

DS #:

5006

APN:

138.20.413.017.5, 138.29.316.001

PROJECT:

TPC Summerlin - Turf Modification

SUBMITTAL:

1st

SCANNED BY/DATE:

CHECKED BY/DATE:



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		June 27, 2018
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
	TPC Summerlin – Turf Modification	GCW Engineers / Surveyors
Cross Streets:	NWC of Summerlin Pkwy. & Rampart Blvd.	Tournament Players Club
File Number:	F:\Depot\DSMemos\DS5006A.doc	Bart Anderson, P.E., DevCo
Parcel Number:	138-20-413-017 & 138-29-310-001	CCRFCD
Zoning Action:	SDR-xxxxx	
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	6/12/2018	6/26/2018	See Comments Below	\$400.00	496704: \$400
TOTAL FEES (LDDRS):				\$400.00	----

REMARKS:

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

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

1. Provide a copy of the zoning/planning conditions associated with this site (SDR-xxxxx) 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. It appears that *Tournament Players Club Summerlin* proposes to reduce grass area above the drainage channel freeboard in various locations and replaces with desert landscaping. If it's in the channel, the velocity will be non-erosive. However, the City recommends not disturbing the channel flow line at all.
3. **Figure 5:** *Hydraulic Section 6* is nowhere to be found on the drainage map. Identify clearly in the next submittal.
4. Provide grading plan with table to detail the locations, exact quantities/dimensions of the grass to be replaced with desert landscaping with respect to the Sections or channel stationings.
5. Provide a detail *Landscape Plan* in the next submittal.

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

END OF REMARKS

ays

T/R/S: T20S/R60E/20

AREA L-20

TRANSACTION REPORT

JUN/27/2018/WED 02:52 PM

FAX(TX)

#	DATE	START T.	RECEIVER	COM.TIME	PAGE	TYPE/NOTE	FILE
001	JUN/27	02:51PM	7028042299	0:00:32	2	MEMORY OK	SG3 1586

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Albert Sung

From: Bart Anderson
Sent: Tuesday, July 10, 2018 2:10 PM
To: Cody Beck; summer.ortiz@snwa.com
Cc: Albert Sung; Steve Jones; Dale Hahn; Tim Parks; Oh-Sang Kwon; Lucien Paet
Subject: RE: TPC Summerlin Turf Removal - Planning conditions required for TDS approval. (398-A894)
Attachments: Area 11 Sewer Map.pdf; Area 6 Sewer Map.pdf; Area 5 Sewer Map.pdf; Area 1 Sewer Map.pdf

Cody:

Flood Control had questioned whether entitlement actions were needed for your proposal. The Planning Department has determined that no entitlement action is needed, so this can be handled through the Drainage Study and coordination with the Sewer Planning Section of the Department of Public Works (Keith Letus – kletus@lasvegasnevada.gov).

Flood Control's concerns are mainly the identification of specific areas within the public drainage easements that will have the turf replaced; what will replace the turf, and will it have similar runoff/erosion protection properties.

Sewer Planning concerns are the presence of a number of public sewer lines crossing the areas in question, and the preservation of the integrity of the sewer lines, and what type of landscaping will be provided in lieu of the turf, as they have specific requirements/limitations on the type of landscaping allowed over public sewers.

Refer to the attached maps indicating locations where public sewer extends across the golf course within public sewer easements. The maps indicate the approximate limits of the easement (10-feet either side of pipeline). Most of these areas are impacted by the proposed conversions. Per the Design and Construction Standards for Wastewater Collection Systems, Southern Nevada Edition 2009, "No permanent landscaping having a mature height of greater than 3-feet shall be placed anywhere in any easement or in the vehicle ingress or egress pathways to easements."

Plans acceptable to Flood and Sewer will need to be submitted to our Land Development Section for a permit and inspection of any construction within the public easement areas.

SNWA: once the referenced plans have been approved by the City and a permit issued, the City will have no objection to the requested Turf Removal process going forward.

Please let me know if any of you have any questions or concerns.

bart

From: Cody Beck [mailto:CBeck@gcwengineering.com]
Sent: Monday, July 09, 2018 9:54 AM
To: Bart Anderson; Lucien Paet
Cc: Albert Sung; Steve Jones; Dale Hahn
Subject: TPC Summerlin Turf Removal - Planning conditions required for TDS approval. (398-A894)

Bart,

TPC Summerlin is proposing to replace some turf areas with desert landscaping. SNWA requires a TDS for this type of project which we submitted to the City of Las Vegas on June 12, 2018. We received comments from the City on June 27th

which indicates that zoning/planning conditions need to be established for the site. Steve and I talked with Lucien this morning and discussed what was required to get the ball rolling on this.

Lucien requested a site plan or exhibit showing the replacement so that you can review areas. I have attached the exhibits of the turf replacement areas here. We are working on a more formal site plan/landscaping plan now and can send that if it is required.

Let me know if you have any questions.

Thanks,



[Cody Beck, EI](#)
Flood Control Division

O 702.804.2000 **D** 702.804.2089
F 702.804.2160



1555 South Rainbow Boulevard
Las Vegas, Nevada 89146

Sending us a large file? Use the [GCW File Transfer Site](#)

Note - Any files contained within are to be used for information ONLY.
Accuracy or design information to be verified from approved original plans. Use of electronic media is at the sole risk of the user.

**TECHNICAL DRAINAGE STUDY
FOR
TPC Summerlin**

398-A894

June 2018

Prepared for:

**Tournament Players Club Summerlin
1750 North Rampart Boulevard
Las Vegas, Nevada 89128**

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: TPC Summerlin Date: June 6, 2018

Location of Development: a) Descriptive (Cross Streets) North/South: Rampart Boulevard
East/West: Summerlin Parkway

b) Section: 20 & 29 Township: 20S Range: 60E

c) APN : 138-20-413-017 & 138-29-310-001

Name of Owner: Tournament Players Club

Telephone No.: 702.254.4340 Fax No.: Not Available E-Mail Address: dalehahn@pgatourtpc.com

Address: 1750 North Rampart Boulevard Las Vegas, Nevada 89128

Contact Person-Name: Steve Jones, P.E. Telephone No.: 702.804.2000

* E-Mail Address: sjones@gcwengineering.com Fax No.: 702.804.2299

Firm: GCW

Address: 1555 South Rainbow Boulevard Las Vegas, Nevada 89146

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	☐	Drainage Study Only

1. Total Owned Land Area: At Site: +/- 227.98 acres Being Developed/Disturbed: +/- 7.96 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.): Surface Replacement

5. Approximate upstream land area which drains to the subject site: 7.68 Square Miles

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

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Angel Park Detention Basin

8. Briefly describe your proposed schedule for the subject project: The Client intends to start construction as soon as practical. Any expediting of this process is appreciated.

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.**

Engineer's Seal

Local Entity File No. _____

Revision

Date

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL		
DRAINAGE SUBMITTAL CHECKLIST		
Project Name: TPC Summerlin	Map ID: 138-20-413-017 & 138-29-310-001	
Firm Name: GCW	Engineer: Steve Jones, P.E.	
Address: 1555 Outh Rainbow Boulevard		
City: Las Vegas	State: Nevada	Zip: 89146
Phone Number: 702.804.2000	Fax Number: 702.804.2299	
Property Owner: Tournament Players Club		
Address: 1750 North Rampart Boulevard		
City: Las Vegas	State: Nevada	Zip: 89146
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 (CCRFCDD) 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. ☐ <u>N/A</u> 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 CCRFCDD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.		
REFERENCE:		STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes No

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

III. DRAINAGE PLAN

Yes No

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

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
☐	<u>N/A</u>	Streets with off-set crowns.
☐	<u>N/A</u>	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
☒	☐	Property lines.
☒	☐	Right-of-way lines and widths, existing and proposed.
☒	☐	Existing improvements and their elevations.
☒	☐	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
☐	<u>N/A</u>	Concentration points and drainage flow direction with Q100 and V100 and D100 in streets.
☒	☐	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
☐	<u>N/A</u>	Location and cross-section of street capacity calculations.
☐	<u>N/A</u>	Cross-sectional detail for channels, including cutoff wall locations.
☒	☐	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations.
☐	<u>N/A</u>	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
☐	<u>N/A</u>	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.
☐	<u>N/A</u>	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
☐	<u>N/A</u>	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
☐	<u>N/A</u>	Building and/or lot numbers.
☒	☐	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☒	☐	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes No

_____ 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 Q100 flows.

_____ N/A 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

_____ N/A Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.

_____ N/A 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.

_____ N/A 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.

_____ N/A Use of correct precipitation values in and around the McCarran Airport rainfall area.

X _____ A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.

X _____ A summary table of stormwater flows showing basin area, Q10 and Q100 for both individual basins and combined basin flows, where applicable.

X _____ Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.

X _____ 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	
_____	<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 Q100 and Q10 flows representing the worst case for interior and all perimeter streets. Q100 d x v < 8. Q10 d x v < 6 and 12 foot dry lane for rights-of-way > 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
_____	<u>N/A</u>	A summary table of interior and exterior street capacity calculations showing the street name, Q100 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 Q100 weir height or flow depth, whichever is greater.
_____	<u>N/A</u>	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
_____	<u>N/A</u>	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
_____	<u>N/A</u>	Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.
<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. _____ 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.

**TECHNICAL DRAINAGE STUDY
FOR
TPC Summerlin**

398-A894

June 2018

Authored By:

Cody Beck, EI

Prepared By:

**GCW, Inc.
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299**

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XI.	REFERENCES	5

I. INTRODUCTION

Tournament Players Club Summerlin is proposing to remove approximately 7.96 acres of grass and replace it with desert landscaping. The replacement areas have been highlighted in green on the attached photographs in Appendix D. The project is located at the northwest corner of Rampart Boulevard and Summerlin Parkway, on Assessor's Parcel Numbers (APN) 138-20-413-017 and 138-29-310-001.

The purpose of this report is to provide a detailed hydrologic and hydraulic analysis for the replacement. The following tasks were performed in the preparation of this report:

- ♦ Identify previous drainage studies for the project site and surrounding areas.
- ♦ Determine the FEMA floodplain designation for the project site.
- ♦ Identify existing and proposed regional drainage facilities adjacent to the project site.
- ♦ Identify existing drainage areas and facilities that affect the replacement areas.
- ♦ Estimate the peak runoff impacting the replacement areas during the 100-year return period storm for the existing and proposed condition.
- ♦ Provide hydraulic calculations in the replacement areas.
- ♦ Determine the impacts downstream of the project site after the grass areas are replaced with desert landscaping, if any.

II. PREVIOUS DRAINAGE STUDIES

In preparation of this study, the following approved drainage studies and improvement plans were referenced to complete hydrologic and hydraulic analyses. These studies have been reviewed and accepted as suitable for reference material.

The Clark County Regional Flood Control District *2013 Las Vegas Valley Flood Control Master Plan Update* (Reference 1, hereinafter referred to as the 2013 Master Plan Update) established the offsite drainage areas and flow rates that impact the project site. The 2013 Master Plan Update subbasins GC1B-C, SF11-C, and SF2-C have been referenced for prorated flow rate calculations. Pertinent reference material has been included in Appendix C.

The *Drainage Study for Summerlin Village 1 South Parcel 4* (Reference 2, hereinafter referred to as the Parcel 4 Study) was approved by the City of Las Vegas on September 11, 1992. This study has been utilized to determine the subbasin delineation (TR5.1) for parcel 4 of Summerlin Village 1 South. Pertinent reference material has been included in Appendix C.

The *Drainage Study for Summerlin Village 1 South Parcel 5* (Reference 3, hereinafter referred to as the Parcel 5 Study) was approved by the City of Las Vegas on November 22, 1991. This study has been utilized to determine the drainage patterns for parcel 5 of Summerlin Village 1 South. It was determined that a majority of this parcel does not impact the project site. Pertinent reference material has been included in Appendix C.

The *Drainage Study for Summerlin Village 1 South Parcel 6* (Reference 4, hereinafter referred to as the Parcel 6 Study) was approved by the City of Las Vegas on April 4, 1991. This study has been utilized to determine the drainage patterns for parcel 6 of Summerlin Village 1 South. It was determined that a majority of this parcel does not impact the project site. Pertinent reference material has been included in Appendix C.

III. LOCATION AND DESCRIPTION

The project is located on Section 20 and 29 of Township 20 South, Range 60 East, in the City of Las Vegas, Nevada. Figure 1 located in Appendix A shows the location of the project site. The project site currently exists as a fully functional golf course which generally slopes from the west to the east. For this study, the proposed improvements consist of replacing various grass areas with desert

landscaping. These areas have been highlighted in green on the attached photographs included in Appendix D.

IV. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD HAZARD ANALYSIS

Figure 2A and 2B, located in Appendix D, show the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) containing Community Panel Number 32003C2145F, dated November 16, 2011 and Community Panel Number 32003C2135F, dated November 16, 2011. A majority of the project site lies within a FEMA designated Zone X area. Areas designated as Zone X are described as areas outside the 0.2 percent annual chance floodplain. A portion of the project site at the southeast corner lies within a FEMA designated Zone A area. Areas designated as Zone A are areas subject to flooding by the 1% annual chance flood with no base flood elevations established. Therefore, a portion of the project site is located within a FEMA designated Special Flood Hazard Area (SFHA). Note that no improvements are recommended within the FEMA designated SFHA and any surface replacement will occur outside the Zone A boundary.

V. CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (CCRFCD) FACILITIES

Figures 3 and 4 are reproductions of Figure H-25 and F-25 of the CCRFCD 2013 Las Vegas Valley Master Plan Update (Reference 1, hereinafter referred to as the 2013 MPU). As shown on the figure, CCRFCD Facility APNO 0013 is located on the project site. Furthermore, CCRFCD Facilities APNO 0012 and APNO 0015 are located adjacent to the project site. Note that APNO 0000 (Angel Park Detention Basin) is located to the east of Rampart Boulevard.

VI. HYDROLOGY AND HYDRAULICS

The methodology presented in this study is in compliance with the *CCRFCD Hydrologic Criteria and Drainage Design Manual* (Reference 5, hereinafter referred to as the Manual).

Hydrologic Model Description

The watersheds have been referenced from the 2013 Master Plan Update which were modeled using the SCS Unit Hydrograph method within the Army Corps of Engineers *HEC-1 Flood Hydrograph Package* (Reference 6).

Drainage Areas and Flow Patterns

The onsite and offsite basin delineation and flow patterns have been determined based on Clark County 2016 2-ft GIS contours and the 2013 Master Plan Update. The proposed condition drainage patterns are consistent with the referenced studies. Pertinent reference material has been included in Appendix C.

Existing Washes

There are multiple existing washes which traverse the project site. The existing Regional Facility APNO 0013 traverses the project site at the southeast corner of the project site and discharges into the Angel Park Detention Basin. There are two additional washes which traverse the project site and discharge to the Angel Park Detention Basin. These washes are unnamed and are located near the southern boundary of APN 138-20-413-017. There is also an existing wash located near the center of the project site. This wash discharges into a local flood control facility near the intersection of Vegas Drive and Rampart Boulevard.

VII. EXISTING CONDITION

Hydrology

The surface runoff generated by the onsite and offsite areas has been analysed in the 2013 Master Plan Update. The existing condition flow rates have been calculated based on prorated subbasin calculations. Prorated subbasin flow rate calculations are included in Appendix A.

Offsite Runoff

Offsite runoff enters the project site at the southeast corner near APNO 0013. A total of 7988 cfs will discharge onto the project site and drain easterly into the Angel Park Detention Basin. The existing residential areas that discharge onto the project site have been indicated on the Existing Condition Basin Map as TR3.1, TR3.2, and TR5.1. A portion of TR7 also encompasses an existing residential area. The remaining residential areas adjacent to the project site drain to existing storm drain facilities and do not affect the project site. Subbasin TR5.1 encompasses a portion of Summerlin Parkway which discharges onto the project site.

Onsite Runoff

The onsite drainage areas have been indicated on the Existing Condition Basin Map. A majority of the onsite subbasins drain to the existing washes mentioned previously. Subbasins TR11, TR12, and TR13 drain north into an existing pond adjacent to Lake Mead Boulevard. Table 1 below contains a summary of the onsite and offsite subbasins and the respective 100-year storm flow rates.

Table 1: Existing Condition Flow Rate Summary.

Basin ID	Parent MPU Basin	Area (ac)	Flow Rate (cfs)
TR1R	SF2-C	6.53	8
TR1L	SF2-C	7.72	9
TR2	SF2-C	1.48	2
TR3	SF2-C	22.2	26
TR3.1	SF2-C	30.23	36
TR3.2	SF2-C	28.74	34
TR4	SF2-C	15.86	19
TR5	SF2-C	37.65	45
TR5.1	SF2-C	19.31	23
TR7	SF2-C	14.54	17
TR11	SF11-C	15.92	23
TR12	SF11-C	24.39	35
TR13	SF11-C	9.91	14
TR14	GC1B-C	7.54	11
TR15	GC1B-C	9.67	14
TR15.1	GC1B-C	35.97	52
TR16	GC1B-C	6.92	10
TR18	GC1B-C	6.76	10

VIII. PROPOSED CONDITION

Hydrology

For the purpose of this study, the proposed grass replacement will not affect the curve number calculations prepared in the 2013 Master Plan Update. The replacement areas are approximately 1% of the total MPU Basin areas $(7.96 / (151.68 + 292.48 + 248.32) = 0.01)$. Therefore, the proposed improvements do not increase runoff significantly which would adversely affect the existing facilities downstream of the project site.

Offsite Runoff

The offsite areas discussed previously remain valid in the proposed condition. The proposed improvements do not affect the offsite areas.

Onsite Runoff

The onsite areas discussed previously remain valid in the proposed condition. The proposed improvements do not alter the drainage patterns. Refer to Table 1 above for a summary of the onsite and offsite subbasins and the respective 100-year storm flow rates.

IX. SURFACE HYDRAULICS

Hydraulic cross sections have been prepared to show the water surface elevations adjacent to the grass replacement areas. Note that all runoff generated by the existing golf course and surrounding residential areas has been assumed as surface flow to be conservative in the surface hydraulic analysis. The replacement areas have been highlighted in green on the attached photographs included in Appendix D. The hydraulics for each section have been analyzed to determine if the proposed desert landscaping will have potential to increase sediment transport. A majority of the replacement areas are outside the hydraulic flow area or contain velocities less than 5 ft/s. Therefore, these areas will have no effect on sediment transport. The replacement areas which will be detrimental to sediment transport include Area 5, and Area 7. These areas have been highlighted in yellow on the attached photographs included in Appendix D. A portion of Area 5 is located within the Zone A floodzone and it is not recommended to replace the grass within the floodzone. The hydraulic section for Area 7 (Section 7) contains velocities greater than 5 ft/s which will have potential for sediment transport.

X. CONCLUSIONS

1. Methodology used in this report is in compliance with the Clark County Regional Flood Control District (CCRFCD) criteria.
2. A majority of the project site lies within a Zone X. A portion of the project site at the southeast corner is located in a FEMA-designated Special Flood Hazard Area Zone A. Note that no improvements are recommended within the FEMA designated SFHA and any surface replacement will occur outside the Zone A boundary.
3. The existing CCRFCD Regional Facility APNO 0013 crosses the project site and the existing Regional Facilities APNO 0012 and APNO 0012 are adjacent to the project site. The surface replacement areas are outside the inundation of the existing CCRFCD wash.
4. The development of the project site, as recommended, does not adversely impact the downstream facilities. The proposed improvements, as recommended, do not change the surface type drastically enough to increase surface runoff. Furthermore, the velocities are less than 5 ft/s which is considered non-erosive.

XI. REFERENCES

1. CCRFCD 2013 Las Vegas Valley Master Plan Update. 2013.
2. G.C. Wallace, Inc. *Drainage Study for Summerlin Village 1 South Parcel 4*. September 1992.
3. G.C. Wallace, Inc. *Drainage Study for Summerlin Village 1 South Parcel 5*. November 1991.
4. G.C. Wallace, Inc. *Drainage Study for Summerlin Village 1 South Parcel 6*. April 1991.
5. Clark County Regional Flood Control District. *Hydrologic Criteria and Drainage Design Manual*. August 1999.
6. U.S. Army Corps of Engineers. *HEC-1 Flood Hydrograph Package*. Revised June 1998.

