

DS #: 05259

APN: 137.22.000-017

PROJECT: Summit West 4125 Zone North Reservoir

SUBMITTAL: 1st

SCANNED BY/DATE:

CHECKED BY/DATE:



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		March 31, 2020
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT: Drainage Study for: Summerlin West 4125 Zone North Reservoir		COPIES TO: Atkins
Cross Streets:	West of Lake Mead Blvd. & Park Drift Trail	Howard Hughes Properties Inc.
File Number:	F:\Depot\DSMemos\DS5259A.doc	Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-017	
Zoning Action:	CRG-78427	
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	3/5/2020	3/31/2020	See Comments Below	\$400.00	3770635: \$400
			TOTAL FEES (LDDRS):	\$400.00	----

REMARKS:

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

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

1. Provide a copy of the zoning/planning conditions associated with this site (**CRG-78427**) with the next submittal to verify compliance with conditions. *Flood Control* will not issue conditional approval of the drainage study without the associated zoning/planning conditions (issued by the *City Council*). Any associated conditions of approval that revise the site drainage parameters will require that the drainage study be revised and resubmitted.
2. Sites with a grade difference of 2 feet above or below existing are required to have approval from the *City Planning and Development Department*. The engineer must submit copies of the grading plans and detail sheet with a letter justifying the grade difference to the *City Planning Department* (229-6301). The engineer must provide Planning approval with the next submittal.
3. Address at the northeast corner of the site, whether there is any wall opening for emergency overflow path in case the proposed drop inlet is totally clogged in the next submittal.
4. Provide a note on the grading plan that states: All offsite berms/swales are owned and to be privately maintained by *Howard Hughes Corporation*.

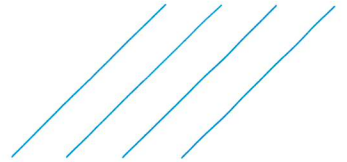
NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained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

ays

T/R/S: T20S/R59E/22

AREA K-22



TRANSMITTAL

Date: March 5, 2020

Job No.: 100065611

To:

Albert Sung
City of Las Vegas Public Works
333 N. Rancho Dr, 7th floor
Las Vegas, NV 89106

Regarding:

Summerlin West 4125 Zone North Reservoir
Technical Drainage Study

Transmitted:

- ☐ Via Overnight
☒ Via Delivery
☐ Via Mail

For:

- ☐ Approval
☒ Review/Comment
☐ Your Use

- ☐ Information
☐ Return after Use
☐ Per your request

The Following:

- 1 x Technical Drainage Study

Comments:

If you have any questions, please contact me at Vance.Skidmore@atkinsglobal.com.

Thank You.

From:

Vance Skidmore, PE
Senior Engineer

(For Deliveries Only)

Received By: _____

_____ Date

TDS for Summerlin West

4125 Zone North Reservoir

Prepared for the Howard Hughes Company, LLC

March 2020

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: TDS for Summerlin 4125 Reservoir Date: 03/04/2020

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

East/West: Lake Mead Blvd

b) Section: 16 & 21 Township: 20S Range: 59E

c) APN : 137-21-101-002

Name of Owner: Howard Hughes Company, LLC

Telephone No.: (702) 791-4000 Fax No.: (702) 791-4450 E-Mail Address: chris.anderson@howardhughes.com

Address: 10845 Griffith Peak Drive, Ste 160, Las Vegas, NV 89135

Contact Person-Name: Vance Skidmore, PE Telephone No.: 702-551-0309

* E-Mail Address: vance.skidmore@atkinsglobal.com Fax No.: _____

Firm: Atkins

Address: 2270 Corporate Circle, Ste 200, Henderson, NV 89074

Type of Land Development/Land Disturbance Process:

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

1. Total Owned Land Area: At Site: +/- 2006 acres Being Developed/Disturbed: +/- 6 acres

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

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

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

5. Approximate upstream land area which drains to the subject site: 6.8 square miles

6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Summerlin West Village 30A Rough Grade Technical Drainage Memo

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: There are three discharge points: 1 - A storm drain out to the existing wash north of the reservoir project site, 2 - A channel discharging to roughly the same location, and 3 - Flow running off onto the rough-grade access road

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

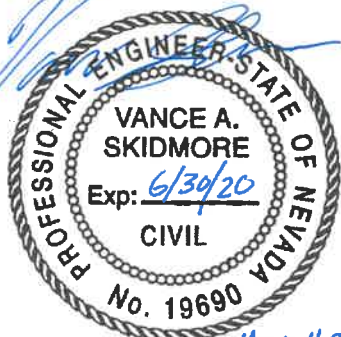
Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

***New Required Field**

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

Revision	Date

Local Entity File No. _____



Engineer's Seal

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: Summerlin West Zone 4125 Reservoir

Map ID:

Firm Name: **Atkins**

Engineer: Vance Skidmore

Address: 2270 Corporate Circle, Ste 200

City: **Henderson**

State:

NV

Zip: **89074**

Phone Number: (702) 551-0309

Fax Number: **(702) 263-7200**

Property Owner: **Howard Hughes Company, LLC**

Address: 10845 Griffith Peak Drive, Ste 160

City: **Las Vegas**

State: **NV**

Zip: **89135**

Reviewed By:

Date Received:

Date Accepted for Review:

The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL).

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

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

I. GENERAL REQUIREMENT

Yes

No

☒

☐

Design Manual **Standard Form 1** with the engineer's seal and signature.

☒

☐

Design Manual **Standard Form 4**.

☒

☐

2 copies of the 24" x 36" Drainage Plan.

☐ **N/A**

A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

II. MAPS AND EXHIBITS

Yes

No

☒

☐

A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.

☒

☐

A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes	No	
<u>X</u>	<u> </u>	Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.
<u>X</u>	<u> </u>	On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs.
<u>X</u>	<u> </u>	Vicinity Map with local and major cross streets identified and a north arrow.

III. DRAINAGE PLAN

Yes	No	
<u>X</u>	<u> </u>	Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.
<u>X</u>	<u> </u>	Minimum scale: 1" = 60'.
<u>X</u>	<u> </u>	Project name.
<u>X</u>	<u> </u>	Vicinity Map with local and major cross streets.
<u>X</u>	<u> </u>	Revision box.
<u>X</u>	<u> </u>	North arrow and bar scale.
<u>X</u>	<u> </u>	Engineer's/consultant's address and phone number.
<u>X</u>	<u> </u>	Elevation datum and benchmark.
<u>X</u>	<u> </u>	Legend for symbols and abbreviations.
<u>X</u>	<u> </u>	Cut/fill scarps, where applicable.
<u>X</u>	<u> </u>	Street names, grades, widths.
<u>X</u>	<u> </u>	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.
<u>X</u>	<u> </u>	Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.
<u>X</u>	<u> </u>	Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
<u>X</u>	<u> </u>	Proposed typical street sections.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
<u> </u>	<u>N/A</u>	Streets with off-set crowns.
<u>X</u>	<u> </u>	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
<u>X</u>	<u> </u>	Property lines.
<u> </u>	<u>N/A</u>	Right-of-way lines and widths, existing and proposed.
<u>X</u>	<u> </u>	Existing improvements and their elevations.
<u>X</u>	<u> </u>	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
<u> </u>	<u>N/A</u>	Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets.
<u> </u>	<u>N/A</u>	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
<u> </u>	<u>N/A</u>	Location and cross-section of street capacity calculations.
<u>X</u>	<u> </u>	Cross-sectional detail for channels, including cutoff wall locations.
<u>X</u>	<u> </u>	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations.
<u>X</u>	<u> </u>	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
<u> </u>	<u>N/A</u>	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.
<u> </u>	<u>N/A</u>	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
<u> </u>	<u>N/A</u>	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
<u>X</u>	<u> </u>	Building and/or lot numbers.
<u> </u>	<u>N/A</u>	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
<u>X</u>	<u> </u>	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
☐	☐ N/A	For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE.
☐	☐ N/A	Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.
☒	☐	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
☐	☐ N/A	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes	No	
☒	☐	Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
☒	☐	Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒	☐	Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒	☐	Use of correct precipitation values in and around the McCarran Airport rainfall area.
☒	☐	A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
☒	☐	A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.
☒	☐	Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
☒	☐	On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
☐	☐ N/A	Calculation for impervious area for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes	No	
☐	☐ N/A	Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
☐	☐ N/A	Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q_{100} and Q_{10} flows representing the worst case for interior and all perimeter streets. $Q_{100} d \times v \leq 8$. $Q_{10} d \times v \leq 6$ and 12 foot dry lane for rights-of-way ≥ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
☐	☐ N/A	A summary table of interior and exterior street capacity calculations showing the street name, Q_{100} flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
☐	☐ N/A	Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)
☐	☐ N/A	Appropriate hydraulic calculations at drainage easement entrance and discharge locations to set finish floor elevations. Hydraulic calculations must include submerged weir, superelevation and tee intersection losses, where appropriate.
☒	☐	Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q_{100} weir height or flow depth, whichever is greater.
☐	☐ N/A	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
☒	☐	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
☒	☐	Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.
☒	☐	The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
☐	☐ N/A	Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2

Engineer's Certification

Atkins certifies that the information contained herein has been prepared in accordance with generally accepted engineering principles and practices, and to the best of our knowledge, is true and correct.

This letter certifies that all items in the **Technical Drainage Study for 4125 Zone North Reservoir** electronic submittal matches the paper version bound into the study.



Vance Skidmore, PE

Senior Engineer

Table of Contents

Section	Page
1. Introduction	1
1.1. Purpose	1
1.2. FEMA Floodplain Status	1
1.3. Clark County Regional Flood Control Facilities and Map	1
1.4. Drainage Plan	1
1.5. Design Criteria	1
2. Hydrologic Analysis	7
2.1. Hydrologic Methodology	7
2.2. Existing Condition	9
2.3. Interim Condition	9
2.4. Ultimate Condition	12
3. Hydraulic Analysis	14
3.1. Channel Calculations	15
3.2. Riprap	15
3.3. Drop Inlet Calculations	16
3.4. Storm Drain Calculations	16
4. Conclusion	18

Tables

Table 1: Curve Number Selections	8
Table 2: Ultimate Condition Hydrologic Model Results	10
Table 3: Proposed Facilities	14
Table 4: Riprap Locations and Sizing	15

Figures

Figure 1	Vicinity Map	2
Figure 2	Effective FEMA Map	3
Figure 3	CCRFGD Master Plan Update Facility Inventory Map	4
Figure 4	CCRFGD Master Plan Update Facility Inventory Table	5
Figure 5	CCRFGD Master Plan Update Hydrologic Summary Map	6
Figure 6	Interim Condition Hydrology Map	11
Figure 7	Ultimate Condition Land Use	13
Figure 8	Hydraulic Analysis Work Map	17

List of Appendices

Appendix A-1	Hydrologic Parameters and Model Results
Appendix A-2	Reference Material
Appendix B	Hydraulic Model Results
Appendix C	Electronic CD

1. Introduction

1.1. Purpose

This Technical Drainage Study (TDS), prepared on behalf of the Howard Hughes Company, LLC (HHC), represents the hydrologic and hydraulic analyses for the 4125 Zone North Reservoir of the Summerlin West development. Summerlin West is located in the northwest Las Vegas Valley and is bound by Charleston Boulevard and Cheyenne Avenue, CC-215 to the east, and BLM land to the west. The 5.6+/- acre reservoir parcel is located on a portion of APN 137-21-101-002 adjacent to the future extension of Lake Mead Boulevard approximately 1.4 miles northwest of the existing 4125 Pump Station. The design and construction of the Reservoir is being completed by HHC (Atkins). The Las Vegas Valley Water District (LVVWD) will oversee construction of the reservoir as the facilities, land and associated easements will eventually be dedicated and deeded to LVVWD. A vicinity map is provided in **Figure 1**. The 4125 Zone North Reservoir development is located northeast of the intersection of Lake Mead Blvd and Street Z.

1.2. FEMA Floodplain Status

Figure 2 is a reproduction of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Clark County (Community Number 32003C), panel 2125E, dated September 27, 2002. As shown on **Figure 2**, the project site lies within a FEMA designated unshaded Zone X Flood Zone. Areas in an unshaded Zone X Flood Zone are defined as being outside the 500-year flood.

1.3. Clark County Regional Flood Control Facilities and Map

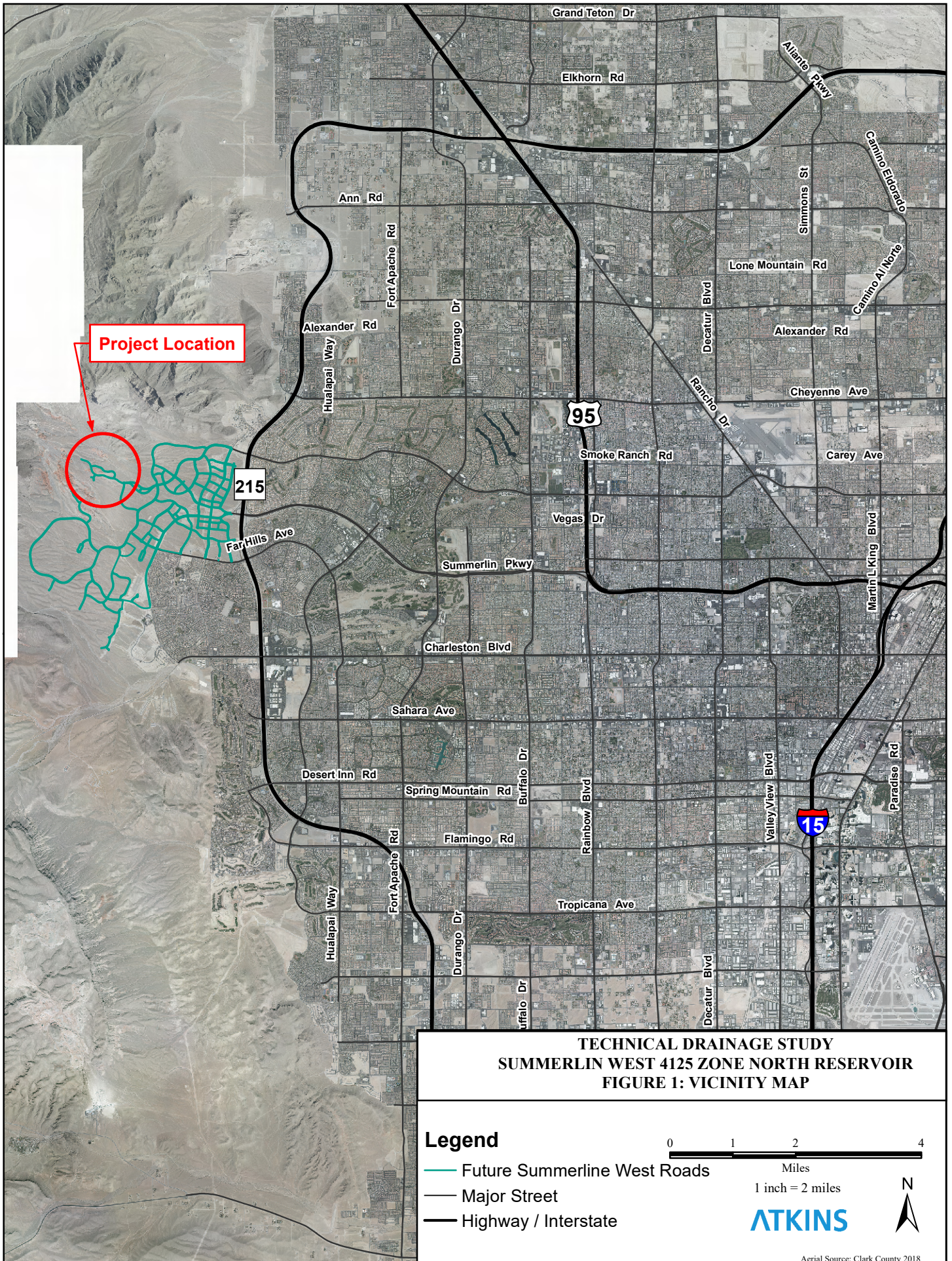
Figure 3 and 4 are a reproduction of Figure F-22 and the associated facilities summary table from the 2018 Las Vegas Valley Flood Control Master Plan Update (MPU). **Figure 5** is watershed map printed from the CCRFCD website on February 26, 2020. As shown on **Figure 3**, there are no existing or proposed CCRFCD Facilities adjacent to the project site.

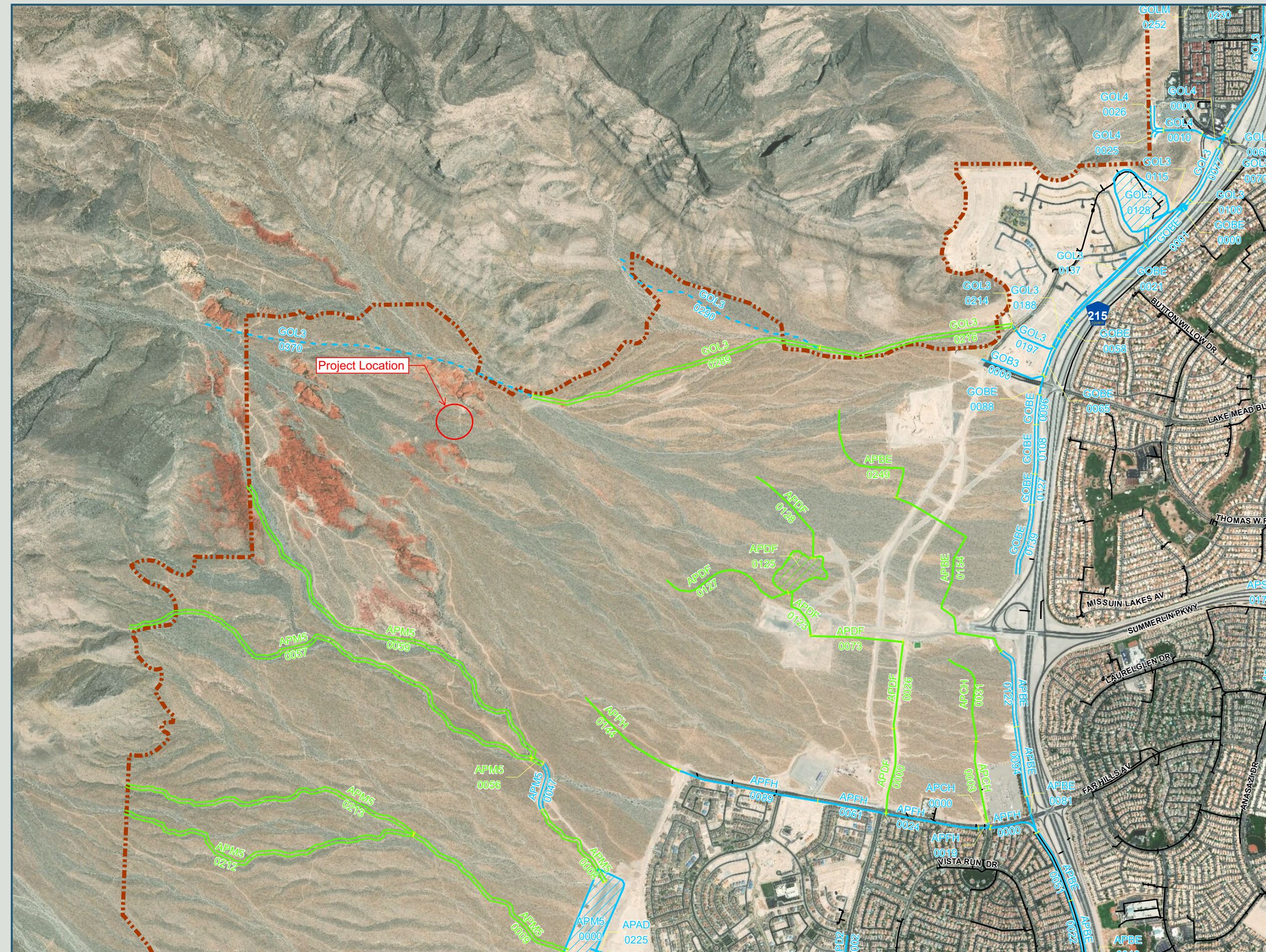
1.4. Drainage Plan

The drainage plan for the 4125 Zone North Reservoir site considers the ultimate grading of the site and all proposed channels, inlets, and storm drains for the ultimate onsite condition. The offsite areas will remain unchanged from the interim condition described in the Village 30A Rough Grade Technical Drainage Memo. Grading plans and details are included in **Appendix C**.

1.5. Design Criteria

This Technical Drainage Study is prepared to comply with criteria set forth in the Hydrologic Criteria and Drainage Design Manual (Design Manual) as required by the City of Las Vegas.





