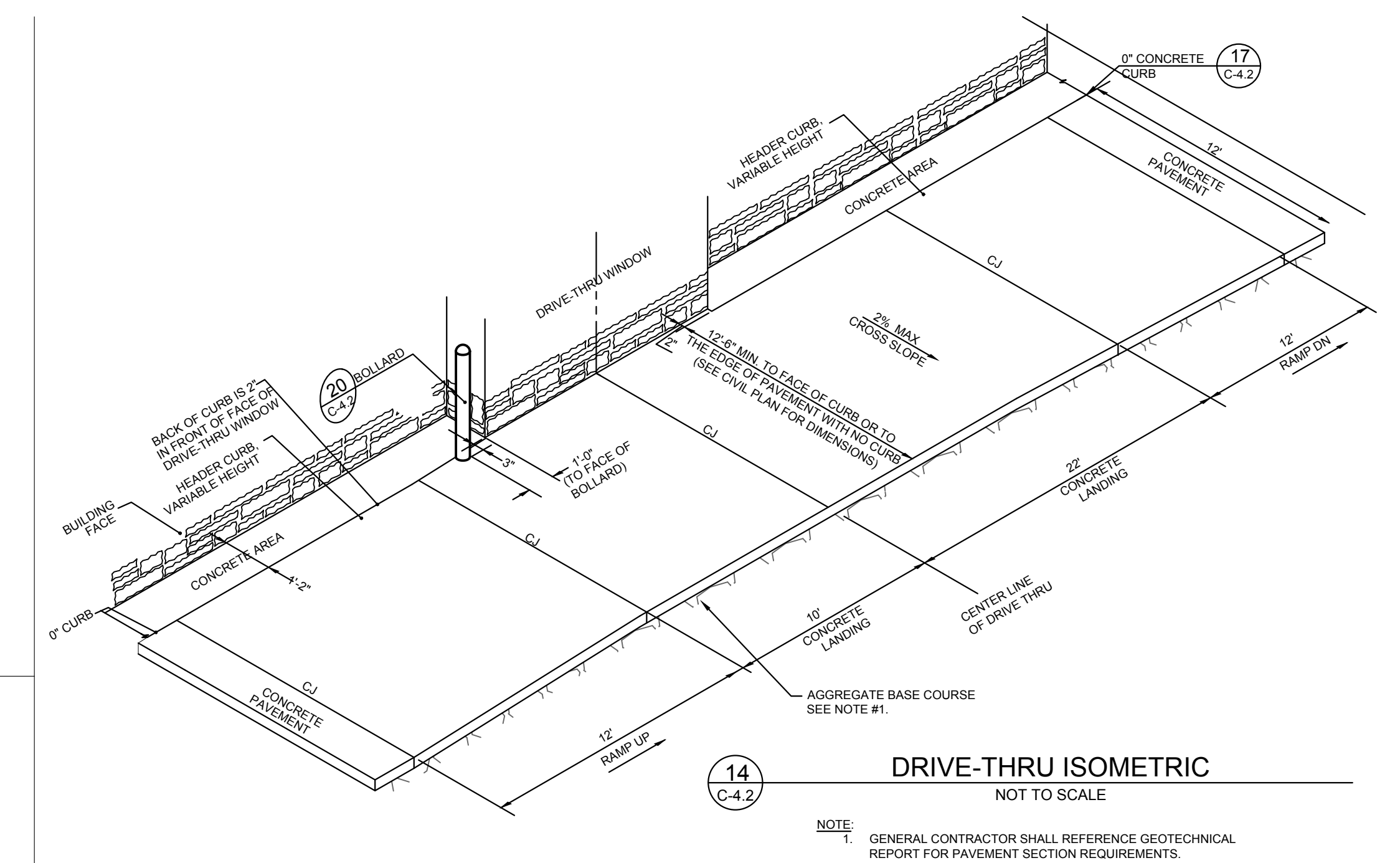
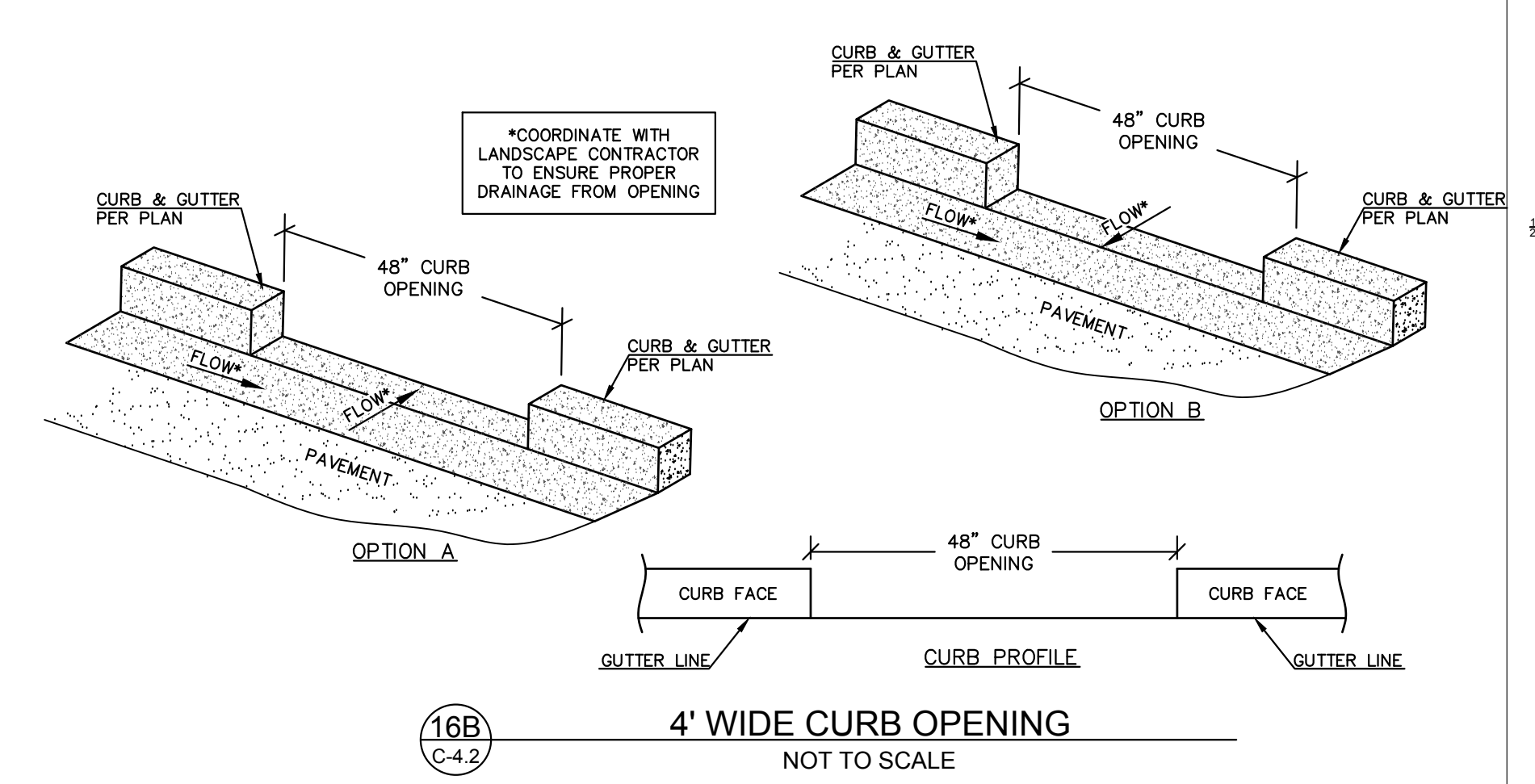
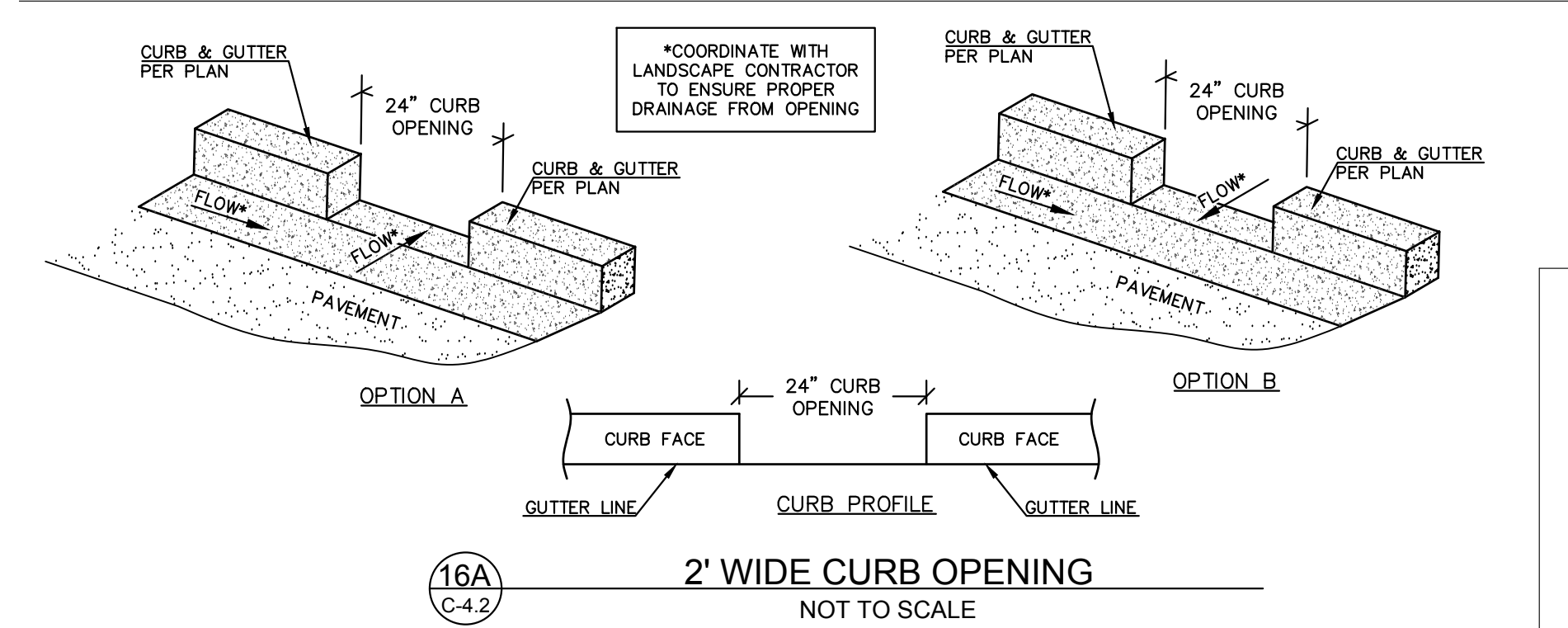
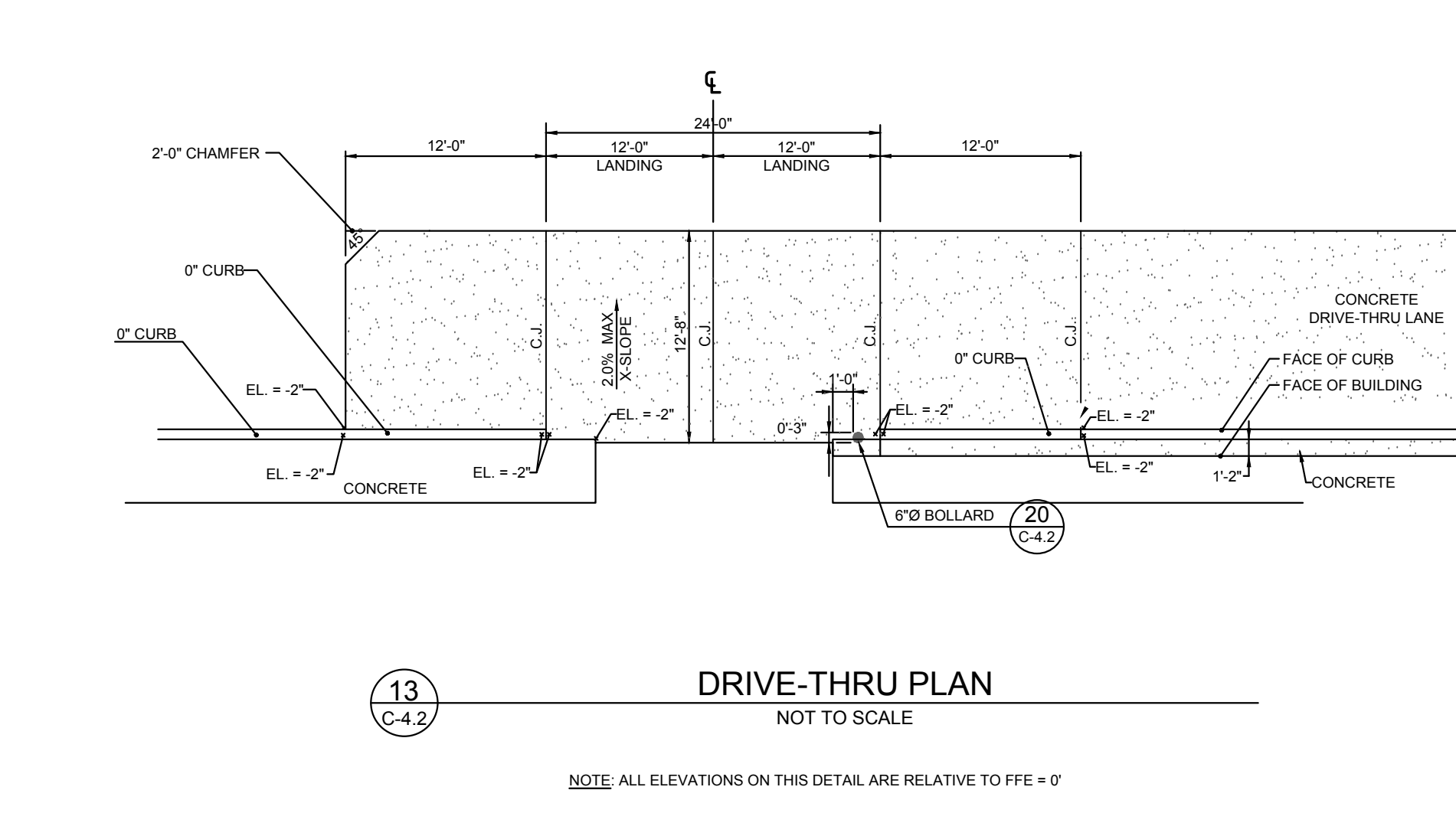