APPENDIX A

Hydrologic Calculations

TPC SUMMERLIN

PRORATED FLOW RATE CALCULATIONS

EXISTING & PROPOSED CONDITION PRORATED FLOW SUMMARY			
MPU Basins			
ID	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
GC1B-C	219	151.68	1.44
SF11-C	419	292.48	1.43
SF2-C	294	248.32	1.18
Onsite Prorated Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
TR1R	8	6.53	1.18
TR1L	9	7.72	1.18
TR2	2	1.48	1.18
TR3	26	22.20	1.18
TR3.1	36	30.23	1.18
TR3.2	34	28.74	1.18
TR4	19	15.86	1.18
TR5	45	37.65	1.18
TR5.1	23	19.31	1.18
TR7	17	14.54	1.18
TOTAL	218	184.26	NA
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
TR14	11	7.54	1.44
TR15	14	9.67	1.44
TR15.1	52	35.97	1.44
TR16	10	6.92	1.44
TR18	10	6.76	1.44
TOTAL	97	66.86	NA
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
TR11	23	15.92	1.43
TR12	35	24.39	1.43
TR13	14	9.91	1.43
TOTAL	72	50.22	1.43

APPENDIX B

Hydraulic Calculations

Cross Section for Section 1 - TR1R

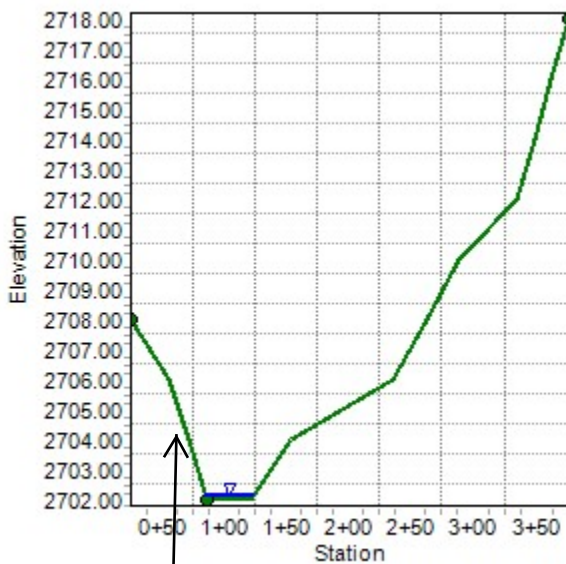
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.62000	%
Normal Depth	0.13	ft
Discharge	8.00	ft ³ /s

Cross Section Image



GRASS
REPLACEMENT
HERE

UPSTREAM PORTION OF AREA LOCATED ON A HIGHPOINT. PORTIONS OF THE AREA ARE LOCATED IN A FLOWLINE WITH VELOCITIES LESS THAN 5 FT/S. OK TO REPLACE.

Worksheet for Section 1 - TR1R

Project Description

Friction Method

Manning Formula

Solve For Normal Depth

Input Data

Channel Slope	1.62000	%
---------------	---------	---

Discharge	8.00	ft ³ /s
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Section Definitions

Station (ft)	Elevation (ft)
0+23.36	2708.00
0+55.12	2706.00
0+71.36	2704.00
0+84.98	2702.00
1+20.99	2702.00
1+52.95	2704.00
2+34.53	2706.00
2+62.50	2708.00
2+87.21	2710.00
3+34.39	2712.00
3+49.85	2714.00
3+62.67	2716.00
3+77.12	2718.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+23.36, 2708.00)	(0+84.98, 2702.00)	0.025
(0+84.98, 2702.00)	(3+77.12, 2718.00)	0.030

Options

Current Roughness Weighted Method Pavlovskii's Method

Open Channel Weighting Method

Closed Channel Weighting Method	Pavlovskii's Method
$W_{\text{CC}} = \frac{1}{N} \sum_{i=1}^N \frac{1}{\sqrt{1 + \frac{1}{\lambda} \left(\frac{1}{\sigma_i^2} - \frac{1}{\sigma_{\text{max}}^2} \right)}}$	$W_{\text{P}} = \frac{1}{N} \sum_{i=1}^N \frac{1}{\sqrt{1 + \frac{1}{\lambda} \left(\frac{1}{\sigma_i^2} - \frac{1}{\sigma_{\text{max}}^2} \right)}}$

Worksheet for Section 1 - TR1R

Results

Normal Depth		0.13	ft
Elevation Range	2702.00 to 2718.00 ft		
Flow Area		4.98	ft ²
Wetted Perimeter		39.05	ft
Hydraulic Radius		0.13	ft
Top Width		39.03	ft
Normal Depth		0.13	ft
Critical Depth		0.11	ft
Critical Slope		2.71744	%
Velocity		1.61	ft/s
Velocity Head		0.04	ft
Specific Energy		0.17	ft
Froude Number		0.79	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.13	ft
Critical Depth	0.11	ft
Channel Slope	1.62000	%
Critical Slope	2.71744	%

Cross Section for Section 1 - TR1L

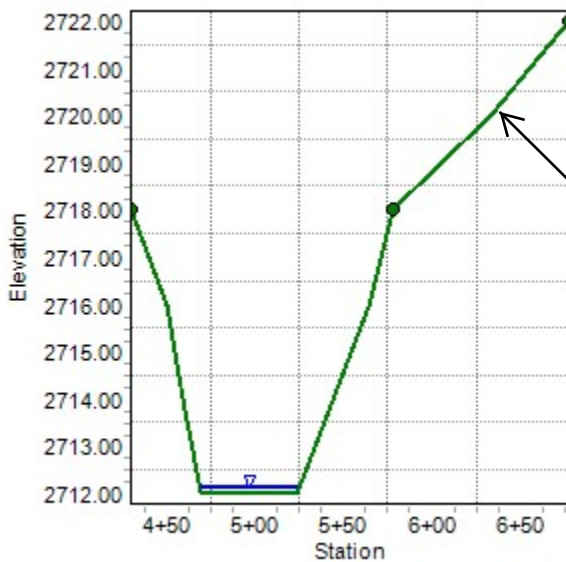
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.62000	%
Normal Depth	0.11	ft
Discharge	9.00	ft ³ /s

Cross Section Image



GRASS REPLACEMENT
HERE

THIS AREA LOCATED ON A HIGHPOINT. WSE
OUTSIDE GRASS REPLACEMENT. OK TO REPLACE.

Worksheet for Section 1 - TR1L

Project Description

Friction Method

Solve For Normal Depth

Input Data

Channel Slope	1.62000	%
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Discharge	9.00	ft ³ /s
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Section Definitions

Station (ft)	Elevation (ft)
4+29.96	2718.00
4+50.79	2716.00
4+59.66	2714.00
4+70.20	2712.00
4+79.62	2712.00
5+23.76	2712.00
5+43.76	2714.00
5+64.28	2716.00
5+78.29	2718.00
6+33.06	2720.00
6+77.36	2722.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(4+29.96, 2718.00)	(5+78.29, 2718.00)	0.030
(5+78.29, 2718.00)	(6+77.36, 2722.00)	0.025

Options

Current Roughness Weighted

Open Channel Weighting Method Pavlovskii's Method

Closed Channel Weighting Method	Pavlovskii's Method
$W_{\text{CC}} = \frac{1}{N} \sum_{i=1}^N \frac{1}{\sqrt{1 + \frac{1}{\lambda} \left(\frac{1}{\sigma_i^2} - \frac{1}{\sigma_{\text{max}}^2} \right)}}$	$W_{\text{P}} = \frac{1}{N} \sum_{i=1}^N \frac{1}{\sqrt{1 + \frac{1}{\lambda} \left(\frac{1}{\sigma_i^2} - \frac{1}{\sigma_{\text{max}}^2} \right)}}$

Results

Normal Depth 0.11 ft

Worksheet for Section 1 - TR1L

Results

Elevation Range	2712.00 to 2722.00 ft	
Flow Area	6.18	ft ²
Wetted Perimeter	55.31	ft
Hydraulic Radius	0.11	ft
Top Width	55.29	ft
Normal Depth	0.11	ft
Critical Depth	0.10	ft
Critical Slope	2.88353	%
Velocity	1.46	ft/s
Velocity Head	0.03	ft
Specific Energy	0.15	ft
Froude Number	0.77	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.11	ft
Critical Depth	0.10	ft
Channel Slope	1.62000	%
Critical Slope	2.88353	%

Cross Section for Section 2

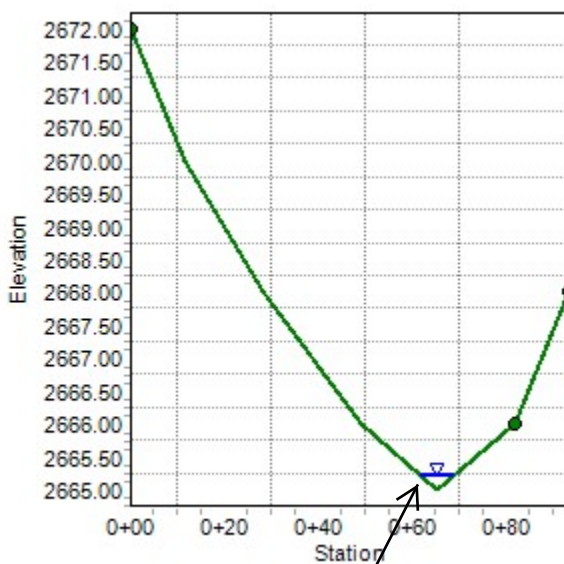
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.31000	%
Normal Depth	0.22	ft
Discharge	2.00	ft ³ /s

Cross Section Image



GRASS
REPLACEMENT
HERE

GRASS REPLACEMENT IN FLOWLINE. VELOCITIES ARE LESS THAN 5 FT/S. OK TO REPLACE.

Worksheet for Section 2

Project Description

Friction Method

Manning Formula

Solve For	Normal Depth
-----------	--------------

Input Data

Channel Slope	3.31000	%
---------------	---------	---

Discharge	2.00	ft ³ /s
-----------	------	--------------------

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2672.00
0+11.51	2670.00
0+28.09	2668.00
0+48.67	2666.00
0+65.18	2665.00
0+81.69	2666.00
0+93.05	2668.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2672.00)	(0+81.69, 2666.00)	0.025
(0+81.69, 2666.00)	(0+93.05, 2668.00)	0.030

Options

Current Roughness Weighted Method Pavlovskii's Method

Open Channel Weighting Method Pavlovskii's Method

Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 0.22 ft

Elevation Range	2665.00 to 2672.00 ft
-----------------	-----------------------

Flow Area	0.80	ft ²
-----------	------	-----------------

Wetted Perimeter	7.30	ft
------------------	------	----

Hydraulic Radius 0.11 ft

Worksheet for Section 2

Results

Top Width	7.29	ft
Normal Depth	0.22	ft
Critical Depth	0.25	ft
Critical Slope	1.83423	%
Velocity	2.49	ft/s
Velocity Head	0.10	ft
Specific Energy	0.32	ft
Froude Number	1.32	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.22	ft
Critical Depth	0.25	ft
Channel Slope	3.31000	%
Critical Slope	1.83423	%

Cross Section for Section 3

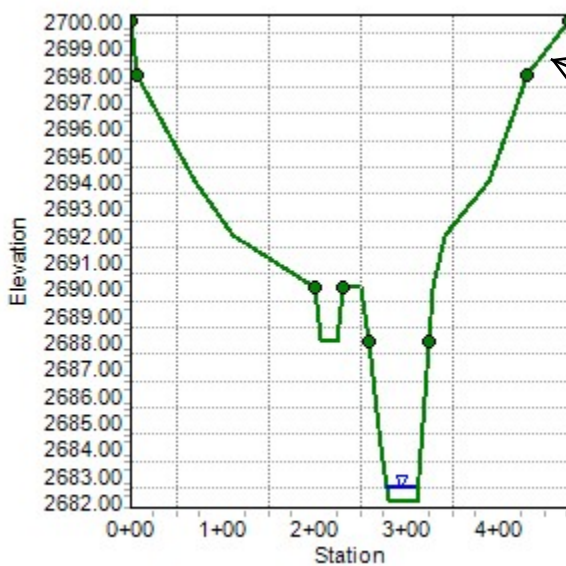
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.45000	%
Normal Depth	0.52	ft
Discharge	96.00	ft ³ /s

Cross Section Image



GRASS
REPLACEMENT
HERE.

WSE OUTSIDE GRASS REPLACEMENT. OK TO
REPLACE.

Worksheet for Section 3

Project Description

Manning Formula

Normal Depth

Input Data

2.45000 %

96.00 ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2700.00
0+07.61	2698.00
0+38.16	2696.00
0+70.46	2694.00
1+11.89	2692.00
2+00.16	2690.00
2+07.63	2688.00
2+24.51	2688.00
2+32.27	2690.00
2+51.83	2690.00
2+59.33	2688.00
2+65.50	2686.00
2+72.19	2684.00
2+80.33	2682.00
3+10.80	2682.00
3+16.13	2684.00
3+20.95	2686.00
3+24.02	2688.00
3+28.21	2690.00
3+41.73	2692.00
3+89.78	2694.00
4+11.51	2696.00
4+32.02	2698.00
4+77.64	2700.00

Roughness Segment Definitions

Worksheet for Section 3

Input Data

(0+00.00, 2700.00)	(0+07.61, 2698.00)	0.025
(0+07.61, 2698.00)	(2+00.16, 2690.00)	0.030
(2+00.16, 2690.00)	(2+32.27, 2690.00)	0.025
(2+32.27, 2690.00)	(2+59.33, 2688.00)	0.030
(2+59.33, 2688.00)	(3+24.02, 2688.00)	0.025
(3+24.02, 2688.00)	(4+32.02, 2698.00)	0.030
(4+32.02, 2698.00)	(4+77.64, 2700.00)	0.025

Options

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

Results

Normal Depth	0.52	ft
Elevation Range	2682.00 to 2700.00 ft	
Flow Area	16.64	ft ²
Wetted Perimeter	34.11	ft
Hydraulic Radius	0.49	ft
Top Width	33.95	ft
Normal Depth	0.52	ft
Critical Depth	0.66	ft
Critical Slope	1.07784	%
Velocity	5.77	ft/s
Velocity Head	0.52	ft
Specific Energy	1.03	ft
Froude Number	1.45	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
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Worksheet for Section 3

GVF Output Data

Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.52	ft
Critical Depth	0.66	ft
Channel Slope	2.45000	%
Critical Slope	1.07784	%

Cross Section for Section 4

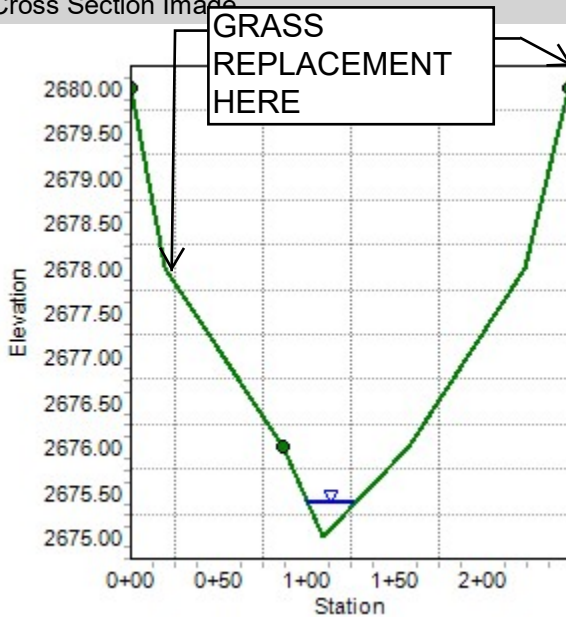
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.51000	%
Normal Depth	0.39	ft
Discharge	19.00	ft ³ /s

Cross Section Image



UPSTREAM GRASS AREA IS IN A FLOWLINE.
VELOCITIES LESS THAN 5 FT/S. OK TO REPLACE.

Worksheet for Section 4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.51000	%
Discharge	19.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2680.00
0+19.34	2678.00
0+87.25	2676.00
1+08.99	2675.00
1+58.19	2676.00
2+24.59	2678.00
2+49.51	2680.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2680.00)	(0+87.25, 2676.00)	0.025
(0+87.25, 2676.00)	(2+49.51, 2680.00)	0.030

Options

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

Results

Normal Depth	0.39	ft
Elevation Range	2675.00 to 2680.00 ft	
Flow Area	5.38	ft²
Wetted Perimeter	27.64	ft
Hydraulic Radius	0.19	ft

Worksheet for Section 4

Results

Top Width	27.63	ft
Normal Depth	0.39	ft
Critical Depth	0.45	ft
Critical Slope	2.16245	%
Velocity	3.53	ft/s
Velocity Head	0.19	ft
Specific Energy	0.58	ft
Froude Number	1.41	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.39	ft
Critical Depth	0.45	ft
Channel Slope	4.51000	%
Critical Slope	2.16245	%

Cross Section for Section 5

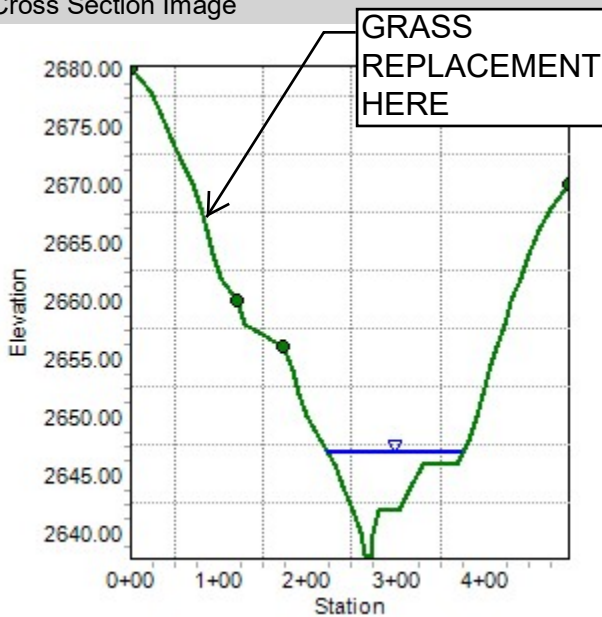
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.40000	%
Normal Depth	8.98	ft
Discharge	7988.00	ft ³ /s

Cross Section Image



WSE OUTSIDE GRASS REPLACEMENT. HOWEVER, PORTION LOCATED IN ZONE A FLOODZONE. REPLACE GRASS THE IS OUTSIDE FLOODZONE

Worksheet for Section 5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.40000	%
Discharge	7988.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2680.00
0+23.62	2678.00
0+35.02	2676.00
0+46.84	2674.00
0+57.91	2672.00
0+69.71	2670.00
0+80.28	2668.00
0+87.49	2666.00
0+94.21	2664.00
1+01.87	2662.00
1+19.66	2660.00
1+29.45	2658.00
1+73.29	2656.00
1+83.83	2654.00
1+90.99	2652.00
2+00.38	2650.00
2+14.74	2648.00
2+30.53	2646.00
2+40.49	2644.00
2+50.20	2642.00
2+60.03	2640.00
2+65.08	2638.00
2+71.69	2638.00
2+74.86	2640.00
2+80.92	2642.00
2+86.90	2642.00
3+02.90	2642.00

Worksheet for Section 5

Input Data

Station (ft)	Elevation (ft)
3+15.82	2644.00
3+30.24	2646.00
3+67.83	2646.00
3+82.64	2648.00
3+90.73	2650.00
3+97.98	2652.00
4+05.65	2654.00
4+13.18	2656.00
4+22.43	2658.00
4+30.32	2660.00
4+39.75	2662.00
4+50.51	2664.00
4+60.85	2666.00
4+75.00	2668.00
4+95.75	2670.00

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2680.00)	(1+19.66, 2660.00)	0.025
(1+19.66, 2660.00)	(1+73.29, 2656.00)	0.030
(1+73.29, 2656.00)	(4+95.75, 2670.00)	0.025

Options

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

Results

Normal Depth 8.98 ft

Worksheet for Section 5

Results

Elevation Range	2638.00 to 2680.00 ft	
Flow Area	511.43	ft ²
Wetted Perimeter	154.55	ft
Hydraulic Radius	3.31	ft
Top Width	152.24	ft
Normal Depth	8.98	ft
Critical Depth	10.12	ft
Critical Slope	0.57976	%
Velocity	15.62	ft/s
Velocity Head	3.79	ft
Specific Energy	12.77	ft
Froude Number	1.50	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.98	ft
Critical Depth	10.12	ft
Channel Slope	1.40000	%
Critical Slope	0.57976	%

Cross Section for Section 6

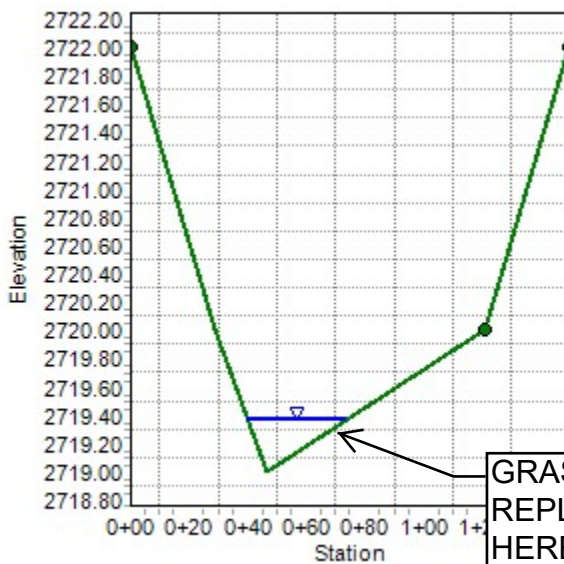
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.03000	%
Normal Depth	0.37	ft
Discharge	17.00	ft ³ /s

Cross Section Image



GRASS REPLACEMENT IN FLOWLINE. VELOCITIES LESS THAN 5 FT/S. OK TO REPLACE.