2018
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

**FIGURE F-22
FLOOD CONTROL FACILITIES**

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



Scale: 1 inch = 2,000 feet
AerialSource: Esri World Imagery 2017

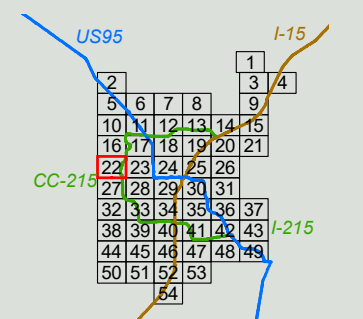


Figure 3: 2018 CCRFCD Master Plan Update Facility Inventory Map

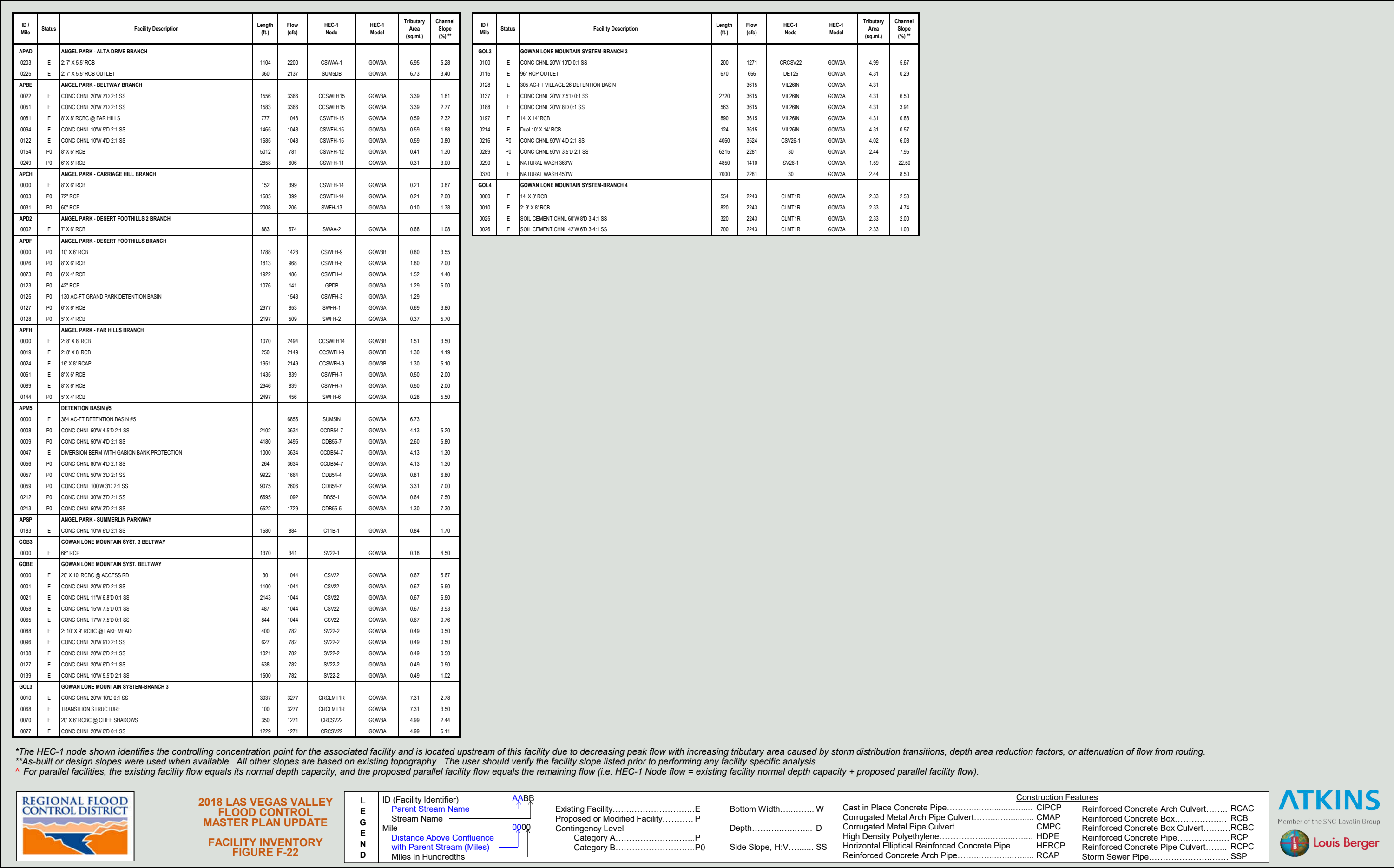
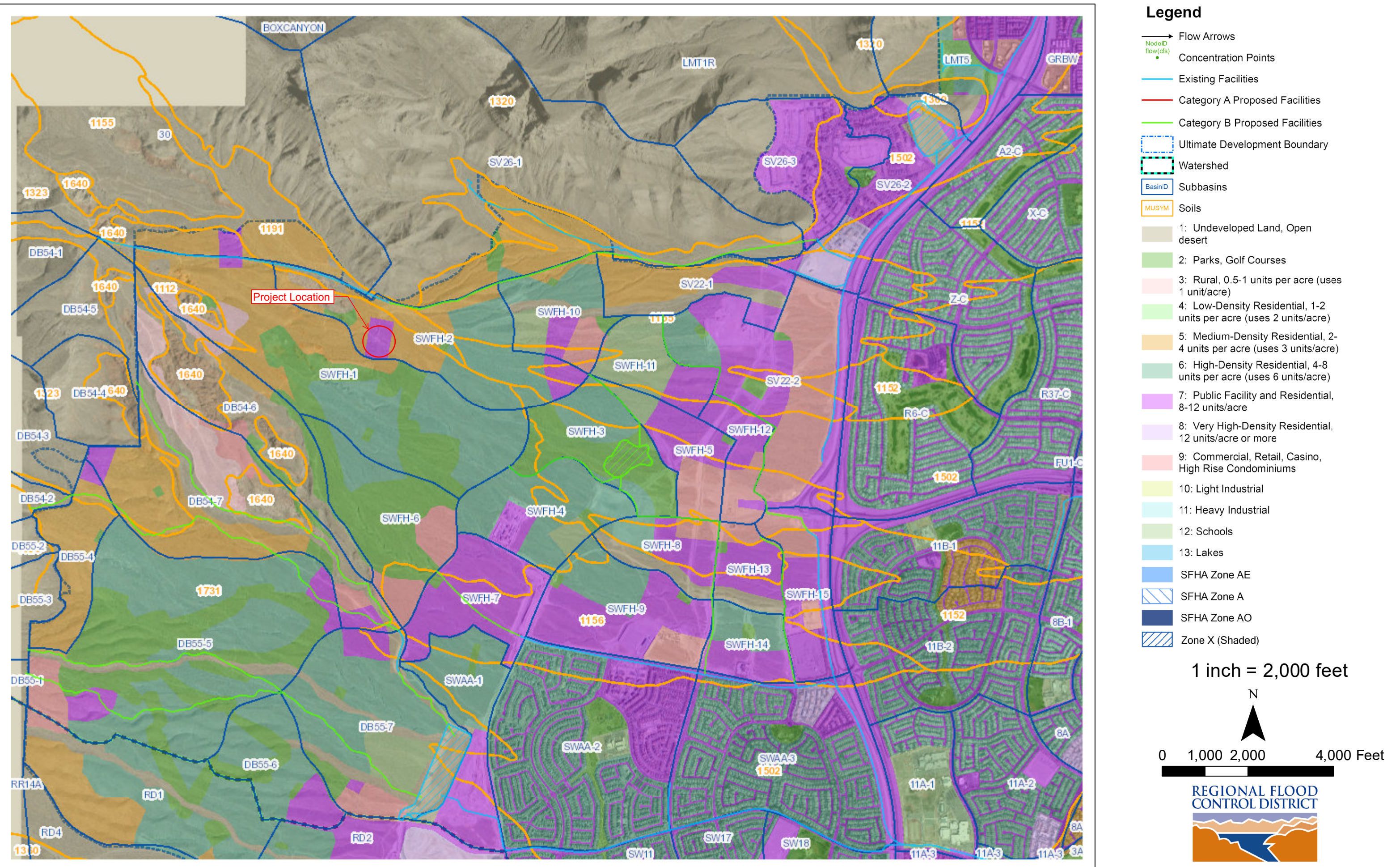


Figure 5 Watershed Map



2. Hydrologic Analysis

2.1. Hydrologic Methodology

2.1.1. Modeling

The SCS Unit Hydrograph Method (SCS Method) was utilized to determine peak flow rates. The SCS Method utilizes precipitation, drainage area, curve number, and lag time parameters to determine peak flow rates. The SCS Method is recommended for the Clark County area per the Design Manual. HEC-1 was used to develop rainfall excess for the project area.

2.1.2. Design Storm

The hydrologic analysis was performed for both the 10-year and 100-year, 6-hour storm events.

2.1.3. Precipitation Depths

All subbasins contributing runoff to the project site are outside the McCarran Airport rainfall area as defined in the Design Manual, and therefore, require only the 10-year and 100-year 6-hour rainfall depths which are 1.984 and 3.575 inches, respectively for all subbasins. The depths were determined by identifying the site locations on Figure 503 and Figure 506 from the Design Manual. The associated rainfall depths were then multiplied by the adjustment factors from Table 501 from the Design Manual. The resulting rainfall depths were input into the HEC-1 model along with a SDN 3 storm distribution and depth-area reduction factors (DARF) of 1.000 and 0.555, see below. The rainfall calculations and associated reference material is included in **Appendix A**.

2.1.4. Storm Distribution

The rainfall depths discussed in the previous section were distributed over the 6-hour design storm period using the SDN 3 storm distribution. According to established CCRFCD methodology, SDN 3 is used for drainage areas less than eight square miles. All combination points and subbasins have a tributary area less than eight square miles.

2.1.5. Depth-Area Reduction Factors

Six-hour DARFs from Table 502 in the Design Manual were applied to the rainfall depths in the HEC-1 model at each subbasin and concentration point based on upstream tributary area. Because the 4125 Zone North Reservoir site is smaller than 0.25 square miles, a DARF of 1.00 was used for each tributary area. A DARF of 0.555 was used to simulate the 10-year storm based on the precipitation depth ratio between the 10 and 100-year storms.

2.1.6. Lag Time

The lag time is defined as the time measured from the center of mass of effective rainfall to the time to peak of the outfall hydrograph. The lag time is related to the time of concentration as 0.6 times the time of concentration. The time of concentration is defined as the time required for runoff to flow from the hydraulically most distant point of a basin to the outlet point of the basin. Standard Form 4, as outlined in the Design Manual, has been utilized to determine the lag times for the basins modelled. The lag time computations have been included in **Appendix A**.

2.1.7. Land Use, Soils, and Curve Number Selection

Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the National Resource Conservation Service (NRCS) curve number (CN) method described in the Design Manual. The curve number method is a function of soil type, land cover, and antecedent moisture condition. Based on the Design Manual, the average antecedent moisture condition (AMC II) is used for computing losses.

Land use for the 4125 Zone North Reservoir site is considered Land Use 10 (Light Industrial). Surrounding areas include rough-grade roadways and undeveloped land. The land use for the project area is shown on **Figure A of Appendix A**.

Soils data used for the site comes from soil survey dated from the NRCS dated 2014. This soils data was used to be consistent with the 2018 Las Vegas Valley MPU. NRCS methodology divides soils into four hydrological groups, as defined below:

- A. High infiltration rate, low runoff potential
- B. Moderate infiltration rate, moderately low runoff potential
- C. Slow infiltration rate, moderately high runoff potential
- D. Very slow infiltration rate, high runoff potential

The entire 4125 Zone North Reservoir project area is located on a swath of group D soil, MUSYM 731. The soil group for the project area is shown on **Figure A of Appendix A** as well as **Figure 7**.

Curve numbers were selected from Table 602 in the Design Manual based off the criteria mentioned above and are summarized in **Table 1**.

Table 1: Curve Number Selections

Subbasin	Land Use	Hydrologic Soil Group	CN
INT-3/2	1 – Undeveloped Land / Open Desert	D	86
INT-3/1	1 – Undeveloped Land / Open Desert	D	86
INT-2/4	1 – Undeveloped Land / Open Desert	D	86
INT-2/3	10 - Light Industrial	D	93
INT-2/2	10 - Light Industrial	D	93
INT-1/2	10 - Light Industrial	D	93
INT-1/1	10 - Light Industrial	D	93

2.2. Existing Condition

The interim condition discussed in the Summerlin West Village 30A Rough Grade Technical Drainage Memo (Rough Grade TDM) will be the existing condition for this study. In this condition, one 6.8 sq. mi. subbasin was modelled over the project area which included the rough grade for various roadways as well as a berm located to the west of the proposed reservoir site. The berm redirects flow to the north, around the reservoir site and into an existing wash. The Rough Grade TDM contains figures depicting these features as well as the hydrologic analysis for this condition. Data from the HEC-RAS model used in the Rough Grade TDM is used in this study to quantify the peak flow from the tributary area upstream of the berm. The Rough Grade TDM and screenshots of the HEC-RAS model are attached in **Appendix A-2** along with its signed approval memorandum. The Rough Grade TDM is dated November 6, 2019 and was approved by the City of Las Vegas on November 21, 2019.

2.3. Interim Condition

In the interim condition all on-site grading and the construction of the reservoir will be completed. All areas adjacent to the project property will remain unchanged from the existing condition.

The 4125 Reservoir site is bound by a CMU wall on its west, north, and east sides which does not allow flow to pass through. The south side of the site will be fenced with tube-rail fencing and is bound by the proposed access road. Per the master planned community design criteria, flow will not overtop the main roadways. Results from the HEC-RAS model presented in the Rough Grade TDM are used for the 100-year flow for the basins upstream from the berm. Therefore, this analysis is limited to the area which is bound by the CMU wall and roadway, the undeveloped area between the berm and west face of the CMU wall, and the catchment area for the proposed channel on the outer north face of the CMU wall excluding the catchment area upstream of berm.

There are three main combination points in the ultimate condition, CP1 through CP3. CP1 is located in the northeast corner of the site and is the low point of the proposed grading and the CMU wall that bounds the site. Runoff is collected in a storm drain inlet located at CP1 and is routed to the existing wash to the north of the site via 18" RCP. On-site flows in this interim condition are being directed to the same wash as in the existing condition; therefore, additional analysis of downstream subbasins is not necessary.

CP2 is located near the southeastern corner of the site in the gutter of the proposed access road. The tributary area for CP2 is the area which drains to the proposed access road and contains both on and offsite subbasins. CP2 also contains the reservoir overflow vault. The proposed reservoir has the potential to overflow at a maximum rate of 30 cfs. This has been accounted for with node INT-2/1. In the unlikely event that the reservoir overflows, this flow will also be routed to the proposed access road south of the site. For the purposes of this study, the access road being shown in the accompanying grading plans reflects subgrade. Ultimate road design and capacity calculations will be included in a future TDS and plans prepared by others.

CP3 is located outside the northeast corner of the site. CP3 is where most offsite flow concentrates before entering the existing wash to the north of the site.

As found in the HEC-RAS model presented in the Rough Grade TDM, the 100-year flow from the catchment area west of the berm is 70.45 cfs. The 10-year flow from the berm is assumed to be 29.8 cfs. Screenshots from the HEC-RAS model can be found in **Appendix A-2**.

Each concentration point is further subdivided into subbasins for onsite analysis. The subbasin naming convention corresponds to the combination point naming convention in order to show which subbasins discharge to which combination point. The subbasins included in this study are depicted in **Figure 6**.

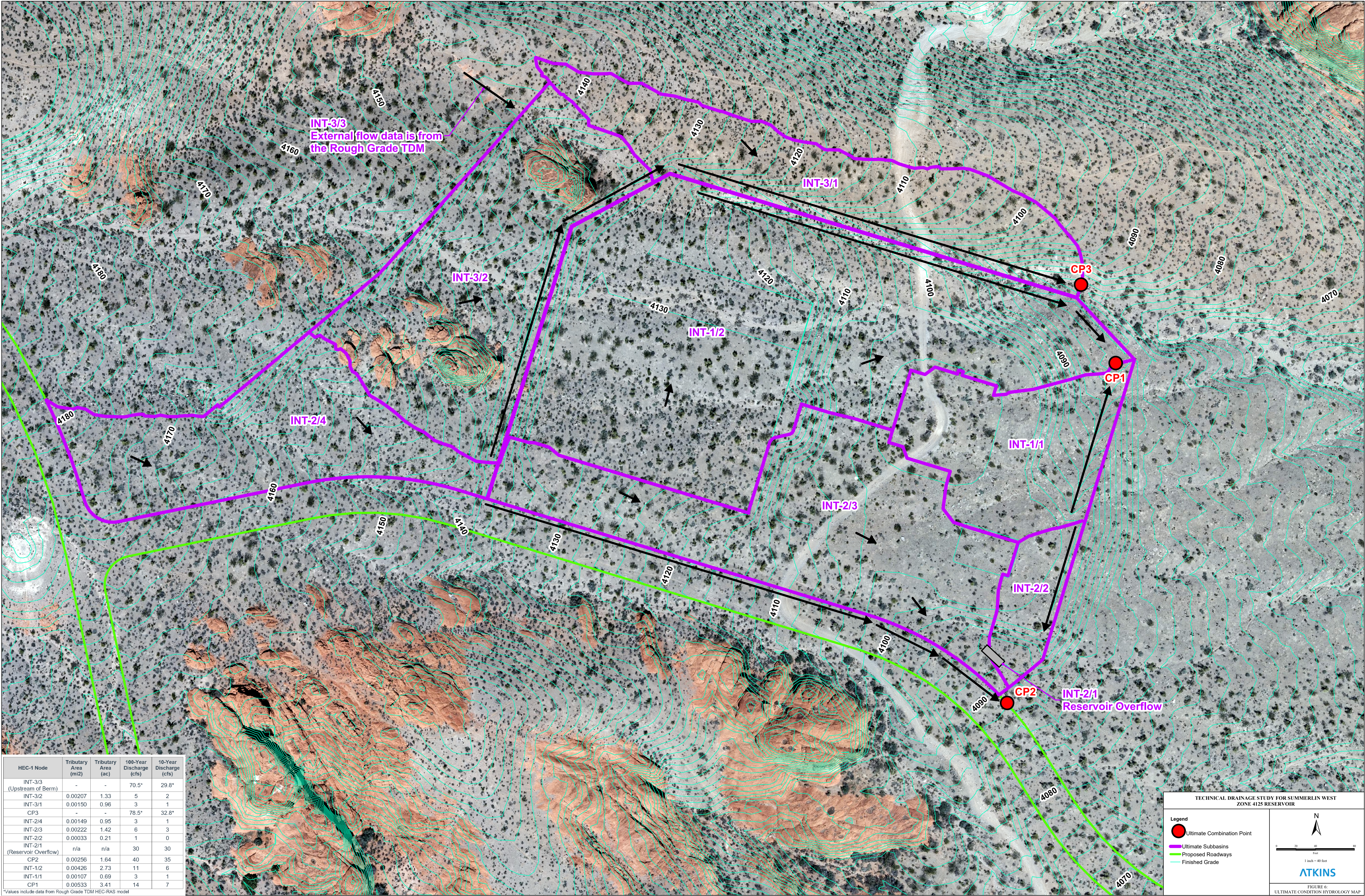
2.3.1. Hydrologic Modeling Results

The hydrologic analysis results are summarized below in **Table 2** and shown on **Figure 6**. Curve number selections, lag time calculations, and HEC-1 model outputs can be found in **Appendix A-1**.

Table 2: Ultimate Condition Hydrologic Model Results

HEC-1 Node	Tributary Area (mi ²)	Tributary Area (ac)	100-Year Discharge (cfs)	10-Year Discharge (cfs)
INT-3/3 (Upstream of Berm)	-	-	70.5*	29.8*
INT-3/2	0.00207	1.33	5	2
INT-3/1	0.00150	0.96	3	1
CP3	-	-	78.5*	32.8*
INT-2/4	0.00149	0.95	3	1
INT-2/3	0.00222	1.42	6	3
INT-2/2	0.00033	0.21	1	0
INT-2/1 (Reservoir Overflow)	n/a	n/a	30	30
CP2	0.00256	1.64	40	35
INT-1/2	0.00426	2.73	11	6
INT-1/1	0.00107	0.69	3	1
CP1	0.00533	3.41	14	7

*Values include data from Rough Grade TDM HEC-RAS model



2.4. Ultimate Condition

In the ultimate condition all on-site grading and drainage facilities will remain unchanged from the interim condition. Off-site areas will be fully developed per the master plan.

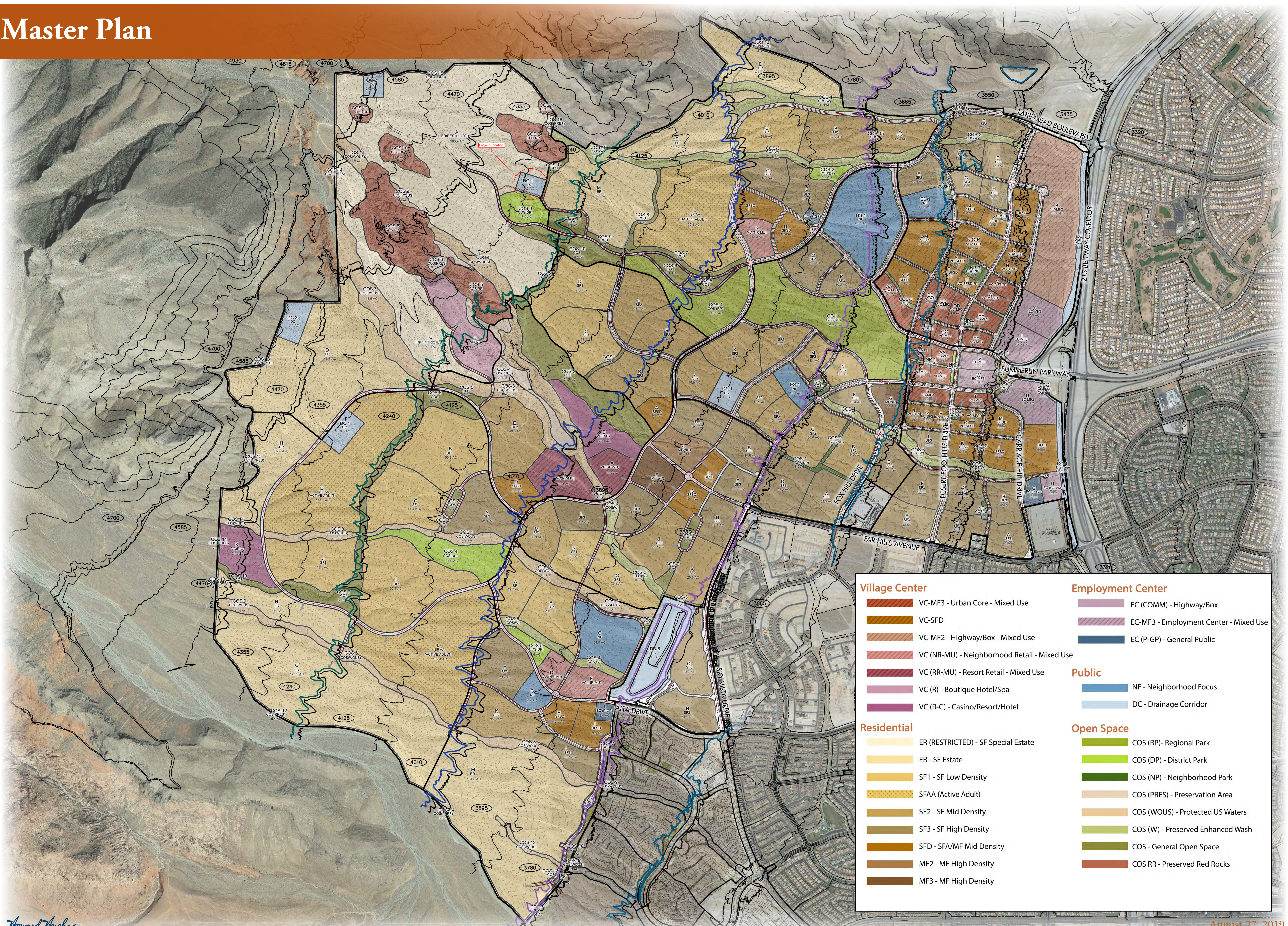
In this condition, the berm to the west of the reservoir site will be removed. The area to the west and upstream of the site will be developed as single-family special estates. Once developed, flows generated in this area will be collected in a future storm drain system before reaching the 4125 Reservoir site. Therefore, the off-site channels proposed in the interim condition will no longer be needed.