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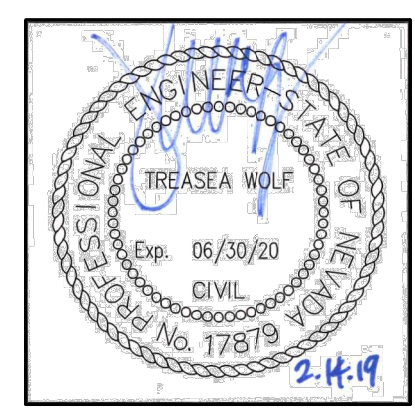
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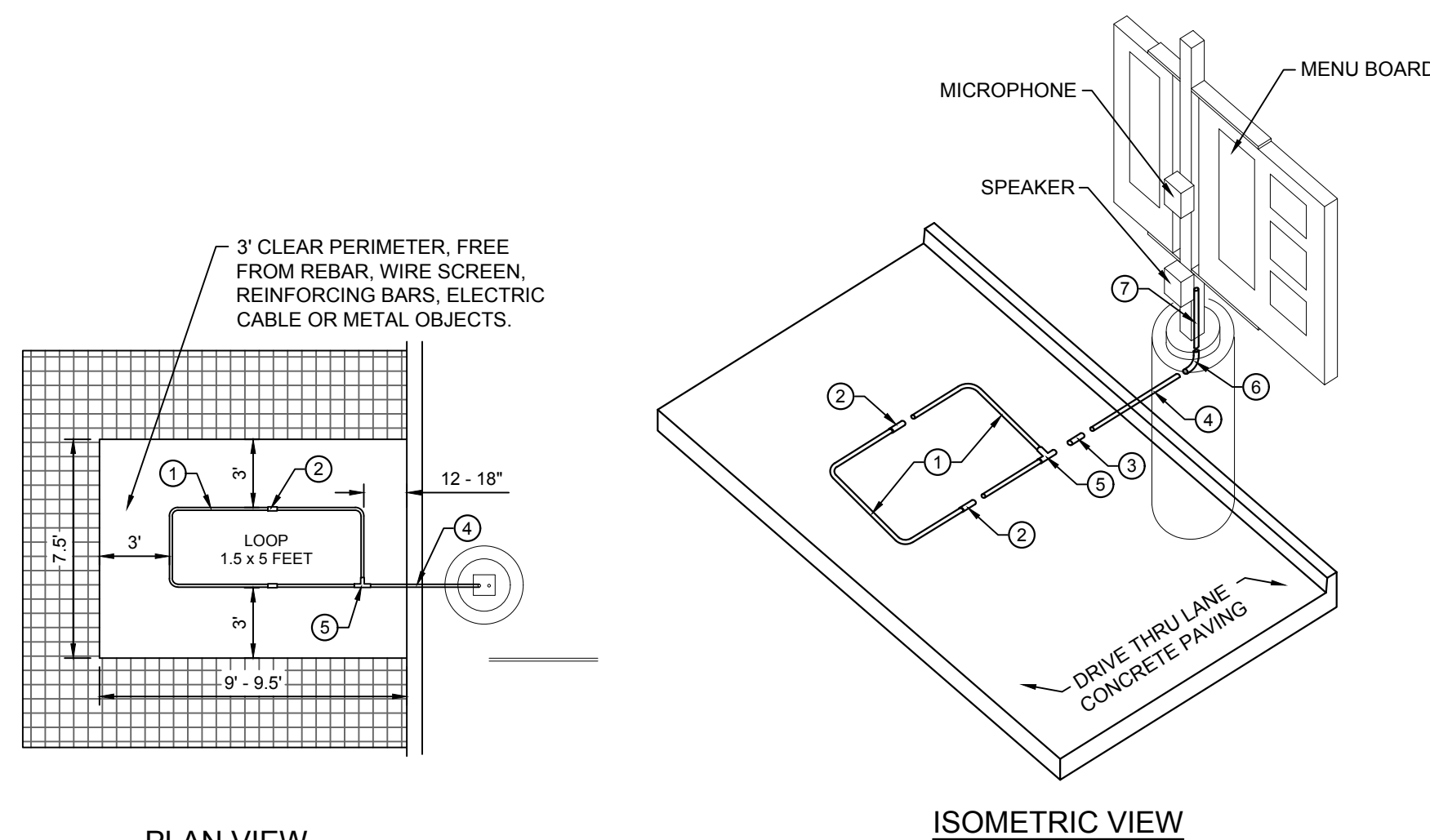
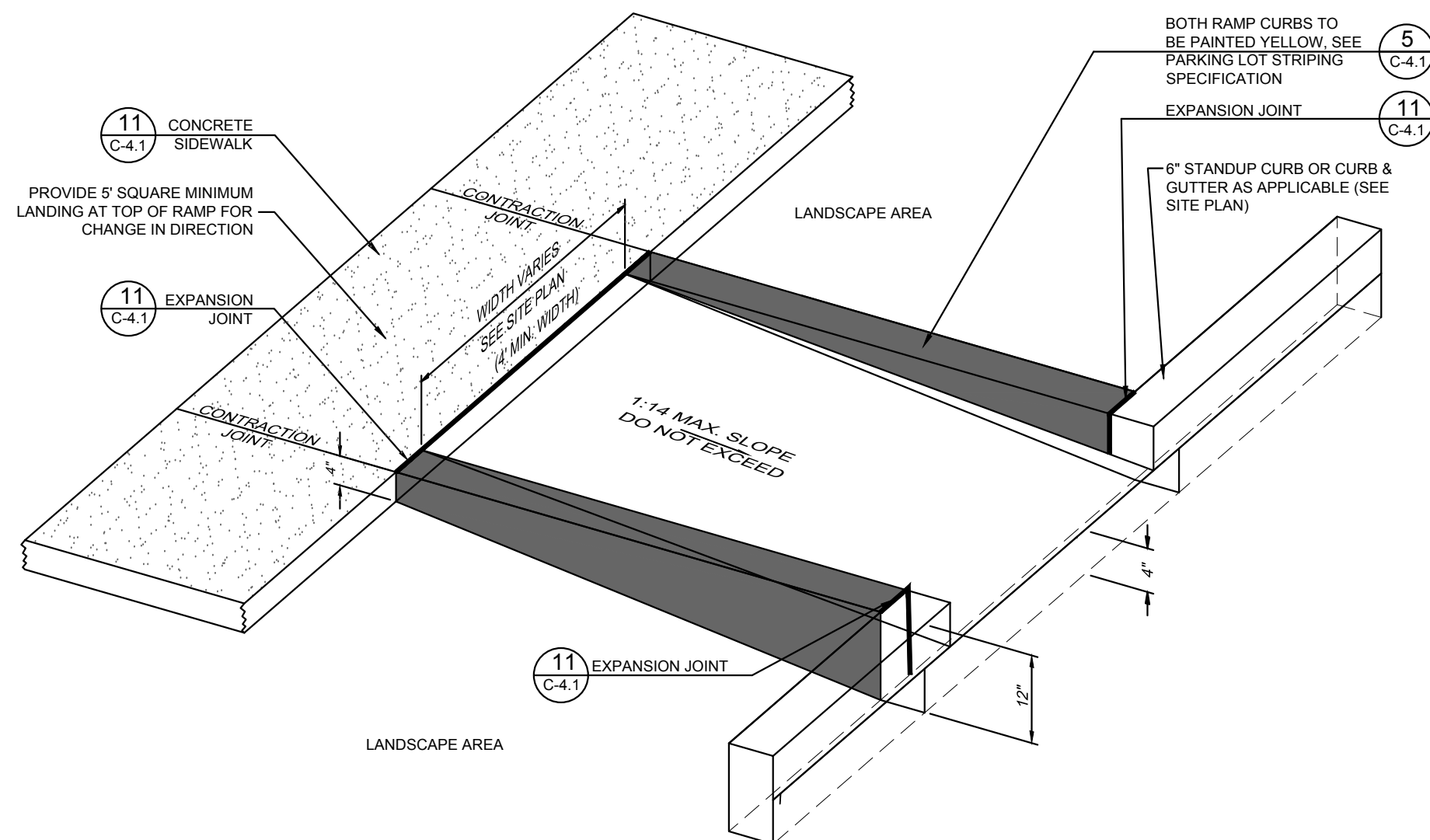