Worksheet for Section 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.03000	%
Discharge	17.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2722.00
0+28.73	2720.00
0+46.32	2719.00
1+20.35	2720.00
1+49.33	2722.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2722.00)	(1+20.35, 2720.00)	0.025
(1+20.35, 2720.00)	(1+49.33, 2722.00)	0.030

Options

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

Results

Normal Depth	0.37	ft
Elevation Range	2719.00 to 2722.00 ft	
Flow Area	6.21	ft²
Wetted Perimeter	33.75	ft
Hydraulic Radius	0.18	ft
Top Width	33.74	ft
Normal Depth	0.37	ft

Worksheet for Section 6

Results

Critical Depth	0.39	ft
Critical Slope	1.57685	%
Velocity	2.74	ft/s
Velocity Head	0.12	ft
Specific Energy	0.48	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.39	ft
Channel Slope	2.03000	%
Critical Slope	1.57685	%

Cross Section for Section 7	
Project Description	

Friction Method	Manning Formula
Solve For	Normal Depth

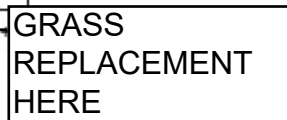
Manning Formula

Normal Depth

Channel Slope	7.59000	%
Normal Depth	0.40	ft
Discharge	17.00	ft³/s

7.59000 %

0.40 ft

17.00 ft³/s

GRASS REPLACEMENT IN FLOWLINE. VELOCITIES
GREATER THAN 5 FT/S. NOT RECOMMENDED TO
REPLACE THIS AREA.

Worksheet for Section 7

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 7.59000 %
Discharge 17.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2720.00
0+44.79	2716.00
0+52.83	2714.00
0+69.34	2712.00
0+78.54	2710.00
0+92.34	2708.00
0+96.47	2706.00
1+15.19	2705.00
1+35.23	2706.00
1+44.79	2708.00
1+53.23	2710.00
1+62.15	2712.00
1+74.65	2714.00
1+97.63	2716.00
2+08.12	2718.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2720.00)	(2+08.12, 2718.00)	0.025

Options

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

Worksheet for Section 7

Results

Normal Depth		0.40	ft
Elevation Range	2705.00 to 2720.00 ft		
Flow Area		3.06	ft ²
Wetted Perimeter		15.42	ft
Hydraulic Radius		0.20	ft
Top Width		15.40	ft
Normal Depth		0.40	ft
Critical Depth		0.54	ft
Critical Slope		1.40769	%
Velocity		5.56	ft/s
Velocity Head		0.48	ft
Specific Energy		0.88	ft
Froude Number		2.20	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.40	ft
Critical Depth	0.54	ft
Channel Slope	7.59000	%
Critical Slope	1.40769	%

Cross Section for Section 8

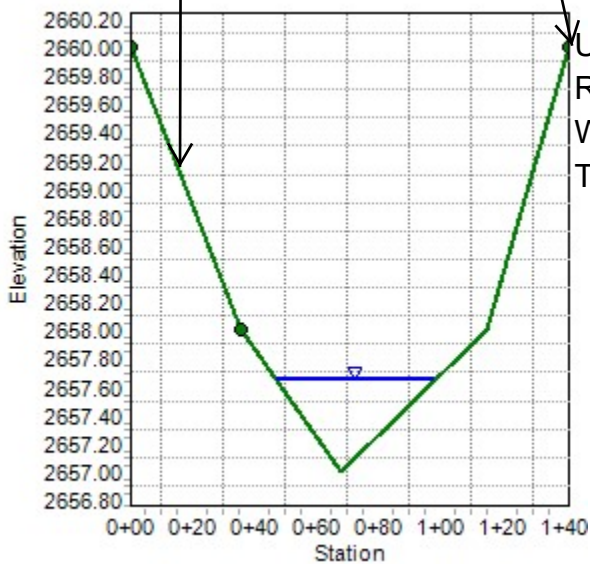
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 2.24000 %
Normal Depth 0.65 ft
Discharge 58.00 ft³/s

Cross Section Image



UPSTREAM AREA NEAR LONGSPUR DRIVE NOT RECOMMENDED. PORTION OF GRASS REPLACEMENT WITHIN FLOWLINE. VELOCITIES LESS THAN 5 FT/S. OK TO REPLACE.

Worksheet for Section 8

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.24000	%
Discharge	58.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
--------------	----------------

0+00.00	2660.00
0+35.73	2658.00
0+67.46	2657.00
1+14.64	2658.00
1+41.20	2660.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2660.00)	(0+35.73, 2658.00)	0.025
(0+35.73, 2658.00)	(1+41.20, 2660.00)	0.030

Options

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

Results

Normal Depth	0.65	ft
Elevation Range	2657.00 to 2660.00 ft	
Flow Area	16.58	ft²
Wetted Perimeter	51.16	ft
Hydraulic Radius	0.32	ft
Top Width	51.15	ft
Normal Depth	0.65	ft

Worksheet for Section 8

Results

Critical Depth	0.67	ft
Critical Slope	1.88979	%
Velocity	3.50	ft/s
Velocity Head	0.19	ft
Specific Energy	0.84	ft
Froude Number	1.08	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.65	ft
Critical Depth	0.67	ft
Channel Slope	2.24000	%
Critical Slope	1.88979	%

Worksheet for Section 9

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 3.31000 %
Discharge 58.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2650.00
0+19.32	2648.00
0+40.12	2646.00
0+63.57	2644.00
0+72.68	2643.00
0+83.67	2644.00
1+68.84	2646.00
2+00.96	2648.00
2+18.40	2650.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2650.00)	(0+40.12, 2646.00)	0.025
(0+40.12, 2646.00)	(2+18.40, 2650.00)	0.030

Options

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

Results

Normal Depth 1.01 ft
Elevation Range 2643.00 to 2650.00 ft
Flow Area 10.31 ft²

Worksheet for Section 9

Results

Wetted Perimeter	20.88	ft
Hydraulic Radius	0.49	ft
Top Width	20.78	ft
Normal Depth	1.01	ft
Critical Depth	1.18	ft
Critical Slope	1.67468	%
Velocity	5.63	ft/s
Velocity Head	0.49	ft
Specific Energy	1.50	ft
Froude Number	1.41	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.18	ft
Channel Slope	3.31000	%
Critical Slope	1.67468	%

Cross Section for Section 10

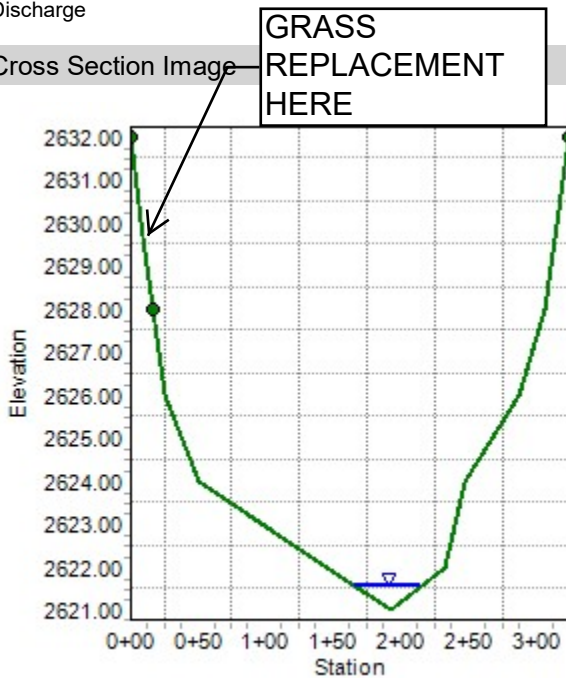
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.84000	%
Normal Depth	0.57	ft
Discharge	58.00	ft ³ /s

Cross Section Image



GRASS REPLACEMENT OUTSIDE WSE. OK TO REPLACE HERE.

Worksheet for Section 10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.84000	%
Discharge	58.00	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2632.00
0+08.57	2630.00
0+16.68	2628.00
0+25.23	2626.00
0+50.52	2624.00
1+45.63	2622.00
1+92.90	2621.00
2+32.08	2622.00
2+47.50	2624.00
2+87.61	2626.00
3+05.82	2628.00
3+15.59	2630.00
3+24.42	2632.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2632.00)	(0+16.68, 2628.00)	0.025
(0+16.68, 2628.00)	(3+24.42, 2632.00)	0.030

Options

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

Worksheet for Section 10

Results

Normal Depth		0.57	ft
Elevation Range	2621.00 to 2632.00 ft		
Flow Area		13.86	ft ²
Wetted Perimeter		48.97	ft
Hydraulic Radius		0.28	ft
Top Width		48.95	ft
Normal Depth		0.57	ft
Critical Depth		0.65	ft
Critical Slope		1.91276	%
Velocity		4.18	ft/s
Velocity Head		0.27	ft
Specific Energy		0.84	ft
Froude Number		1.39	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.65	ft
Channel Slope	3.84000	%
Critical Slope	1.91276	%

Cross Section for Section 11

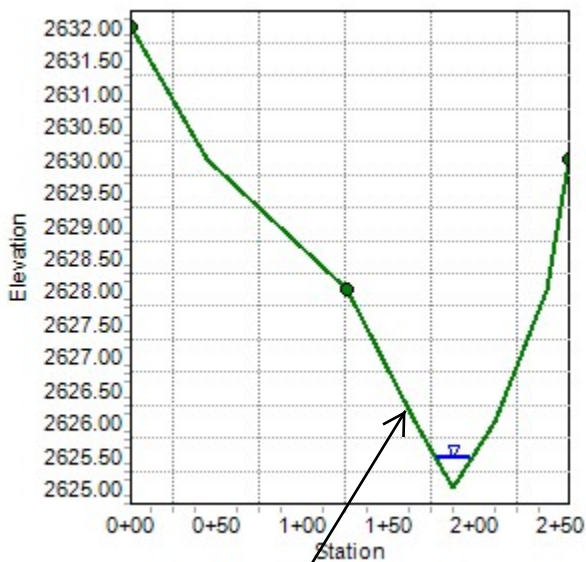
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.95000	%
Normal Depth	0.45	ft
Discharge	14.00	ft ³ /s

Cross Section Image



GRASS
REPLACEMENT
HERE

A PORTION OF THE GRASS REPLACEMENT IS WITHIN A FLOWLINE. VELOCITIES LESS THAN 5 FT/S. OK TO REPLACE.

Worksheet for Section 11

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.95000 %
Discharge 14.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2632.00
0+44.19	2630.00
1+25.02	2628.00
1+65.57	2626.00
1+86.82	2625.00
2+11.64	2626.00
2+41.29	2628.00
2+54.67	2630.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2632.00)	(1+25.02, 2628.00)	0.030
(1+25.02, 2628.00)	(2+54.67, 2630.00)	0.025

Options

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

Results

Normal Depth 0.45 ft
Elevation Range 2625.00 to 2632.00 ft
Flow Area 4.59 ft²
Wetted Perimeter 20.59 ft

Worksheet for Section 11

Results

Hydraulic Radius	0.22	ft
Top Width	20.57	ft
Normal Depth	0.45	ft
Critical Depth	0.47	ft
Critical Slope	1.47757	%
Velocity	3.05	ft/s
Velocity Head	0.14	ft
Specific Energy	0.59	ft
Froude Number	1.14	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.47	ft
Channel Slope	1.95000	%
Critical Slope	1.47757	%

Cross Section for Section 12

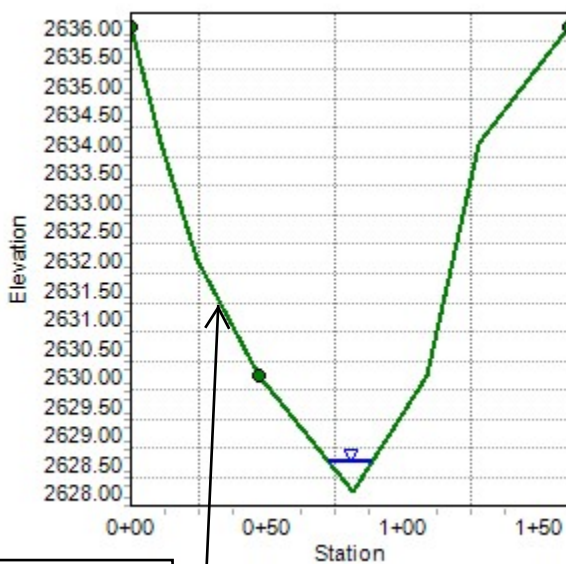
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.88000	%
Normal Depth	0.51	ft
Discharge	11.00	ft ³ /s

Cross Section Image



GRASS
REPLACEMENT
HERE

GRASS REPLACEMENT OUTSIDE WSE, OK TO REPLACE

Worksheet for Section 12

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.88000 %
Discharge 11.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2636.00
0+10.86	2634.00
0+24.38	2632.00
0+47.01	2630.00
0+82.16	2628.00
1+08.76	2630.00
1+18.62	2632.00
1+27.88	2634.00
1+61.48	2636.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2636.00)	(0+47.01, 2630.00)	0.025
(0+47.01, 2630.00)	(1+61.48, 2636.00)	0.030

Options

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

Results

Normal Depth 0.51 ft
Elevation Range 2628.00 to 2636.00 ft
Flow Area 4.03 ft²

Worksheet for Section 12

Results

Wetted Perimeter	15.81	ft
Hydraulic Radius	0.25	ft
Top Width	15.77	ft
Normal Depth	0.51	ft
Critical Depth	0.50	ft
Critical Slope	2.08610	%
Velocity	2.73	ft/s
Velocity Head	0.12	ft
Specific Energy	0.63	ft
Froude Number	0.95	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.50	ft
Channel Slope	1.88000	%
Critical Slope	2.08610	%

Cross Section for Section 13

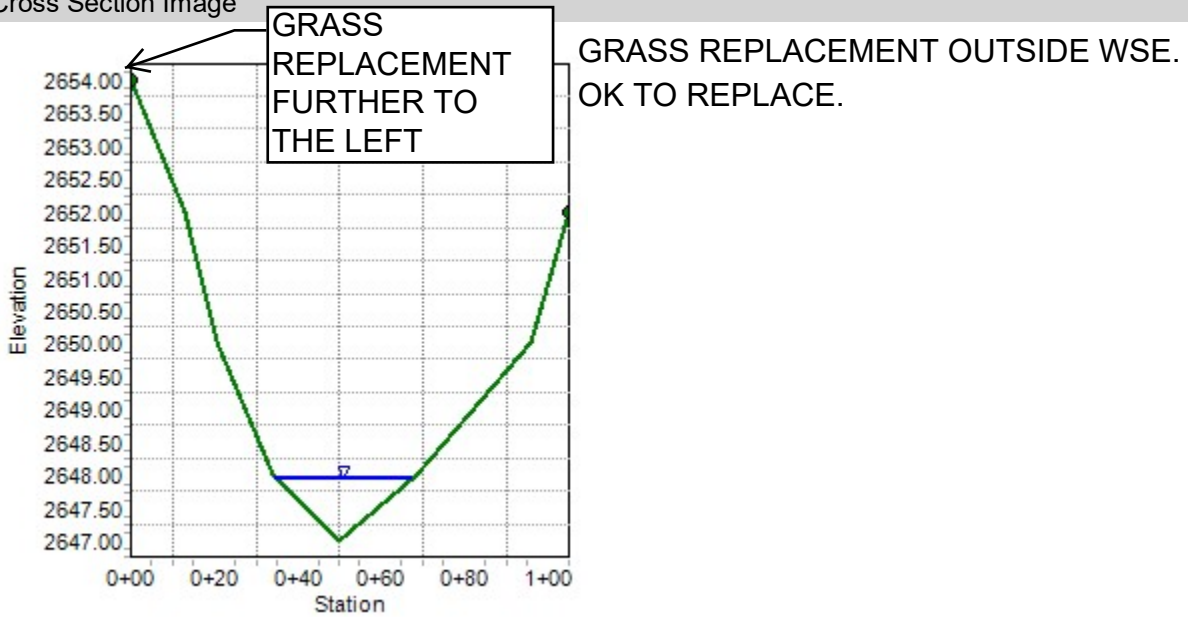
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.30000	%
Normal Depth	0.95	ft
Discharge	86.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
--------------	----------------

Roughness Segment Definitions

Options

Results

Bentley Systems, Inc. Bentley FlowMaster V8i (SELECTseries 1) [08.11.01.03]

Worksheet for Section 13

Results

Top Width	32.83	ft
Normal Depth	0.95	ft
Critical Depth	1.09	ft
Critical Slope	1.59505	%
Velocity	5.49	ft/s
Velocity Head	0.47	ft
Specific Energy	1.42	ft
Froude Number	1.40	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.95	ft
Critical Depth	1.09	ft
Channel Slope	3.30000	%
Critical Slope	1.59505	%

Cross Section for Section 14

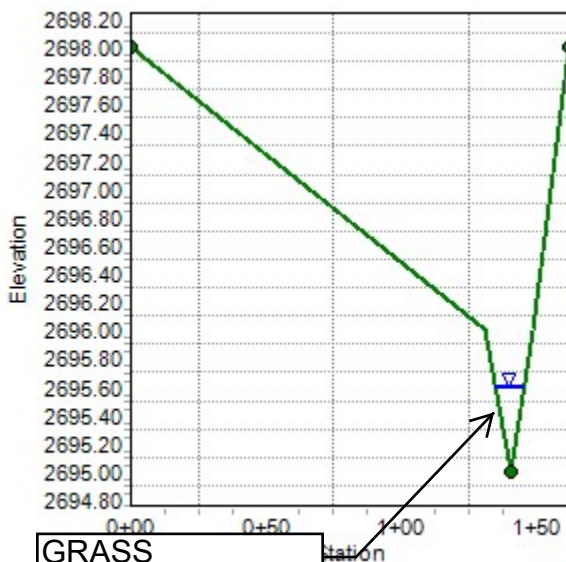
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.62000	%
Normal Depth	0.60	ft
Discharge	10.00	ft ³ /s

Cross Section Image



GRASS
REPLACEMENT
HERE

PORTION OF GRASS REPLACEMENT IS IN FLOWLINE. VELOCITIES LESS THAN 5 FT/S. OK TO REPLACE.