The areas to the east and down stream of the site will be developed as single-family estates. In order to avoid encumbering the ultimate developments, on-site flows collected at CP-1 will be rerouted to a future storm drain system.

Future storm drain systems will be designed by others when the adjacent roadways are constructed. The surrounding area, roadways, and storm drain will be part of the master planned system. The developer will submit a revised master drainage study for this area which will include the ultimate condition of the surrounding areas. This revised master drainage study will supersede any offsite drainage patterns depicted in this study.

The ultimate land use plan is presented in **Figure 7**.

Master Plan



Village Center

- VC-MF3 - Urban Core - Mixed Use
- VC-SFD
- VC-MF2 - Highway/Box - Mixed Use
- VC (NR-MU) - Neighborhood Retail - Mixed Use
- VC (RR-MU) - Resort Retail - Mixed Use
- VC (R) - Boutique Hotel/Spa
- VC (R-C) - Casino/Resort/Hotel

Employment Center

- EC (COMM) - Highway/Box
- EC-MF3 - Employment Center - Mixed Use
- EC (P-GP) - General Public

Public

- NF - Neighborhood Focus
- DC - Drainage Corridor

Open Space

- COS (RP) - Regional Park
- COS (DP) - District Park
- COS (NP) - Neighborhood Park
- COS (PRES) - Preservation Area
- COS (WOUS) - Protected US Waters
- COS (W) - Preserved Enhanced Wash
- COS - General Open Space
- COS RR - Preserved Red Rocks

Residential

- ER (RESTRICTED) - SF Special Estate
- ER - SF Estate
- SF1 - SF Low Density
- SFAA (Active Adult)
- SF2 - SF Mid Density
- SF3 - SF High Density
- SFD - SFA/MF Mid Density
- MF2 - MF High Density
- MF3 - MF High Density

3. Hydraulic Analysis

This Section of the report documents the results of the hydraulic analysis pertaining to the drainage facilities proposed for this project. The proposed facilities are designed for a 6hr, 100yr storm for the interim condition described above. The proposed facilities are summarized below in **Table 3** and depicted on **Figure 8**.

Table 3: Proposed Facilities

Name	Facility Type	100-yr Design Flow (cfs)	Corresponding HEC-1 Node
CHNL-4	Triangular Channel	5	INT-3/2
CHNL-3	Trapezoidal Channel	78.5	CP3
CHNL-2	Trapezoidal Channel	11	INT-1/2
CHNL-1	Triangular Channel	3	INT-1/1
INLT-1	NDOT Type 2 Drop Inlet	14	CP1
SD-1	18" RCP	14	CP1

3.1. Channel Calculations

All proposed channels were modeled with normal depth analysis using Bentley FlowMaster V10.2. The calculations can be found in **Appendix B**. **Figure 8** depicts channel locations. The grading plans provided in **Appendix C** depict the proposed channels in plan and section view.

The channel running along the outside of the western face of the CMU wall (CHNL-4) corresponds to INT-3/2 and is designed for 5.0 cfs. CHNL-4 is a triangular channel with side slopes of 3:1 and a depth of 2-feet.

The channel along the outside of the northern face of the CMU wall (CHNL-3) corresponds to CP3 and is designed for 78.5 cfs. CHNL-3 is a trapezoidal channel with a bottom width of 5-feet, side slopes of 3:1, and a depth of 2-feet.

The channel running along the inside of the CMU wall along northern boundary of the site (CHNL-2) corresponds to INT-1/2 and is designed for 11 cfs. CHNL-2 is a trapezoidal channel with a bottom width of 3-feet, side slopes of 3:1, and a depth of 2-feet.

The channel running along the eastern boundary of the site (CHNL-1) corresponds to INT-1/1 and is designed for 3 cfs. CHNL-1 is a triangular channel with side slopes of 3:1, and a depth of 2-feet.

3.2. Riprap

Riprap sizing calculations were performed using the methodology presented in the Design Manual. Median riprap sizes of 0.5 to 2.0-feet are needed for the proposed channels. Riprap sizes can be seen below in **Table 4**. The grading plans provided in **Appendix C** depict the proposed channels in plan and section view. The riprap calculations are provided in **Appendix B**.

Table 4: Riprap Locations and Sizing

Location	Riprap D50 (inches)	Riprap Layer Thickness (inches)	Representative Manning's Roughness Coefficient
CHNL-1	6"	12"	0.035
CHNL-2	12"	24"	0.040
CHNL-3	24"	48"	0.044
CHNL-4	6"	12"	0.035
SD-1 Outlet	16"	36"	0.041

3.3. Drop Inlet Calculations

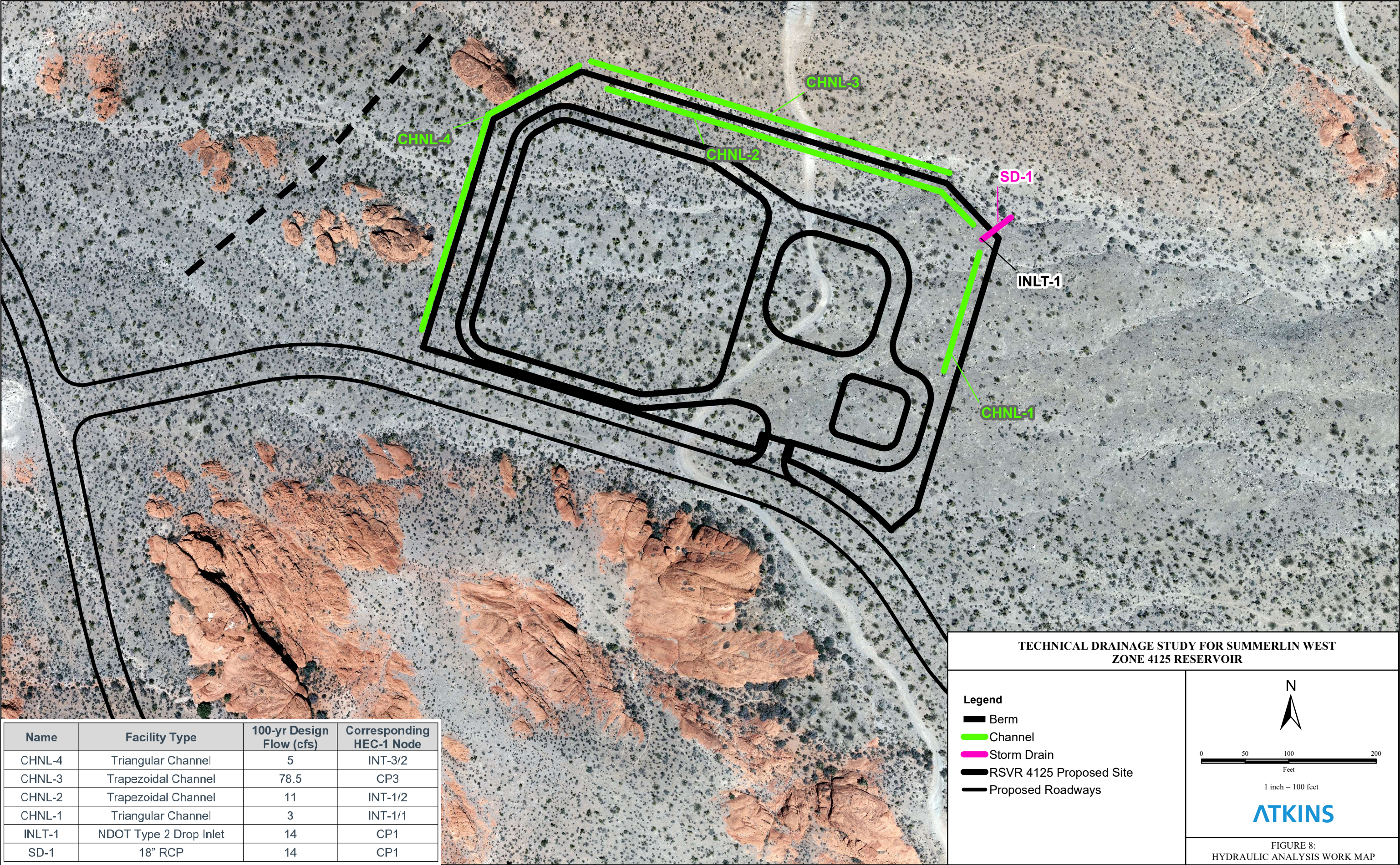
Drop inlets were modeled using Bentley FlowMaster V10.2. The calculations can be found in the FlowMaster output in **Appendix B**.

The drop inlet at the northeast corner of the site (INLT-1) corresponds to CP1 and is designed for 14 cfs. INLT-1 shall be a Nevada Department of Transportation (NDOT) Type 2 Drop Inlet. INLT-1 is designed as a double grate inlet and shall have a height “H” of 3.5-feet, a width “A” of 2.5-feet, and a length “L” of 4-feet, see grading plans in **Appendix C**.

3.4. Storm Drain Calculations

Proposed storm drain was modeled with normal depth analysis using Bentley FlowMaster V10.2. The calculations can be found in the FlowMaster output in **Appendix B**.

Leading out from INLT-1 is storm drain SD-1. SD-1 corresponds to CP1 and has a design flow of 14 cfs. While the surrounding areas are in the interim condition, SD-1 will lead out to the wash that runs along the north of the site. Roughly 41.5 LF of 18-inch RCP at a slope of 2.83% will be used for this purpose. SD-1 is depicted in the grading plans provided in **Appendix C** in both plan and profile. Once offsite areas reach their ultimate condition, SD-1 will need to be routed to a future storm drain system. Future storm drain systems will be designed by others when the adjacent roadways are constructed. The surrounding area, roadways, and storm drain will be part of the master planned system which the developer will submit in the future. This revised master drainage study will supersede any offsite drainage patterns depicted in this study.



4. Conclusion

The Summerlin 4125 Reservoir is designed to be in compliance with the Design Manual. The hydrologic and hydraulic analyses presented in this TDS are for the interim condition as described in this study. The reservoir site will be incorporated with the Summerlin West drainage master plan which is currently being revised.

A 100-year peak flow of 14 cfs is being directed to SD-1, located in the northeast corner of the site. In the interim condition, SD-1 will direct this flow to the existing wash to the north of the site. Once the surrounding areas have reached ultimate conditions, flows will need to be routed to a future storm drain system. Future storm drain systems will be designed by others when the adjacent roadways are constructed.

SD-1 is designed with the capacity needed to convey the 100-year flows for the reservoir site to the wash. Because the site is planned to ensure the 100-year developed flows are directed to the existing wash, as in existing conditions, the ultimate condition will not change the impacts that would occur on-site with a 100-year storm.

From the hydrologic analysis, a 100-year peak flow of 10 cfs is being directed to the proposed access road via overland flow. The proposed reservoir has the potential to overflow at a maximum rate of 30 cfs. In the unlikely event that the reservoir overflows, this flow will also be routed to the proposed access road. For the purposes of this study, the access road being shown in the accompanying grading plans reflect subgrade. Ultimate road design and capacity calculations will be included in a future TDS and plans provided by others.

During construction, the contractor shall use best practices to mitigate any nuisance flows.

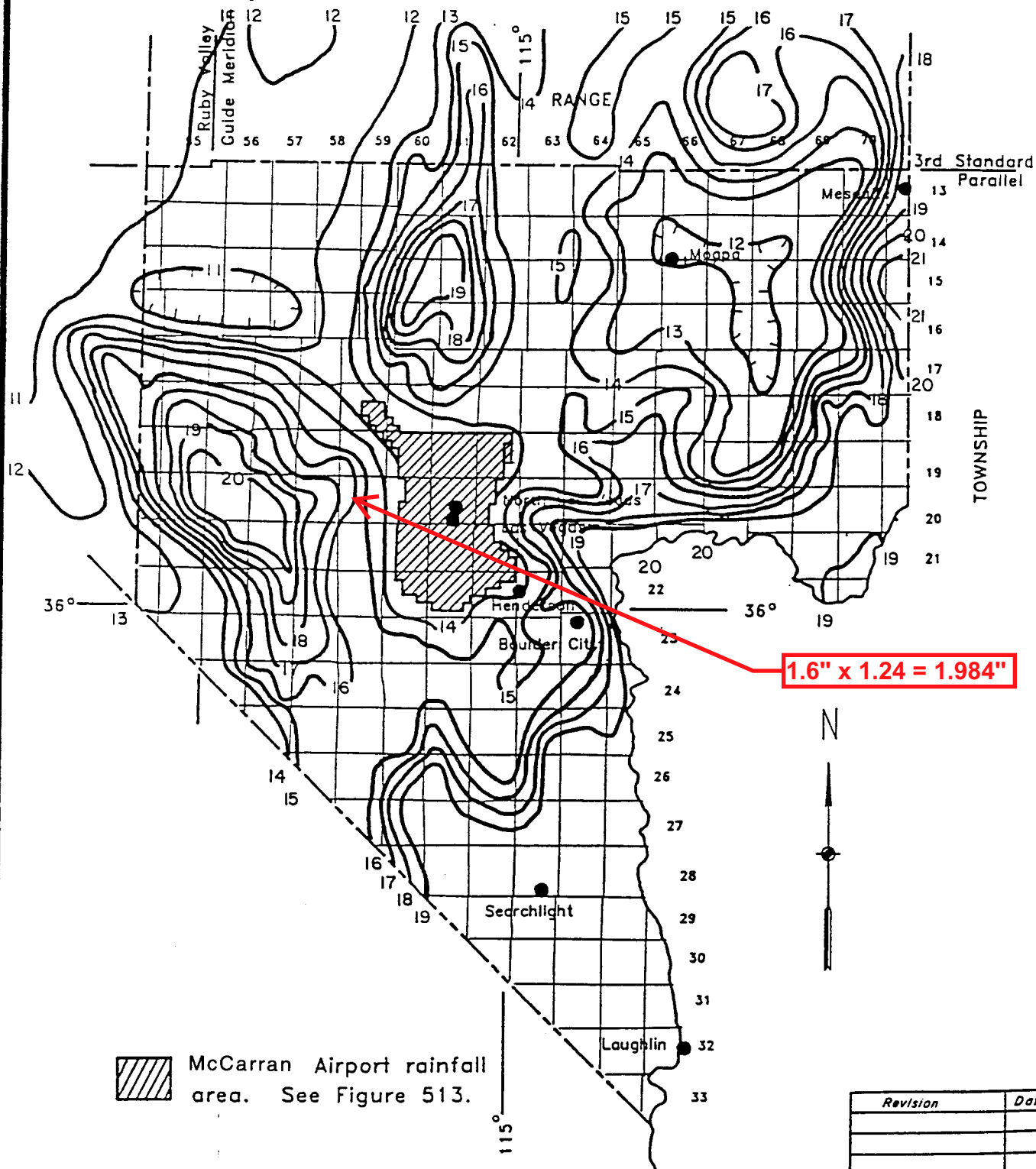
Appendices



Appendix A-1

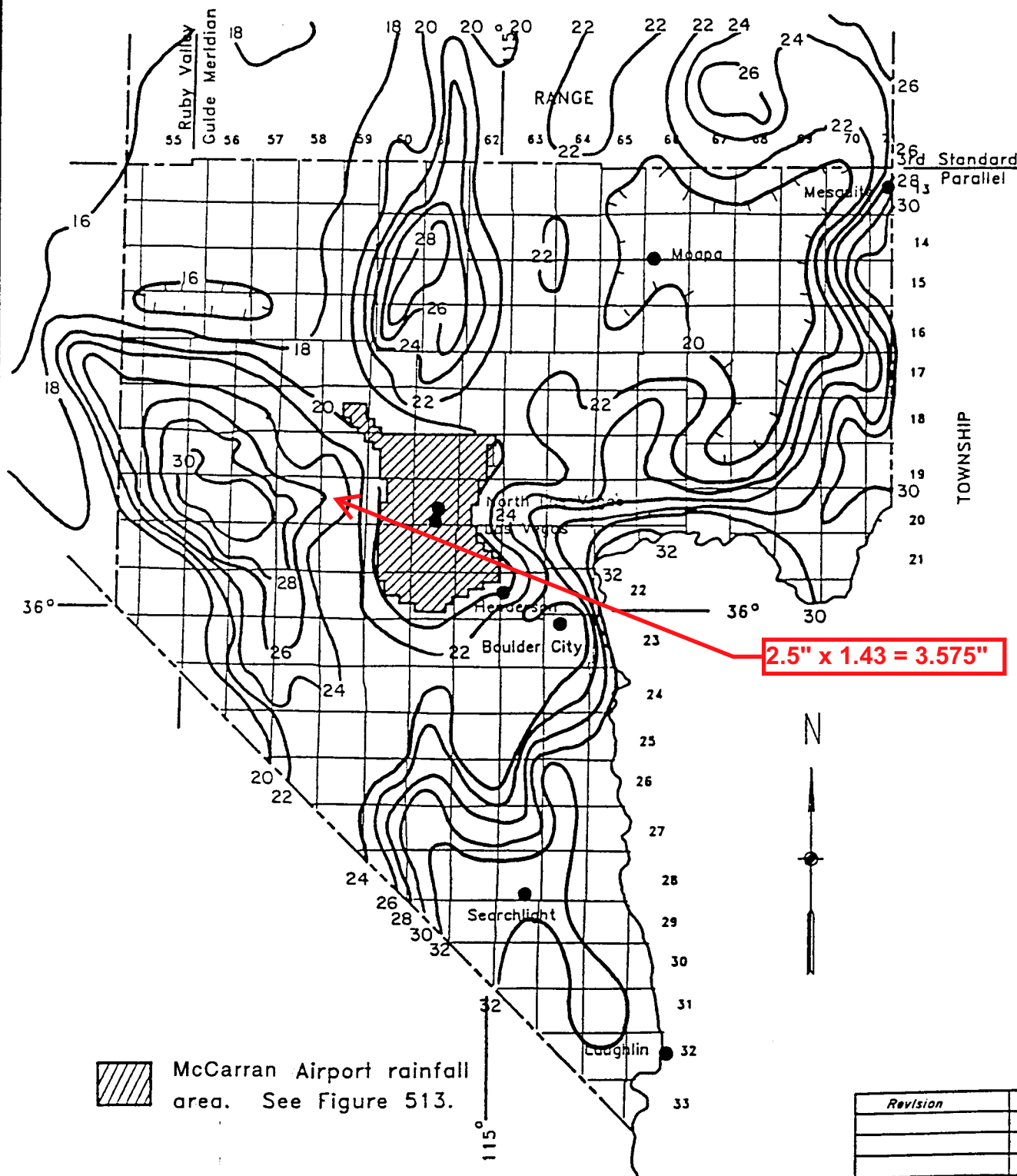
Hydrologic Analysis Parameters and Model Results

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



Revision	Date

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>

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>

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL																
TIME OF CONCENTRATION																
Atkins File: FORM4.XLS						Summerlin 4125 Reservoir Ultimate Condition						BY: DATE:		BPM 2/26/20		
SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag
DESIG:	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY FPS	V2 VELOCITY FPS	Tt Min	Min	Min	Tlag= 0.6Tc/60 Hours
INT-3/1	E	86.0	0.7452	0.96	0.00150	191	9.1	4.2	428	10.7	4.8	9.6	1.5	5.7	N/A	0.057
INT-3/2	E	86.0	0.7452	1.33	0.00207	252	10.7	4.6	186	4.1	3.0	5.9	1.0	5.6	N/A	0.056
INT-2/4	E	86.0	0.7452	0.95	0.00149	193	9.5	4.2	278	7.5	4.1	8.1	1.1	5.3	N/A	0.053
INT-2/3	D	93.0	0.8376	1.42	0.00222	100	3.5	3.1	508	7.7	5.6	8.5	1.5	4.6	13.4	0.050*
INT-2/2	D	93.0	0.8376	0.21	0.00033	57	7.7	1.8	140	6.9	5.3	8.0	0.4	2.2	11.1	0.050*
INT-1/2	D	93.0	0.8376	2.73	0.00426	100	1.0	4.8	699	7.2	5.4	8.2	1.9	6.7	14.4	0.067
INT-1/1	D	93.0	0.8376	0.69	0.00107	100	2.0	3.7	251	9.1	6.1	9.2	0.7	4.4	12.0	0.050*
Tc = Ti + Tt Tlag = 0.6 Tc Ti = 1.8 (1.1 - K) L^1/2 / S^1/3 K = 0.0132 (CN) - 0.39 Tc Check = L/180+10 For the travel time (Tt) calculations, V1 applies to the first 500 feet of travel distance; V2 applies to the remaining travel distance. V1 = 14.8*(S/100)^1/2 Developed V2 = 29.4*(S/100)^1/2 Developed V1 = 20.2*(S/100)^1/2 V2 = 30.6*(S/100)^1/2																
REFERENCE :													STANDARD FORM 4			

*Minimum recommended Tc for developed subbasins is 5 mins. A value of 0.05 was used for the Tlag where the calculated Tc was less than 5 mins.