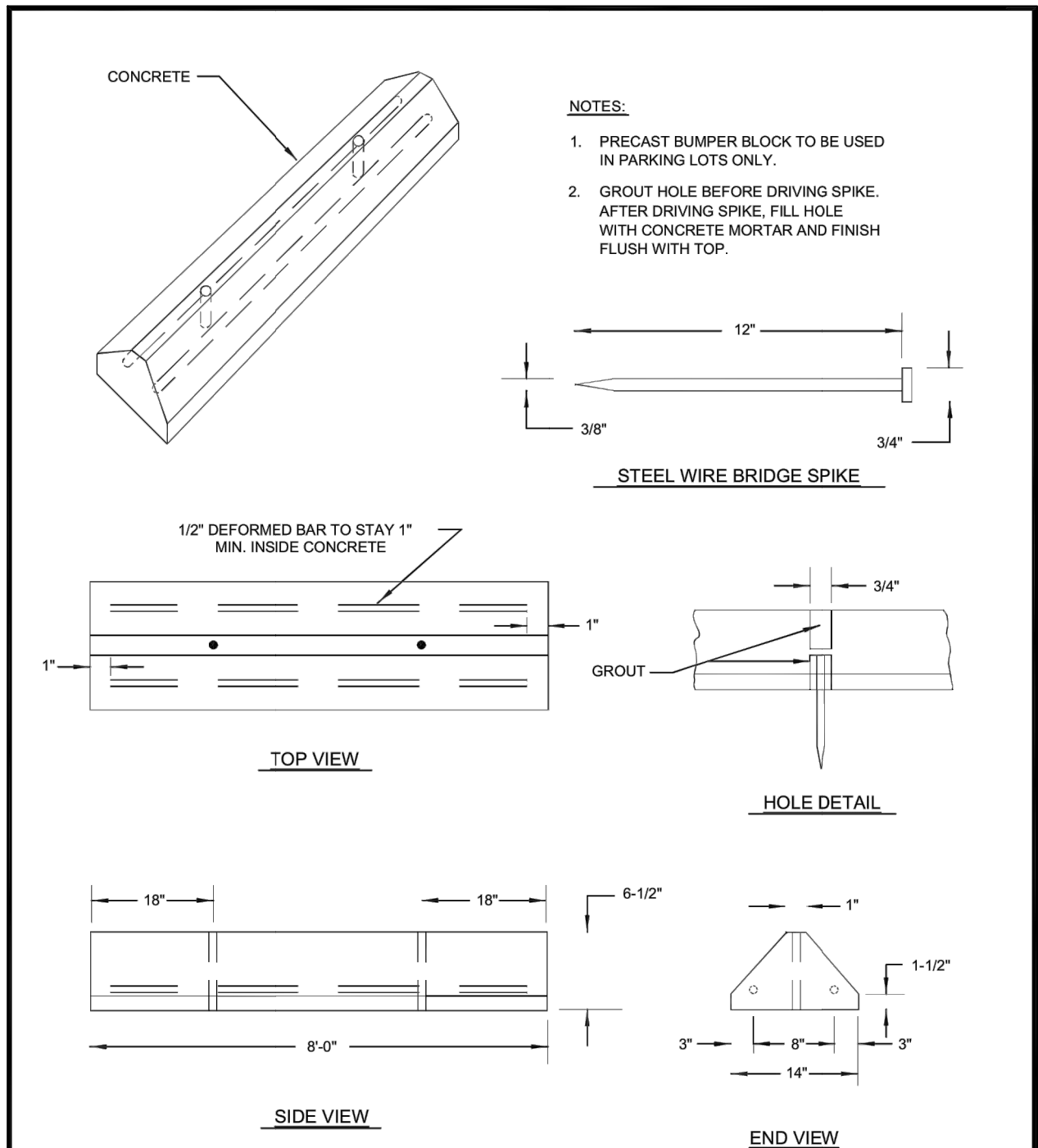
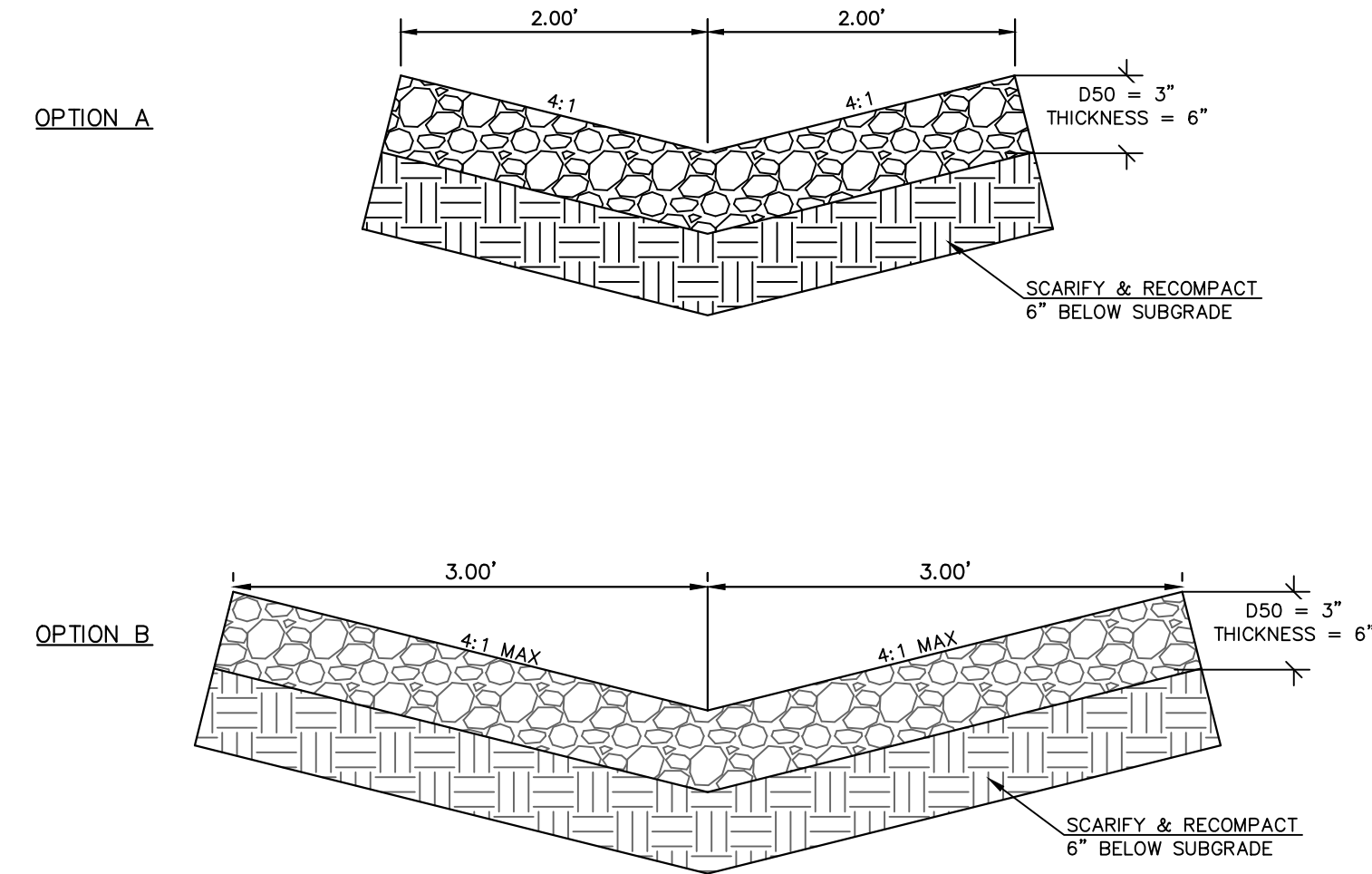
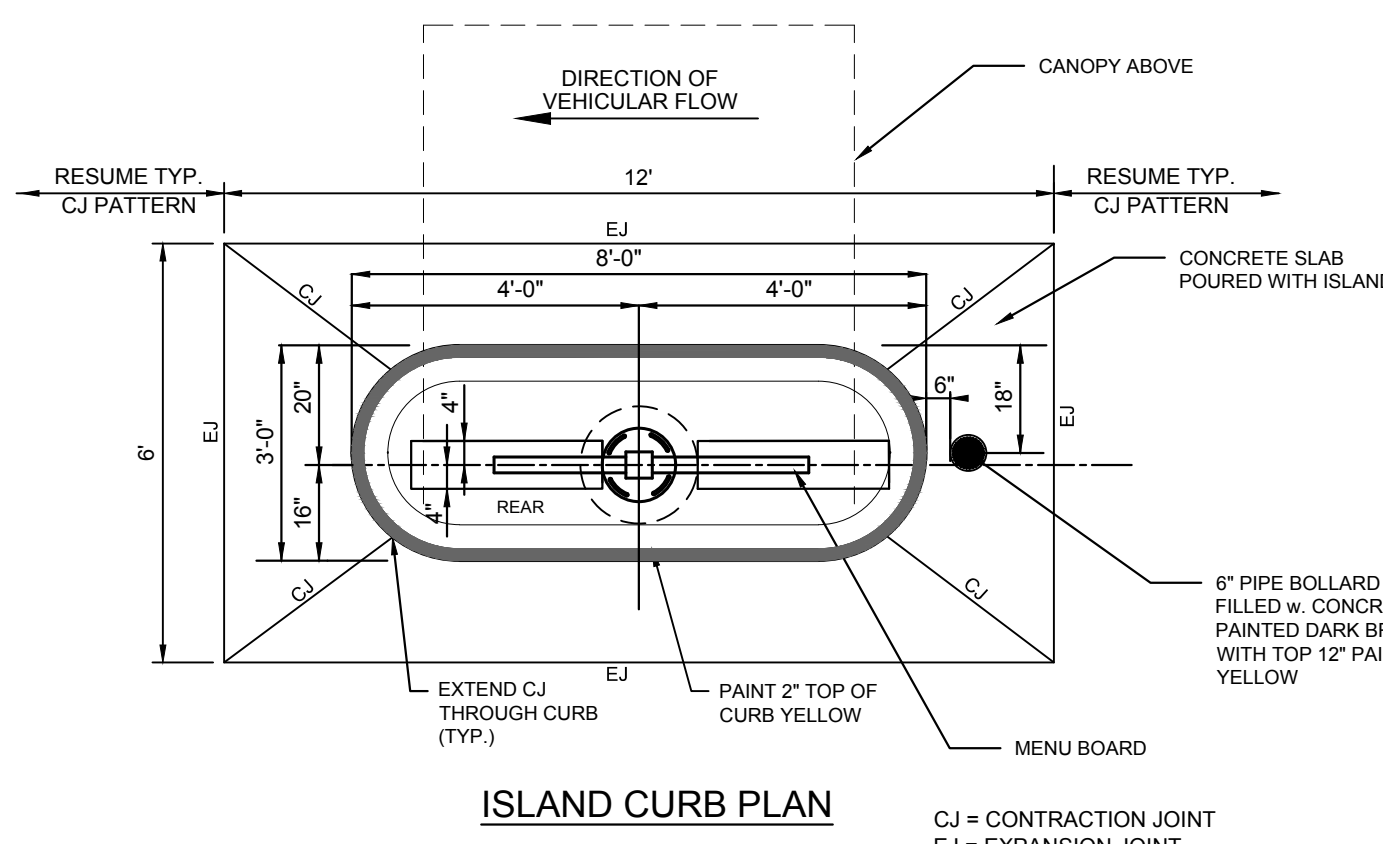
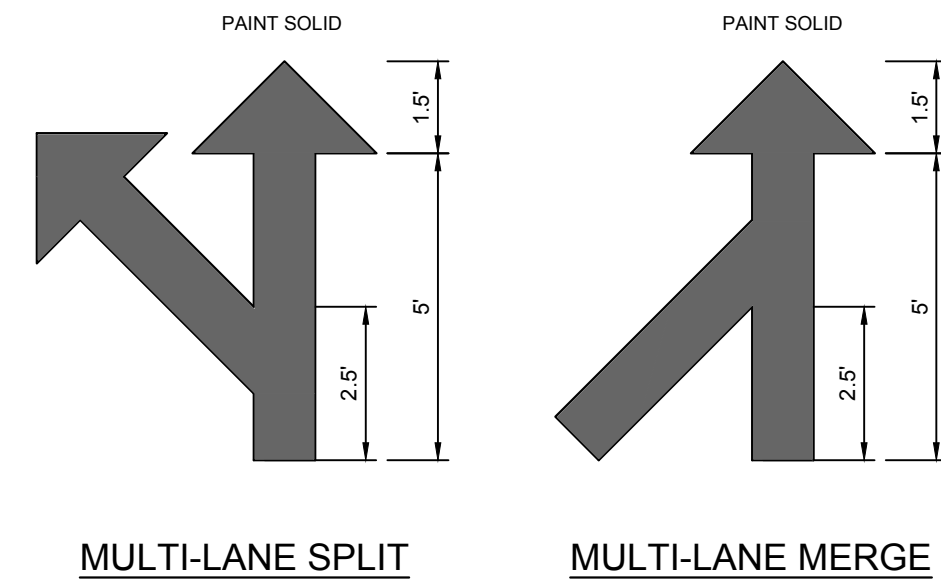