Worksheet for Section 14

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.62000 %
Discharge 10.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2698.00
0+89.84	2696.63
1+30.82	2696.00
1+40.01	2695.00
1+48.74	2696.00
1+61.90	2698.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2698.00)	(1+40.01, 2695.00)	0.025
(1+40.01, 2695.00)	(1+61.90, 2698.00)	0.030

Options

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

Results

Normal Depth 0.60 ft
Elevation Range 2695.00 to 2698.00 ft
Flow Area 3.25 ft²
Wetted Perimeter 10.86 ft
Hydraulic Radius 0.30 ft
Top Width 10.80 ft

Worksheet for Section 14

Results

Normal Depth	0.60	ft
Critical Depth	0.60	ft
Critical Slope	1.66639	%
Velocity	3.07	ft/s
Velocity Head	0.15	ft
Specific Energy	0.75	ft
Froude Number	0.99	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.60	ft
Channel Slope	1.62000	%
Critical Slope	1.66639	%

APPENDIX C

Referenced Material and Supporting Documents


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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 23JUN08 TIME 10:09:22
*
*****

                                GW3SC.OUT

*****
*
* 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 XXXX      X
X   X X      X   X      XX
X   X X      X          X
XXXXXX XXXX  X      XXXX  X
X   X X      X          X
X   X X      X   X      X
X   X XXXXXXX XXXX      XXX

```

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

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

1 HEC-1 INPUT PAGE 1

```

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

*DIAGRAM

*** FREE ***
1 ID CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2008 MASTER PLAN UPDATE
2 ID GOWAN WATERSHED
3 ID RECOMMENDED DRAINAGE SYSTEM WITH ULTIMATE DEVELOPMENT
4 ID INPUT FILE = GW3SC.DAT
5 ID INPUT FILE DATE = MAY 5, 2008
6 ID DESIGN STORM = 100-YEAR 6-HR STORM
7 ID STORM DISTRIBUTION = SDN #3
8 ID MODELED BY PBS&J (MICHELE L. D'ALESSANDRO, E.I., CFM)
9 ID CHECKED BY PBS&J (HARSHAL B. DESAI, P.E., CFM)
10 ID STORM CENTERING = REMOVE DETENTION BASIN OUTFLOWS
11 ID
12 ID REFERENCED HYDROLOGIC MODELS:
13 ID CITY OF LAS VEGAS CITY WIDE HYDROLOGY ANALYSIS (PBS&J 1997)
14 ID NORTHWEST NEIGHBORHOOD STUDY PHASE 1 (PBS&J 1997)
15 ID RESPONSE TO COMMENTS ON THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD
16 ID CONTROL MASTER PLAN UPDATE (G.C. WALLACE 2006)
17 ID 3RD RESPONSE TO COMMENTS ON THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD
18 ID CONTROL MASTER PLAN UPDATE (G.C. WALLACE 2006)
19 ID SUPPLEMENT FOR THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD CONTROL
20 ID MASTER PLAN UPDATE (G.C. WALLACE 2006)
21 ID GOWAN OUTFALL - LONE MOUNTAIN BRANCH PRELIMINARY DESIGN REPORT
22 ID (G.C. WALLACE 2007)
23 ID LONE MOUNTAIN WESTERN BELTWAY DETENTION BASIN PARAMETERS (RECEIVED
24 ID FROM G.C. WALLACE ON JANUARY 31, 2008)
25 ID US 95/RANCHO FIS RESTUDY (PBS&J 1998)
26 ID JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
27 ID
28 ID AREA DARF
29 ID SQ. MI.
30 ID 0-0.5 0.99
31 ID 0.5-1 0.975
32 ID 1-2 0.95
33 ID 2-3 0.925
34 ID 3-4 0.915
35 ID 4-5 0.908
36 ID 5-6 0.903
37 ID 6-7 0.895
38 ID 7-8 0.885
39 ID
40 ID JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)
41 ID
42 ID 100-YEAR, 6-HOUR STORM, SDN3
43 ID
44 ID 5 0 0 300
45 ID 5 0 0
46 ID 5 0 0
47 JR PREC 0.99 0.975 0.95 0.925 0.915 0.908 0.903 0.895 0.885
*

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1 HEC-1 INPUT PAGE 2

1

HEC-1 INPUT

PAGE 49

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

1825 KK C8A
 1826 KM COMBINE 8A AND R11A-2
 1827 HC 2
 *

1828 KK RC8A
 1829 KM ROUTE C8A TO C3B-2A
 1830 KM NATURAL WASH
 1831 KM TRAVEL LENGTH = 4,500
 1832 KM SLOPE = 2.8%
 1833 KM N = 0.040
 1834 KM HYDRAULIC RADIUS = 1.5
 1835 KM VELOCITY = 13.1
 1836 RM 1 0.096 0.15
 *

1837 KK 3B-2A
 1838 BA 0.243
 1839 PB 3.06
 1840 LS 0 88.5
 1841 UD 0.213
 *

1842 KK C3B-2A
 1843 KM COMBINE 3B-2A AND RC8A
 1844 HC 2
 *

1845 KK CC3B-2A
 1846 KM COMBINE C3B-2A AND RC8B-2
 1847 HC 2
 *

1848 KKRCC3B-2A
 1849 KM ROUTE CC3B-2A TO C3B-2B
 1850 KM FACILITY = ANGEL PARK - SUMMERLIN PARKWAY
 1851 KM FACILITY # = APSP 0001
 1852 KM LINING = UNLINED
 1853 RD 3924 0.03 0.025 0 TRAP 20 2
 *

1854 KK 3B-2B
 1855 BA 0.273
 1856 PB 2.99
 1857 LS 0 85.1
 1858 UD 0.309
 *

1859 KK C3B-2B
 1860 KM COMBINE RCC3B-2A AND 3B-2B
 1861 HC 2
 *

1

HEC-1 INPUT

PAGE 50

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

1862 KK CC3B-2B
 1863 KM COMBINE RC3B-1 AND C3B-2B
 1864 HC 2
 *

1865 KKRCC3B-2B
 1866 KM ROUTE CC3B-2B TO CSF2-C
 1867 KM FACILITY = ANGEL PARK NORTH
 1868 KM FACILITY # = APNO 0012,0013,0015 APSP 0000
 1869 KM LINING = UNLINED (NATURAL WASH)
 1870 KM CONVERTED TO MUSKINGUM-CUNGE TO ACHIEVE STABILITY
 1871 RD 1854 0.025 0.04 0 TRAP 100 3
 *

1872 KK SF2-C
 1873 BA 0.388
 1874 PB 2.91
 1875 LS 0 84.2
 1876 UD 0.443
 *

1877 KK CSF2-C
 1878 KM COMBINE SF2-C AND RCC3B-2B
 1879 HC 2
 *

GW3SC.OUT

2240	KM	LINING = RCP									
2241	RD	4080	0.022	0.015	0	CIRC	5				
	*										
2242	KK	GD34AC									
2243	BA	0.388									
2244	PB	2.77									
2245	LS	0	92.8								
2246	UD	0.350									
	*										
2247	KK	CGD34AC									
2248	KM	COMBINE RCGD34AB AND GD34AC									
2249	KM	BUFFALO AND VEGAS DRIVE									
2250	HC	2									
	*										
2251	KK	CCGD34AC									
2252	KM	COMBINE RCGD34AA AND CGD34AC									
2253	KM	APOF JUNCTION WITH GOSO									
2254	KM	BUFFALO AND VEGAS DRIVE									
2255	HC	2									
	*										
2256	KK	RCGD34AC									
2257	KM	ROUTE CCGD34AC TO CCCVILL23									
2258	KM	FACILITY = GOWAN SOUTH FACILITIES									
2259	KM	FACILITY # = GOSO 0170, 0173, 0176, 0178, 0181									
2260	KM	LINING = CONCRETE									
2261	RD	3057	0.0058	0.015	0	TRAP	12	2			
	*										
2262	KK	K-C									
2263	BA	0.204									
2264	PB	2.85									
2265	LS	0	88.8								
2266	UD	0.220									
	*										
2267	KK	DK-C									
2268	KM	FLOW SPLIT TO VILL2-3									
2269	KM	OPPOSITE OF DLAKEM FROM CITY WIDE HYDROLOGY MODEL									
2270	KM	36" RCP IN RAMPART, CAPACITY = 80 CFS, DIVERT FIRST 80 CFS TO RAMPART									
2271	KM	A 50/50 FLOW SPLIT IS ASSUMED FOR FLOWS IN EXCESS OF 80 CFS.									
2272	KM	MINIMUM 1 CFS IS DIVERTED TO AVOID ZERO FLOW									
2273	DT	DCHEY									
2274	DI	0	11	51	81	100	200	500	1000	5000	
2275	DQ	0	10	50	80	90	140	290	540	2954	
	*										

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HEC-1 INPUT

PAGE 61

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

2276	KK	RDK-C									
2277	KM	ROUTE DK-C TO CCVILL23									
2278	KM	LAKE MEAD BOULEVARD									
2279	RD	8100	0.0194	0.016	0	TRAP	0	50			
	*										
2280	KK	GC1B-C									
2281	BA	0.237									
2282	PB	2.90									
2283	LS	0	81.4								
2284	UD	0.215									
	*										
2285	KK	RGD1B									
2286	KM	ROUTE GC1B-C TO CVILL2-2									
2287	KM	FACILITY = GOWAN LAKE MEAD - BUFFALO									
2288	KM	LINING = UNLINED (NATURAL WASH)									
2289	RD	6000	0.0215	0.04	0	TRAP	100	3			
	*										
2290	KK	VILL2-1									
2291	BA	0.226									
2292	PB	2.80									
2293	LS	0	87.6								
2294	UD	0.250									
	*										
2295	KK	VILL2-2									
2296	BA	0.326									
2297	PB	2.79									
2298	LS	0	89.7								
2299	UD	0.325									
	*										
2300	KK	CVILL2-2									

*
 2472 KK A1-C
 2473 BA 0.238
 2474 PB 2.99
 2475 LS 0 88.1
 2476 UD 0.128
 *
 2477 KK CA1-C
 2478 KM COMBINE RFU6-C, AND A1-C
 2479 KM LAKE MEAD BOULEVARD @ HILLS CENTER DRIVE
 2480 HC 2
 *
 2481 KK RCA1-C
 2482 KM ROUTE CA1-C TO CNFA-C
 2483 KM LAKE MEAD BOULEVARD
 2484 RD 3000 0.0167 0.016 0 TRAP 0 50
 *
 2485 KK SF11-C
 2486 BA 0.457
 2487 PB 2.95
 2488 LS 0 85.5
 2489 UD 0.354
 *

1

HEC-1 INPUT

PAGE 67

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

2490 KK RSF11-C
 2491 KM ROUTE SF11-C TO CNFA-C
 2492 KM LINING = GRASS
 2493 RD 2800 0.02 0.035 0 TRAP 35 6
 *

2494 KK NFA-C
 2495 BA 0.300
 2496 PB 2.91
 2497 LS 0 88.3
 2498 UD 0.386
 *

2499 KK CNFA-C
 2500 KM COMBINE RSF11-C, RCA1-C, AND NFA-C
 2501 KM LAKE MEAD BOULEVARD
 2502 HC 3
 *

2503 KK RCNFA-C
 2504 KM ROUTE CNFA-C TO CC-C
 2505 KM LINING = GOLF COURSE
 2506 RD 5100 0.017 0.035 0 TRAP 100 3
 *

2507 KK AREA1-C
 2508 BA 0.361
 2509 PB 2.97
 2510 LS 0 82.0
 2511 UD 0.453
 *

2512 KKRAREA1-C
 2513 KM ROUTE AREA1-C TO CC-C
 2514 KM LINING = GOLF COURSE
 2515 RD 1400 0.0214 0.035 0 TRAP 100 3
 *

2516 KK C-C
 2517 BA 0.331
 2518 PB 2.89
 2519 LS 0 87.0
 2520 UD 0.378
 *

2521 KK CC-C
 2522 KM COMBINE C-C, RCNFA-C, RAREA1-C, AND RCH-C
 2523 KM CHEYENNE @ BRIGHTBRIDGE
 2524 HC 4
 *

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HEC-1 INPUT

PAGE 68

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

2525 KK RCC-C
 2526 KM ROUTE CC-C TO CCB-C

GW3SC.OUT													
2 COMBINED AT													
+	C8A	.60	1	FLOW TIME	805. 3.67	788. 3.67	755. 3.67	725. 3.67	713. 3.67	705. 3.67	700. 3.67	690. 3.67	679. 3.67
ROUTED TO													
+	RC8A	.60	1	FLOW TIME	751. 3.75	734. 3.75	704. 3.75	675. 3.75	664. 3.75	657. 3.75	651. 3.75	643. 3.75	632. 3.75
HYDROGRAPH AT													
+	3B-2A	.24	1	FLOW TIME	329. 3.67	322. 3.67	311. 3.67	300. 3.67	295. 3.67	292. 3.67	290. 3.67	286. 3.67	282. 3.67
2 COMBINED AT													
+	C3B-2A	.84	1	FLOW TIME	1040. 3.75	1018. 3.75	977. 3.75	939. 3.75	924. 3.75	914. 3.75	907. 3.75	895. 3.75	880. 3.75
2 COMBINED AT													
+	CC3B-2A	2.40	1	FLOW TIME	2803. 3.75	2743. 3.75	2644. 3.75	2540. 3.75	2505. 3.75	2476. 3.75	2453. 3.75	2428. 3.75	2384. 3.75
ROUTED TO													
+	RCC3B-2A	2.40	1	FLOW TIME	2769. 3.83	2725. 3.83	2623. 3.83	2515. 3.83	2493. 3.83	2463. 3.83	2431. 3.83	2413. 3.83	2367. 3.83
HYDROGRAPH AT													
+	3B-2B	.27	1	FLOW TIME	271. 3.75	265. 3.75	254. 3.75	244. 3.75	240. 3.75	237. 3.75	235. 3.75	231. 3.75	227. 3.75
2 COMBINED AT													
+	C3B-2B	2.67	1	FLOW TIME	3025. 3.83	2975. 3.83	2863. 3.83	2746. 3.83	2720. 3.83	2687. 3.83	2653. 3.83	2632. 3.83	2582. 3.83
2 COMBINED AT													
+	CC3B-2B	14.42	1	FLOW TIME	9273. 3.92	9102. 3.92	8792. 3.92	8477. 3.92	8367. 3.92	8276. 3.92	8208. 3.92	8120. 3.92	7988. 3.92
ROUTED TO													
+	RCC3B-2B	14.42	1	FLOW TIME	9227. 3.92	9055. 3.92	8737. 3.92	8419. 3.92	8315. 3.92	8224. 3.92	8154. 3.92	8064. 3.92	7928. 3.92
HYDROGRAPH AT													
+	SF2-C	.39	1	FLOW TIME	294. 3.92	287. 3.92	275. 3.92	263. 3.92	259. 3.92	255. 3.92	253. 3.92	249. 3.92	245. 3.92
2 COMBINED AT													
+	CSF2-C	14.81	1	FLOW TIME	9520. 3.92	9342. 3.92	9012. 3.92	8682. 3.92	8574. 3.92	8479. 3.92	8407. 3.92	8314. 3.92	8173. 3.92
ROUTED TO													
+	RCSF2-C	14.81	1	FLOW TIME	9444. 3.92	9260. 3.92	8921. 3.92	8586. 3.92	8478. 3.92	8390. 3.92	8307. 3.92	8220. 3.92	8078. 3.92
HYDROGRAPH AT													
+	SW11	.59	1	FLOW TIME	759. 3.75	743. 3.75	717. 3.75	691. 3.75	680. 3.75	673. 3.75	668. 3.75	660. 3.75	649. 3.75
ROUTED TO													
+	RSW11	.59	1	FLOW TIME	754. 3.75	738. 3.75	712. 3.75	686. 3.75	676. 3.75	668. 3.75	663. 3.75	655. 3.75	644. 3.75
HYDROGRAPH AT													
+	SW17	.36	1	FLOW TIME	479. 3.67	469. 3.67	452. 3.67	436. 3.67	429. 3.67	424. 3.67	421. 3.67	416. 3.67	409. 3.67
2 COMBINED AT													
+	CSW17	.94	1	FLOW TIME	1221. 3.75	1196. 3.75	1153. 3.75	1111. 3.75	1095. 3.75	1083. 3.75	1075. 3.75	1061. 3.75	1044. 3.75
ROUTED TO													
+	RCSW17	.94	1	FLOW TIME	1211. 3.75	1186. 3.75	1143. 3.75	1101. 3.75	1083. 3.75	1073. 3.75	1063. 3.75	1051. 3.75	1035. 3.75
HYDROGRAPH AT													
+	SW18	.41	1	FLOW TIME	519. 3.67	507. 3.67	489. 3.67	470. 3.67	463. 3.67	457. 3.67	454. 3.67	448. 3.67	440. 3.67
2 COMBINED AT													
+	CSW18	1.35	1	FLOW TIME	1718. 3.75	1682. 3.75	1622. 3.75	1562. 3.75	1537. 3.75	1521. 3.75	1508. 3.75	1490. 3.75	1467. 3.75
ROUTED TO													
+	RCSW18	1.35	1	FLOW TIME	1610. 3.92	1576. 3.92	1520. 3.92	1464. 3.92	1441. 3.92	1426. 3.92	1414. 3.92	1397. 3.92	1375. 3.92
HYDROGRAPH AT													
+	12A	.39	1	FLOW TIME	576. 3.67	565. 3.67	547. 3.67	529. 3.67	521. 3.67	516. 3.67	513. 3.67	507. 3.67	500. 3.67
2 COMBINED AT													

GW3SC.OUT													
ROUTED TO													
+	RDK-C	.20	1	FLOW TIME	93.3.92	89.3.92	77.4.00	82.4.00	83.4.00	88.4.00	88.4.00	87.4.00	76.4.00
HYDROGRAPH AT													
+	GC1B-C	.24	1	FLOW TIME	219.3.67	214.3.67	204.3.67	195.3.67	191.3.67	188.3.67	186.3.67	183.3.67	180.3.67
ROUTED TO													
+	RGC1B	.24	1	FLOW TIME	262.3.92	255.3.92	242.3.92	226.3.92	190.4.00	189.4.00	188.4.00	201.3.92	195.4.00
HYDROGRAPH AT													
+	VILL2-1	.23	1	FLOW TIME	249.3.67	243.3.67	234.3.67	225.3.67	221.3.67	219.3.67	217.3.67	214.3.67	210.3.67
HYDROGRAPH AT													
+	VILL2-2	.33	1	FLOW TIME	346.3.75	339.3.75	327.3.75	315.3.75	310.3.75	307.3.75	304.3.75	301.3.75	296.3.75
3 COMBINED AT													
+	CVILL2-2	.79	1	FLOW TIME	714.3.92	699.3.92	670.3.92	638.3.92	593.3.92	584.3.92	578.3.92	595.3.92	579.3.92
ROUTED TO													
+	RCVILL22	.79	1	FLOW TIME	683.4.08	663.4.08	629.4.08	590.4.08	567.4.08	558.4.08	551.4.08	546.4.08	535.4.17
HYDROGRAPH AT													
+	VILL2-3	.47	1	FLOW TIME	456.3.83	447.3.83	432.3.83	417.3.83	411.3.83	406.3.83	403.3.83	398.3.83	392.3.83
2 COMBINED AT													
+	CVILL2-3	1.26	1	FLOW TIME	1061.3.92	1036.3.92	995.3.92	957.3.92	946.3.92	935.3.92	927.3.92	911.3.92	896.3.92
2 COMBINED AT													
+	CCVILL23	1.46	1	FLOW TIME	1154.3.92	1125.3.92	1071.3.92	1022.3.92	1006.3.92	991.4.00	982.4.00	962.4.00	935.3.92
2 COMBINED AT													
+	CCCIVIL23	26.51	1	FLOW TIME	4065.3.92	3981.3.92	3830.3.92	3679.3.92	3620.3.92	3587.3.92	3546.3.92	3498.3.92	3435.3.92
ROUTED TO													
+	R3CVIL23	26.51	1	FLOW TIME	3993.3.92	3931.3.92	3778.3.92	3615.3.92	3578.3.92	3545.3.92	3489.4.00	3440.3.92	3399.3.92
HYDROGRAPH AT													
+	BUF01-C	.36	1	FLOW TIME	285.3.92	279.3.92	268.3.92	258.3.92	254.3.92	251.3.92	249.3.92	245.3.92	241.3.92
2 COMBINED AT													
+	CBUF01-C	26.87	1	FLOW TIME	4278.3.92	4209.3.92	4046.3.92	3873.3.92	3831.3.92	3796.3.92	3735.3.92	3686.3.92	3641.3.92
HYDROGRAPH AT													
+	A2-C	.22	1	FLOW TIME	316.3.58	309.3.58	297.3.58	286.3.58	282.3.58	278.3.58	276.3.58	272.3.58	268.3.58
HYDROGRAPH AT													
+	R6-C	.50	1	FLOW TIME	559.3.75	547.3.75	526.3.75	505.3.75	497.3.75	491.3.75	487.3.75	480.3.75	472.3.75
ROUTED TO													
+	RR6-C	.50	1	FLOW TIME	561.3.92	549.3.92	528.3.92	508.3.92	500.3.92	494.3.92	490.3.92	484.3.92	475.3.92
HYDROGRAPH AT													
+	Z-C	.39	1	FLOW TIME	533.3.67	521.3.67	502.3.67	484.3.67	476.3.67	471.3.67	467.3.67	461.3.67	453.3.67
2 COMBINED AT													
+	CZ-C	.89	1	FLOW TIME	964.3.83	942.3.83	906.3.83	870.3.83	856.3.83	846.3.83	839.3.83	827.3.83	813.3.83
ROUTED TO													
+	RZ-C	.89	1	FLOW TIME	964.3.83	935.3.83	900.3.83	866.3.83	847.3.83	839.3.83	832.3.83	818.3.83	806.3.83
HYDROGRAPH AT													
+	R37-C	.38	1	FLOW TIME	422.3.83	413.3.83	398.3.83	383.3.83	377.3.83	373.3.83	370.3.83	366.3.83	360.3.83
2 COMBINED AT													
+	CR37-C	1.28	1	FLOW TIME	1386.3.83	1348.3.83	1298.3.83	1249.3.83	1224.3.83	1212.3.83	1203.3.83	1183.3.83	1166.3.83
ROUTED TO													