Figure A: Ultimate Land Use and Soil Type



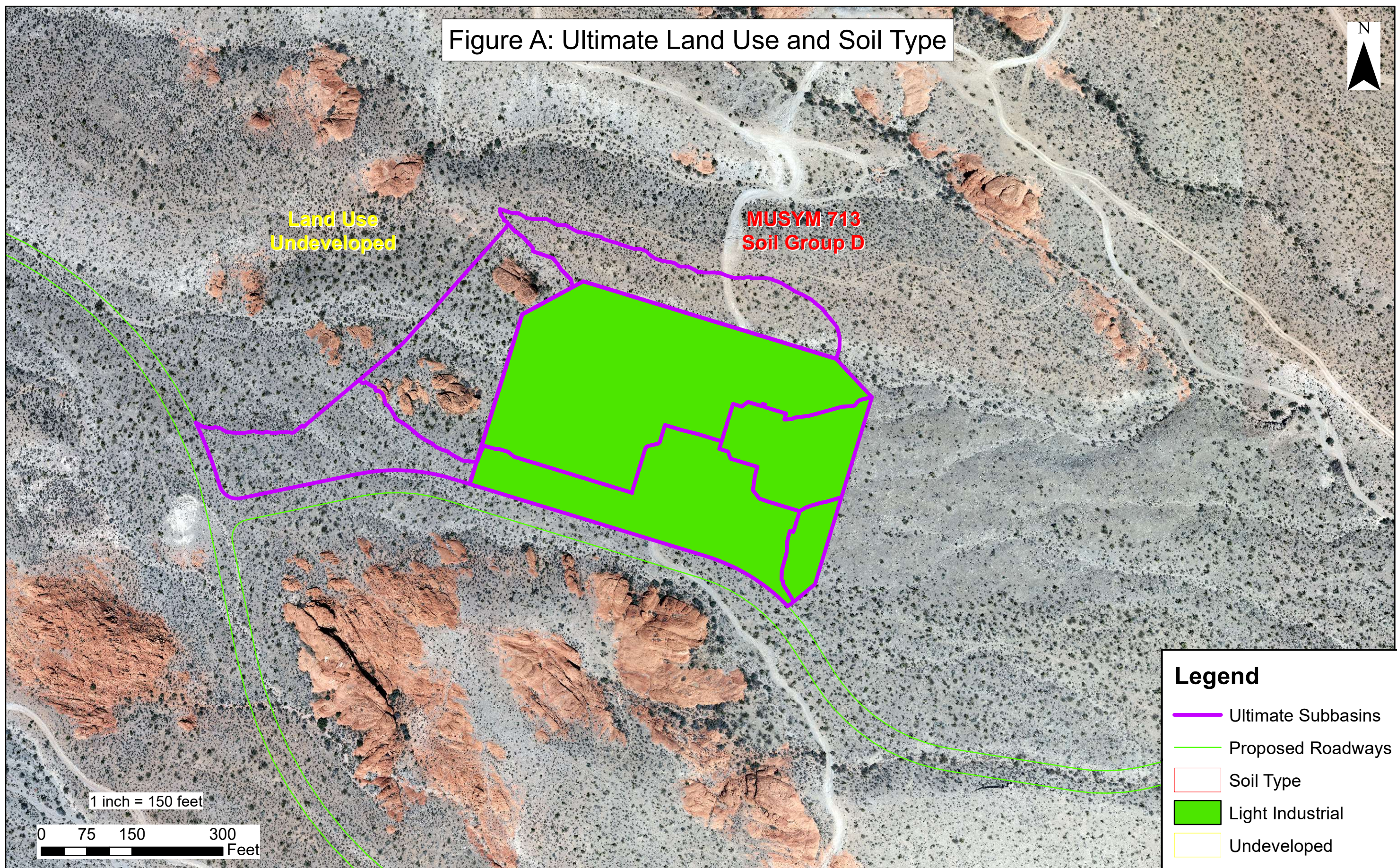
Land Use
Undeveloped

MUSYM 713
Soil Group D

Legend

- Ultimate Subbasins
- Proposed Roadways
- Soil Type
- Light Industrial
- Undeveloped

1 inch = 150 feet



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

RUNOFF CURVE NUMBERS (SEMIARID RANGELANDS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition ²	A ³	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

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

²Poor: <30% ground cover (litter, grass, and brush overstory).

Fair: 30 to 70% ground cover.

Good: >70% ground cover.

³Curve numbers for group A have been developed only for desert shrub.

Revision	Date

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
*
* RUN DATE 26FEB20 TIME 10:22:20 *
*

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

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

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

1 HEC-1 INPUT PAGE 1

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

*DIAGRAM

*** FREE ***

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1 ID *****
2 ID *
3 ID * TECHNICAL DRAINAGE STUDY FOR SUMMERLIN 4125 RESERVOIR
4 ID * INTERIM CONDITION
5 ID * CLIENT_ _ _ _ _ THE HOWARD HUGHES CORP
6 ID * RETURN PERIOD_ _ _ _ 100-YEAR AND 10-YEAR
7 ID * DISTRIBUTION_ _ _ _ 6-HOUR SDN3
8 ID * PROJECT NO_ _ _ _ 100065611
9 ID * FILENAME_ _ _ _ _ 4125INT.PRN
10 ID * DATE_ _ _ _ _ 2/24/20
11 ID *
12 ID * JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
13 ID * AREA (SQUARE MILE)
14 ID * 100-YR DARF
15 ID * 0 - 0.25 1.000
16 ID * 10-YR DARF
17 ID * 0 - 0.25 0.555
18 ID *****
19 ID
20 ID
21 IT 5 0 0 300
22 IN 5 0 0
23 IO 5
24 JR PREC 1 0.555
25 ID
26 ID

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27 KK INT-1/1
28 KM ROUTE TO CP1
29 BA0.001072 0
30 PB 3.575
31 PC 0 0.02 0.057 0.07 0.087 0.108 0.124 0.13 0.13 0.13
32 PC 0.13 0.13 0.13 0.133 0.14 0.142 0.148 0.158 0.172 0.181
33 PC 0.19 0.197 0.199 0.2 0.201 0.204 0.214 0.229 0.241 0.249
34 PC 0.251 0.256 0.27 0.278 0.281 0.283 0.295 0.322 0.352 0.409
35 PC 0.499 0.59 0.71 0.744 0.781 0.812 0.819 0.835 0.851 0.856
36 PC 0.86 0.868 0.876 0.888 0.91 0.926 0.937 0.95 0.97 0.976
37 PC 0.982 0.985 0.987 0.989 0.99 0.993 0.993 0.994 0.995 0.998
38 PC 0.998 0.999 1
39 LS 0 93.0
40 UD 0.050
*

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41 KK INT-1/2
42 KM ROUTE TO CP1
43 BA0.004262 2
44 LS 0 93.0
45 UD 0.067
*

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1 HEC-1 INPUT

PAGE 2

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
46	KK CP1
47	HC 2
	*
48	KK INT-2/1RSVR OVERFLOW
49	KM ROUTE TO CP2
50	BA0.000001
51	PB 0
52	LS 0 93.0
53	BF 30
	*
54	KK INT-2/2
55	KM ROUTE TO CP2
56	BF 0
57	BA0.000326 4
58	PB 3.575
59	LS 0 93.0
60	UD 0.050
	*
61	KK INT-2/3
62	KM ROUTE TO CP2
63	BA0.002222 1
64	LS 0 93.0
65	UD 0.050
	*
66	KK INT-2/4
67	BA0.001491 8
68	LS 0 86.0
69	UD0.053328
	*
70	KK R1
71	KM 2/4 ROUT TO CP2
72	RD 567 0.083 0.016 0 TRAP 30 0.1
	*
73	KK CP2
74	HC 4
	*
75	KK INT-3/1
76	KM ROUTE TO CP4
77	BA0.001499 8
78	LS 0 86.0
79	UD0.057085
	*

1

HEC-1 INPUT

PAGE 3

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
80	KK INT-3/2
81	KM ROUTE TO CP4
82	BA0.002073 5
83	LS 0 86.0
84	UD 0.0564
	*
85	KK CP3
86	HC 2
	*
87	ZZ

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
27	INT-1/1	
	.	
41	INT-1/2	
	.	
46	CP1.....	
	.	
48	INT-2/1	
	.	
54	INT-2/2	
	.	
61	INT-2/3	


```

      .      .      .      .
66      .      .      .      .      INT-2/4
      .      .      .      .      V
      .      .      .      .      V
70      .      .      .      .      R1
      .      .      .      .
      .      .      .      .
73      .      CP2.....
      .
      .      .
75      .      .      INT-3/1
      .      .      .
      .      .      .
80      .      .      .      INT-3/2
      .      .      .
      .      .      .
85      .      .      CP3.....

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 26FEB20 TIME 10:22:20
*
*****

```

```

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

```

```

*****
*
* TECHNICAL DRAINAGE STUDY FOR SUMMERLIN 4125 RESERVOIR
* INTERIM CONDITION
* CLIENT _ _ _ _ _ THE HOWARD HUGHES CORP
* RETURN PERIOD _ _ _ 100-YEAR AND 10-YEAR
* DISTRIBUTION _ _ _ 6-HOUR SDN3
* PROJECT NO _ _ _ _ 100065611
* FILENAME _ _ _ _ _ 4125INT.PRN
* DATE _ _ _ _ _ 2/24/20
*
* JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
* AREA (SQUARE MILE)
* 100-YR DARF
* 0 - 0.25 1.000
* 10-YR DARF
* 0 - 0.25 0.555
*****

```

```

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

```

```

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

          COMPUTATION INTERVAL      .08 HOURS
          TOTAL TIME BASE      24.92 HOURS

```

```

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

```

```

JP      MULTI-PLAN OPTION
          NPLAN      1  NUMBER OF PLANS

```

```

JR      MULTI-RATIO OPTION
          RATIOS OF PRECIPITATION
          1.00      .56

```


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 1.00	RATIO 2 .56
HYDROGRAPH AT +	INT-1/1	.00	1 FLOW TIME	3. 3.50	1. 3.50
HYDROGRAPH AT +	INT-1/2	.00	1 FLOW TIME	11. 3.50	6. 3.50
2 COMBINED AT +	CP1	.01	1 FLOW TIME	14. 3.50	7. 3.50
HYDROGRAPH AT +	INT-2/1	.00	1 FLOW TIME	30. .00	30. .00
HYDROGRAPH AT +	INT-2/2	.00	1 FLOW TIME	1. 3.50	0. 3.50
HYDROGRAPH AT +	INT-2/3	.00	1 FLOW TIME	6. 3.50	3. 3.50
HYDROGRAPH AT +	INT-2/4	.00	1 FLOW TIME	3. 3.50	1. 3.50
ROUTED TO +	R1	.00	1 FLOW TIME	3. 3.50	1. 3.58
4 COMBINED AT +	CP2	.00	1 FLOW TIME	40. 3.50	35. 3.50
HYDROGRAPH AT +	INT-3/1	.00	1 FLOW TIME	3. 3.50	1. 3.50
HYDROGRAPH AT +	INT-3/2	.00	1 FLOW TIME	5. 3.50	2. 3.50
2 COMBINED AT +	CP3	.00	1 FLOW TIME	8. 3.50	3. 3.50

1	SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)								
	ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL PEAK	VOLUME
			(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(IN)
	FOR PLAN = 1	RATIO=	.00						
	R1	MANE	2.27	3.28	211.15	2.17	5.00	3.12	210.00
									2.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1721E+00 EXCESS= .0000E+00 OUTFLOW= .1722E+00 BASIN STORAGE= .3406E-03 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00
 R1 MANE 3.16 1.29 211.70 .84 5.00 1.22 215.00 .84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6640E-01 EXCESS= .0000E+00 OUTFLOW= .6644E-01 BASIN STORAGE= .3599E-03 PERCENT ERROR= -.6

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

Appendix A-2

Reference Material

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM		DATE: November 21, 2019
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	
	Summerlin West Village 30A – Rough Street Grading	
Cross Streets:	Future Lake Mead Blvd. & Park Drift Trail	
File Number:	F:\Depot\DSMemos\DS5214A.doc	
Parcel Number:	137-21-101-001	
Zoning Action:	N/A	
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X
COPIES TO:		Atkins
		Howard Hughes Company
		Bart Anderson, P.E., DevCo

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	11/6/2019	11/21/2019	See Comments Below	\$400.00	3638198: \$400
TOTAL FEES (LDDRS):				\$400.00	----

REMARKS:

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

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

Note that the Clark County Regional Flood Control District (District) has begun efforts to update the Hydrologic Criteria and Drainage Design Manual (HCDDM) and is requesting participation from the engineering community. The District is collecting comments and suggestions on errors, clarifications, or changes needed to the current Manual and/or content and usability enhancements to be incorporated into the updated Manual. Additional information on procedures and deadline to provide feedback and comments are available online at (<http://www.ccrfed.org/hcddmupdate.html>).

1. The approval of this drainage study is for the issuance of rough grading permit for future streets and temporary construction access only.
2. Howard Hughes Company (Summerlin) is solely responsible for the maintenance and erosion control of the interim facilities.

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 Update 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 of Las Vegas* 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.

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

ays

T/R/S: T20S/R59E/21
AREA K-21

Summerlin West Village 30A

Rough Grade Technical Drainage Memo

Prepared for The Howard Hughes Company, LLC
November 6, 2019

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: Summerlin West Village 30A Rough Grade Date: November 6, 2019
Location of Development: a) Descriptive (Cross Streets) North/South: Park Drift Trail (future)
East/West: Lake Mead Boulevard (future)
b) Section: 21 Township: 20S Range: 59E
c) APN : 137-21-101-001

Name of Owner: Howard Hughes Company, LLC
Telephone No.: (702) 791-4000 Fax No.: (702) 791-4450 E-Mail Address: chris.anderson@howardhughes.com
Address: 10801 West Charleston Blvd, Ste 300, Las Vegas, NV 89135

Contact Person-Name: Molly Anderson, PE Telephone No.: (702) 551-0330
* E-Mail Address: molly.anderson@atkinsglobal.com Fax No.: (702) 263-7200
Firm: Atkins
Address: 2270 Corporate Circle, Ste 200, Henderson, NV 89074

Type of Land Development/Land Disturbance Process:

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

1. Total Owned Land Area: At Site: +/- 2006 acres Being Developed/Disturbed: +/- 47 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.): Rough Grade
5. Approximate upstream land area which drains to the subject site: 6.8 square miles
6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Overall Master Conceptual Drainage Study for Summerlin West
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: The northern portion of the rough grade discharges to the Grand Park Detention Basin, which eventually discharges to the Western Beltway Channel. The southern portion of the proposed development discharges to DB45.
8. Briefly describe your proposed schedule for the subject project: ASAP

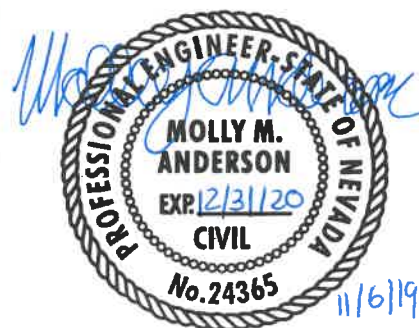
Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

***New Required Field**

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

Revision	Date

Local Entity File No. _____



Engineer's Seal

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: Summerlin West Village 30A Rough Grade

Map ID:

Firm Name: **Atkins**

Engineer: **Molly Anderson, PE**

Address: 2270 Corporate Circle, Ste 200

City: **Henderson**

State:

NV

Zip: **89074**

Phone Number: **(702) 551-0330**

Fax Number: **(702) 263-7200**

Property Owner: **Howard Hughes Company, LLC**

Address: 10801 West Charleston Blvd, Ste 300

City: **Las Vegas**

State: **NV**

Zip: **89135**

Reviewed By:

Date Received:

Date Accepted for Review:

The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL).

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

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

I. GENERAL REQUIREMENT

Yes

No

 x

Design Manual **Standard Form 1** with the engineer's seal and signature.

 N/A

Design Manual **Standard Form 4**.

 N/A

2 copies of the 24" x 36" Drainage Plan.

 N/A

A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

II. MAPS AND EXHIBITS

Yes

No

 N/A

A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.

 N/A

A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes	No	
<u>X</u>	_____	Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.
<u>X</u>	_____	On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs.
<u>X</u>	_____	Vicinity Map with local and major cross streets identified and a north arrow.

III. DRAINAGE PLAN

Yes	No	
<u>X</u>	_____	Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.
_____	<u>N/A</u>	Minimum scale: 1" = 60'.
<u>X</u>	_____	Project name.
<u>X</u>	_____	Vicinity Map with local and major cross streets.
<u>X</u>	_____	Revision box.
<u>X</u>	_____	North arrow and bar scale.
<u>X</u>	_____	Engineer's/consultant's address and phone number.
<u>X</u>	_____	Elevation datum and benchmark.
<u>X</u>	_____	Legend for symbols and abbreviations.
<u>X</u>	_____	Cut/fill scarps, where applicable.
<u>X</u>	_____	Street names, grades, widths.
_____	<u>N/A</u>	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.
<u>X</u>	_____	Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.
_____	<u>N/A</u>	Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
<u>X</u>	_____	Proposed typical street sections.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
<u> </u>	<u>N/A</u>	Streets with off-set crowns.
<u>X</u>	<u> </u>	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
<u>X</u>	<u> </u>	Property lines.
<u> </u>	<u>N/A</u>	Right-of-way lines and widths, existing and proposed.
<u>X</u>	<u> </u>	Existing improvements and their elevations.
<u>X</u>	<u> </u>	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
<u>X</u>	<u> </u>	Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets.
<u>X</u>	<u> </u>	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
<u>X</u>	<u> </u>	Location and cross-section of street capacity calculations.
<u>X</u>	<u> </u>	Cross-sectional detail for channels, including cutoff wall locations.
<u>X</u>	<u> </u>	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations.
<u>X</u>	<u> </u>	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
<u> </u>	<u>N/A</u>	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.
<u> </u>	<u>N/A</u>	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
<u> </u>	<u>N/A</u>	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
<u> </u>	<u>N/A</u>	Building and/or lot numbers.
<u> </u>	<u>N/A</u>	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
<u> </u>	<u>N/A</u>	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.
☐	<u>N/A</u>	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
☐	<u>N/A</u>	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes	No	
☐	<u>N/A</u>	Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
<u>X</u>	☐	Use of correct precipitation values in and around the McCarran Airport rainfall area.
<u>X</u>	☐	A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
<u>X</u>	☐	A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.
<u>X</u>	☐	Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
<u>X</u>	☐	On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
☐	<u>N/A</u>	Calculation for impervious area for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes	No	
☐	<u>N/A</u>	Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
☐	<u>N/A</u>	Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q_{100} and Q_{10} flows representing the worst case for interior and all perimeter streets. $Q_{100} d \times v \leq 8$. $Q_{10} d \times v \leq 6$ and 12 foot dry lane for rights-of-way ≥ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
<u>X</u>	☐	A summary table of interior and exterior street capacity calculations showing the street name, Q_{100} flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
☐	<u>N/A</u>	Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q_{100} weir height or flow depth, whichever is greater.
☐	<u>N/A</u>	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
☐	<u>N/A</u>	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
<u>X</u>	☐	Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.
<u>X</u>	☐	The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
☐	<u>N/A</u>	Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

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

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

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

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

II. GRADING PLAN INFORMATION		
Yes	No	
X		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
	N/A	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.
X		Label existing topography at a minimum 5 foot elevation interval including adjacent developments, finished floor elevations of existing buildings and top of existing curbs extending 100 feet around the perimeter of the site. (*Measured from the centerline of the adjacent roadway.)

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
	N/A	Proposed on-site and off-site storm drains and other flood control facilities with plan and profile sheets for public storm drains showing the class of pipe, (Class III, IV, V, etc.), design hydraulic grade line, (HGL) and 100 year storm flow. A public drainage easement must be provided over on-site storm drains conveying off-site flows. An overflow path must be provided over all storm drains.
	N/A	All existing and "to be constructed" walls with cross-sections showing wall type, (e.g. block wall, retaining wall, flood wall, etc.), with limits clearly defined, adjacent ground elevations. Wall heights must meet current ordinances and in no case exceed 14 feet above the adjacent property.
	N/A	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.
	N/A	Sites with a grade difference two feet above or below existing ground are required to have approval from City of Las Vegas Current Planning. Current Planning approval is required prior to final approval of the drainage study.
X		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.
	N/A	Commercial and Common Lot Landscape areas are not allowed to drain over the sidewalk. The grading plans show flow lines with grades and sidewalk under drains for all landscape areas draining to the public ROW.

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

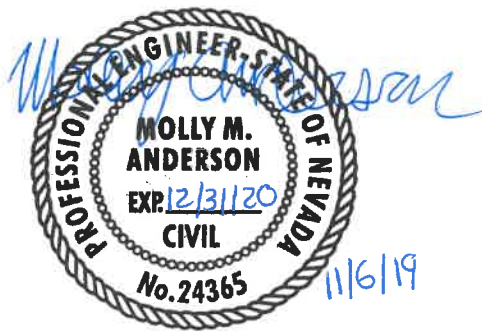
- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

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

Engineer's Certification

Atkins certifies that the information contained herein has been prepared in accordance with generally accepted engineering principles and practices, and to the best of our knowledge, is true and correct.

This letter certifies that all items in the **Technical Drainage Memo for Summerlin West Village 30A: Rough Grade** electronic submittal matches the paper version bound into the study.



Molly M. Anderson, PE (NV #24365)
Senior Engineer

Executive Summary

This Technical Drainage Memo, prepared on behalf of Howard Hughes Company, LLC represents the hydrologic and hydraulic analysis for the rough grade roadway improvements of the Summerlin West Village 30A development. Summerlin West Village 30A is located in the northwest Las Vegas Valley west of the CC-215 beltway and Summerlin Parkway. The proposed rough grade street improvements detailed in this study extend from the future site of the 4125 North reservoir, west to the future street K (Park Drift Trail). Five portions of rough grade roadway are included in this study: the reservoir temporary access road, the future reservoir access road, Lake Mead Boulevard from the future access road to Street K, Street Z from Lake Mead Boulevard to Street K, and a portion of Street K from just north of the intersection with Street Z, south to the intersection with the future Sandstone Rise Drive. A detailed drainage study was performed using HEC-RAS 2D modeling software to ensure that existing hydrologic and hydraulic conditions were not negatively impacted by the proposed rough grade improvements, as well as to ensure that the proposed grading would be able to adequately handle a 100-year storm event without damage from highly erosive stormwater velocities. The following memo provides key insights and findings from the full-scale Technical Drainage Study (TDS). The complete TDS is available upon request.