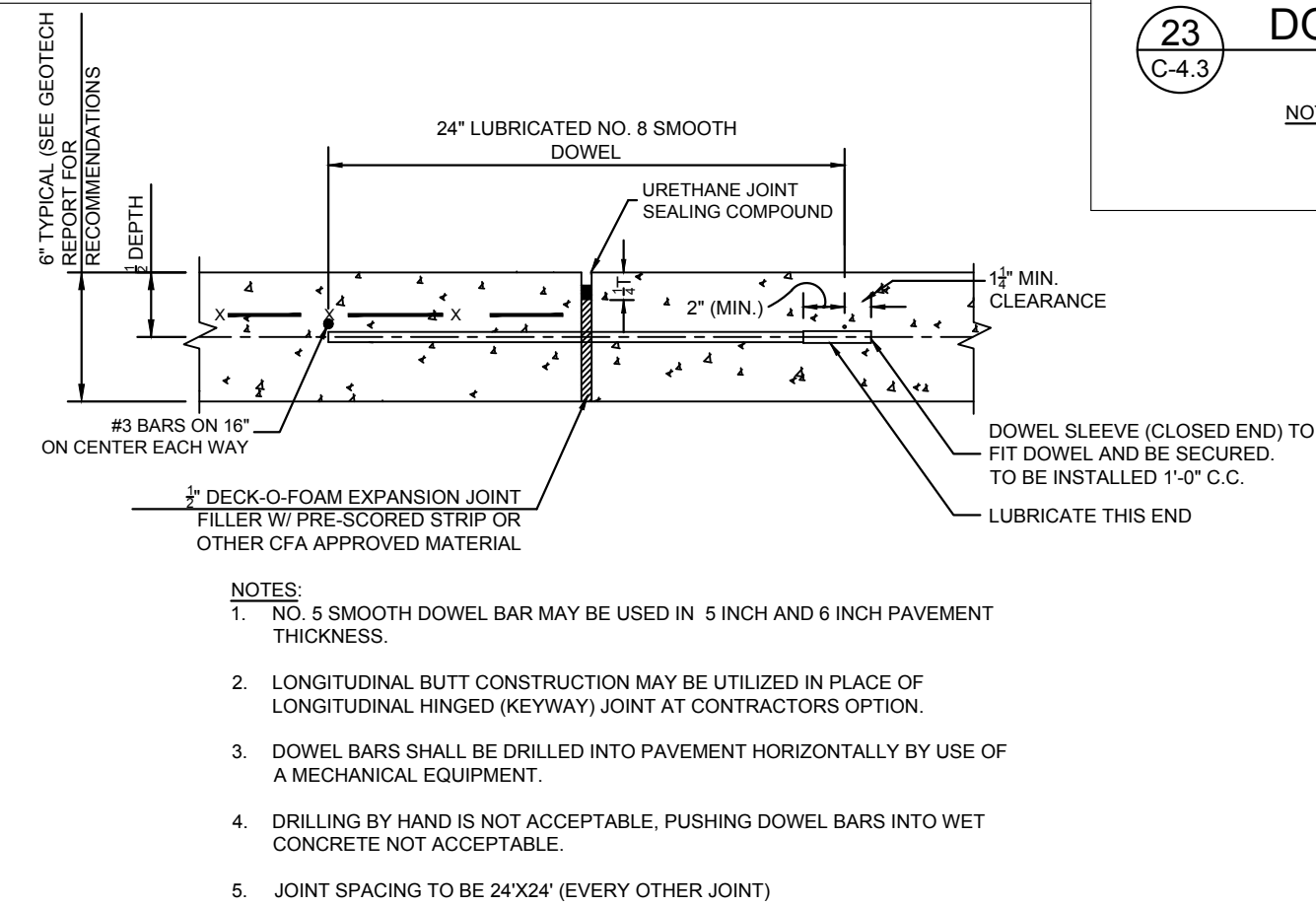
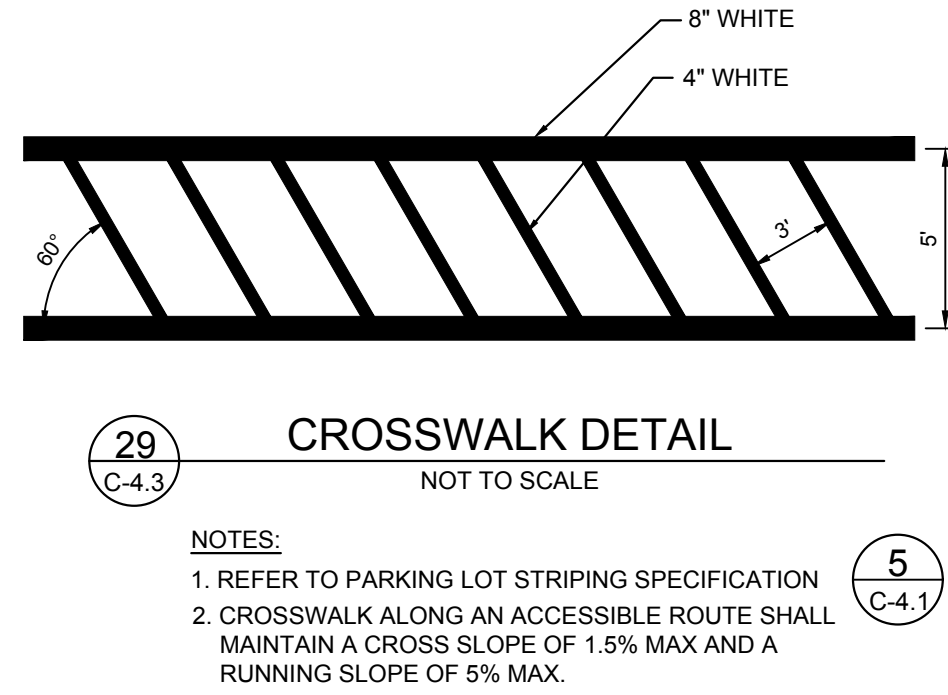
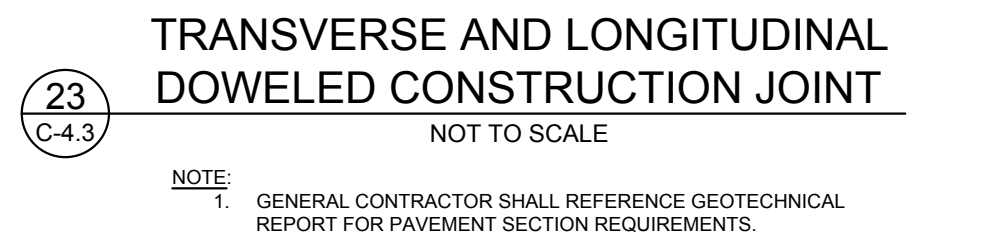
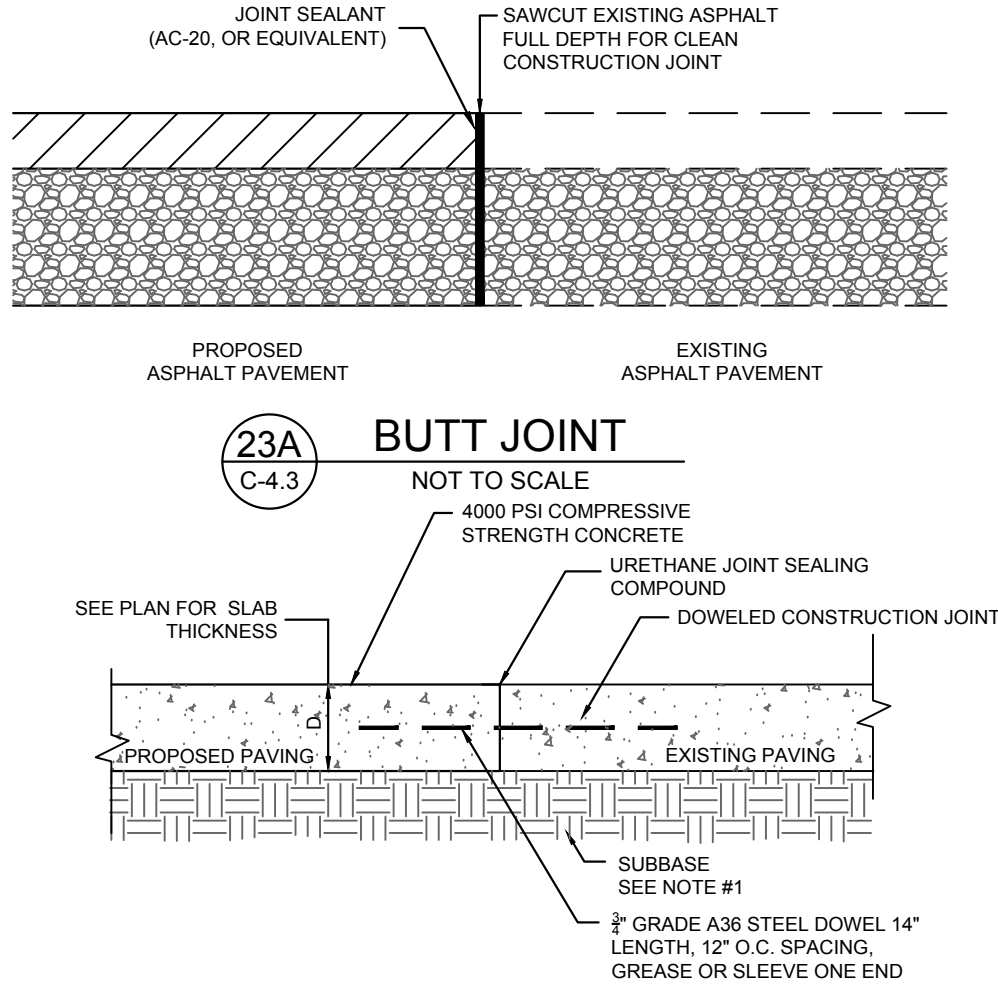
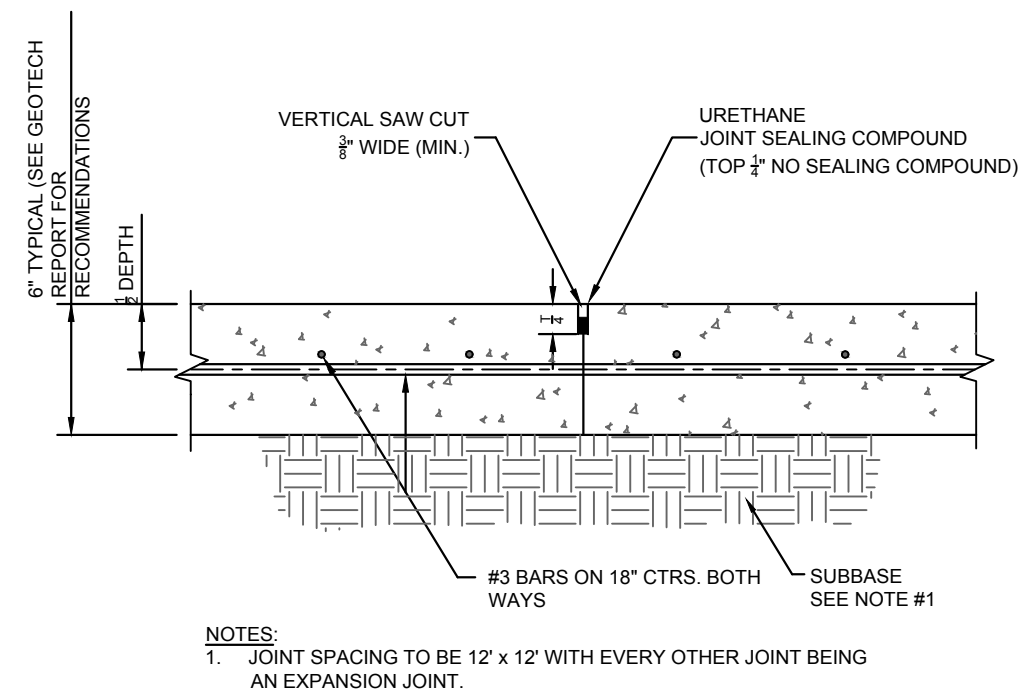
CHICK-FIL-A
CHARLESTON & FT. APACHE
8975 W CHARLESTON BLVD
LAS VEGAS, NV 89117

FSR# 4293
REVISION SCHEDULE
NO. DATE DESCRIPTION

AGENCY # TBD
PROJECT # 092908012
PRINTED FOR DRAINAGE
DATE 02/14/19
DESIGN BY JZ
DRAWN BY CT
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SHEET
TYPICAL DETAILS 2

SHEET NUMBER
CLV #: TBD
H #: TBD
C4.2

K:\A\A_Civil\090808012-Chick-fil-A-Charleston - Foot Apache.dwg 04/20/2019 12:07 PM Sheet No. C-4.3 Saved by: clark\jator Friday, February 01, 2019 9:44 AM Printed by: Zho, Juyim February 14, 2019 9:44 AM



		AGENCY APPROVED		B	C	H	L	M	N
SPECIFICATION REFERENCE		UNIFORM STANDARD DRAWINGS CLARK COUNTY AREA							
501	CONCRETE	PRECAST BUMPER BLOCK							
505	REINFORCING STEEL								
</									