								GW3SC.OUT						
			TIME		3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT														
+	CA1-C	.71	1	FLOW	628.	615.	592.	570.	561.	555.	551.	544.	535.	
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	
ROUTED TO														
+	RCA1-C	.71	1	FLOW	630.	616.	594.	572.	563.	557.	552.	545.	536.	
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	
HYDROGRAPH AT														
+	SF11-C	.46	1	FLOW	419.	409.	393.	377.	371.	366.	363.	358.	352.	
				TIME	3.75	3.75	3.75	3.83	3.83	3.83	3.83	3.83	3.83	
ROUTED TO														
+	RSF11-C	.46	1	FLOW	420.	410.	393.	379.	372.	368.	365.	360.	354.	
				TIME	3.83	3.83	3.83	3.92	3.92	3.92	3.92	3.92	3.92	
HYDROGRAPH AT														
+	NFA-C	.30	1	FLOW	292.	286.	275.	265.	261.	258.	256.	253.	249.	
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	
3 COMBINED AT														
+	CNFA-C	1.47	1	FLOW	1326.	1297.	1250.	1203.	1184.	1171.	1161.	1146.	1127.	
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	
ROUTED TO														
+	RCNFA-C	1.47	1	FLOW	1326.	1297.	1249.	1200.	1181.	1167.	1158.	1142.	1123.	
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
HYDROGRAPH AT														
+	AREA1-C	.36	1	FLOW	253.	246.	235.	225.	220.	217.	215.	212.	208.	
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	
ROUTED TO														
+	RAREA1-C	.36	1	FLOW	251.	242.	232.	221.	217.	216.	214.	209.	205.	
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
HYDROGRAPH AT														
+	C-C	.33	1	FLOW	306.	299.	288.	276.	272.	269.	266.	263.	258.	
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	
4 COMBINED AT														
+	CC-C	5.42	1	FLOW	4903.	4782.	4586.	4394.	4318.	4264.	4225.	4158.	4084.	
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	
ROUTED TO														
+	RCC-C	5.42	1	FLOW	4887.	4767.	4568.	4376.	4300.	4244.	4206.	4139.	4064.	
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	
HYDROGRAPH AT														
+	DCHEY	.00	1	FLOW	166.	163.	159.	155.	153.	152.	151.	149.	148.	
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	
ROUTED TO														
+	RDCHEY	.00	1	FLOW	163.	161.	156.	152.	150.	152.	151.	150.	148.	
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	
HYDROGRAPH AT														
+	B-C	.45	1	FLOW	472.	462.	446.	430.	423.	419.	416.	411.	404.	
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	
2 COMBINED AT														
+	CB-C	.45	1	FLOW	619.	607.	588.	568.	560.	557.	554.	547.	540.	
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	
2 COMBINED AT														
+	CCB-C	5.87	1	FLOW	5471.	5340.	5123.	4913.	4829.	4772.	4730.	4657.	4575.	
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	
ROUTED TO														
+	RCCB-C	5.87	1	FLOW	5394.	5261.	5048.	4833.	4747.	4694.	4655.	4587.	4512.	
				TIME	3.92	3.92	3.92	3.92	4.00	4.00	4.00	4.00	4.00	
HYDROGRAPH AT														
+	1-C	.22	1	FLOW	224.	219.	211.	204.	200.	198.	197.	194.	191.	
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	
DIVERSION TO														
+	LAKE1	.22	1	FLOW	56.	56.	56.	56.	56.	56.	56.	56.	56.	
				TIME	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42	
HYDROGRAPH AT														
+	D1-C1	.22	1	FLOW	168.	163.	155.	148.	144.	142.	141.	138.	135.	
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	
DIVERSION TO														
+	LAKE2	.22	1	FLOW	56.	56.	56.	56.	56.	56.	56.	56.	56.	
				TIME	3.50	3.50	3.58	3.58	3.58	3.58	3.58	3.58	3.58	

DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 1 SOUTH

PARCEL 4
TOURNAMENT HILLS - UNIT III

JUNE 1992

620.702ED

Prepared for:

Howard Hughes Properties
3800 Howard Hughes Parkway
Las Vegas, Nevada 89109

Prepared by:

G. C. Wallace, Inc.
1555 South Rainbow Boulevard
Las Vegas, Nevada 89102

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Tournament Hills-Unit 3 Date: June 16, 1992

Location of Development: a) Descriptive Summerlin Expressway/Rampart
b) Sect. 29 Twn. 20S Rng. 60E

Name of Owner: Howard Hughes Properties Assessor's Parcel No: _____

Contact Person-Name: Randall K. Gremlich Telephone No: 363-1200

Firm: G. C. Wallace, Inc.

Address: 1555 S. Rainbow Blvd.

Type of Land Development/Land Disturbance Process:

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

- Total Owned Land Area: At Site: 29 Acres Being Developed/Disturbed: 29 Acres
- Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? YES* NO
- Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES* NO
- Proposed type of development (Residential, Commercial, Etc.)? Residential
- Approximate upstream land area which drains to the subject site? 0.2 Acres
- Has the site drainage been evaluated in the past? YES NO. If yes, please identify documentation: G. C. Wallace, Village 1 South, 1991
- If known, please briefly identify the proposed discharge point(s) of runoff from the site: RPT1 - Culverts under Rampart
- Briefly describe your proposed schedule for the subject project: Winter 1991



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.

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

Local Entity File No. _____

Revision	Date

REFERENCE:

STANDARD FORM 1

CITY OF LAS VEGAS

INTER-OFFICE MEMORANDUM

DATE:

September 11, 1992

Hydrology
Library

TO:

Kent Nash
Land Development Services
Department of Public Works

FROM:

MAS for
Tom Chiatovich, PE
Chief, Flood Control
Dept. of Public Works

SUBJECT:

Summerlin Village 1 South - Parcel 4, AKA
Tournament Hills - Unit III
File No. DS901C
Date of Engineer's Stamp: 08/26/92
Date Received by City: 08/27/92

COPIES TO:

G. C. Wallace, Inc.
CCRFC
John McNellis, PE
Charles Kajkowski, PE

HISTORY:

1st Submittal	07/24/92 - Not Acceptable
2nd Submittal	08/21/92 - Not Acceptable
3rd Submittal	(See below comments)

REMARKS:

3rd Submittal (Addendum 2)

The drainage study for the subject project has been reviewed and

 X is acceptable in concept subject to conformance to all
City standards and the following conditions:

 must be resubmitted or supplemented.

1. Section A showing the grass lined overflow section on sheet G-3 (3 of 8) does not correspond with the plan view shown on the same sheet. This section must be revised to show the 15-foot sideyard setback in Lot 13 as the same line as the 20-foot private drainage easement line to reflect the plan view (or revise the plan to reflect the section).

END OF REMARKS

ssn

T/R/S: 20/60/29
L-29

Post-It™ brand fax transmittal memo 7871		# of pages > 1
To	Randy Greulich	
From	Flood Control	
Co.	G.C. WALLACE	
Co.	CLV	
Dept.	229-6276	
Phone #	363-8974	
Fax #	382-8551	

DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 1 SOUTH

PARCEL 5
TOURNAMENT HILLS - UNIT II

SEPTEMBER 1991

620.703ED

Prepared for:

Howard Hughes Properties
3800 Howard Hughes Parkway
Las Vegas, Nevada 89109

Prepared by:

G. C. Wallace, Inc.
1555 South Rainbow Boulevard
Las Vegas, Nevada 89102

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Tournament Hills Unit II (Parcel 5) Date: Sept. 25, 1991

Location of Development: a) Descriptive Rampart Boulevard & Vegas Drive
b) Sect. 29 Twn. 20S Rng. 60E

Name of Owner: Howard Hughes Properties Assessors Parcel No: _____

Contact Person-Name: Randy Gremlich Telephone No: (702) 363-1200

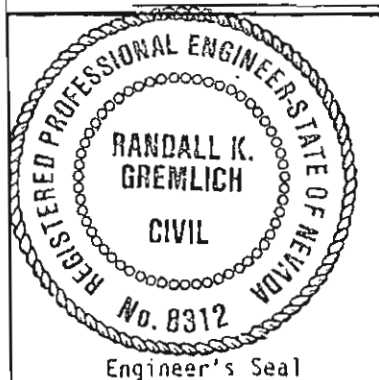
Firm: G. C. Wallace, Inc.

Address: 1555 S. Rainbow Blvd., Las Vegas, Nevada 89102

Type of Land Development/Land Disturbance Process:

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

- Total Owned Land Area: At Site: 21 Acres Being Developed/Disturbed: 100%
- Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? YES* NO
- Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES* NO
- Proposed type of development (Residential, Commercial, Etc.)? Residential
- Approximate upstream land area which drains to the subject site? 5 Acres
- Has the site drainage been evaluated in the past? YES NO. If yes, please identify documentation: Village 1 South, G. C. Wallace, Inc. June 9, 1989
- If known, please briefly identify the proposed discharge point(s) of runoff from the site: Culverts under Rampart Boulevard near Vegas Drive identified as RPT1 and RPT2
- Briefly describe your proposed schedule for the subject project: 1991



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.

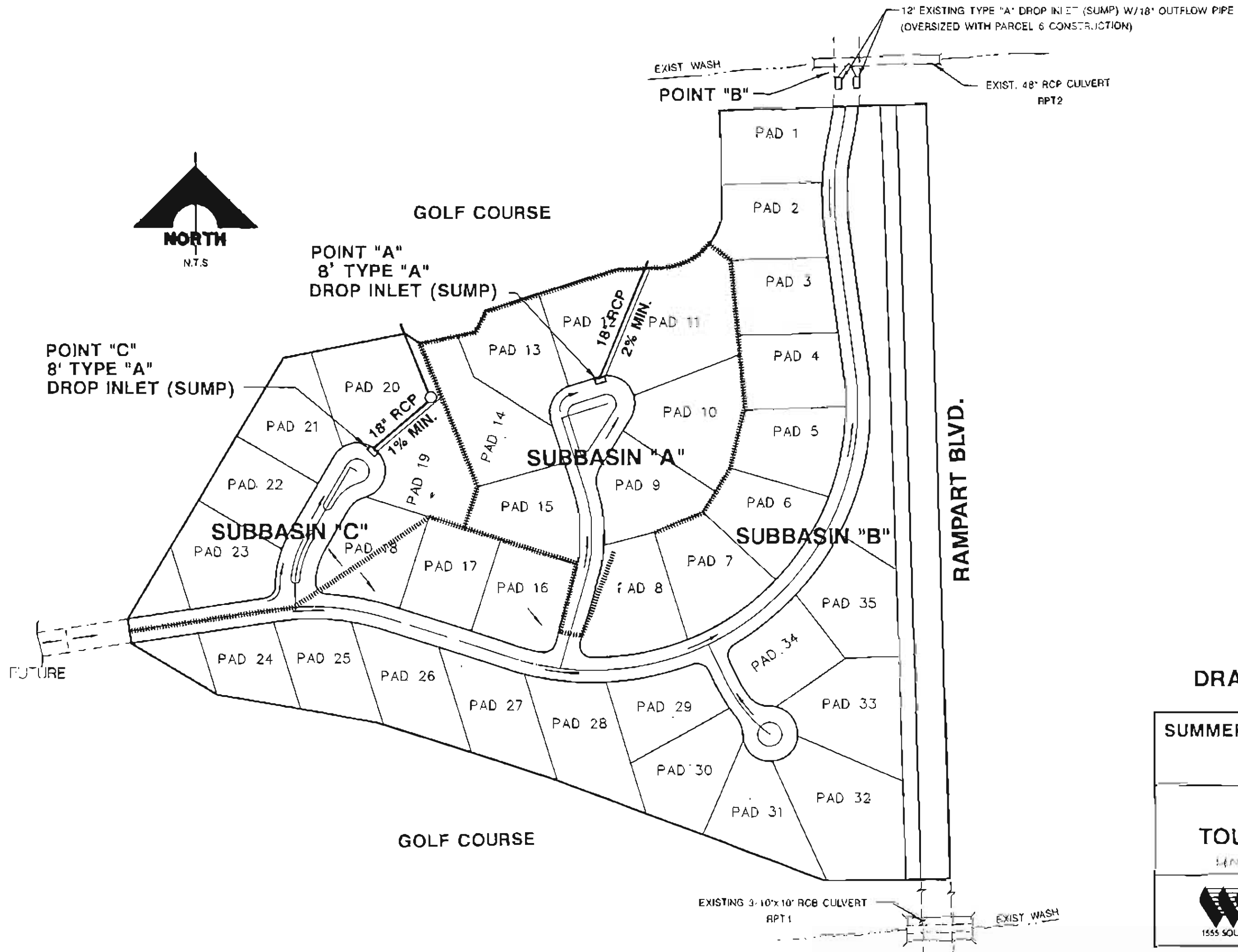
* Review and concurrence of the Clark County Regional Flood Control District is required.

Local Entity File No. _____

Revision	Date

REFERENCE:

STANDARD FORM 1



DRAINAGE PATTERNS

SUMMERLIN VILLAGE 1 SOUTH

PARCEL 5

FIGURE 6

TOURNAMENT HILLS
UNIT PHASE II



G.C. WALLACE, INC.
Engineering/Architecture

1555 SOUTH RAINBOW BLVD. / LAS VEGAS, NEVADA 89102

CITY OF LAS VEGAS

DATE:

INTER-OFFICE MEMORANDUM

November 22, 1991

TO:

Paul Webster
Land Development Services
Department of Public Works

FROM:

RT
Tom Chiatovich, PE
Chief, Flood Control
Dept. of Public Works

SUBJECT:

Summerlin Village 1 South, Parcel 5
(Tournament Hills - Unit 2)
File No. DS803A
Date of Engineer's Stamp: 09/25/91
Date Received by City: 10/21/91

COPIES TO:

G.C. Wallace, Inc.

John McNellis, PE
Charles Kajkowski, PE

REMARKS:

1st Submittal

The drainage study for the subject project has been reviewed and

 X is acceptable in concept subject to the following conditions:

 must be resubmitted or supplemented.

1. The Grading Note No. 8 indicates the finished floor elevation will be a minimum of 0.70 feet higher than the pad elevation. The pad grade for the following Lots 8, 9, 18 and 29 must be raised to reflect the CCRFCD Design Criteria. Therefore, the minimum pad elevation for Lot 8 should be set at 77.3, Lot 9 at 76.1, Lot 18 at 88.7 and Lot 29 at 75.3 respectively.
2. The location of the drainage easement for "Subbasin C" in the report does not correspond with the location on the grading plan "Sheet G-5". Also on "Sheet G-5", the drop inlet location does not correspond with the location of the 20-foot drainage easement.
3. Please note, all drainage facilities must be shown on the Grading Plan (i.e., 18-inch stormdrains, invert elevations, outlet location, etc.).
4. A revised Grading Plan, must be reviewed and approved by CLV Flood Control prior to Final Map Approval.

END OF REMARKS

esn

T/R/S: 20/60/29

L-29

**DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 1 SOUTH**

PARCEL 6

MARCH 1991

620.704ED

Prepared for:

**Howard Hughes Properties
3800 Howard Hughes Parkway
Las Vegas, Nevada 89109**

Prepared by:

**G. C. Wallace, Inc.
1555 South Rainbow Boulevard
Las Vegas, Nevada 89102**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Village 1 South, Parcel 6 Date: February 20, 1991

Location of Development: a) Descriptive Rampart Boulevard & Vegas Drive
b) Sect. 20/29 Twn. 20 S Rng. 60 E

Name of Owner: Howard Hughes Properties Assessors Parcel No: -

Contact Person-Name: Randy Gremlich Telephone No: 702-363-1200

Firm: G.C. Wallace, Inc.

Address: 1555 South Rainbow Boulevard

Las Vegas, Nevada 89102

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: 46 Acres Being Developed/Disturbed: 100%

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)

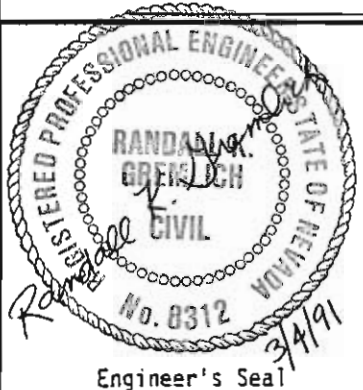
4. Proposed type of development (Residential, Commercial, Etc.)? Residential

5. Approximate upstream land area which drains to the subject site? 0

6. Has the site drainage been evaluated in the past? (YES) NO. If yes, please identify documentation: Village 1 South, G. C. Wallace, Inc. June 9, 1989

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Culverts under Rampart Boulevard near Vegas Drive identified as RPT3 and RPT2

8. Briefly describe your proposed schedule for the subject project: 1991



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.

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

Local Entity File No. _____

Revision	Date

REFERENCE:

STANDARD FORM 1

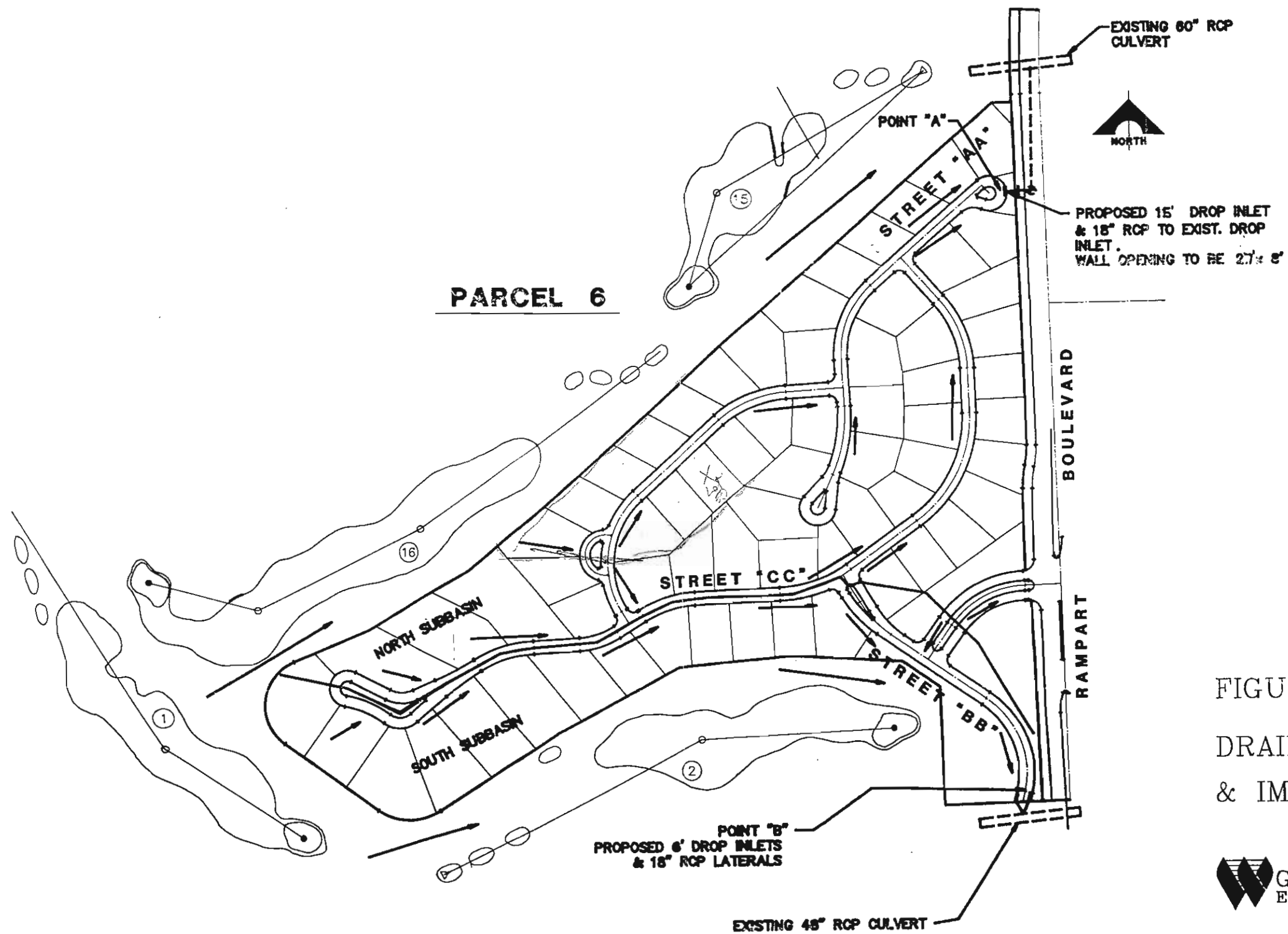


FIGURE 5
DRAINAGE PATTERNS
& IMPROVEMENTS

CITY OF LAS VEGAS

DATE:

INTER-OFFICE MEMORANDUM

April 4, 1991

TO:

Kent Nash
Land Development Division
Department of Public Works

FROM:

T. Chiatovich
T. Chiatovich, PE
Chief Flood Control
Dept. Public Works

SUBJECT:

Summerlin Village 1 South Parcel 6

COPIES TO:

G. C. Wallace

File No. DS679A

Date of Engineer's Stamp: 03/04/91

Date Received by City: 03/14/91

John McNellis, PE

Charles Karkowski, PE

REMARKS:

1st Submittal

The drainage study for the subject project has been reviewed and

 X is acceptable in concept subject to the following conditions:

 must be resubmitted or supplemented.