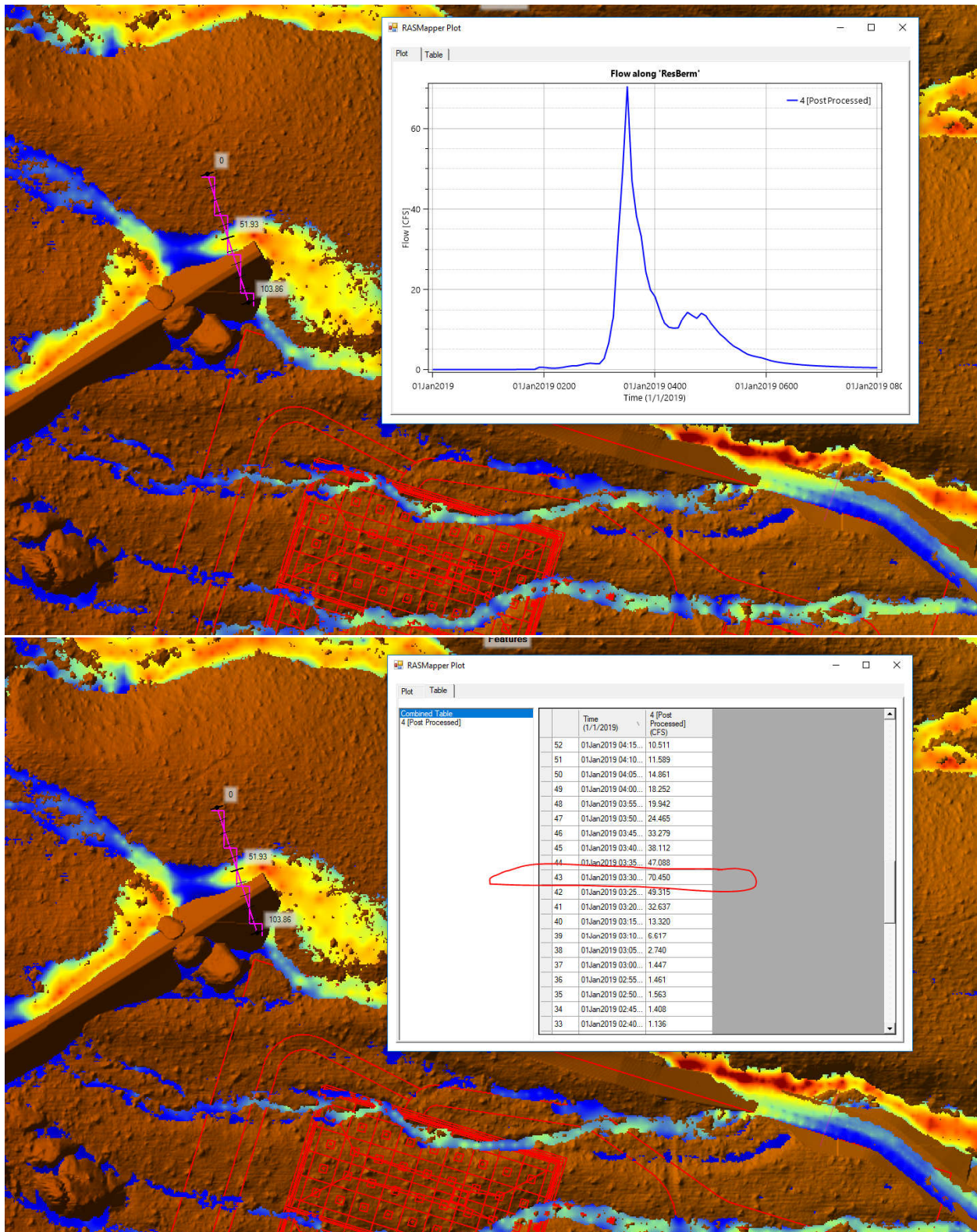
Hydrologic Analysis

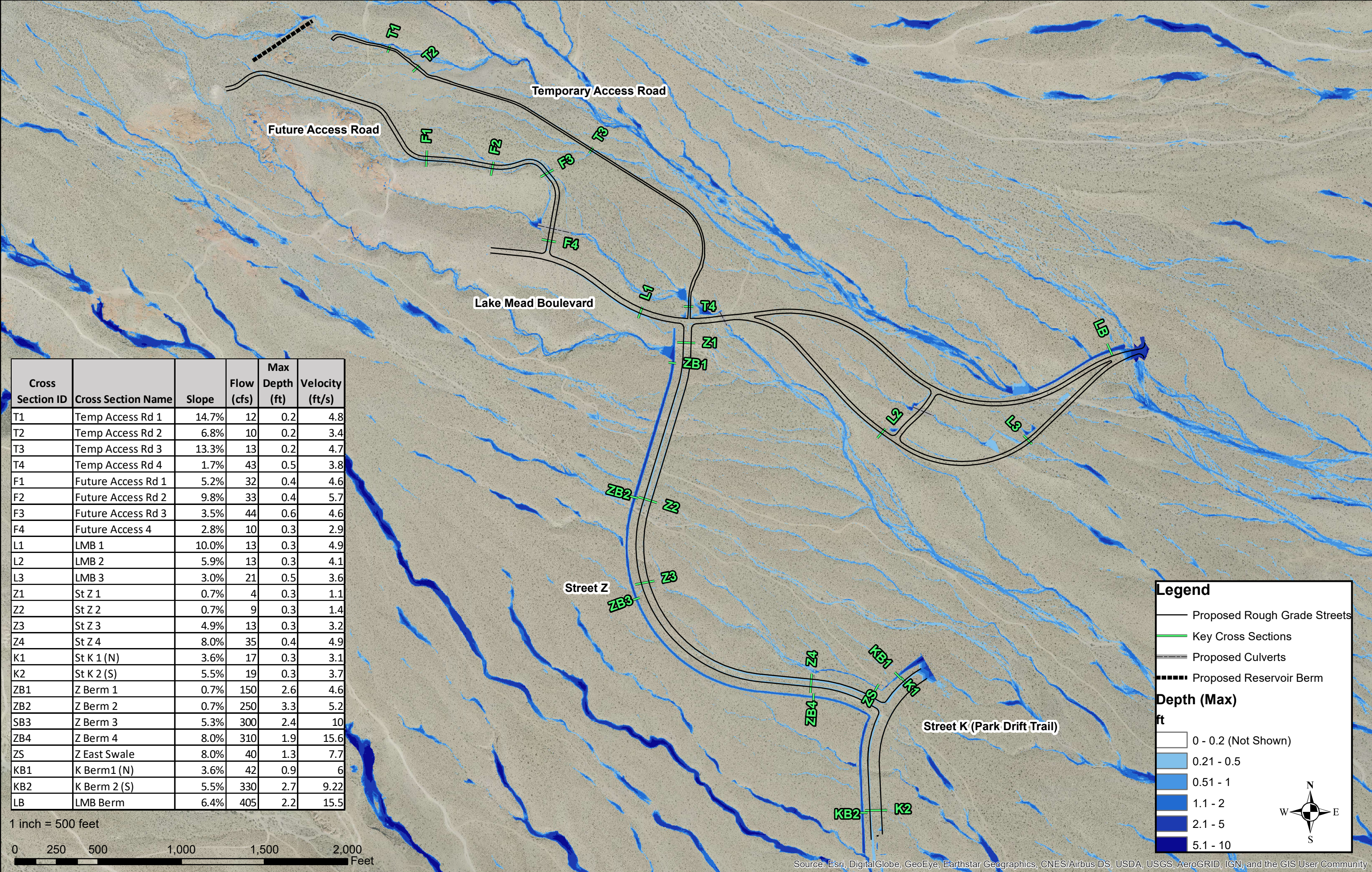
Atkins developed a two-dimensional (2D) hydraulic model of existing terrain in the Summerlin West development area in August 2019 to establish baseline existing hydraulic conditions. The model was developed using the US Army Corps of Engineers HEC-RAS v. 5.0.7. The original 2D model which had four subbasins and covered 20.7 sq. mi. was reduced to one of the original subbasins of 6.8 sq. mi., after determining that no flow from the adjacent subbasins was tributary to the proposed rough grade project area. LiDAR collected by the Southern Nevada Water Authority (SNWA) in 2016 with a resolution of 1-ft was used as a primary source for digital elevation data. Proposed grading for the Village 30A rough grade project was merged with the existing grade topography at 1-ft by 1-ft grid spacing to be used at the terrain in the 2D hydraulics model. HEC-HMS v. 4.3 was used to develop rainfall excess for the project area which was then used as input into the HEC-RAS 2D model. The 2018 Las Vegas Valley Master Plan Update (LVVMPU) rainfall polygon was used to determine the average rainfall depth for the basin tributary to the proposed project site. An SDN3 storm distribution curve was used to calculate the rainfall hyetograph. A depth area reduction factor (DARF) of 0.895 was applied to the rainfall depth of the 6.8 sq. mi basin. A composite runoff curve number of 85.0 was determined from the 2018 LVVMPU soils and undeveloped land use which was used to calculate rainfall losses in HEC-HMS. The 2D model simulations were run for an 8-hour duration of the 100-year 6-hour rainfall storm event using a variable time step based on courant condition.

Hydraulic Analysis

A Manning's roughness coefficient of 0.027 was used on the surface of all proposed rough grade streets, and a roughness coefficient of 0.035 was used for the remainder of the model domain. Initial model runs highlighted the need for rip-rap on several portions of roadway as well as in interim roadside swales/berms to inhibit erosive velocities. Rip-rap calculations were performed based on HCDDM Section 705 using HEC-11 methodology. These calculations determined a median riprap particle size (D_{50}) required to resist the average channel shear stresses. Manning's roughness values representative of the median rip-rap particle size (D_{50}) were then overlain in the representative swales/berms and the 2D model was re-run accordingly. Median rip-rap sizes of 6-inches through 2-feet are needed in various areas throughout the project area. In portions of the Street Z berm where slopes are greater than 8%, and in the Lake Mead berm, grouted rip-rap is needed. Rip-rap sizes and extents are included in the detailed plan-set. To determine average depths and velocities across critical sections of roadways and swales independently from the 2D model, normal depth calculations were performed in Flowmaster 10.2. Maximum depth and velocity 2D model results are show in Figures 1 and 2, respectively. Tabular data of flows, depths, and velocities from Flowmaster determined at critical cross sections can also be found on Figures 1 and 2. Critical cross sections for each roadway were selected where flows and slopes were the greatest.

Flow From Berm
HEC-RAS Results
Village 30A Rough Grade Technical Drainage Study





Cross Section ID	Cross Section Name	Slope	Flow (cfs)	Max Depth (ft)	Velocity (ft/s)
T1	Temp Access Rd 1	14.7%	12	0.2	4.8
T2	Temp Access Rd 2	6.8%	10	0.2	3.4
T3	Temp Access Rd 3	13.3%	13	0.2	4.7
T4	Temp Access Rd 4	1.7%	43	0.5	3.8
F1	Future Access Rd 1	5.2%	32	0.4	4.6
F2	Future Access Rd 2	9.8%	33	0.4	5.7
F3	Future Access Rd 3	3.5%	44	0.6	4.6
F4	Future Access 4	2.8%	10	0.3	2.9
L1	LMB 1	10.0%	13	0.3	4.9
L2	LMB 2	5.9%	13	0.3	4.1
L3	LMB 3	3.0%	21	0.5	3.6
Z1	St Z 1	0.7%	4	0.3	1.1
Z2	St Z 2	0.7%	9	0.3	1.4
Z3	St Z 3	4.9%	13	0.3	3.2
Z4	St Z 4	8.0%	35	0.4	4.9
K1	St K 1 (N)	3.6%	17	0.3	3.1
K2	St K 2 (S)	5.5%	19	0.3	3.7
ZB1	Z Berm 1	0.7%	150	2.6	4.6
ZB2	Z Berm 2	0.7%	250	3.3	5.2
SB3	Z Berm 3	5.3%	300	2.4	10
ZB4	Z Berm 4	8.0%	310	1.9	15.6
ZS	Z East Swale	8.0%	40	1.3	7.7
KB1	K Berm1 (N)	3.6%	42	0.9	6
KB2	K Berm 2 (S)	5.5%	330	2.7	9.22
LB	LMB Berm	6.4%	405	2.2	15.5



Legend

Proposed Rough Grade Streets

Key Cross Sections

Proposed Culverts

Proposed Reservoir Berm

Depth (Max)
ft

0 - 0.2 (Not Shown)

0.21 - 0.5

0.51 - 1

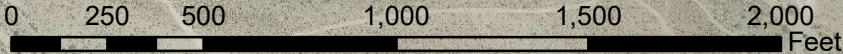
1.1 - 2

2.1 - 5

5.1 - 10

Cross Section ID	Cross Section Name	Slope	Flow (cfs)	Max Depth (ft)	Velocity (ft/s)
T1	Temp Access Rd 1	14.7%	12	0.2	4.8
T2	Temp Access Rd 2	6.8%	10	0.2	3.4
T3	Temp Access Rd 3	13.3%	13	0.2	4.7
T4	Temp Access Rd 4	1.7%	43	0.5	3.8
F1	Future Access Rd 1	5.2%	32	0.4	4.6
F2	Future Access Rd 2	9.8%	33	0.4	5.7
F3	Future Access Rd 3	3.5%	44	0.6	4.6
F4	Future Access 4	2.8%	10	0.3	2.9
L1	LMB 1	10.0%	13	0.3	4.9
L2	LMB 2	5.9%	13	0.3	4.1
L3	LMB 3	3.0%	21	0.5	3.6
Z1	St Z 1	0.7%	4	0.3	1.1
Z2	St Z 2	0.7%	9	0.3	1.4
Z3	St Z 3	4.9%	13	0.3	3.2
Z4	St Z 4	8.0%	35	0.4	4.9
K1	St K 1 (N)	3.6%	17	0.3	3.1
K2	St K 2 (S)	5.5%	19	0.3	3.7
ZB1	Z Berm 1	0.7%	150	2.6	4.6
ZB2	Z Berm 2	0.7%	250	3.3	5.2
SB3	Z Berm 3	5.3%	300	2.4	10
ZB4	Z Berm 4	8.0%	310	1.9	15.6
ZS	Z East Swale	8.0%	40	1.3	7.7
KB1	K Berm1 (N)	3.6%	42	0.9	6
KB2	K Berm 2 (S)	5.5%	330	2.7	9.22
LB	LMB Berm	6.4%	405	2.2	15.5

1 inch = 500 feet



Legend

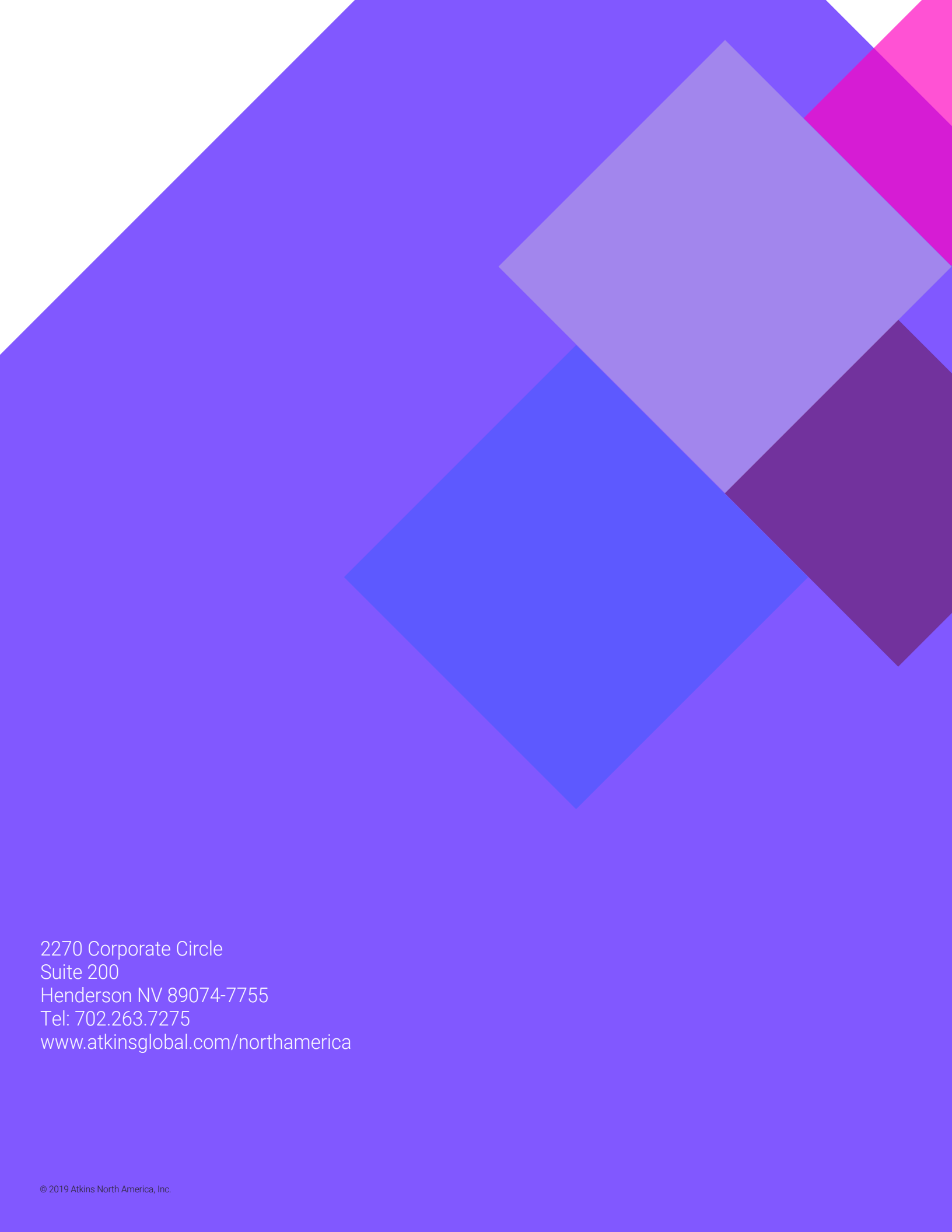
- Proposed Rough Grade Streets
- Key Cross Sections
- Proposed Culverts
- Proposed Reservoir Berm

Velocity (Max)

ft/s

High :25

Low :0



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Appendix B

Hydraulic Model Results

Worksheet for CHNL-1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.035
Channel Slope	0.105 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	3.00 cfs
Results	
Normal Depth	5.4 in
Flow Area	0.6 ft ²
Wetted Perimeter	2.9 ft
Hydraulic Radius	2.6 in
Top Width	2.71 ft
Critical Depth	6.9 in
Critical Slope	0.029 ft/ft
Velocity	4.91 ft/s
Velocity Head	0.38 ft
Specific Energy	0.83 ft
Froude Number	1.824
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.4 in
Critical Depth	6.9 in
Channel Slope	0.105 ft/ft
Critical Slope	0.029 ft/ft

Worksheet for CHNL-2 (0.7% slope)

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.040
Channel Slope	0.007 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	3.00 ft
Discharge	11.00 cfs
Results	
Normal Depth	10.9 in
Flow Area	5.2 ft ²
Wetted Perimeter	8.7 ft
Hydraulic Radius	7.1 in
Top Width	8.45 ft
Critical Depth	7.3 in
Critical Slope	0.032 ft/ft
Velocity	2.12 ft/s
Velocity Head	0.07 ft
Specific Energy	0.98 ft
Froude Number	0.476
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.9 in
Critical Depth	7.3 in
Channel Slope	0.007 ft/ft
Critical Slope	0.032 ft/ft

Worksheet for CHNL-2 (11.8% slope)

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.040
Channel Slope	0.118 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	3.00 ft
Discharge	11.00 cfs
Results	
Normal Depth	5.1 in
Flow Area	1.8 ft ²
Wetted Perimeter	5.7 ft
Hydraulic Radius	3.9 in
Top Width	5.57 ft
Critical Depth	7.3 in
Critical Slope	0.032 ft/ft
Velocity	5.99 ft/s
Velocity Head	0.56 ft
Specific Energy	0.99 ft
Froude Number	1.839
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.1 in
Critical Depth	7.3 in
Channel Slope	0.118 ft/ft
Critical Slope	0.032 ft/ft

Worksheet for CHNL-3 (10.5% slope)

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.044
Channel Slope	0.105 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	5.00 ft
Discharge	78.50 cfs
Results	
Normal Depth	12.8 in
Flow Area	8.7 ft ²
Wetted Perimeter	11.7 ft
Hydraulic Radius	8.9 in
Top Width	11.39 ft
Critical Depth	17.6 in
Critical Slope	0.030 ft/ft
Velocity	8.99 ft/s
Velocity Head	1.25 ft
Specific Energy	2.32 ft
Froude Number	1.809
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.8 in
Critical Depth	17.6 in
Channel Slope	0.105 ft/ft
Critical Slope	0.030 ft/ft

Worksheet for CHNL-3 (11.5% slope)

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Roughness Coefficient	0.044
Channel Slope	0.115 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	5.00 ft
Discharge	78.50 cfs
Results	
Normal Depth	12.5 in
Flow Area	8.4 ft ²
Wetted Perimeter	11.6 ft
Hydraulic Radius	8.8 in
Top Width	11.24 ft
Critical Depth	17.6 in
Critical Slope	0.030 ft/ft
Velocity	9.29 ft/s
Velocity Head	1.34 ft
Specific Energy	2.38 ft
Froude Number	1.890
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.5 in
Critical Depth	17.6 in
Channel Slope	0.115 ft/ft
Critical Slope	0.030 ft/ft

Worksheet for CHNL-4 (0.90% slope)

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Roughness Coefficient	0.035
Channel Slope	0.009 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	5.00 cfs
Results	
Normal Depth	10.4 in
Flow Area	2.2 ft ²
Wetted Perimeter	5.5 ft
Hydraulic Radius	4.9 in
Top Width	5.19 ft
Critical Depth	8.4 in
Critical Slope	0.027 ft/ft
Velocity	2.22 ft/s
Velocity Head	0.08 ft
Specific Energy	0.94 ft
Froude Number	0.596
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.4 in
Critical Depth	8.4 in
Channel Slope	0.009 ft/ft
Critical Slope	0.027 ft/ft

Worksheet for CHNL-4 (6.0% slope)

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.035
Channel Slope	0.060 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	5.00 cfs
Results	
Normal Depth	7.3 in
Flow Area	1.1 ft ²
Wetted Perimeter	3.8 ft
Hydraulic Radius	3.5 in
Top Width	3.64 ft
Critical Depth	8.4 in
Critical Slope	0.027 ft/ft
Velocity	4.52 ft/s
Velocity Head	0.32 ft
Specific Energy	0.92 ft
Froude Number	1.447
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.3 in
Critical Depth	8.4 in
Channel Slope	0.060 ft/ft
Critical Slope	0.027 ft/ft

Worksheet for INLT-1

Project Description	
Solve For	Spread
Input Data	
Discharge	14.00 cfs
Left Side Slope	10.000 H:V
Right Side Slope	10.000 H:V
Bottom Width	10.00 ft
Grate Width	2.50 ft
Grate Length	4.0 ft
Local Depression	0.0 in
Local Depression Width	0.0 in
Grate Type	P-50 mm x 100 mm (P-1- 7/8"-4")
Clogging	50.0 %
Results	
Spread	21.6 ft
Depth	7.0 in
Wetted Perimeter	21.7 ft
Top Width	21.65 ft
Open Grate Area	4.0 ft ²
Active Grate Weir Length	10.5 ft