1. Erosion protection must be provided from the back of curb to the bottom of the wash at point "B" along street BB where the Q100 flow enters the wash.

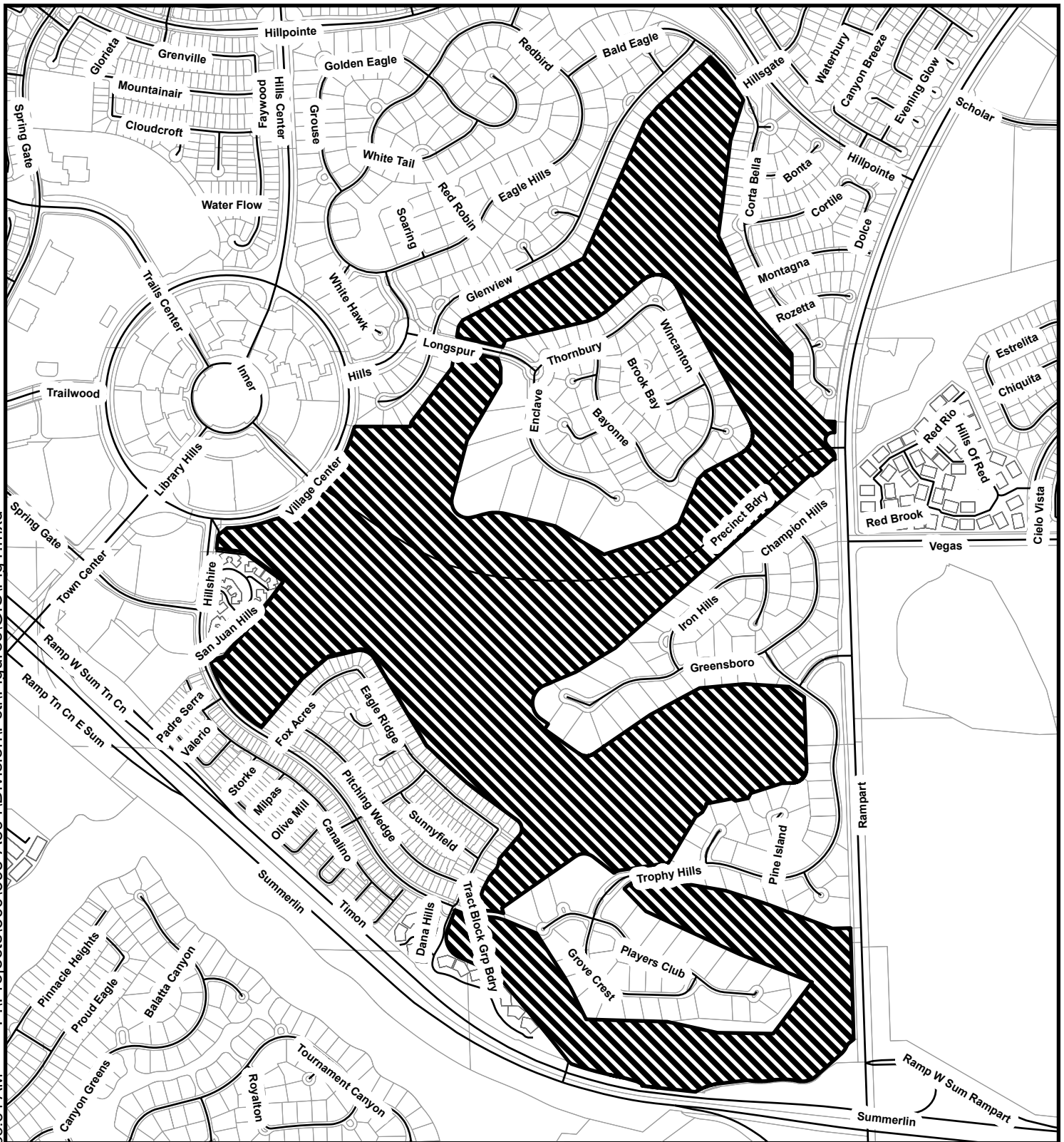
END OF REMARKS

T/R/S: L20

dbm

APPENDIX D

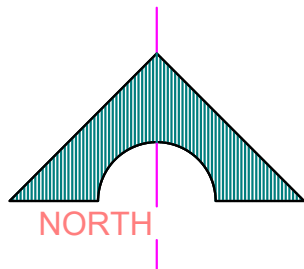
Figures



GRAPHIC SCALE

0 500 1,000 1,500
Feet

1 in = 927 ft



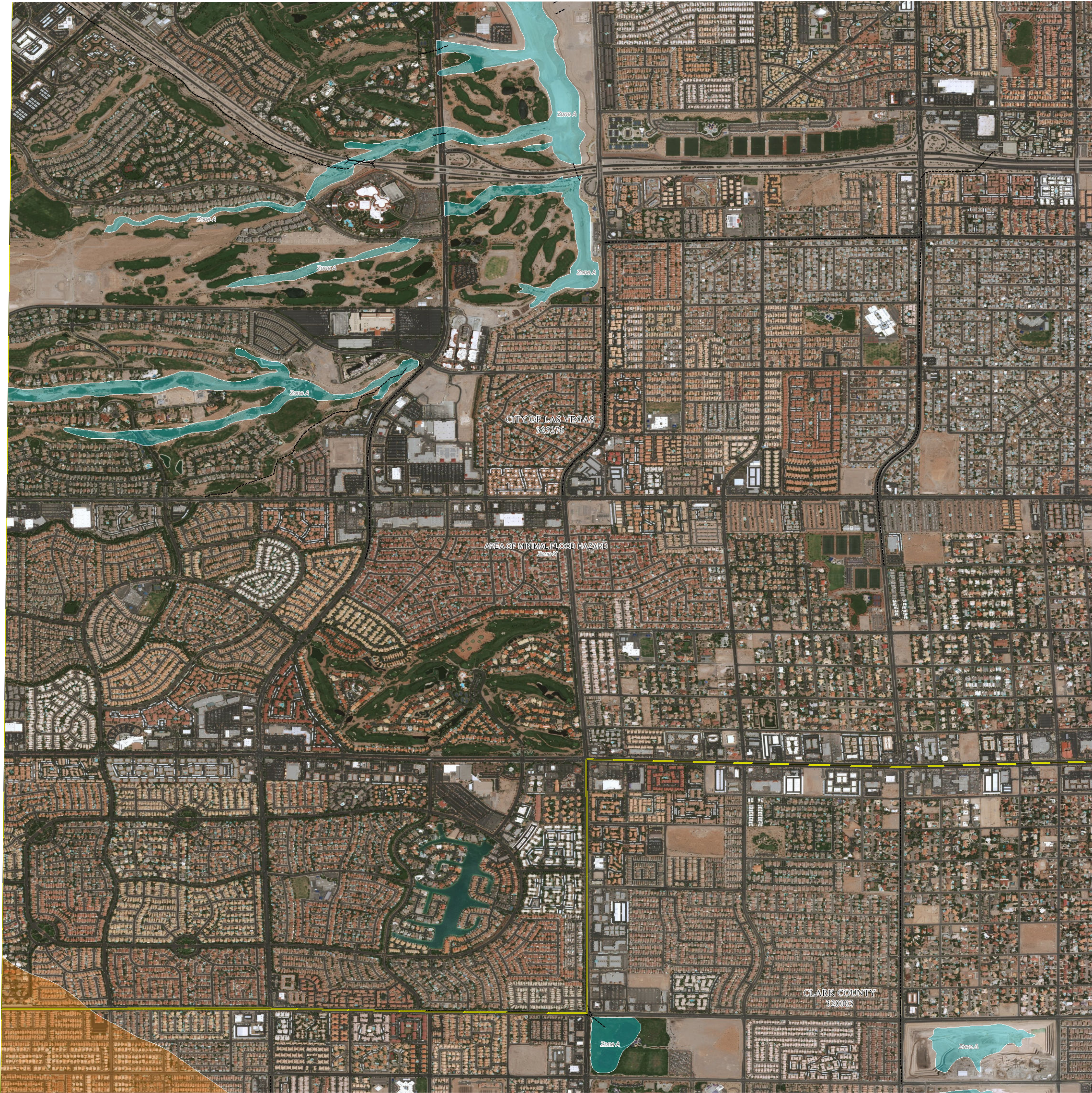
TPC SUMMERLIN
SUMMERLIN PKWY & RAMPART BLVD

FIG 1 VICINITY MAP

GCV
ENGINEERS SURVEYORS

1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcvengineering.com

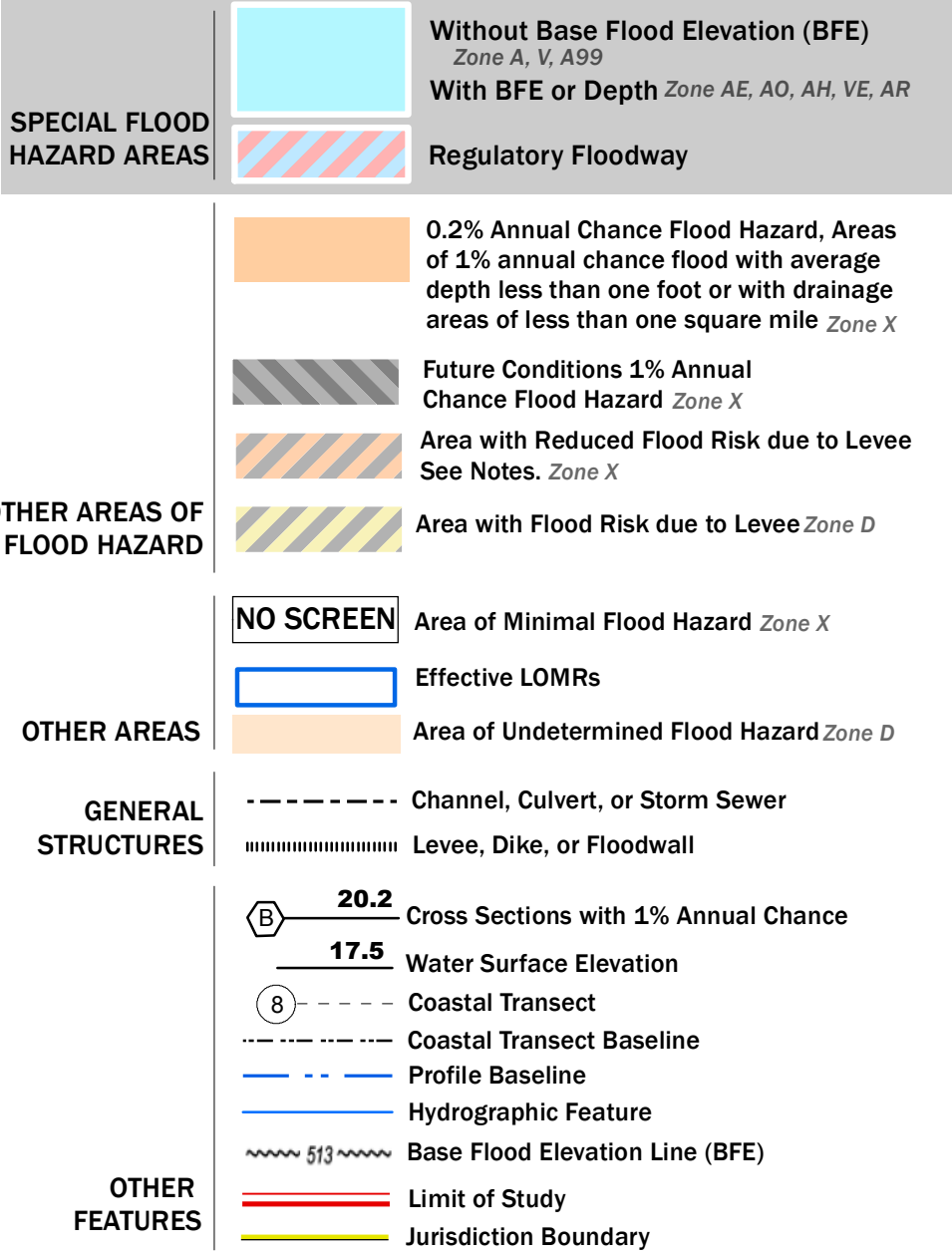
FIGURE 2A



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
36°16.70'N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT



NOTES TO USERS

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

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

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

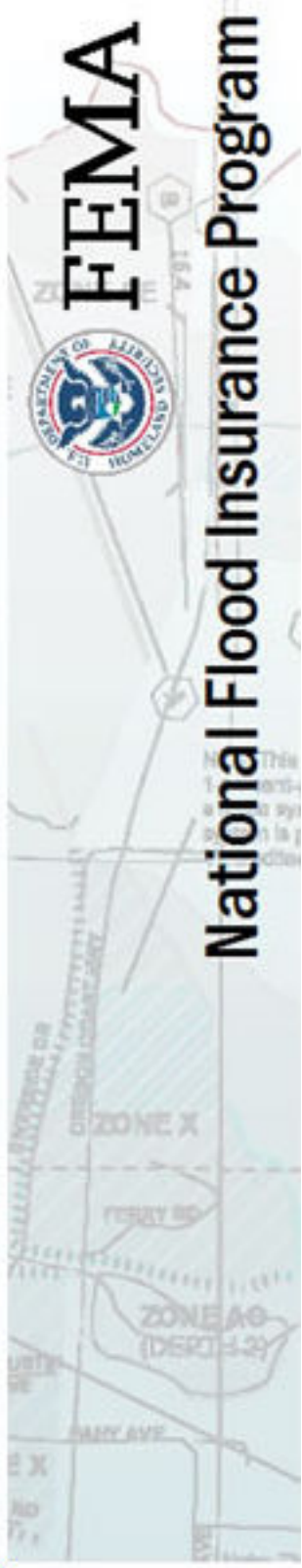
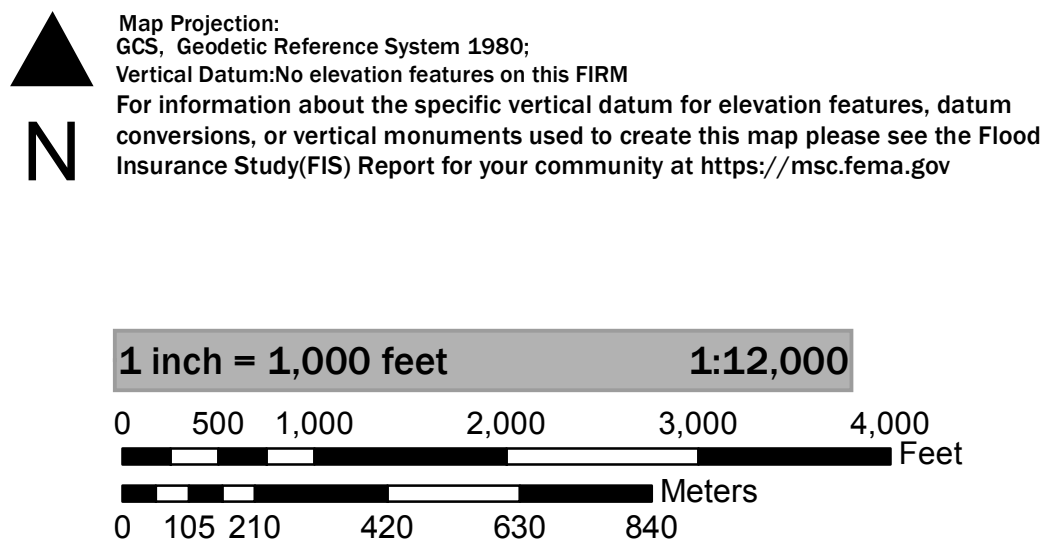
Base map information shown on this FIRM was provided in digital format by DigitalGlobe. This information was derived from GE01, dated 05/13/2017, 05/16/2017.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **5/24/2018 5:41:24 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL, and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at <https://www.fema.gov/media-library/assets/documents/118418>

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

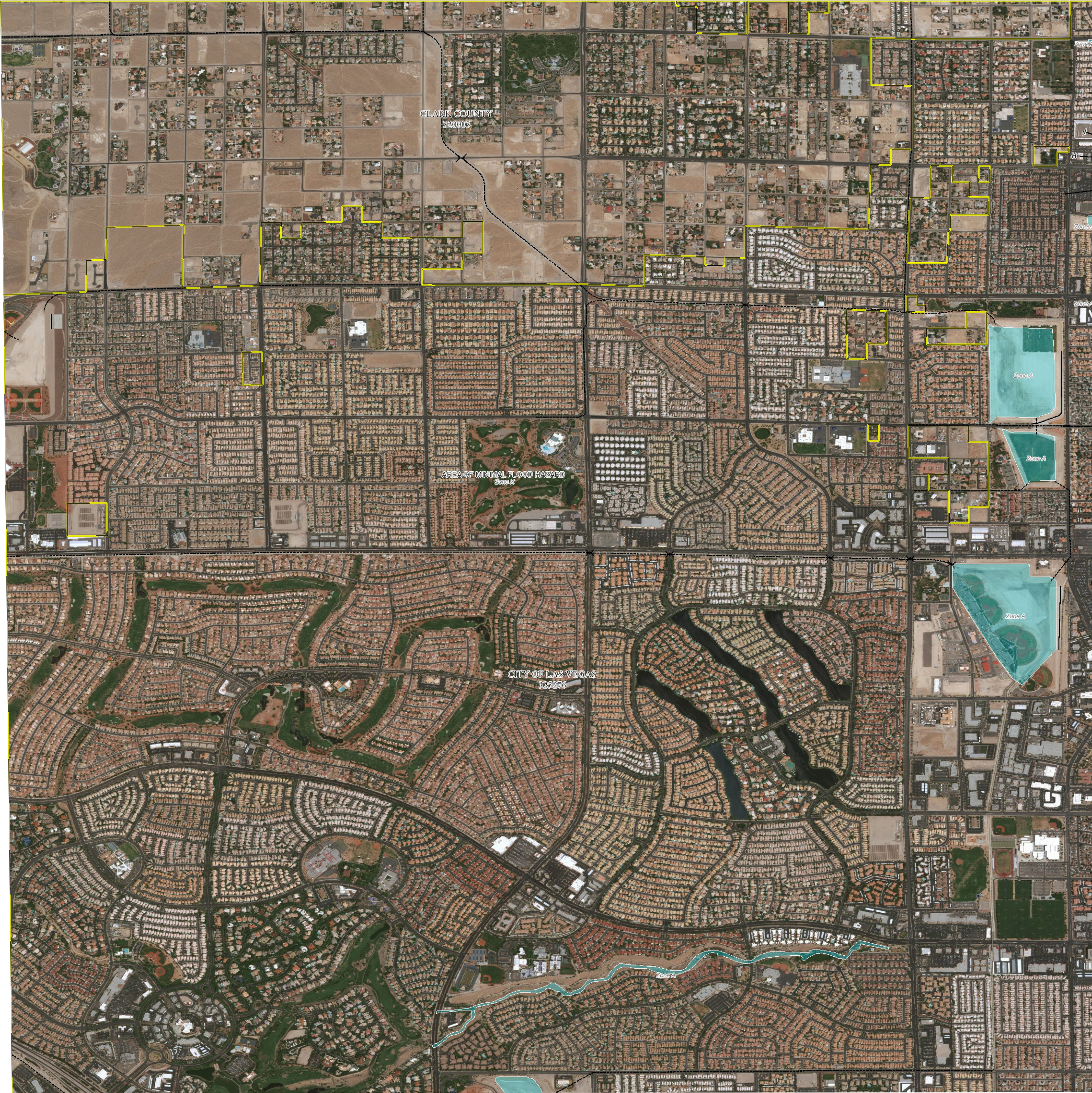


NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA
AND INCORPORATED AREAS
PANEL 2145 OF 4090

Panel Contains:		
COMMUNITY	NUMBER	PANEL
UNINCORPORATED AREAS CLARK COUNTY NEVADA	320003	2145
CLARK COUNTY NEVADA	320003	2145
CITY OF LAS VEGAS NEVADA	325276	2145

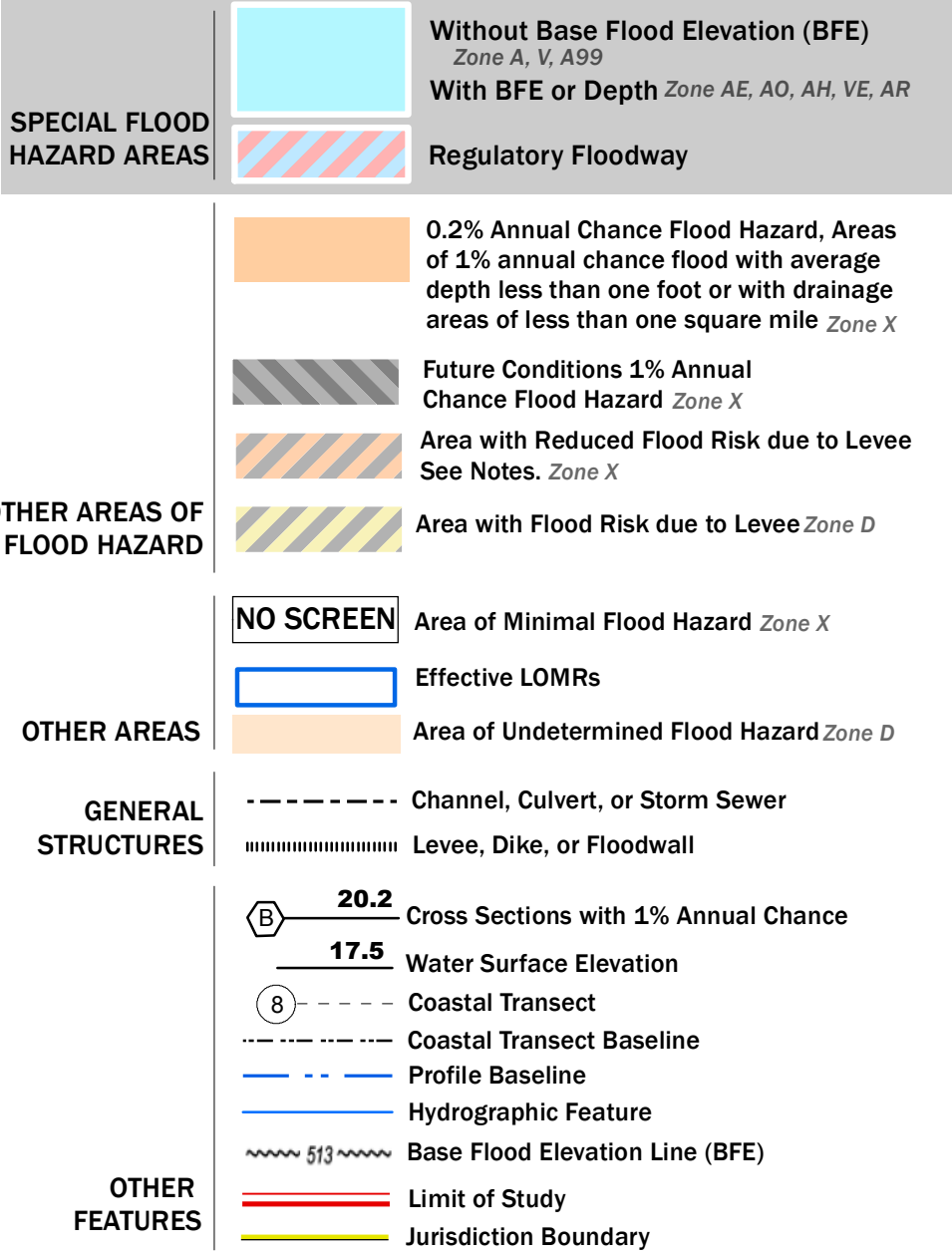
FIGURE 2B



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
36°11'1.60"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT



NOTES TO USERS

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

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

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

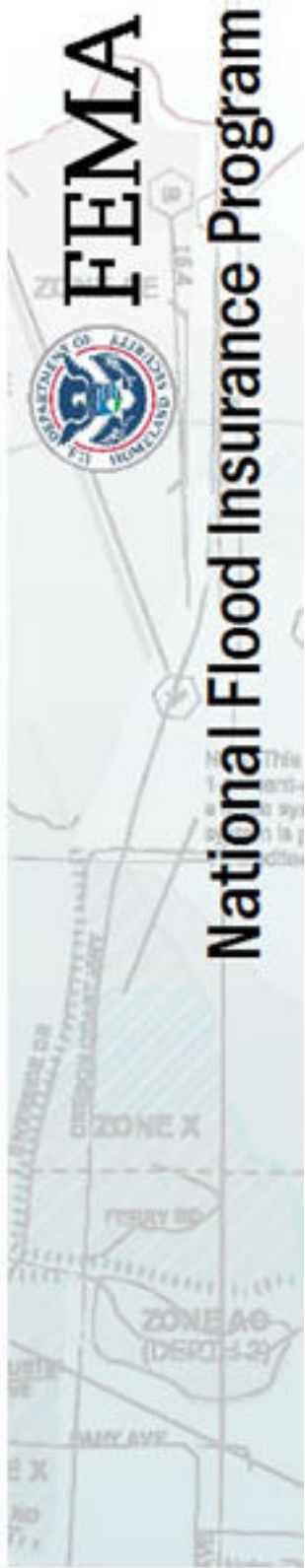
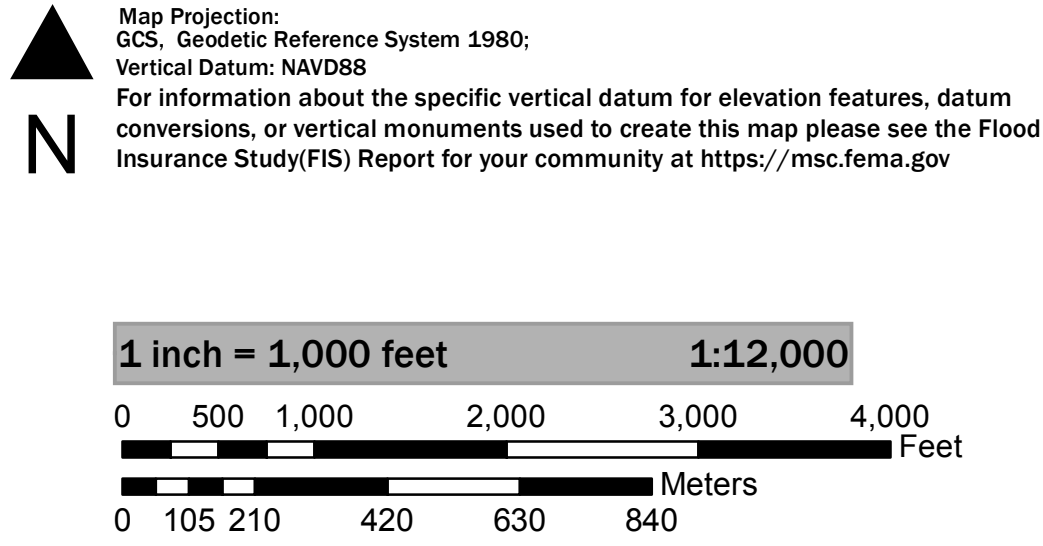
Base map information shown on this FIRM was provided in digital format by DigitalGlobe. This information was derived from GE01, dated 05/13/2017, 05/16/2017.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **5/24/2018 5:43:43 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL, and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at <https://www.fema.gov/media-library/assets/documents/118418>

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA
AND INCORPORATED AREAS
PANEL 2135 OF 4090

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF LAS VEGAS	325276	2135
CLARK COUNTY NEVADA		
CLARK COUNTY NEVADA	320003	2135
UNINCORPORATED AREAS CLARK COUNTY NEVADA	320003	2135

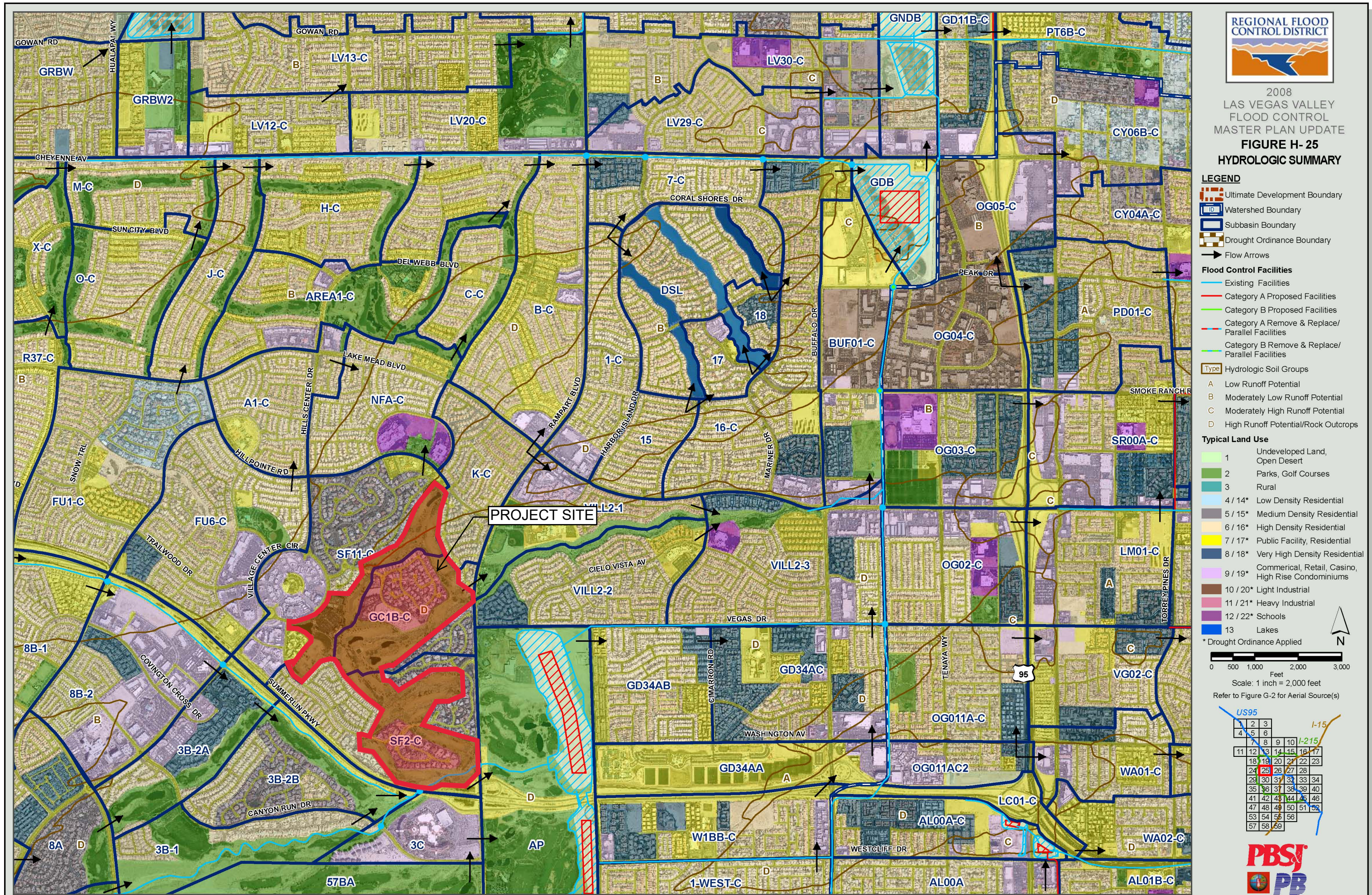


FIGURE 3

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
APMD		ANGEL PARK - MIDDLE BRANCH						
0000	E	Natural Wash	940	6048	C11A-3*	ALLGOW4	11.31	2.90
0027	E	1: 12' X 10' and 2: 12' X 2' RCBC @ Canyon Run	170	6048	C11A-3*	ALLGOW4	11.31	3.00
0030	E	Natural Wash	7000	6048	C11A-3*	ALLGOW4	11.31	3.00
0132	E	2: 12'x10' RCBC @ Hualapai	120	6048	C11A-3*	ALLGOW4	11.31	1.00
APNO		ANGEL PARK NORTH						
0001	E	1,512 ac-ft Angel Park Detention Basin		9199	ANGLPKIN	ALLGOW5	21.99	
0002	E	2: 33" & 1: 42" RCP Emergency Outlet	190	406	ANGLPKDB	ALLGOW5	21.99	
0004	E	14' X 12' RCB Connector Pipe under Summerlin Pkwy	380	9199	ANGLPKIN	ALLGOW5	21.99	1.00
0005	E	Natural Wash	1369	7988	CC3B-2B*	GW3SC	7.68	2.00
0012	E	3: 12' X 10' RCBC @ Rampart	232	7988	CC3B-2B*	GW3SC	7.68	1.00
0013	E	Natural Wash	1283	7988	CC3B-2B	GW3SC	7.68	1.40
0015	E	Two Span Bridge 28' W 14'D @ Summerlin Pkwy	236	7988	CC3B-2B	GW3SC	7.68	1.00
APOF		ANGEL PARK OUTFALL						
0000	E	66" RCP	1297	728	CGD34AC	GW3SC	0.65	1.90
0015	E	60" RCP	5472	454	CGD34AB	ALLGOW5	22.25	2.20
0124	E	54" RCP Outlet	810	406	ANGLPKDB	ALLGOW5	21.99	2.50
APSP		ANGEL PARK - SUMMERLIN PARKWAY						
0000	E	Concrete Chute Drop	103	7988	CC3B-2B	GW3SC	7.68	3.00
0001	E	Unlined Chnl with Gabion Drops 20'W Depth Varies 2:1 SS	3924	2746	C3B-2B	ALLGOW3	2.67	3.00
0002	E	Unlined Chnl with Gabion Drops 50'W 3:1 SS	1424	2746	C3B-2B	ALLGOW3	2.67	3.50
0066	E	5: 8' X 4' RCBC @ Town Center Dr.	200	1697	C8B-2	ALLGOW3	1.56	2.40
0069	E	Conc Chnl 10'W 6'D 2:1 SS	3195	1697	C8B-2	ALLGOW3	1.56	2.40
0133	E	3: 9'X4' RCBC @ Crestdale	180	1173	C8B-1	ALLGOW3	1.14	2.33
0135	E	Conc Chnl 10'W 6'D 2:1 SS	2030	1173	C8B-1	ALLGOW3	1.14	2.40
G002		GOWAN SOUTH FACILITIES (CHEYENNE CHANNEL)						
0000	E	Free Span Bridge 34'W 9.25'D @ Ronemus	100	4978	C16-C	ALLGOW3	7.09	0.50
0010	E	Conc Chnl 30'W 9'D 0:1 SS	600	4978	C16-C	ALLGOW3	7.09	0.50
0015	E	Free Span Bridge 31'W 7.25'D @ Buffalo	102	4978	C16-C	ALLGOW3	7.09	1.40
0018	E	Conc Chnl 30'W 9'D 0:1 SS	250	4978	C16-C	ALLGOW3	7.09	1.50
0020	E	Conc Chnl 10'W 7.25'D 1.5:1 SS	1000	4978	C16-C	ALLGOW3	7.09	1.50
0028	E	Free Span Bridge 35'W 7'D @ Soft Breezes	72	4800	CC7-C	ALLGOW3	6.78	2.20
0029	E	Conc Chnl 10'W 7.25'D 1.5:1 SS	2700	4800	CC7-C	ALLGOW3	6.78	1.50
0084	E	Free Span Bridge 35'W 7'D @ Soaring Gulls	95	4657	CCB-C	ALLGOW3	6.07	1.30
0085	E	Conc Chnl 10'W 7.25'D 1.5:1 SS	1240	4657	CCB-C	ALLGOW3	6.07	1.50
0111	E	Free Span Bridge 35'W 7'D @ Rampart	127	4657	CCB-C	ALLGOW3	6.07	2.90
0112	E	Conc Chnl 10'W 7'D 1.5:1 SS	7640	4225	CC-C	ALLGOW3	5.42	2.30
0257	E	Conc Chnl 10'W 6.75'D 1.5:1 SS	4293	2577	CCJ-C	ALLGOW3	2.97	4.10
G095		GOWAN OUTFALL - U.S. 95 CHANNEL						
0000	P1	Conc Chnl 12'W 4'D 2:1 SS	2640	299	GD17BG-C	ALLGOW3	0.36	0.30
GODU		GOWAN NORTH - DURANGO BRANCH						
0000	E	12' X 6' RCB	2629	1150	CLV14-C	ALLGOW3	1.40	0.91
0050	E	9' X 6' RCB	865	835	CLV20-C	ALLGOW3	0.97	1.50
GOLB		GOWAN LAKE MEAD-BUFFALO						
0000	E	12' X 6' RCB	1294	1071	CCVILL23	ALLGOW3	1.46	1.50
0025	E	10' X 7' RCB	145	1071	CCVILL23	ALLGOW3	1.46	0.50
0030	E	2: 8' X 4' RCB	408	1071	CCVILL23	ALLGOW3	1.46	0.85
GOLM		GOWAN LONE MOUNTAIN SYSTEM						
0146	E	888 ac-ft Lone Mountain Detention Basin		7252	LMTNIN	GW3SC	6.13	
GONO		GOWAN NORTH SYSTEM						
0000	E	8' X 8' RCB Outlet	184	558	GWNNDB	ALLGOW5	68.49	0.51
0001	E	8' X 8' RCB Outlet	156	558	GWNNDB	ALLGOW5	68.49	0.63
0006	E	30,780 cfs PMF Spillway		30780	GWNNDB	ALLGOW5	68.49	
0008	E	921 ac-ft Gowan North Detention Basin		4937	CCLV43-C*	GW4SC	11.93	
GOOF		GOWAN OUTFALL FACILITIES						
0511	E	8' X 5' RCB	8390	699	CPT6B-C	GW3SC	1.08	0.50
0531	E	8' X 5' RCB	1300	558	GWNNDB	ALLGOW5	68.49	0.50
0551	E	72" RCP	524	558	GWNNDB	ALLGOW5	68.49	0.62
0773	E	60" RCP	803	286	LV30-C	ALLGOW3	0.42	1.40
0775	E	60" RCP	1300	286	LV30-C	ALLGOW3	0.42	1.00

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
GOSO		GOWAN SOUTH FACILITIES						
0000	E	72" RCP Outlet	2303	454	GWNSDB	GW5SC	12.13	0.53
0050	E	39,030 cfs PMF Spillway		39030	GWNSIN	GW5SC	12.13	
0051	E	624 ac-ft Gowan South Detention Basin		5625	GWNSIN	GW5SC	12.13	
0052	P1	Upgrade to 686 ac-ft Gowan South Detention Basin		5625	GWNSIN	GW5SC	12.13	
0068	E	Conc Chnl 15'W 7'D 2:1 SS	380	3796	CBUF01-C	GW3SC	4.88	0.40
0076	E	2: 10' X 7' RCBC @ Peak Dr	80	2119 ^A	CBUF01-C ^A	GW3SC	4.88	0.56
0077	P0	Add 2: 14' X 7' RCBC @ Peak Dr	80	1677 ^A	CBUF01-C ^A	GW3SC	4.88	0.56
0078	E	Conc Chnl 22'W 10'D 0:1 SS	60	3796	CBUF01-C	GW3SC	4.88	0.56
0108	E	Conc Chnl 22'W 9'D 2:1 SS	2078	3796	CBUF01-C	GW3SC	4.88	0.56
0119	E	Conc Chnl 22'W 10'D 0:1 SS	180	3587	CCCvil23	GW3SC	4.52	0.95
0123	E	2: 10' X 7' RCBC @ Smoke Ranch	100	2229 ^A	CCCvil23 ^A	GW3SC	4.52	0.62
0124	P0	Add 2: 10' X 7' RCBC @ Smoke Ranch	100	1358 ^A	CCCvil23 ^A	GW3SC	4.52	0.62
0125	E	Conc Chnl 22'W 9'D 0:1 SS	50	3587	CCCvil23	GW3SC	4.52	0.62
0126	E	Conc Chnl 12'W 7'D 2:1 SS	2155	3587	CCCvil23	GW3SC	4.52	0.62
0170	E	Conc Chnl 12'W 7'D 2:1 SS	220	2657	CCGD34AC	GW3SC	3.06	0.62
0173	E	Conc Chnl 22'W 7'D 0:1 SS	158	2657	CCGD34AC	GW3SC	3.06	0.62
0176	E	2: 10' X 7' RCBC @ Lake Mead	100	2657	CCGD34AC	GW3SC	3.06	0.62
0178	E	Conc Chnl 22'W 7'D 0:1 SS	150	2657	CCGD34AC	GW3SC	3.06	1.00
0181	E	Conc Chnl 12'W 7'D 2:1 SS	2429	2657	CCGD34AC	GW3SC	3.06	0.58
0227	E	2 : 10' X 7' RCBC @ Vegas Drive	100	2065	CGD34AA	ALLGOW3	2.41	1.36
0229	E	Conc Chnl 12'W 7'D 1:1 SS	2649	2065	CGD34AA	ALLGOW3	2.41	1.36
0279	E	12' X 7' RCB	80	2065	CGD34AA	ALLGOW3	2.41	1.36
0280	E	12' X 8' RCB	875	2065	CGD34AA	ALLGOW3	2.41	0.34
0297	E	12' X 7' RCB	2124	1825	CW1BB-C	ALLGOW3	2.14	1.60
0336	E	12' X 7' RCB	602	1593	C1-WESTC	ALLGOW3	1.84	3.40
0352	E	2: 8' X 5' RCB	2740	1374	C1-DUCHC	ALLGOW3	1.60	0.73
GOTE		GOWAN -TENAYA BRANCH						
0000	E	60" RCP	1954	272	LV29-C	ALLGOW3	0.28	1.30
GOWC		GOWAN SOUTH FACILITIES - WEST CLIFF						
0000	E	24" RCP	5400	257	1-WEST-C	ALLGOW3	0.24	1.67
LCCH		LAS VEGAS CREEK CHANNEL						
0438	E	60" RCP	1090	162	CLC01-C	SW3	1.20	1.60
0458	E	60" RCP	1060	162	CLC01-C	SW3	1.20	1.60
0478	E	60" RCP	1110	162	CLC01-C	SW3	1.20	0.55
0499	E	42" RCP Outlet	660	85	RAINBWDB	SW3	1.11	1.88
0513	E	102 ac-ft Rainbow Detention Basin		970	RAINBWIN	SW3	1.11	
0518	E	60" RCP Connector Pipe Under Rainbow Blvd	670	970	RAINBWIN	SW3	1.11	1.85
0534	E	60" RCP	460	279	AL00A-C	SW3	0.23	5.38
0543	E	Conc Chnl 10'W 4'D 0:1 SS	700	279	AL00A-C	SW3	0.23	1.88
LCLO		LAS VEGAS CREEK - LORENZI						
0000	P3	7' X 6' RCB	445	265	DAL00A	SW3	0.41	3.37
0008	P3	7' X 6' RCB	2415	265	DAL00A	SW3	0.41	0.40
LVLM		LAS VEGAS WASH - LAKE MEAD						
0475	E	48" RCP	2632	235	LM02-C	NW3	0.29	1.24
0525	E	48" RCP	2600	542	CLM01-C	NW3	0.64	1.24
LVOW		OWENS AVENUE SYSTEM						
0460	P1	7' X 6' RCB	2700	616	CVG03-C	NW3	0.95	1.48
LVPK		PEAK DRIVE SYSTEM						
0130	E	7' X 5' RCB	1435	400	CPD01-C	NW3	0.67	0.61
LVSR		LAS VEGAS WASH - SMOKE RANCH						
0496	P1	10' X 7' RCB	2855	1245	CSR02E	NW3	1.64	1.27
0546	P1	8' X 8' RCB	2640	758	CSR00A	NW3	1.01	0.57

* The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.