Worksheet for SD-1 Outlet Protection

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.041
Channel Slope	0.100 ft/ft
Left Side Slope	4.600 H:V
Right Side Slope	3.600 H:V
Bottom Width	20.00 ft
Discharge	92.50 cfs
Results	
Normal Depth	6.8 in
Flow Area	12.6 ft ²
Wetted Perimeter	24.8 ft
Hydraulic Radius	6.1 in
Top Width	24.65 ft
Critical Depth	9.9 in
Critical Slope	0.028 ft/ft
Velocity	7.31 ft/s
Velocity Head	0.83 ft
Specific Energy	1.40 ft
Froude Number	1.800
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.8 in
Critical Depth	9.9 in
Channel Slope	0.100 ft/ft
Critical Slope	0.028 ft/ft

Worksheet for SD-1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.028 ft/ft
Diameter	18.0 in
Discharge	14.00 cfs
Results	
Normal Depth	12.1 in
Flow Area	1.3 ft ²
Wetted Perimeter	2.9 ft
Hydraulic Radius	5.3 in
Top Width	1.41 ft
Critical Depth	16.6 in
Percent Full	67.2 %
Critical Slope	0.015 ft/ft
Velocity	11.09 ft/s
Velocity Head	1.91 ft
Specific Energy	2.92 ft
Froude Number	2.065
Maximum Discharge	19.01 cfs
Discharge Full	17.67 cfs
Slope Full	0.018 ft/ft
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	67.2 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.1 in
Critical Depth	16.6 in
Channel Slope	0.028 ft/ft
Critical Slope	0.015 ft/ft

4125 Reservoir Riprap Sizing

Design Manual Eq. 734: $V = 3(d_{50})^{0.5}(S_s - 1)/S^{0.17}$

Ss= 2.5

	V	S	d50
CHNL-1	4.91	0.105	0.55
CHNL-2	5.99	0.118	0.86
CHNL-3	9.29	0.115	2.04
CHNL-4	4.52	0.060	0.39
SD-1 Outlet	7.44	0.100	1.25

RIPRAP LENGTH OF PROTECTION

Project: 4125 RSVR SD-1

Riprap Pad Length

Equation 764 (CCRFCDD HCDDM)

$$L = \left(\frac{1}{2 \tan \theta} \right) \left[\left(\frac{A_t}{Y_t} \right) - D \right]$$

$[1/(2 \tan \theta)]$ = expansion angle of culvert flow
(from Figure 714 or 715)

3.5

Q_{100} = Discharge

14

 cfs

A_t = area of flow at allowable velocity = Q/V
 $V = 11.09 \text{ ft/s}$

1.3

 ft²

Y_t = tailwater depth ; if unknown use $Y_t = D \times 0.4$

0.6

 ft

D = diameter of RCP or width of RCB

1.5

 ft

L = Length of protection

2

 ft

Check:

If Equation 764 yields an unreasonable result, use the following:
(Per section 707.4.3 CCRFCDD Design Manual)

For RCB if $Q/WH^{1.5} \leq 8.0$ then;

For RCP if $Q/D^{2.5} \leq 6.0$ then;

5.08

$L \geq 3H$ or $3D$

4.5

 ft

OR

$L \leq 10H$ or $10D$

15

 ft

RIPRAP CALCULATION

RCP Outlet Protection

Project: 4125 RSVR SD-1

If the flow is supercritical use D_a for D:

Equation 762 (CCRFGD HCDDM)

$$D_a = 1 / 2 (D + Y_n)$$

Y_n = normal depth of supercritical flow in the culvert
(from Flowmaster or WSPG)

1.0083 ft

D = diameter of culvert

1.5 ft

D_a = average depth at supercritical flow

1.25 ft

Riprap d_{50}

Equation 760 (CCRFGD HCDDM)

$$d_{50} = D \times 0.023 \times \left[\frac{\left(\frac{Q}{D^{2.5}} \right)}{\left(\frac{Y_t}{D} \right)^{1.2}} \right]$$

D = diameter of culvert (or use D_a)

1.25 ft

Q = design discharge

14 cfs

Y_t = tailwater depth ; if unknown use $Y_t = D \times 0.4$

0.5017 ft

d_{50} = minimum rock size

0.688 ft

8.3 in

Appendix C

Electronic CD

Vance Skidmore, PE

Atkins
2270 Corporate Circle
Suite 200
Henderson, NV 89074-7755

vance.skidmore@atkinsglobal.com
702-551-0309

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LAS VEGAS VALLEY WATER DISTRICT

CONTRACT NO. C1548

4125 ZONE NORTH RESERVOIR

GRADING PLANS



LOCATION MAP

NOT TO SCALE

CAUTION TO CONTRACTOR:

THE CONTRACTOR SHALL BE RESPONSIBLE TO INVESTIGATE AND VERIFY THE ACTUAL LOCATION AND DEPTH OF ALL EXISTING UNDERGROUND FACILITIES AT LEAST 48 HOURS IN ADVANCE OF THE PERFORMANCE OF ANY WORK.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK:
D368 (REVISED 2008)
NAVD88 ELEVATION: 989.574 METERS (3,246.63 FEET)
FND USC&GS DISC SET IN ROCK
RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF
DETENTION BASIN.
T 21 S, R 59 E, S 03

Avoid cutting underground
utility lines. It's costly.

Call
before you
Dig

1-800-227-2600

CLV DWG # _____

LAS VEGAS VALLEY WATER DISTRICT

VERIFY SCALE

2270 Corporate Circle
Suite 200 Henderson,
Nevada 89074 Telephone:
702/263-7275
Fax: 702/263-7200

ATKINS

1 1/2 0 1/2 1
BAR REPRESENTS
ONE AND ONE-HALF
INCHES ON ORIGINAL

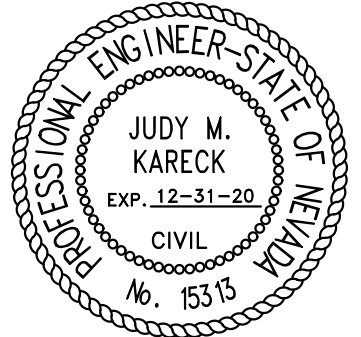
4125 ZONE NORTH RESERVOIR

COVER SHEET

SCALE
HORIZONTAL
VERTICAL
NONE

DRAWN BY: B. MILLER
CHECKED BY: J. KARECK
RECOMMENDED BY: L. STEVEN ANDERSON
ACCEPTED BY: RYAN C. PEARSON

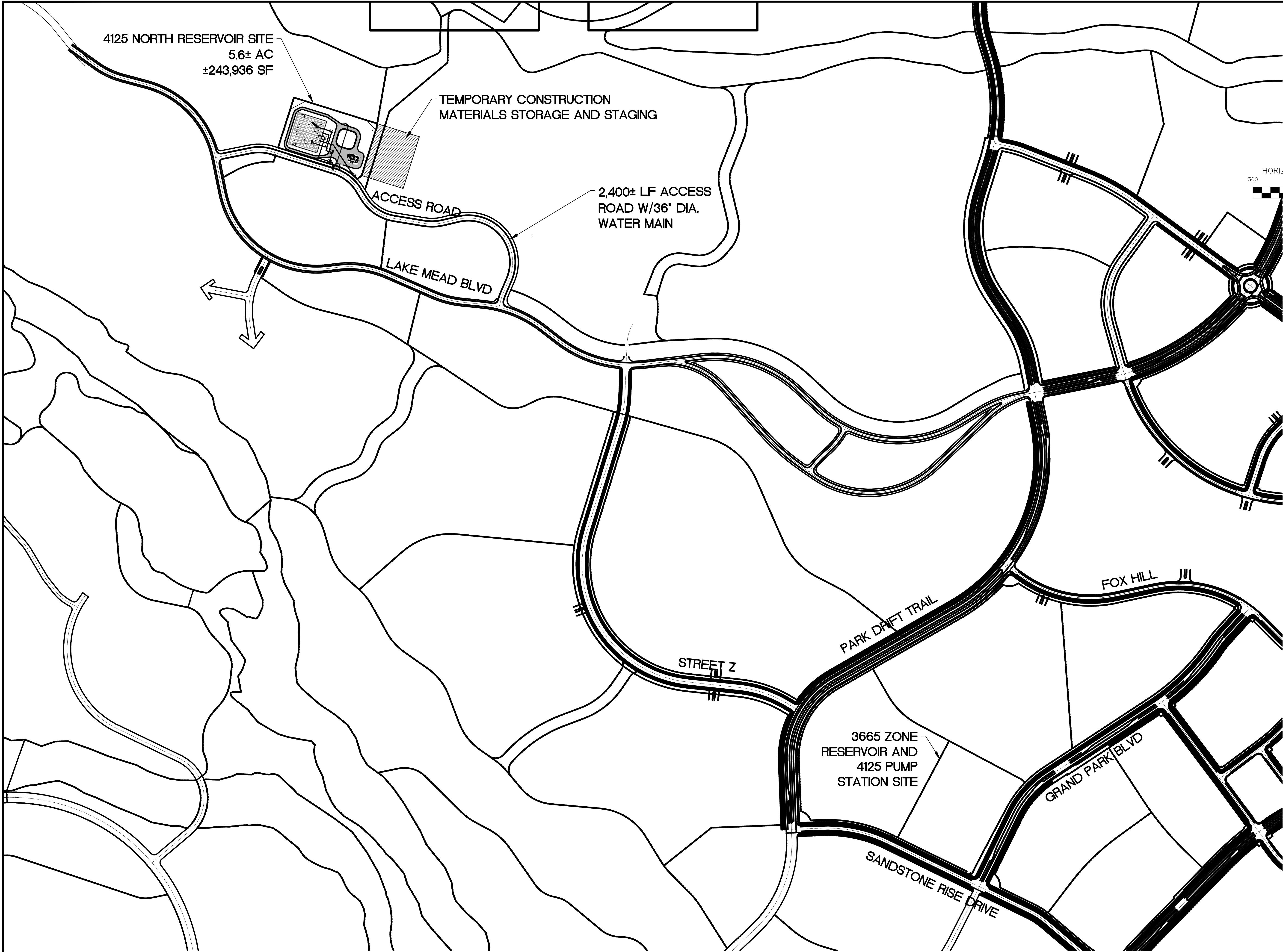
03/01/2020
03/01/2020
DATE
DATE



CONTRACT NUMBER

C1548

DRAWING NUMBER 61
SHEET 1 OF 142



4125 NORTH RESERVOIR SITE
5.6± AC
±243,936 SF

TEMPORARY CONSTRUCTION
MATERIALS STORAGE AND STAGING

ACCESS ROAD

2,400± LF ACCESS
ROAD W/36" DIA.
WATER MAIN

LAKE MEAD BLVD

STREET Z

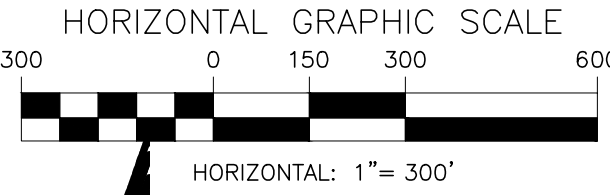
PARK DRIFT TRAIL

FOX HILL

GRAND PARK BLVD

3665 ZONE
RESERVOIR AND
4125 PUMP
STATION SITE

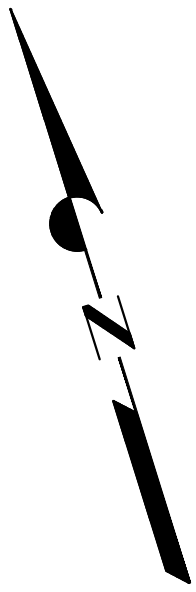
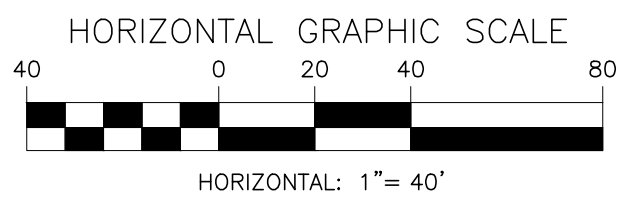
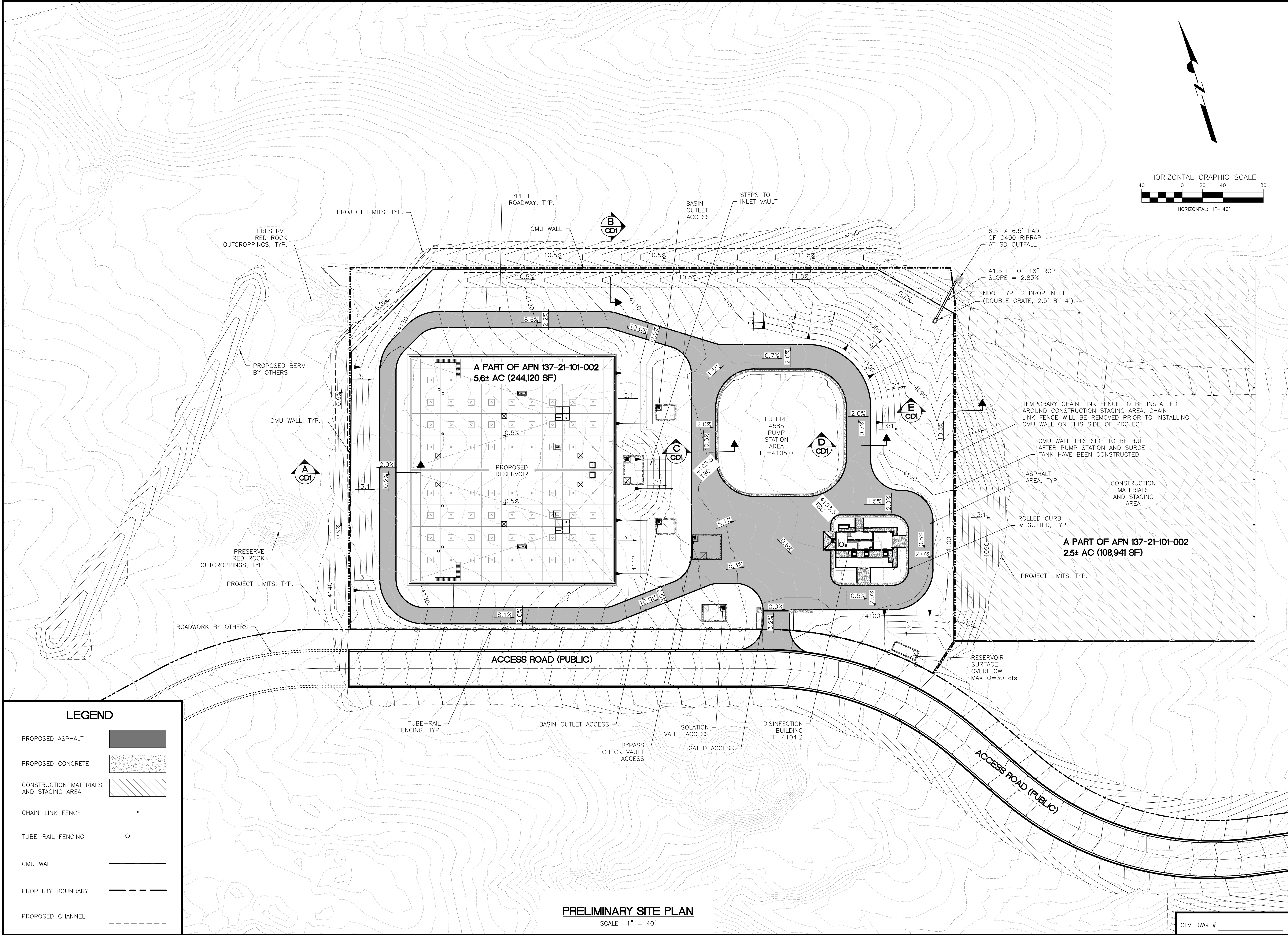
SANDSTONE RISE DRIVE



SITE VICINITY MAP
SCALE 1" = 300'

CLV DWG # _____

LAS VEGAS VALLEY WATER DISTRICT		2270 Corporate Circle Las Vegas, NV 89074 Telephone: 702/263-7275 Fax: 702/263-7200	
VERIFY SCALE	1/2" = 0' 1/2"	BAR REPRESENTS ONE AND ONE-HALF INCHES ON ORIGINAL	
4125 ZONE NORTH RESERVOIR		SITE VICINITY MAP	
DRAWN BY: _____		DATE: _____	
CHECKED BY: _____		DATE: _____	
RECOMMENDED BY: _____		DATE: _____	
ACCEPTED BY: _____		DATE: _____	
PROFESSIONAL ENGINEER-STATE OF NEVADA JUDY M. KARECK EXP. 12-31-20 CIVIL No. 15315		CONTRACT NUMBER G1548	
REVISIONS:		DRAWING NUMBER G6 SHEET 6 OF 142	



LEGEND

- PROPOSED ASPHALT
- PROPOSED CONCRETE
- CONSTRUCTION MATERIALS AND STAGING AREA
- CHAIN-LINK FENCE
- TUBE-RAIL FENCING
- CMU WALL
- PROPERTY BOUNDARY
- PROPOSED CHANNEL

PRELIMINARY SITE PLAN
SCALE 1" = 40'

LAS VEGAS VALLEY WATER DISTRICT

2270 Corporate Circle
Suite 200
Nevada 89074 Telephone:
702/263-7275
Fax: 702/263-7200

ATKINS

VERIFY SCALE

1/2 0 1/2

BAR REPRESENTS
ONE AND ONE-HALF
INCHES ON ORIGINAL

4125 ZONE NORTH RESERVOIR

OVERALL CIVIL SITE GRADING PLAN

SCALE
HORIZ. SCALE
VERT. SCALE
NONE

DRAWN BY: 03/04/2020

CHECKED BY: 03/04/2020

RECOMMENDED BY: DATE

L. STEVEN ANDERSON DATE

ACCEPTED BY: DATE

PROFESSIONAL ENGINEER-STATE OF NEVADA

JUDY M. KARECK

EXP. 12-31-20

CIVIL

No. 15313

CONTRACT NUMBER

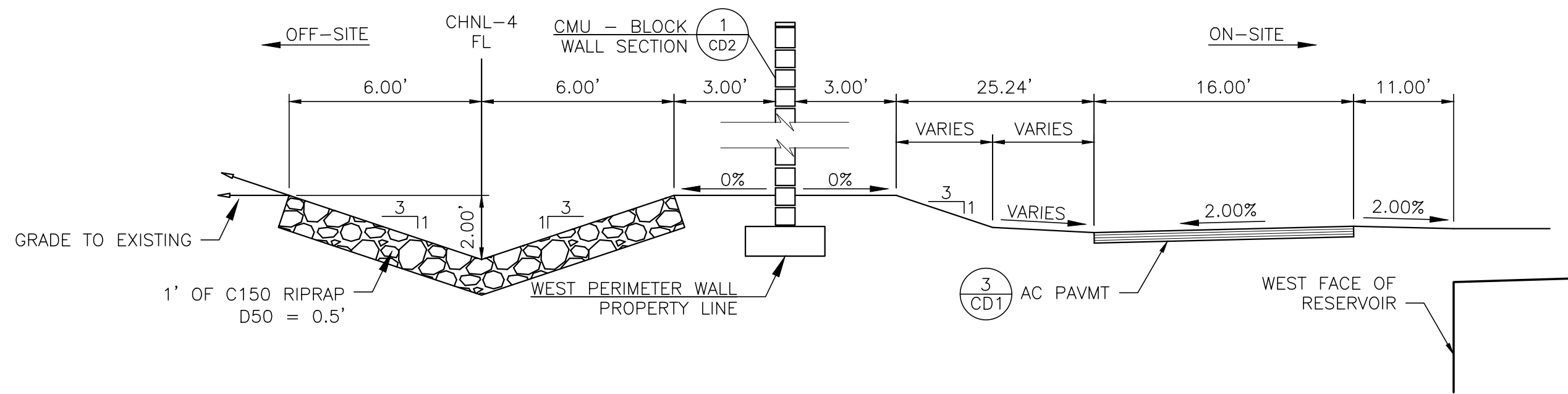
C1548

DRAWING NUMBER C1

SHEET 11 OF 142

REVISIONS:

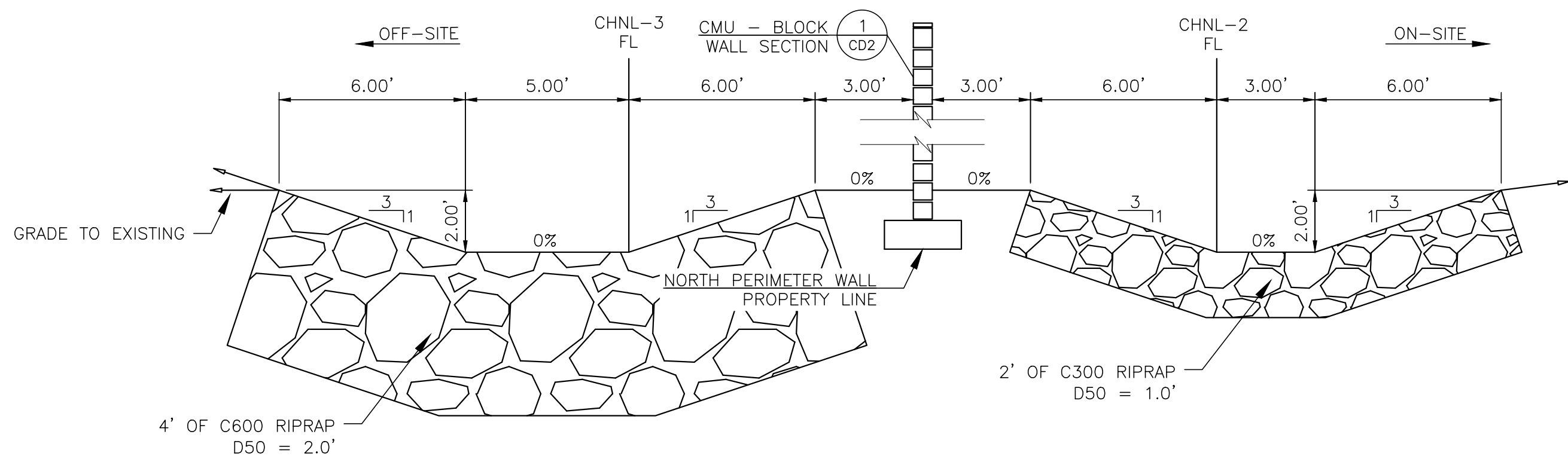
CLV DWG #



SECTION A

SCALE: NONE

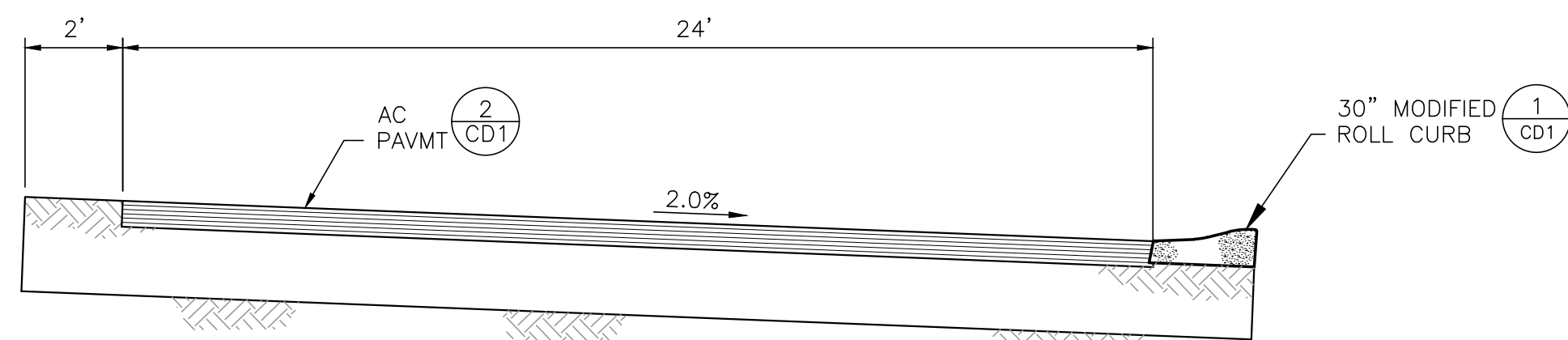
A
CD1



SECTION B

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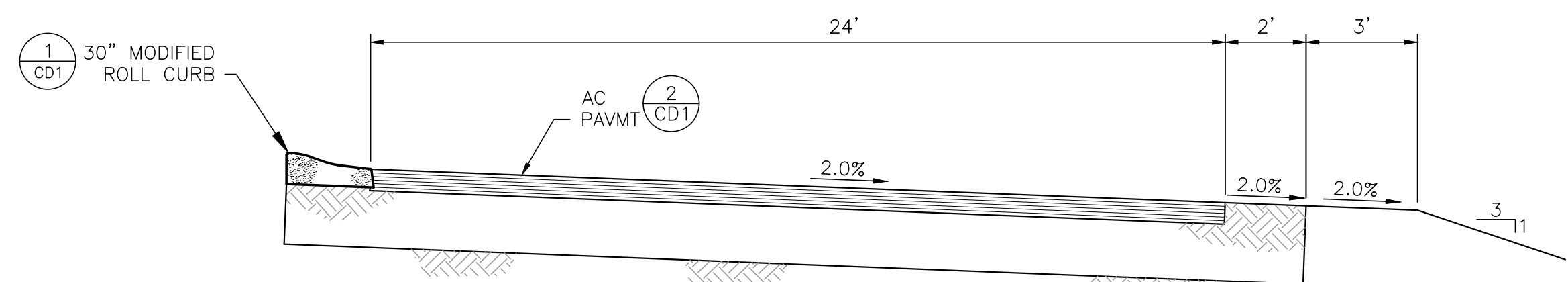
B
CD1



SECTION C

SCALE: NONE

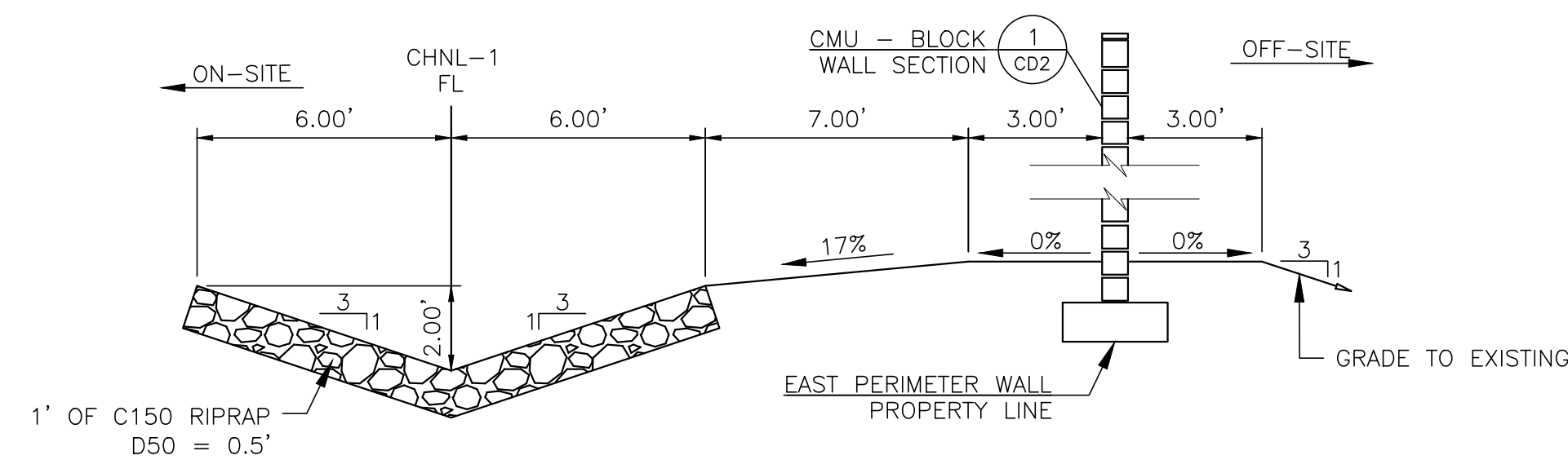
C
CD1



SECTION D

SCALE: NONE

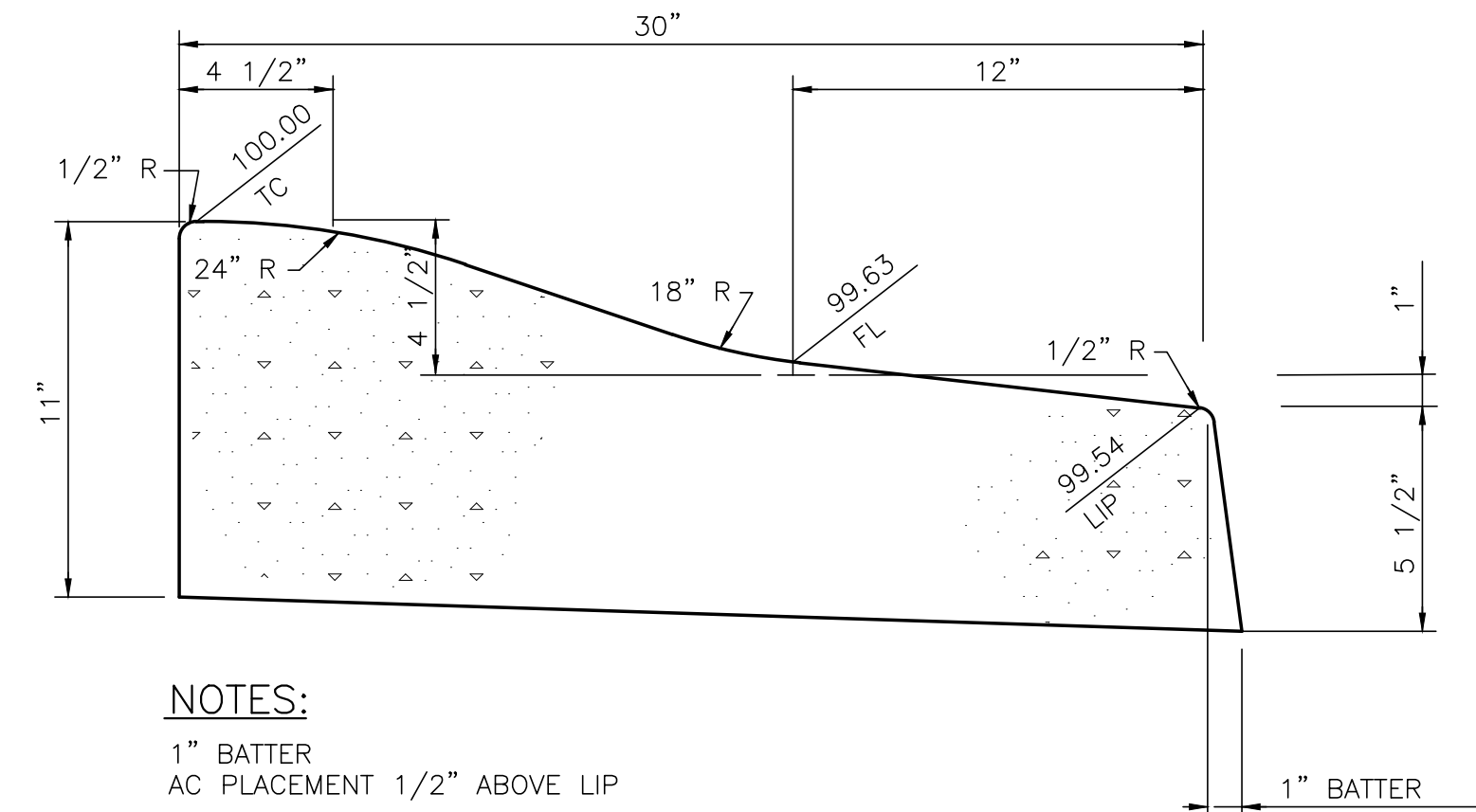
D
CD1



SECTION A

SCALE: NONE

E
CD1



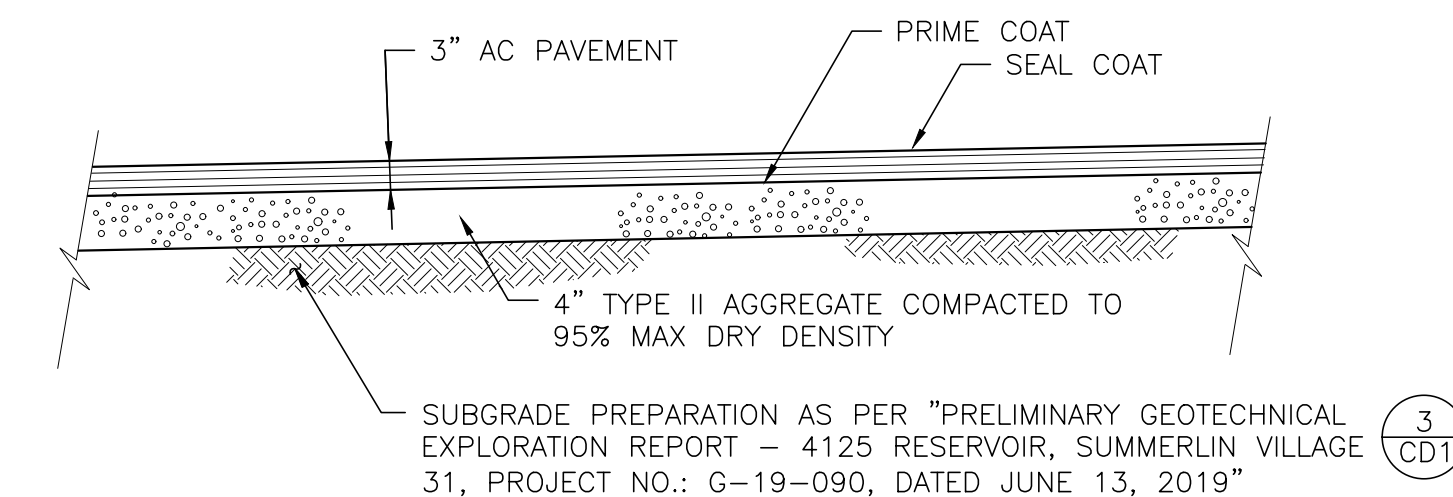
NOTES:

- 1" BATTER
- AC PLACEMENT 1/2" ABOVE LIP

30" MODIFIED ROLL TYPE CURB DETAIL

SCALE : 3/16" = 1'-0"

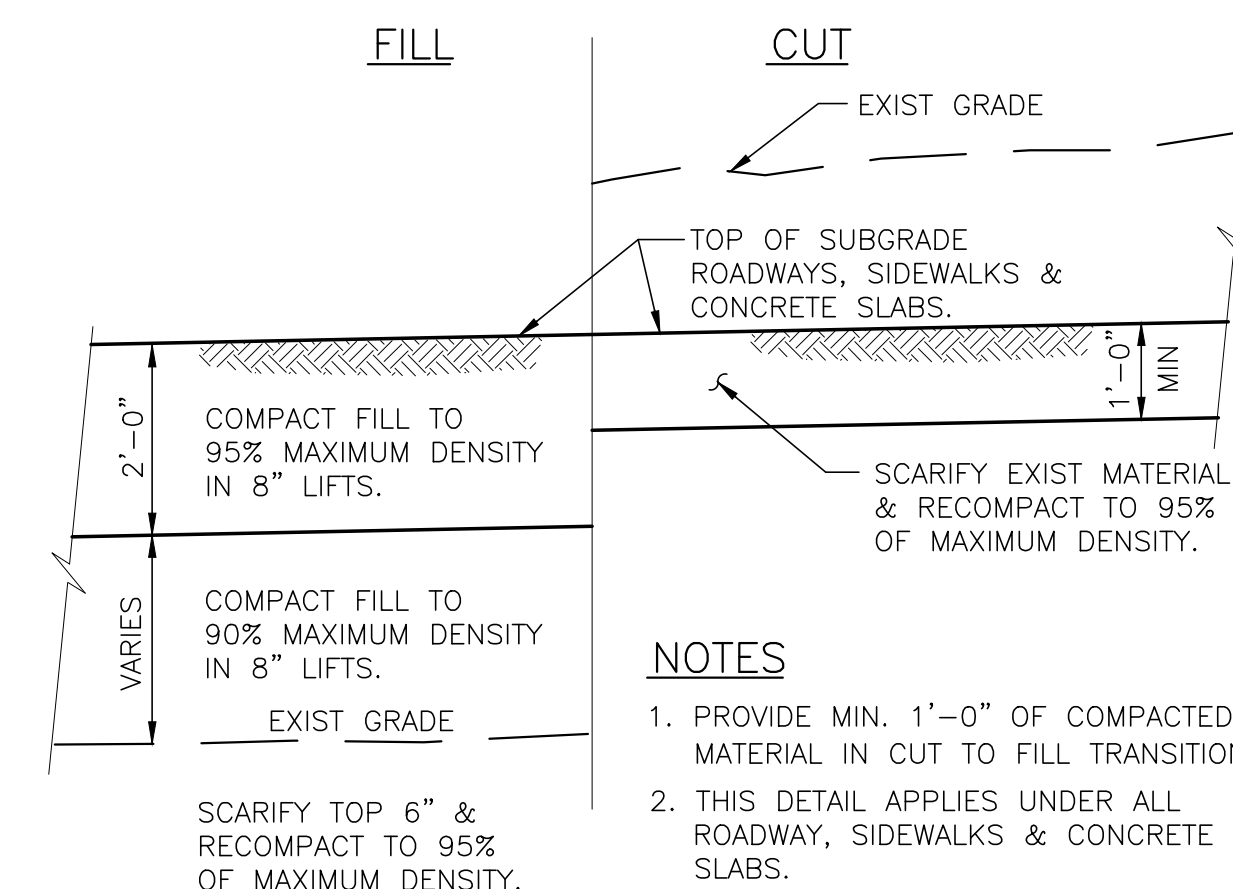
1
CD1



ASPHALTIC CONCRETE PAVEMENT - SECTION 2

SCALE: NONE

2
CD1



SUB GRADE PREPARATION - SECTION 3

NTS

3
CD1

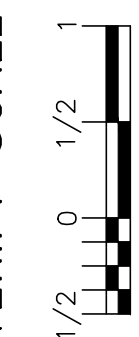
CLV DWG # _____

LAS VEGAS VALLEY WATER DISTRICT

2270 Corporate Circle
Summerlin, NV 89174
Telephone: 702/263-1275
Fax: 702/263-7200

ATKINS

VERIFY SCALE



BAR REPRESENTS
ONE AND ONE-HALF
INCHES ON ORIGINAL

4125 ZONE NORTH RESERVOIR

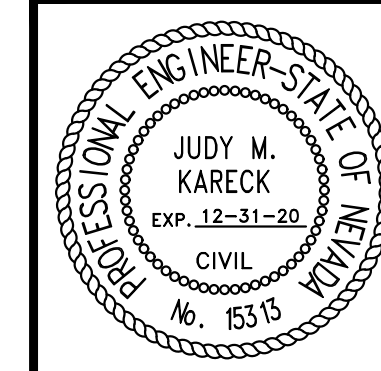
SITE WORK DETAILS I

SCALE
HORIZ. SCALE
VERT. SCALE

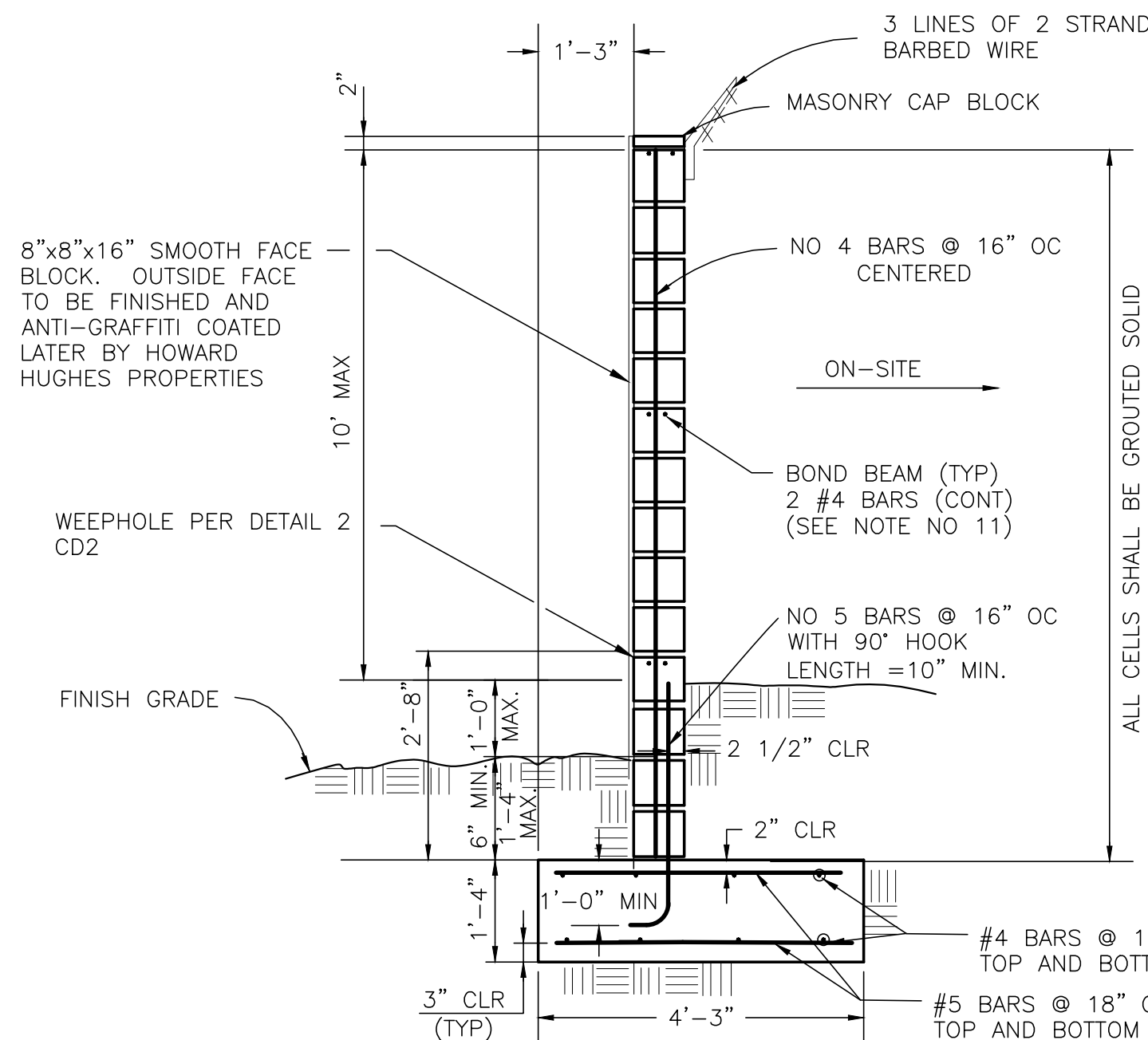
NONE

DRAWN BY: JUDY M. KARECK
CHECKED BY: JUDY M. KARECK
DATE: 03/04/2020

RECOMMENDED BY: L. STEVEN ANDERSON
ACCEPTED BY: RYAN C. PEARSON
DATE: 03/04/2020



CONTRACT NUMBER
C1548
DRAWING NUMBER CD1
SHEET 1 OF 3



NOTES:

- MASONRY UNITS SHALL BE ASTM C-90, GRADE N-1 HOLLOW CONCRETE UNITS. MASONRY DESIGN STRESS IS AS FOLLOWS: $f_m = 1500$ PSI
- MORTAR SHALL BE ASTM C270, TYPE "M" OR "S".
- GROUT SHALL HAVE A MINIMUM STRENGTH OF 2000 PSI AT 28 DAYS USING TYPE V CEMENT PER ASTM C-150.
- CONCRETE SHALL HAVE A MINIMUM STRENGTH OF 4500 PSI AT 28 DAYS USING TYPE V CEMENT PER ASTM C-150.
- REINFORCING STEEL SHALL CONFORM TO ASTM A-615, GRADE 60, $F_y = 60,000$ PSI.
- UNLESS OTHERWISE NOTED, ALL MATERIALS SHALL CONFORM TO THE INTERNATIONAL BUILDING CODE, LATEST EDITION, AND PER STANDARD SPECIFICATIONS FOR THE CITY OF LAS VEGAS, NEVADA.
- SOLID GROUT ALL MASONRY UNITS AS SHOWN IN DRAWINGS.
- ALL WALLS ARE SUBJECT TO APPROVAL BY THE CITY OF LAS VEGAS BUILDING DEPARTMENT.
- STEP WALL AT 8" COURSE TO MAINTAIN MINIMUM 8' HEIGHT. THE 1'-0" MAXIMUM GRADE DIFFERENCE MAY BE PLACED ON EITHER SIDE OF THE WALL.
- ALL CORNERS OR ANGLES SHALL BE TIED TOGETHER WITH REINFORCING STEEL AND GROUTED SOLID.
- THE WALL SHALL HAVE HORIZONTAL JOINT REINFORCEMENT AT EVERY COURSE OR ELSE A HORIZONTAL BOND BEAM WITH 2-#4 BARS EVERY 32".
- BOND BEAMS AND JOINT REINFORCING SHALL NOT BE CONTINUOUS THROUGH WALL CONSTRUCTION JOINTS.
- WHERE VERTICAL GROUT LIFTS ARE NOT CONTINUOUS FOR THE ENTIRE HEIGHT OF THE WALL, TERMINATE LIFT 1" BELOW TOP OF TOP LOCATION TO FORM A KEY FOR FUTURE LIFTS.
- LOCATE CONSTRUCTION JOINTS IN WALL AT STEP LOCATIONS OR AT 24'-0" MAXIMUM (SEE MASONRY CONTROL JOINT DETAIL 10 SHEET SD3).
- PROJECT SOILS REPORT: NOVA GEOTECHNICAL AND INSPECTION SERVICES. NOVA PROJECT NO. G-19-090 JUNE 13, 2019

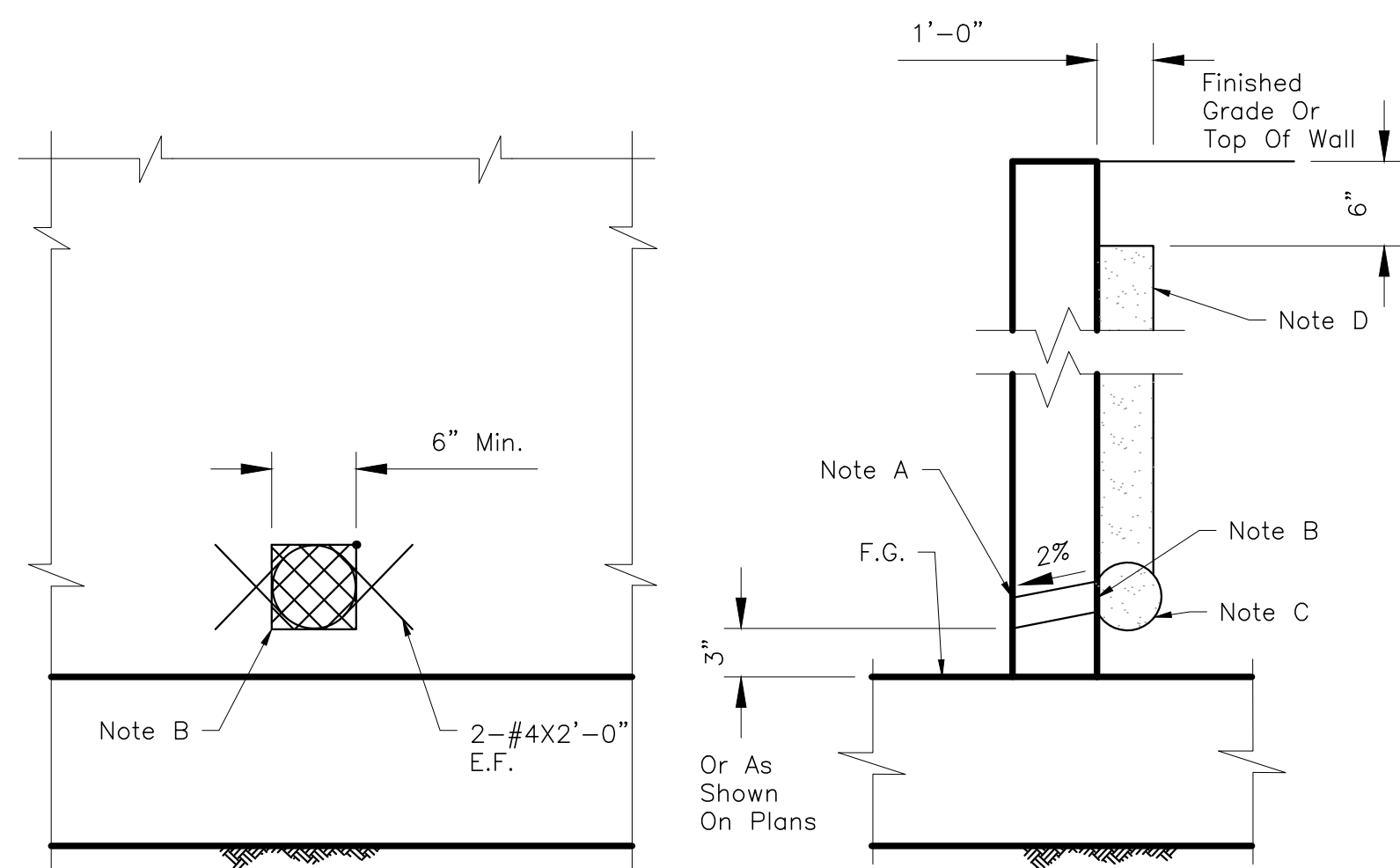
ALL RECOMMENDATIONS MADE BY THE ABOVE SOILS REPORT SHALL BE IMPLEMENTED DURING CONSTRUCTION.

- WATERPROOFING: APPLY ONE COAT OF ASPHALT EMULSION TO THE BACK OF THE RETAINING WALL, APPLY 15-LB FELT INTO THE ASPHALT, AND THEN APPLY A SECOND COAT OF ASPHALT EMULSION OVER THE FELT.

CMU - BLOCK WALL SECTION (TYPICAL)

SCALE : 1/2" = 1'-0"

1
CD2



ELEVATION

SECTION

- 2" DIA. PVC WEEPHOLES SPACED AT 8'-0" MAX. FOR CANTILEVER WALLS. BOTTOM OF EXPOSED WALL DRAINS SHALL BE LOCATED 3" ABOVE FINISHED GRADE OR AS SHOWN ON PLANS
- 6" SQUARE ALUMINUM OR GALVANIZED STEEL WIRE 1/4" MESH HARDWARE CLOTH (MIN. WIRE DIA. 0.030") ANCHOR FIRMLY TO BACK SPACE.
- ONE CU. FT/FT OF DRAIN BACKFILL, ENCAPSULATED IN NONWOVEN FILTER FABRIC, MIRAFL 180N OR EQUAL.
- 2" OR 3" SIZE DRAIN BACKFILL PER SECTION 704.03.01 OF THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA.

WEEP HOLE DETAIL

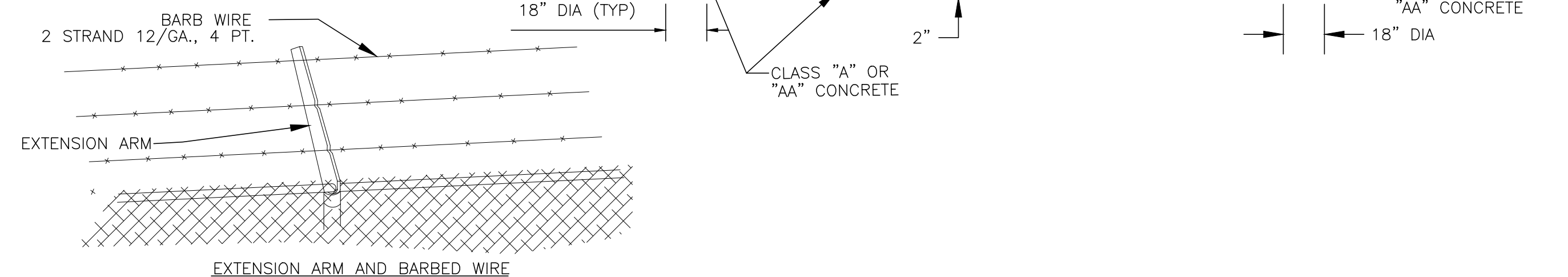
SCALE: N.T.S.

2
CD2

NOTES

- FENCING SHALL BE CHAIN LINK AND SHALL CONSIST OF GALVANIZED CHAIN LINK FABRIC WITH BLACK VINYL COATING ON STEEL POSTS.
 - ALL POST TOPS SHALL BE FITTED WITH SUITABLE FINIALS
 - ALL POSTS SHALL CONFORM TO ASTM A53, GRADE B STEEL
 - BRACES SHALL BE SPACED APPROXIMATELY 12" BELOW TOP OF TERMINAL POSTS OF TERMINAL POSTS AND SHALL EXTEND FROM END, GATE, OR CORNER POSTS TO FIRST ADJACENT LINE POST.
 - ALL FITTINGS SHALL BE HOT DIPPED GALVANIZED MALLEABLE, CAST IRON, OR PRESSED STEEL.
 - TOP AND BOTTOM SELVAGES OF THE FENCE SHALL HAVE A TWISTED AND BARBED FINISH.
- BARBED WIRE, EXTENSION ARMS, AND TOP HORIZONTAL RAILS SHALL BE INSTALLED.

TABLE 1 FOR CHAIN LINK FENCE 8' AND LESS		
LOCATION	MIN. SIZE	MIN. WEIGHT
END, CORNER & PULL	5.56 OD	14.6
LINE	5.56 OD	14.6
BRACES	2.38 OD	3.66
TOP RAIL	2.38 OD	3.66



CHAIN LINK FENCE

NOT TO SCALE

3
CD2

LAS VEGAS VALLEY WATER DISTRICT

2270 Corporate Circle
Las Vegas, NV 89074
Telephone: 702/263-7275
Fax: 702/263-7200

ATKINS

VERIFY SCALE

1/2 0 1/2 1

BAR REPRESENTS ONE AND ONE-HALF INCHES ON ORIGINAL

4125 ZONE NORTH RESERVOIR

SITE WORK DETAILS II

SCALE
HORIZ. SCALE
VERT. SCALE
NONE

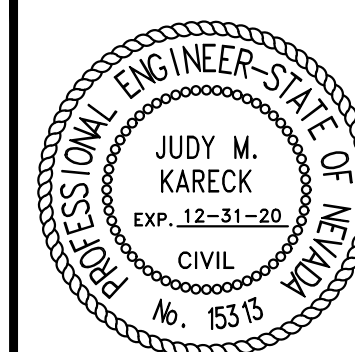
DRAWN BY: 03/04/2020
CHECKED BY: 03/04/2020

RECOMMENDED BY: DATE

L. STEVEN ANDERSON DATE

ACCEPTED BY: DATE

RYAN C. PEARSON DATE



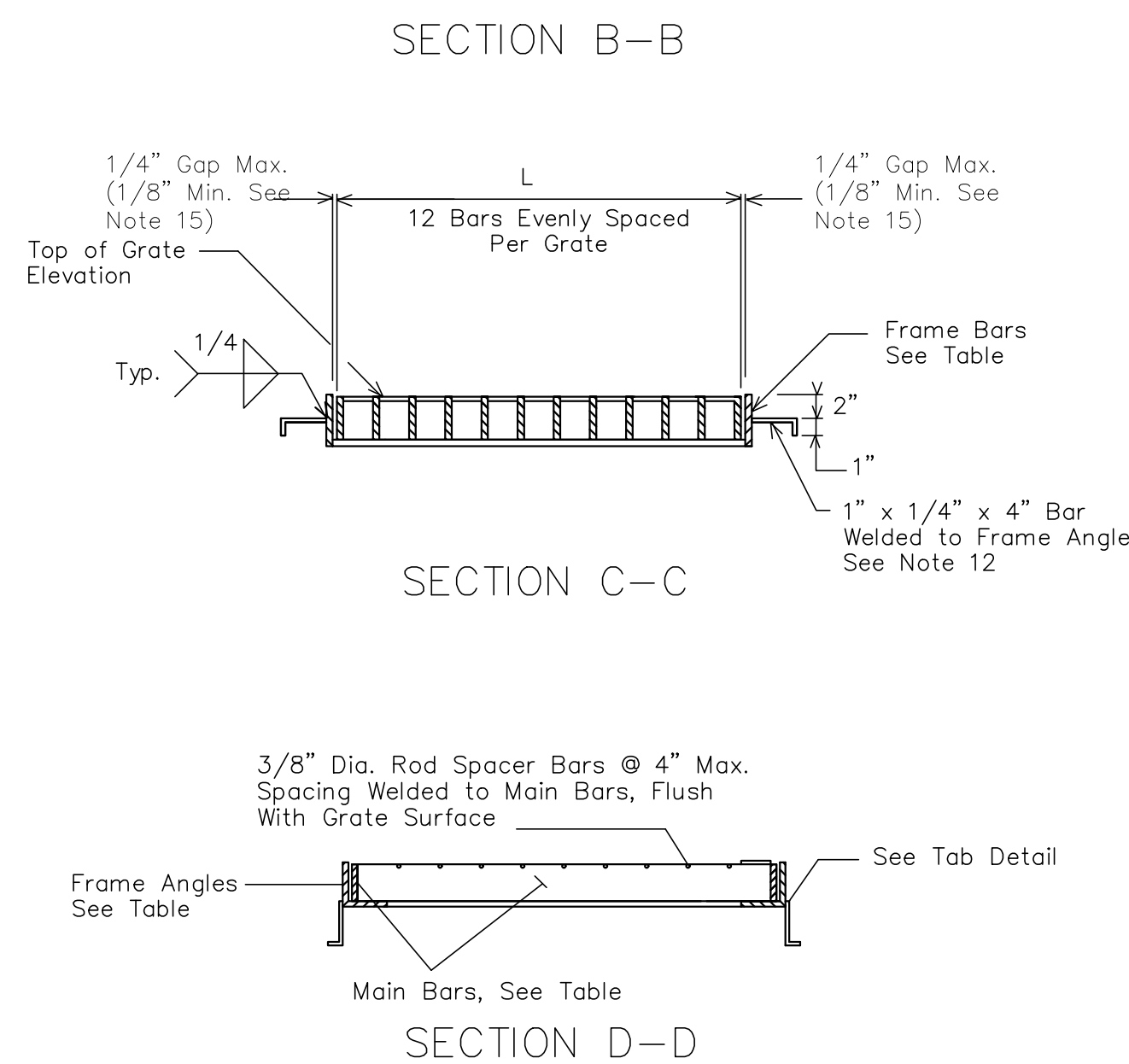
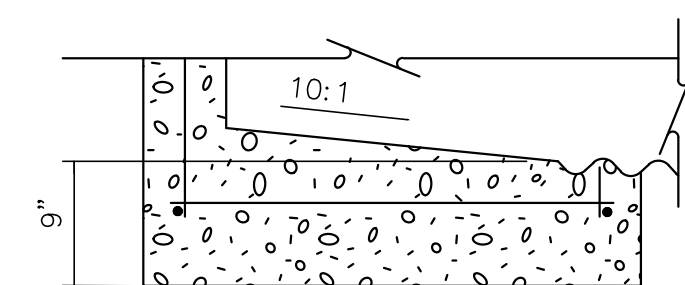
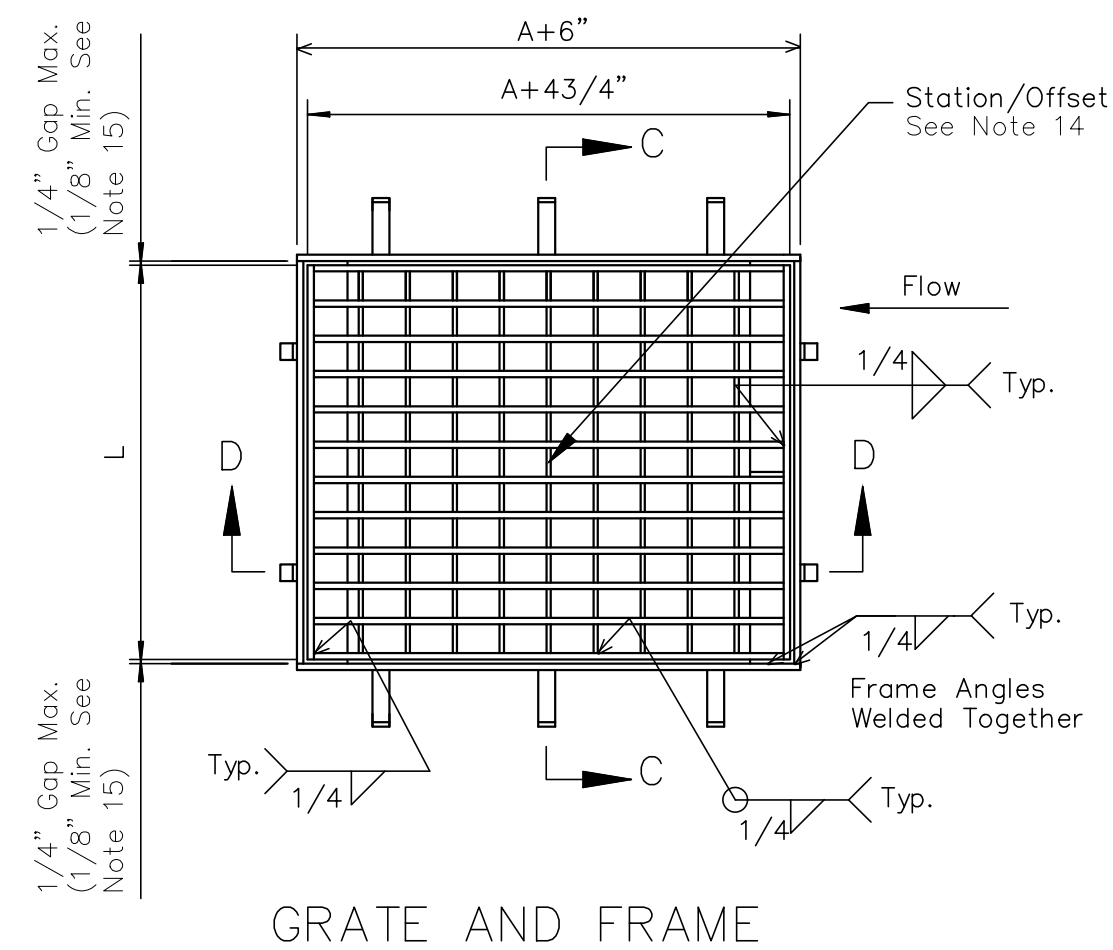
CONTRACT NUMBER

C1548

DRAWING NUMBER CD2
SHEET 2 OF 3

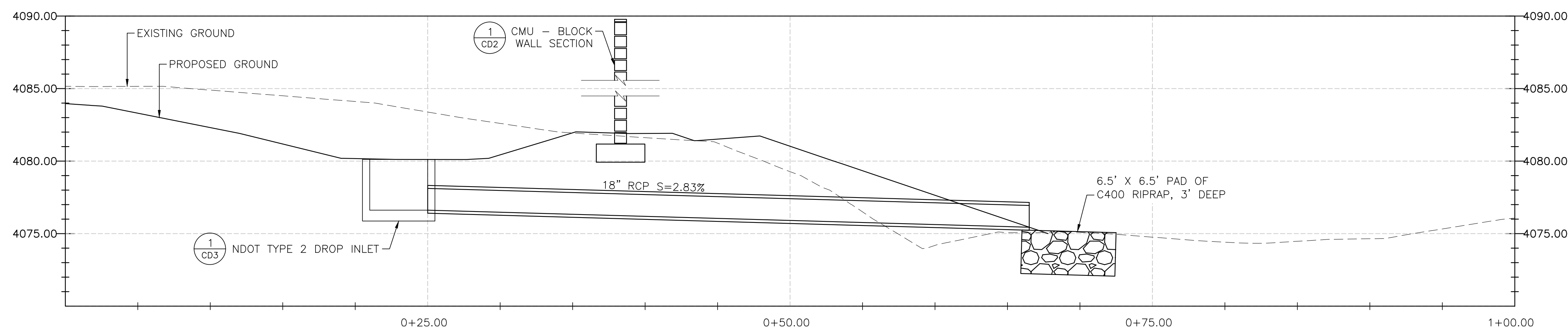
CLV DWG #

PIPE SIZE (INCH)	A	H (FT)	MAIN BARS (INCH)	FRAME ANGLES (INCH)	FRAME BARS (INCH)	L (FT)
						DOUBLE GRATE
18	2' 6"	3.50	41/2 X 3/8	5 X 3 X 3/8	5 X 3/8	4'



1. All concrete shall be class A or AA.
2. Reinforcing steel shall be No.4 bars with maximum spacing at 18 inch centers, wired tightly at all intersections and embedded 2 inches clear of all concrete surfaces.
3. Exposed edges of concrete shall be chamfered 1 inch.
4. Dimensions may be varied to fit local conditions if ordered by the engineer.
5. Commercial prefabricated gratings approved by the bridge division may be used in lieu of the field-welded grating shown.
6. Extreme low cover situations to be reviewed by hydraulics engineer.
7. Slope catch basin floors 10:1 from all directions toward outlet pipe. If basin is used as a junction, shape flow line(s) to outlet pipe and provide a 10:1 slope to flow line(s).
8. See sheet R-2.9.1 for details if connecting HDPE pipe.
9. A single Type 2 drop inlet shall be constructed unless a double or triple is specified.
10. Single grate configuration shown for clarity. Outside dimensions of each grate shall measure 2 feet by A+43/4".
11. Run rebar continuous thru construction joint. Joint must be a minimum of 3 inches from horizontal bars.
12. Weld one tab on > of grate and remaining two tabs 6 inches from edge of frame. Six tabs per inlet, three tabs on each side
13. Weld tabs 6 inches from edge of frame. Four tabs per grate, two on each side.
14. For multiple grate installations, the station/offset is to the center of the concrete drop inlet structure.
15. Grate is to fit in the frame and be easily removed.
If the gap between the grate and frame is greater than 1/4" on each side of the grate, the grate and frame shall be removed and reconstructed to the tolerances specified or, with approval of the engineer, a filler strip up to 1/4" in thickness may be welded flush to the top of the frame to reduce the gap to a maximum of 1/4"
16. Additional pipe penetrations may be placed in any wall. Pipe penetrations are to be to the center of the structure wall unless specified otherwise.

NOT TO SCALE



1 INCH = 5 FEET