** As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.

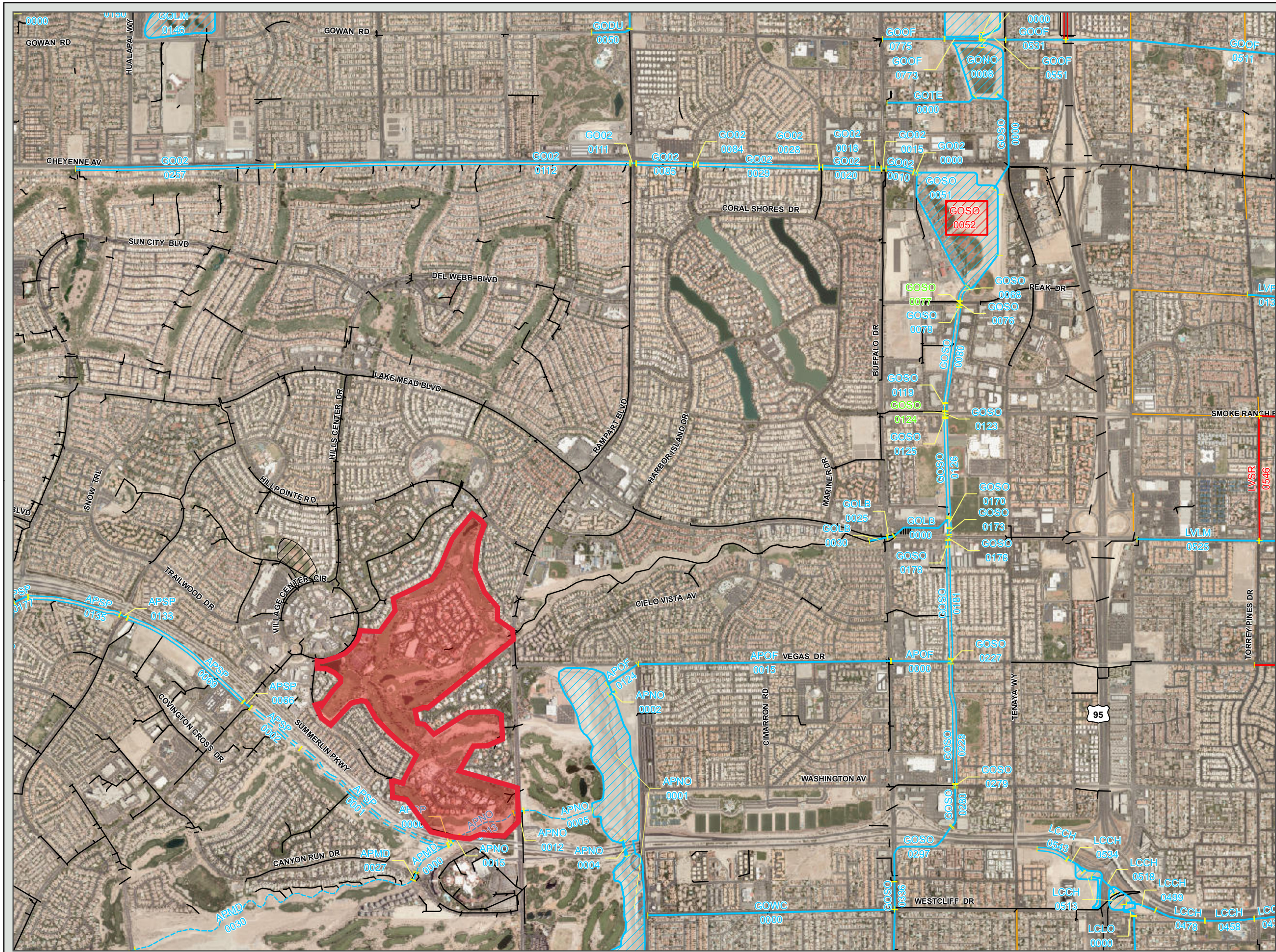
^A For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e., HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).



2013 LAS VEGAS VALLEY
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FACILITY INVENTORY
FIGURE F - 25

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



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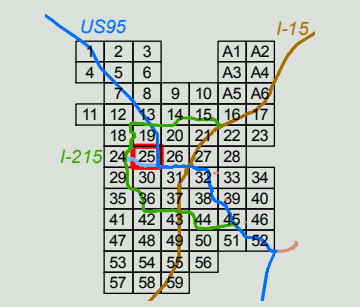
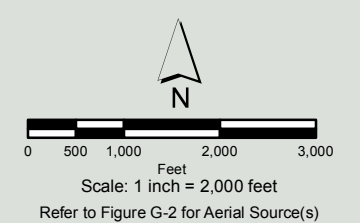
FIGURE F- 25 FLOOD CONTROL FACILITIES

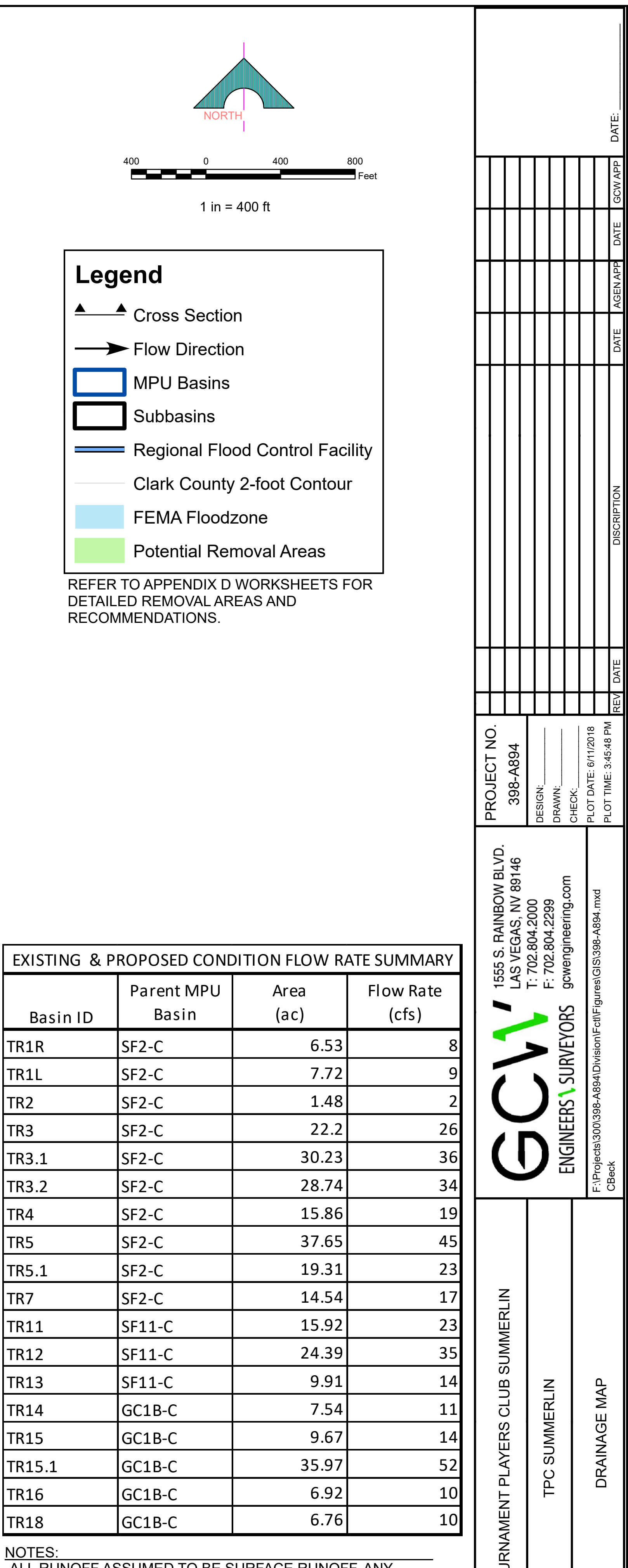
LEGEND

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

- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

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





EXISTING & PROPOSED CONDITION FLOW RATE SUMMARY			
Basin ID	Parent MPU Basin	Area (ac)	Flow Rate (cfs)
TR1R	SF2-C	6.53	8
TR1L	SF2-C	7.72	9
TR2	SF2-C	1.48	2
TR3	SF2-C	22.2	26
TR3.1	SF2-C	30.23	36
TR3.2	SF2-C	28.74	34
TR4	SF2-C	15.86	19
TR5	SF2-C	37.65	45
TR5.1	SF2-C	19.31	23
TR7	SF2-C	14.54	17
TR11	SF11-C	15.92	23
TR12	SF11-C	24.39	35
TR13	SF11-C	9.91	14
TR14	GC1B-C	7.54	11
TR15	GC1B-C	9.67	14
TR15.1	GC1B-C	35.97	52
TR16	GC1B-C	6.92	10
TR18	GC1B-C	6.76	10

NOTES:

- ALL RUNOFF ASSUMED TO BE SURFACE RUNOFF. ANY EXISTING STORM DRAIN HAS NOT BEEN QUANTIFIED BY THIS STUDY.
- SUBBASIN FLOW RATES BASED ON MPU PRORATED CALCULATIONS. REFER TO APPENDIX B OF THE TECHNICAL DRAINAGE STUDY.

Legend:

- Proposed Grass Replacement Area
- Existing Desert Landscaping
- Existing Desert Landscaping
- Grass Replacement Area Not Recommended

Area 1, Left; Section 1-TR1R:



Area 1, Right; Section 1-TR1L



Area 1, Left; Section 1-TR1R:



Area 1, Right; Section 1-TR1L



An aerial map of a residential development. A large, irregularly shaped green area is outlined in red. This area is labeled "SUMMERLIN VILLAGE 1 SOUTH - UNIT NO 6" in blue text. The green area contains several smaller green patches and is surrounded by a red boundary. To the left of the green area, there is a red-shaded area labeled "PT1". The map shows various lot numbers in blue and red, including 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100. The map also shows a road labeled "Greensboro Ln" and a scale bar indicating 35m and 100ft. The map is overlaid with a grid of blue and red lines, and various lot numbers are scattered throughout. The text "SUMMERLIN VILLAGE 1 SOUTH - UNIT NO 6" is prominently displayed in the center of the green area. The red-shaded area to the left is labeled "PT1". The map shows a mix of green spaces, roads, and residential lots. The overall layout suggests a planned community with designated green areas and residential units. The red boundary likely indicates a specific unit or phase of the development. The lot numbers provide a detailed view of the individual parcels within the area. The scale bar and road names provide context for the map's location and size. The grid lines and colored text help in identifying specific features and areas of interest. The map is a detailed representation of the land use and planning for Summerlin Village 1 South.

[illegible]

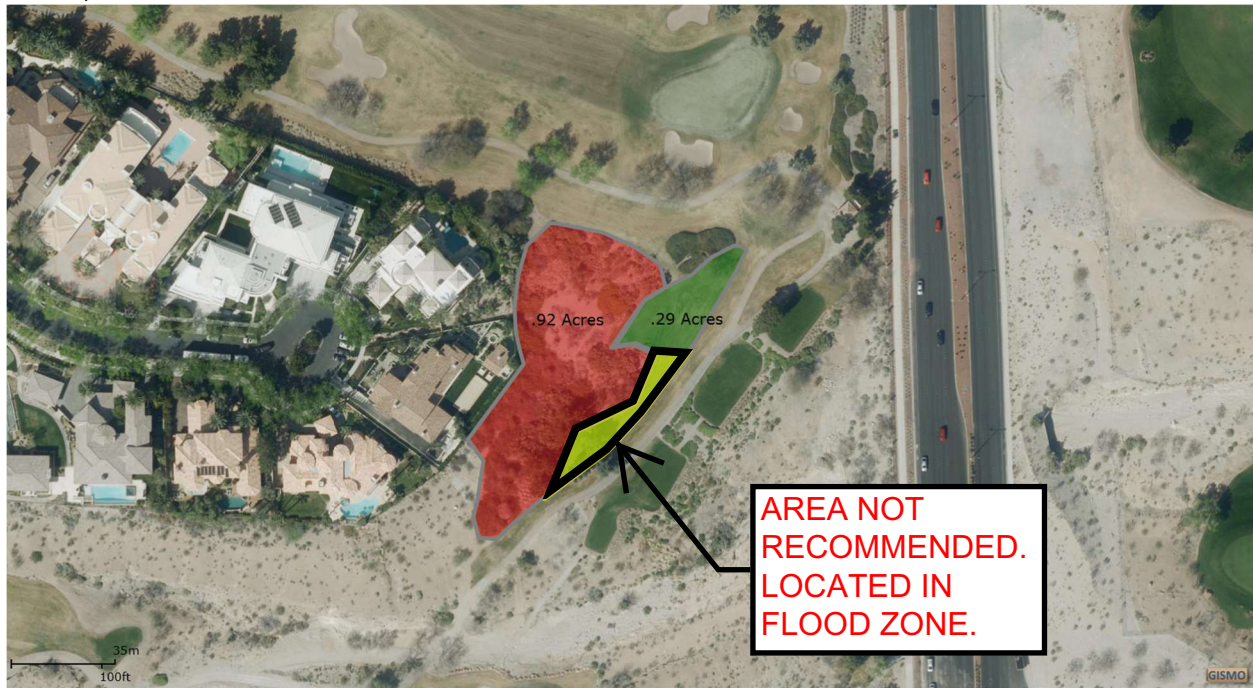
Area 4a; Section 4:



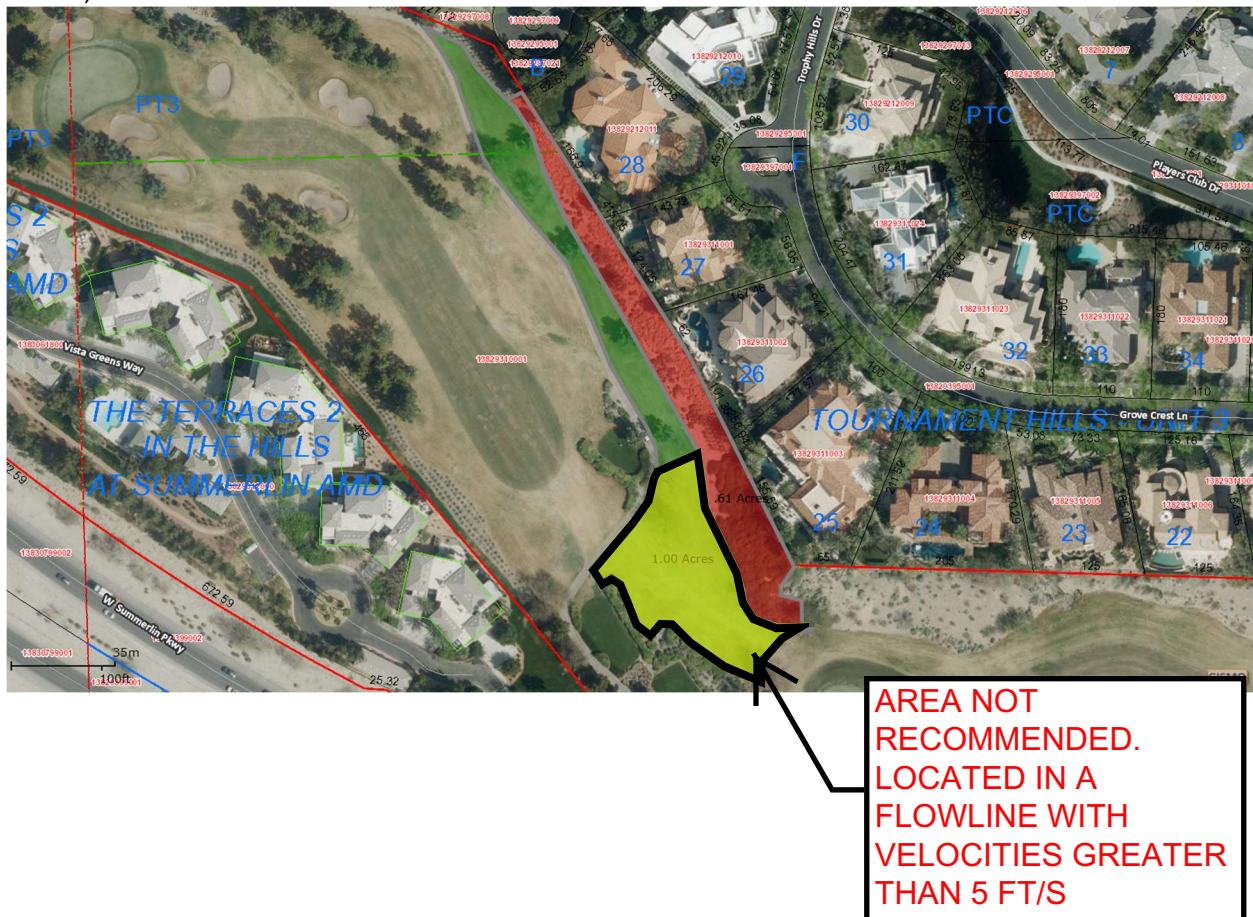
Area 4b; Section 4:



Area 5; Section 5:



Area 6; Section 6 and Section 7:



Area 7; Section 8 and Section 9:



Area 8; Section 10:



Area 9; Section 11:



Area 10; Section 12:



[illegible]

The aerial map illustrates the proposed 1.2-acre site for the 10th hole extension. The site is divided into five distinct colored segments, each labeled with its area in acres:

- Red segment (bottom left): .53 Acres
- Green segment (bottom left): .10 Acres
- Blue segment (center): .32 Acres
- Red segment (top right): .31 Acres
- Green segment (top left): .53 Acres

The map also shows the surrounding golf course, including the 9th and 10th holes, and the adjacent residential area. A scale bar in the bottom left corner indicates distances of 50m and 100ft. The GISMO logo is visible in the bottom right corner.

Area 13; Section 14:

