DS #: 4693

APN: 137-27-813-002

PROJECT: SAVONA – SMRCN V23B PARCEL CC – Ph. 1

SUBMITTAL: 1ST

SCANNED BY/DATE:

CHECKED BY/DATE:

CITY OF LAS VEGAS NEVADA

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: August 19, 2014
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: **Savona – Summerlin V23B Parcel CC**			**COPIES TO:** L.R. Nelson Consulting Engineers
Cross Streets:	NWC Desert Foothills Dr & Antelope Ridge Dr			Woodside Homes
File Number:	F:\Depot\DSMemos\DS4693A.doc			Bart Anderson, P.E., DevCo
Parcel Number:	137-27-813-002			
Zoning Action:	TMP-54802			
FEMA Flood Zone	YES	NO **X**		
Proposed Storm Drain	YES **X**	NO		

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1st Submittal	7/31/2014	8/18/2014	See Comments Below	$400.00	365457: $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 (**TMP-54802**) with the next submittal to verify compliance with conditions. *Flood Control* will not issue conditional approval of the drainage study without the associated zoning/planning conditions (issued by the *City Council*). Any associated conditions of approval that revise the site drainage parameters will require that the drainage study be revised and resubmitted.

2. Sites with a grade difference of 2 feet above or below existing are required to have approval from the *City Planning and Development Department*. The engineer must submit copies of the grading plans and detail sheet with a letter justifying the grade difference to the *City Planning Department* (229-6301). The engineer must provide Planning approval with the next submittal.

3. This drainage study assumes that the project will be constructed in one phase. If improvement plans are submitted to break the project into separate phases, a drainage study update will be required for each phase addressing the interim condition.

4. ***Figure 6***: *Concentration Point* **COM1** is missing in the existing drainage map. Identify clearly in the next submittal.

5. ***Figure 7***: The text on the proposed drainage map is too small and not legible. Provide a better quality print in the next submittal.

6. ***Grading Plan 3 and Grading Plan 5***: The finished floor elevations from Lot 3 up to Lot 16 along *Antelope Ridge Drive* are lower than the corresponding street grades. *Detail Section A/10* is not a correct representation for those lots. Provide a correct detail section for those lots in the next submittal. Note that the bottom three courses of the boundary wall must be 8"-CMU to be solid grouted from the adjacent high grade.

7. ***Grading Plan 6***:

   - The CAD layer of the onsite storm drain system was missing or frozen. Reveal as such in the next submittal.
   - Provide a connection detail between the proposed 42"-RCP and the existing 42"-stub in Common Element C.
   - Label clearly on the plan that Common Element C is a "Public Drainage Easement to be Privately Maintained by the HOA".
   - Provide a longitudinal profile of the proposed drainage easement in the next submittal.
   - On the plan, it appears that there is a proposed wall at the east end of the drainage easement. No openings are indicated for the emergency overflow to discharge. Provide a construction note for the installation of a wrought iron fence or equivalent.

8. Indicate whether the interior streets are private or public streets on the grading plans. For private streets which must be public drainage easements. Provide a note on the grading plans: "Note: All private streets are P.U.E., Public Sewer Easements and Public Drainage Easements to be privately maintained by the HOA".

9. Revise all drop inlets to Type "CM" or Neenah Pre-cast inlets. Contact Raul Cruz at 229-3224 for an AutoCAD detail to be included within the improvement plans if Type "CM" drop inlets are used. Note that the lengths of "CM" inlets are in the multiple of 2.5'. Revise all pertinent construction notes and callouts accordingly.

10. All drainage easements must be public drainage easements to be privately maintained and common lots to be labeled on the grading plans and to be dedicated as such in the final map.

11. The *City Council* of the *City of Las Vegas* recently adopted an amendment to Title 20 of the Municipal Code in which Section 20.10.030 requires all public drainage easements to be concrete lined. Revise the grading plan and *Detail Section P/10* and all pertinent plans and construction notes accordingly.

12. The engineer must provide a table on the grading plans that shows a quantity estimate of all drainage improvements within Public Drainage Easements. All drainage improvements within Public Drainage Easements must be bonded and inspected.

13. Show existing storm drain systems in the perimeter streets (*Desert Foothills Boulevard* and *Antelope Ridge Drive*) on all grading plans. Label with *City of Las Vegas* recorded construction drawing numbers also.

14. All wrought iron fence at drainage easement must utilize *City of Las Vegas* Standard Drawing 421B. Contact Raul Cruz at 229-3224 for the AutoCAD details (421 series) to be included with the improvement plans.

15. Add a note in all pertinent sheets for the construction of all storm drain drop inlets per a newly adopted USDCCA Drawing No. 421 (*Stormwater Quality Management Stamp and Sign Detail*).

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

END OF REMARKS

ays

T/R/S: T20S/R59E/27

AREA K-27

****
*** FAX TX REPORT ***
****

TRANSMISSION OK

JOB NO.	4351
DESTINATION ADDRESS	7024512296
PSWD/SUBADDRESS	
DESTINATION ID	
ST. TIME	08/19 16:42
USAGE T	00'48
PGS.	3
RESULT	OK

CITY OF LAS VEGAS
INTER-OFFICE MEMORANDUM

DATE: August 19, 2014

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:
Savona – Summerlin V23B Parcel CC

COPIES TO:
L.R. Nelson Consulting Engineers
Woodside Homes
Bart Anderson, P.E., DevCo

Cross Streets:	NWC Desert Foothills Dr & Antelope Ridge Dr		
File Number:	F:\Depot\DSMemos\DS4693A.doc		
Parcel Number:	137-27-813-002		
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FEMA Flood Zone	YES	NO X	
Proposed Storm Drain	YES X	NO	

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TECHNICAL DRAINAGE STUDY FOR SAVONA

(Parcel CC @ The Paseos)

CITY OF LAS VEGAS, NEVADA
Project Number: 220-013-131
July 2014

Prepared For:

Woodside Homes
4670 S. Fort Apache
Suite 200
Las Vegas, NV 89147
(702) 889-7800

Prepared By:

L.R. Nelson Consulting Engineers
6765 W. Russell Rd., Suite 200
Las Vegas, Nevada 89118
(702) 798-7978

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: SAVONA Date: Jul 28, 2014

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

East/West: ANTELOPE RIDGE DRIVE

b) Section: 27 Township: 20 South Range: 59 East

c) APN : 137-27-813-002

Name of Owner: WOODSIDE HOMES

Telephone No.: 702-889-7824 Fax No.: E-Mail Address:

Address: 4670 S. FORT APACHE, #200, Las Vegas, NV 89147

Contact Person-Name: Jon Hayslip **Telephone No.:** 702-798-7978

* **E-Mail Address:** jon.hayslip@lrneng.com **Fax No.:** 451-2296

Firm: L. R. Nelson Consulting Engineers, Inc.

Address: 6765 W. Russell Road, Suite 200, Las Vegas, NV 89118

Type of Land Development/Land Disturbance Process:

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

1. Total Owned Land Area: At Site: 28.57 (+/-) Ac. Being Developed/Disturbed: 28.57 (+/-) Ac.
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: 10 (+/-) acres
6. Has the site drainage been evaluated in the past? ☒ **YES** ☐ **NO** If yes, please identify documentation: Conceptual Drainage Study for Summerlin Village 23B – Update #3, DS3420
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: MASTER PLANNED STORM DRAIN SYSTEM PROVIDED IN THE SUMMERLIN VILLAGE 23B DESIGN DOCUMENTS
8. Briefly describe your proposed schedule for the subject project: As soon as possible.

Engineer's Seal

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

*New Required Field

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

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

Updated 05/01/2008

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: SAVONA	Map ID:
Firm Name: L.R. NELSON CONSULTING	Engineer:
Address: 6765 W. RUSSELL ROAD, SUITE 200	
City: LAS VEGAS State: NEVADA Zip: 89118	
Phone Number: (702) 798-7978	Fax Number: (702) 451-2296
Property Owner: WOODSIDE HOMES	
Address: 4670 S. FORT APACHE, #200	
City: Las Vegas State: NV Zip: 89147	

Reviewed By:	Date Received:	Date Accepted for Review:

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

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

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

I. GENERAL REQUIREMENT

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

II. MAPS AND EXHIBITS

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

REFERENCE:	STANDARD FORM 2

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

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

III. DRAINAGE PLAN

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

REFERENCE:	STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
N/A		Streets with off-set crowns.
X		Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
X		Property lines.
X		Right-of-way lines and widths, existing and proposed.
X		Existing improvements and their elevations.
X		Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
X		Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets.
X		Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
X		Location and cross-section of street capacity calculations.
X		Cross-sectional detail for channels, including cutoff wall locations.
X		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.
X		Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
N/A		Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.
X		Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
X		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.
X		Building and/or lot numbers.
X		Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
X		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**

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.
X	____	Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.
X	____	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
X	____	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes	No	
X	____	Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
X	____	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.
X	____	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.
X	____	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, Q_{10} and Q_{100} 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.
X	____	Calculation for impervious area for parking lots and LIDs (if required).

REFERENCE:	STANDARD FORM 2

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes	No	
N/A		Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
X		Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q_{100} and Q_{10} flows representing the worst case for interior and all perimeter streets. Q_{100} d x v $\leq$ 8. Q_{10} d x v $\leq$ 6 and 12 foot dry lane for rights-of-way $\geq$ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
X		A summary table of interior and exterior street capacity calculations showing the street name, Q_{100} flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
N/A		Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)
X		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.
X		Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q_{100} weir height or flow depth, whichever is greater.
N/A		A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
X		Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
X		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.
X		The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
X		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 06/06/01)

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 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 Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (Design Manual).

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.)
X		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions. APPENDIX E

II. GRADING PLAN INFORMATION		
Yes	No	
X		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
X		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.)
X		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.
X		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.
X		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.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
X		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	
X		Concrete valley gutters are required in parking lots with slopes less than 1 percent. Slopes through cul-de-sac must be at a 1 percent minimum where flow is drained through the cul-de-sac.
N/A		Ten-foot wide public drainage easements to be privately maintained are allowed for flow less than 20 cfs. The depth of flow entering the easement must be checked using the submerged weir calculation.
N/A		The limits of the flood zones and the base flood elevations (BFE) must be shown on all grading plans for all developments within a Special Flood Hazard Zone A, AO, AE, etc.
X		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.
X		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.
N/A		Lots with "B and C Type Drainage" shall be required to install an underground nuisance drainage system or a 2-foot valley gutter through the lot. 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.

July 28, 2014

Mr. Albert Sung, P.E.
Flood Control Project Engineer
Department of Public Works
City of Las Vegas
333 N. Rancho Drive
7th Floor
Las Vegas, Nevada 89107

Technical Drainage Study: Savona (Parcel CC @ The Paseos)

Dear Mr. Sung:

Submitted herewith for your review and approval is one (1) bond copy and one (1) electronic copy of the *Technical Drainage Study for Savona (Parcel CC @ The Paseos)* project.

This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by L.R. Nelson Consulting Engineers shall be without liability to L.R. Nelson Consulting Engineers.

If you have any questions regarding this Study, please contact our office at (702) 798-7978.

Sincerely,

Jon Hayslip, P.E., CFM
Flood Control Manager

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I. INTRODUCTION

A. Study Overview and Purpose

This study is intended to serve as the technical hydrology study for the proposed *Savona* (*Parcel CC @ The Paseos),* a single-family residential development. The project site is approximately 28.5 (+/-) acres is located within the *Summerlin West* Master Planned Area and this site is known as Summerlin Village 23B Unit 2 (Parcel CC of the G.C. Wallace Engineers design documents). The proposed development consists of 124 single-family residential lots, interior roadways, common elements and storm drain connection stub for the conveyance of onsite water to master planned flood control system.

This study is a stand-alone document that presents the findings of a hydrologic analysis of the site and contributing watershed area. Flow rates are computed for the *10- and 100-Year Design Storm* to be used to in the design of flood protection facilities as recommended by current criteria and regulatory agency requirements. This study has been conducted in accordance with the criteria set forth by the Clark County Regional Flood Control District's (CCRFCD) *Hydrologic Criteria and Drainage Design Manual* (Reference #2).

B. Location

The project area is within the South Half (S 1/2) of the Southeast Quarter (SE 1/4) of Section 27, Township 20 South, Range 59 East, Mount Diablo Meridian, City of Las Vegas, Nevada. The project site nearest intersection is Desert Foothills Drive and Antelope Ridge Drive. A *General Vicinity Map* is shown of Figure 1 in Appendix A.

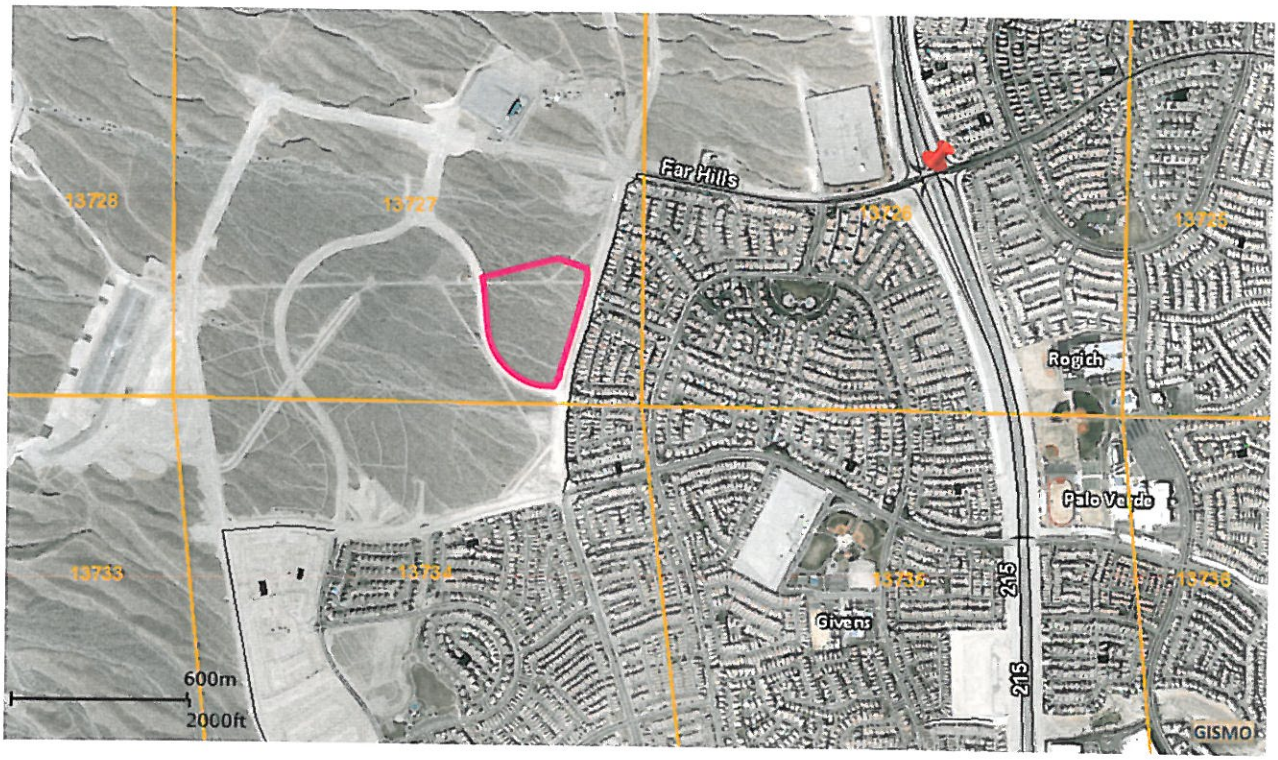
The Assessor's Parcel Number (APN) for the proposed apartment development is 137-27-813-002 and highlighted on Figure 2 in Appendix A.

C. Existing Site Description

As determined in a site visit, the area is currently undeveloped. The area generally slopes to the southeast at approximately 4 percent. The site is bordered by Desert Foothills Drive right-of-way alignment on the southeast, Antelope Ridge Drive right-of-way alignment on the west and Summerlin Village 23B Parcel BB on the north. The area is undeveloped and improvements in the area are planned for residential, commercial and park uses.

The area is subject to the G.C. Wallace Inc. master planning for Village 23B and the individual parcels are beginning to be developed. It is assumed that the infrastructure backbone, perimeter streets, curb, gutter, side and storm drains will be constructed prior construction of Savona (Parcel CC). The photo on the following page shows the parcel outline in magenta and current condition seen in the site visit.

Photo 1: Existing Onsite Condition & Location (ref. GISMO)



D. CCRFCD Master Plan Information

As shown on the Figure 3 in Appendix A which references *2013 Clark County Regional Flood Control Districts Las Vegas Valley Flood Control Master Plan Update* (MPU) Figure F-24, the project site is not adjacent to an existing or proposed Master Plan Flood Control Facility.

E. FEMA Flood Plain Information

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community-Panel Number 32003C 2150E, revised to reflect LOMR dated September 27, 2002, the site is located within a Zone 'X'. A Zone 'X' is described by FEMA as an *area outside the 0.2% annual chance floodplain*. Based on research, no Letters of Map Revisions known as LOMRs were found for this panel number. A map depicting the FEMA flood zones in the vicinity of the site is included in Appendix A of this study. The site boundary has been provided on Figure 4, *Flood Insurance Rate Map*.

F. City of Las Vegas Flood Control Master Plan

Figure F-7 of the *1997 City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis* was reviewed for referenced offsite flood control facilities and drainage flow rates for the 10- and 100-Year design storm flows adjacent to the project site. As shown on Figure 5 in Appendix A the project site is located within the middle of a proposed regional facility. Due to the age of this document and subsequent master planning changes for the control of drainage in the Summerlin West area, the flood control facility alignment is no longer valid. The master plan changes provided by others and adopted in the CCRFCD MPU represents the best available information regarding control of drainage around the subject site. The proposed site is shown on Figure 5 of the referenced document in Appendix D.

G. Previous Drainage Studies

The following technical drainage studies listed below were referenced in preparation for this study:

- *Conceptual Drainage Study for Summerlin Village 23B – Update #3,* by G.C. Wallace, Inc., July 2013, DS3420.

Based upon a review of the above mention study by L.R. Nelson Consulting Engineers it appears these studies meet the minimum criteria and concur with the results. The former study was referenced for ultimate design buildout for the Summerlin Village 23B. This Study has provided the pertinent portions of these referenced drainage studies and are included in Appendix D.

II. METHODOLOGY

A. Compliance with Regulations

This Study was conducted in accordance with the Clark County standards and the criteria set forth by Clark County Regional Flood Control District (CCRFCD) *Hydrologic Criteria and Drainage Design Manual* (HC&DDM), prepared by WRC Engineering and updated by Montgomery Watson, August 1999.

B. Hydrologic Criteria

1. Rainfall Criteria

The referenced drainage study utilized a 100-Year precipitation depth of 3.29 inches and a HEC-1 JR card ratio of 0.55 for the estimated 10-Year precipitation estimate equal to 1.81 inches. No Depth-Area-Reduction factors were used since the onsite watershed area is approximately 28.57 acres or 0.04 sq. miles.

Table 1: Non-McCarran Airport Rainfall Values

10-Year 6-Hour (in)	100-Year 6-Hour (in)
1.81	3.29

2. Runoff Computations

For the existing condition, the Soil Conservation Service or SCS dimensionless unit hydrograph method provided within the HEC-1 model was utilized to compute design storm hydrographs. The **U.S. Army Corps of Engineers HEC-1, *Flood Hydrograph Package Computer Model***, June 1998 Version 4.1 was utilized to model the surface runoff estimate of a given watershed to rainfall. The HEC-1 program represents the watershed as an interconnected system of hydraulic components. Each component represents an aspect of the rainfall runoff process within a portion of the watershed. The smaller portion is referred to as a sub-basin. The computed hydrographs from each sub-basin are then combined at appropriate locations to obtain the final discharge hydrograph. The HEC-1 parameter calculations are located in Appendix B of this study.

Lag Time T_L is defined as the time measured from the centroid of effective rainfall to the peak of the outflow hydrograph. It is a measure of the watershed's response time and is a coherent property to basin length, slope, roughness characteristics and land use. The lag-times for this study were estimated by calculating the drainage basins' time of concentration, T_C. The time of concentration consists of two components; the initial overland flow time, t_i, and the gutter or channel flow time, t_t. The equation for the time of concentration is $TC = t_i + t_t$. The equation for lag time is $T_L = 0.6T_C$. Standard Form 4 from the CCRFCD HC&DDM was utilized to establish the T_L for input into the HEC-1 models and is included in Appendix B for review.

For the existing and developed onsite conditions, the SCS method described above was used for the hydrologic analysis within the HEC-1 computer software. Routing of onsite flow along the proposed flow paths used the Muskingum-Cunge method shown as the RD card in the HEC-1 model.

3. Soils Classification

The United States Department of Agriculture (USDA) Soil Conservation Service (SCS) Soil Survey published for the Las Vegas Valley was consulted to establish the Hydrologic Soil Group (HSG) information for the watershed area. The SCS results indicate the soil is listed as *Canuti-Cave*, Unit 502, HSG is Type 'D'. The onsite area has been located on the Soil Exhibit prepared by G.C. Wallace for the referenced drainage study listed in Section I (G) and included in Appendix D for review. The referenced information in Appendix D indicates the *developed condition* Curve Number (CN) was determined to be 89.7 for the Village 23B Update #3 conceptual drainage study. For the existing condition CN values the summary table below is provided

The Curve Numbers for the onsite and offsite drainage basins were determined using Table 602 (page and 4 of 4) and Table 602A from the CCRFCD Manual Reference #1). The land use category for the developed onsite basins is *Urban Districts: Commercial and Business*.

Table 2: Existing CN Values

Soil Name: Canutio-Cave **Soil No.:** 502
Description: Gravelly Loamy Fine Sand

Cover Type: Soil Sub-Group	Developed Condition Residential Districts HSG	% of Group	CN	Computed CN %
Canuito	B	55	77	42.35
Cave	D	40	88	35.20
Arizo	A	5	63	3.15
			Weighted CN	80.7

C. Hydraulic Analysis

The following Bentley Systems computer software, FlowMaster, software was used to compute the normal depth and velocity for the offsite and onsite area. The software uses Manning's Equation to determine the results used to calculate depth times velocity values required by the HC&DDM. Drop Inlet Analysis capture capacity for the proposed drop inlets utilized the Bentley Systems FlowMaster software, which is based upon the Federal Highway Administrations (FHWA) HEC-22 document. Drop inlet calculation clogging factors (CF) are 50% and applied within the software for each inlet.

For storm drain hydraulic analysis, Los Angeles County Flood Control District Water Surface and Pressure Gradient model for Windows (WSPGW v14.06) as modified by CivilDesign Corporation was utilized to determine the hydraulic characteristics of the offsite and onsite storm drain systems. There were a total of two (2) models prepared for the proposed systems, northern and southern onsite models were created for analysis of storm water captured and routed through the proposed site.

Bentley Systems computer software, CulvertMaster (v3.0) software was used to compute the headwater and HGL profile for one of the storm drain laterals assuming tailwater depth based upon the WSPGW analysis.

III. DRAINAGE BASIN DESCRIPTIONS

A. Existing Drainage Description

Based upon site inspection, review of the GISMO aerial map and existing topographic information, the site gradient is to the southeast draining into the future Desert Foothills Drive roadway alignment. Storm runoff is conveyed by grade in to shallow braided washes towards the southeastern boundary of the site. The area is covered in typical desert vegetation consisting of sagebrush and appears to be remnants of alluvial fan flow based upon review of the GISMO aerial photo.

Table 3: Existing Onsite Runoff Summary

HEC-1 ID/ BASIN NAME	AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
ON1EX	10.77	7	23
ON2EX	17.77	11	37
COM1	28.54	19	59

The HEC-1 modeling for the onsite existing condition is summarized in the table above. An existing drainage basin map, Figure 6 in Appendix A, shows the onsite basins and concentration points. A copy of the existing condition HEC-1 model is included in Appendix B for review.

B. Future Drainage Description

Under the future condition assumptions the site will be fully developed; all offsite basins are assumed to be constructed and surrounding roadway and storm drain infrastructure is completed. Offsite drainage patterns will conform to the Village 23B master drainage plan and flow computed in the adjacent right-of-way by G.C. Wallace Engineers is assumed to be accurate and will be utilized in depth of flow calculations for the offsite roadways. Based upon the approved G. C. Wallace analysis the 10- and 100-Year computed flow rates area are 36 and 83 cfs.

The onsite area is proposed to drain the single-family residential units to the interior streets as surface flow and be conveyed by grade to the low point on Street C where a 42-in RCP storm drain stub provided by the master developer for Parcel CC to convey the 100-Year flow rate 83 cfs. The entire onsite parcel drains to this low point and a series of Clark County Area Uniform Standard Drawings (CCAUSD) drop inlets No. 412.1 are proposed to pick up the flow and convey it to the provided RCP stub. An emergency overflow section will be provide at the low approximately 50-ft in width which serves as the common element area.

The HEC-1 hydrologic analysis is summarized in the following table and the onsite area is divided into seven (7) basins and is shown in Figure 7, *Proposed Onsite Drainage Basin Map*, in Appendix A.

Table 4: Future Onsite Runoff Summary

HEC-1 BASIN NAME/ COMBINATION POINT	AREA (ac)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
ON1	2.06	3	7
ON2	5.15	6	15
ON3	3.08	5	10
ON4	4.74	7	16
ON5	1.44	2	5
ON6	8.16	11	26
ON7	3.91	5	12
COM1	-	25	59
COM2	-	35	82

These flows combine at the low point in Street C are summarized in the following table.

Table 5: Design Runoff Comparison Summary

AREA/NODE	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)	REMARKS
Parcel CC	36	83	GCW HEC-1 Total Flow
COM2	35	82	LRN HEC-1 – Total Flow
Difference	-1	-1	Comparison to GCW V23B MP

Based on the comparison of the HEC-1 models for the G.C. Wallace Village 23 Master Plan and that of the LRN analysis, the summary results indicate the 10 and 100-Year design storm flow rate has been reduced by 1 cfs for each analyzed event.

C. Roadway Depth of Flow Calculations

Onsite and offsite street flow calculations for the 10-year and 100-year, 6-hour storm events are summarized in the following tables. The hydraulic calculations are included in Appendix C. The onsite depth of flow calculations are for a 41-ft private street with a 4-ft sidewalk on onside only and standard "L" curb.

Table 6: Onsite Street Flow Calculations

Street	Slope (%)	Q_{100} (cfs)	D_{100} (ft)	V_{100} (ft/s)	DV
Onsite Street – Sec. 1	5.40	19	0.39	5.68	2.2
Onsite Street – Sec. 2	0.60	34	0.61	3.07	1.9
Onsite Street – Sec. 3	5.20	10	0.33	4.86	1.6
Onsite Street – Sec. 4	5.00	5	0.28	4.17	1.2
Onsite Street – Sec. 5	4.80	16	0.38	5.22	2.0
Onsite Street – Sec. 6	2.80	26	0.46	4.75	2.2
Onsite Street – Sec. 7	7.30	26	0.41	6.87	2.8

Based upon the above FlowMaster calculations for the onsite conditions, the computed 100-Year design storm flow rates are contained within the private onsite roadways areas and the minimum finish floor criterion is met for all the buildings. Depth of flow cross section locations are shown on Figure 7, *Onsite Drainage Basin Map*, in Appendix A.

Table 7: Offsite Street Flow Calculations

Street	Slope (%)	Q_{10}/Q_{100} (cfs)	D_{10}/D_{100} (ft)	V_{10}/V_{100} (ft/s)	DV	Dry Lane (ft)
Antelope Ridge – Sec. 8	3.90	11/24	0.35/0.43	4.44/5.30	1.6/2.3	8.51/-

The approved referenced study for Village 23B indicates the estimated 10- and 100-Year flow rate in Antelope Ridge Drive is 11 and 24 cfs, respectively, and denoted as drainage basin ST2 (Fox Hill) plus approximately 1/3 of ST4 (Antelope Ridge) on Figure 6U3, *Ultimate Conditions Drainage Basin Map* highlighted and located in Appendix D. The high point at the entrance to Savona was set to a minimum of one (1) above the flow line in Antelope Ridge greater than the required 6 inches per §903.6 of the HC&DDM.

D. Drop Inlet Hydraulic Analysis

Based upon the hydraulic analysis in the following section, six (6) drop inlets will be located near the low point to capture the 100-Year computed design storm flow rate of 83 cfs and conveyed to the 42-in RCP connection. The following drop inlet table shows the captured and flow bypass for each inlet. Due to the rounding that occurs in the HEC-1 analysis, the total computed flow captured in the inlets is 84 cfs while the computed 100-Year design storm is 82 cfs, the design flow difference is approximate 2.3% over the total capture flow.

Table 8: Drop Inlet Capture Summary Table

Drop Inlet #	Total Q (cfs)	Qcapture (cfs)	Qbypass (cfs)	Remarks
1	13.20	13.20	0.00	10' Mod. Type C - Sump
2	13.50	13.50	0.00	10' Mod. Type C - Sump
3	13.00	10.71	2.29	12.5' Mod. Type C on Grade
4	29.50	18.59	10.91	12.5' Mod. Type C on Grade
5	13.00	9.39	3.61	15' Mod. Type C on Grade
6	29.50	18.59	10.91	12.5' Mod. Type C on Grade

In the sump condition, drop inlets #1 and #2 were sized to pick up the bypass flow and limit the ponding elevation to top of curb elevations. The drop inlet hydraulic calculations are included in Appendix C for review. The drop inlet layout is shown on the Figure 8, *Storm Drain Location Map*, in Appendix A.

E. Storm Drain Hydraulic Calculations

The storm drain system was broken down into three (3) models with two (2) using WSPGW and one (1) utilizing CulvertMaster to analyze the lateral pipe. As shown on Figure 8, *Storm Drain Location Map*, will pick up the 100-Year design storm flow at and near the sump location currently known as Street C and direct it into the 42-in RCP provided by the master developers.

The southern WSPGW analysis starts at drop inlet #5 and routes to drop inlet #3 then to drop inlet #1 where it picks the northern drop inlets (#4 & #6) and sump flow at #2. The CulvertMaster lateral hydraulic analysis analyzes the flow picked on the west (DI #2).

The results of the WSPGW analysis included in Appendix C show the local onsite system is surcharged and will operate under pressure condition until exits the back of drop inlet #1. From this point on downstream, the pipe slope is steep and the WSPGW analysis shows the hydraulic grade line (HGL) returns to non-pressurized condition. The HGL in the entire system is greater than one (1) foot below the proposed design grade along the RCP and drop inlet profile.

The 100-Year HGL information has been placed on the plan and profile sheets for review.

F. Emergency Overflow Hydraulic Calculations

The 50-ft common element / easement located at the sump condition serves as an emergency overflow section in case the drop inlets become clogged. A hydraulic analysis using the Submerged Weir Equation shown below;

$$Q_S - Q_1 \times \left[1 - \left(\frac{H_2}{H_1}\right)^{\frac{3}{2}}\right]^{0.385}$$

was utilized to estimate the headwater depth at curb line of the common element area. The results of the hydraulic analysis indicate the estimated headwater depth of 0.74-ft above the curb line for estimate 100-Year water surface elevation of 36.46 (= 35.72 + 0.74) at the low point. The minimum finished floor elevations for the lots at the sump is 38.33 (lots 23, 76 and 77) providing a freeboard of 1.87 feet. The complete hydraulic Submerged Weir analysis is provided in Appendix C for review.

IV. CONCLUSIONS

Based upon a comparison of the original analysis prepared by G.C. Wallace Consulting Engineers for Village 23B, the proposed development flow rates are nearly the same for the 10- and 100-Year design storms as shown in the Table 5 comparison. The onsite storm drain system captures and conveys the 100-Year design storm flow rate into the proposed 42-in RCP stub designed for flow conveyance of Summerlin Village 23B Parcel CC (Savona). No flow onsite surface flow contribution will be routed to the surrounding offsite streets.

Nuisance flow will be carried onsite within the onsite curb and gutter and be released into the storm drain systems within the site.

The site is not located within a Special Flood Hazard Area as determined by the Federal Emergency Management Agency Flood Insurance Rate Map review of the latest publication of Community-Panel Number 32003C 2150E.

The drainage study for the Savona single-family residential meets and exceeds the minimum finished floor elevations for the onsite flow depths as all onsite generated storm water is contained below top of curbs. Finished floor elevations are in excess of twice the depth of flow throughout the proposed residential community and meet the criteria of §304.4(E) of the HC&DDM based upon the 100-Year design storm flow rate.

The hydrologic and hydraulic analysis meets the minimum criteria requirements of the Clark County Regional Flood Control District Hydrologic Criteria and Drainage Design Manual.

V. RECOMMENDATIONS

The following recommendations are provided to facilitate safety, both public and private, for the proposed apartment complex.

1. Construct the proposed storm drain systems and grade the site according to the proposed grading plans to meet the CCRFCD & CLV drainage criteria for the 10- and 100-year, 6-hour design storm event.

2. The site entrance is elevated to prevent offsite runoff from entering the site and exceeds the minimum criteria of Section 903.6 in the HC&DDM.

3. Construct all proposed street and gutter improvements to allow proper conveyance of storm water.

V. REFERENCES

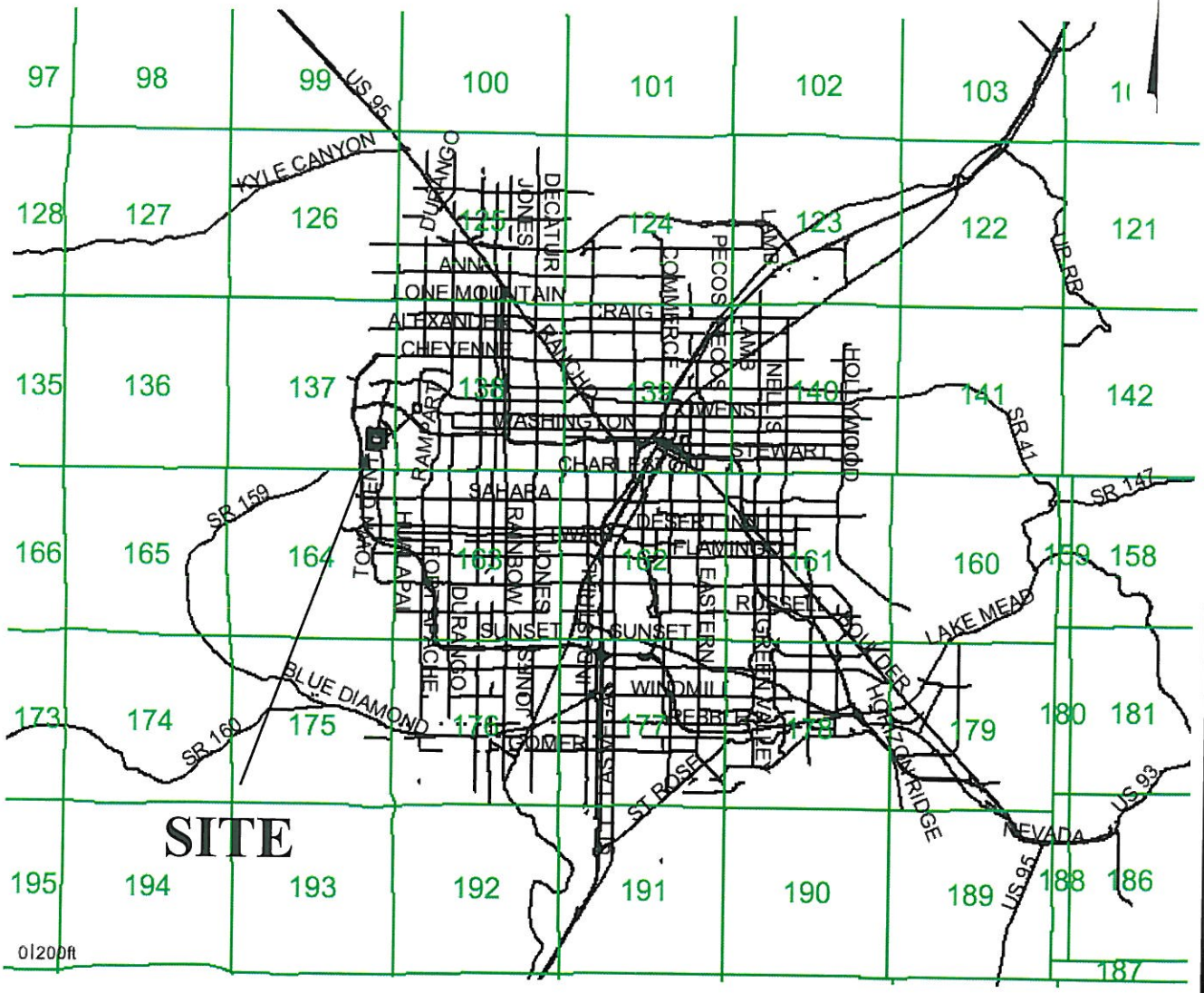
1. *CCRFCD Flood Control Master Plan*, by P.B.S. & J., Inc. and PB, Inc., 2008.

2. *CCRFCD Hydrologic Criteria and Drainage Design Manual*, WRC Engineering, 1999.

3. *1997 City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis*, PBS&J.

4. *Conceptual Drainage Study for Summerlin Village 23B – Update #3,* by G.C. Wallace, Inc., July 2013, DS3420.

Appendix A: Figures



L.R. Nelson Consulting Engineers 6765 W. Russell Rd., Suite 200 Las Vegas, NV 89118	PARCEL CC WOODSIDE HOMES	Figure 1 General Vicinity Map

NOTES

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

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

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

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

0 100 200 400 600 800

MAP LEGEND

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

ASSESSOR'S PARCELS - CLARK CO., NV.
Michele W. Shafe - Assessor

BOOK	SEC.	MAP	
T20S R59E	27	S 2 SE 4	137-27-8

136	137	138
165	164	163

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

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

Scale: 1" = 200' Rev: 10/16/2013

CLARK COUNTY ASSESSOR MAPPING DIVISION NEVADA

SUMMERLIN VILLAGE 23B UNIT NO.2
PB 145-83

PROJECT SITE

PT CC
CC
COS-5
NP-2
ES-2
PT COS-5
PT 137-27-411-002
PT 137-34-519-001
PT Q
PT P
PT 137-34-519-002
ANTELOPE RIDGE DR
DESERT FOOTHILLS DR
CORSICANA ST
DENTON SPRINGS CT
MARBLE FALLS ST
MOUNTAIN SHADOW RD
STONEWALL SPRINGS AVE
KINGSLAND AVE
LILY RUBIN AVE
CARA VELLA AT THE SUMMERLIN VISTAS
CORRIGAN PL
HETZEL LN
TALAVERDE AT THE VISTAS
CANTERRA AT THE VISTAS - UNIT 2
PB 104-94
PB 106-48
PB 107-47

FIGURE 2

TAX DIST 200

REGIONAL FLOOD CONTROL DISTRICT

2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 24
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

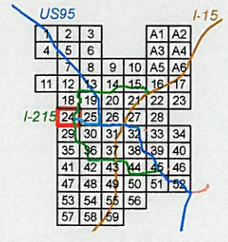
Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

N

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

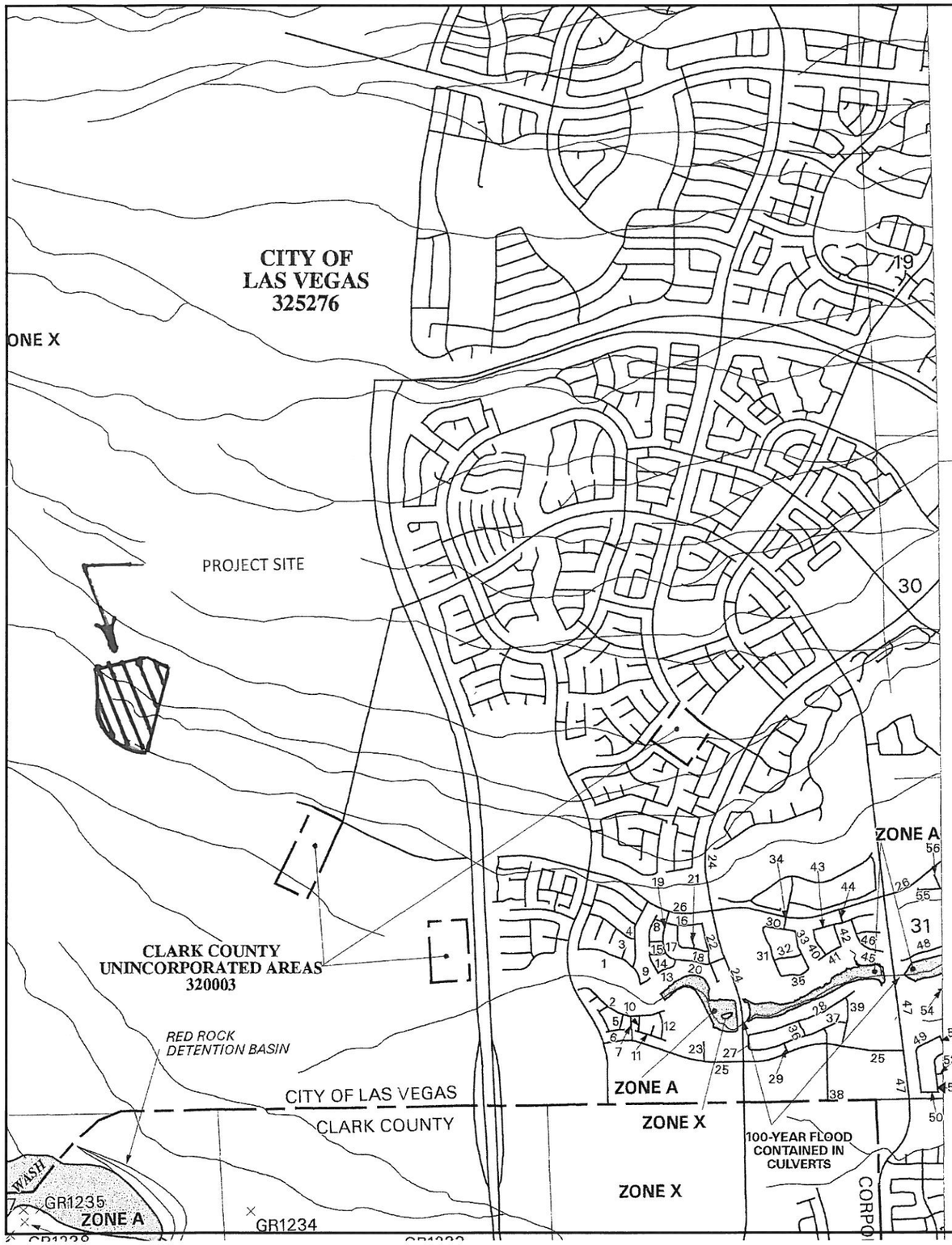
Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)



PROJECT SITE

FIGURE 3



KEY TO NUMBERED ROADS

1.....ELK LAKE DRIVE
2.....AMBER RIDGE DRIVE
3.....CELSO COURT
4.....JOE WILLIS STREET
5.....SUNRISE PEAK LANE
6.....PAPPAS LANE
7.....AFFINITY STREET
8.....BEAR GRASS STREET
9.....TRIXIS PLACE
10.....GLACIER PEAK LANE
11.....COZETTE COURT
12.....PICOTTE STEET
13.....TINTA LANE
14.....WHITEBRUSH AVENUE
15.....INDIGO BRUSH AVENUE
16.....ALLTHORNE AVENUE
17.....BLUE YUCCA STREET
18.....RED WOOD AVENUE
19.....MARIOLA STREET
20.....GARDEN PARK DRIVE
21.....JOJOBA COURT
22.....CHASE TREE STREET
23.....CANYON BLUFF COURT
24.....TOWN CENTER DRIVE
25.....PARK RUN DRIVE
26.....ALTA DRIVE
27.....QUEEN ASP DRIVE
28.....BIRCH BLUFF LANE
29.....PACIFIC PALMS STREET
30.....LUXEMBORG AVENUE
31.....POINT RIDGE PLACE
32.....WELLSID HILL AVENUE
33.....CANYON BROOK PLACE
34.....MONTE LANE
35.....CANYON VALLEY AVENUE
36.....SUMAC SPRINGS STREET
37.....JUNIPER CREEK LANE
38.....INDIGO DRIVE
39.....MAJESTIC OAK STREET
40.....HERMOSA CANYON DRIVE
41.....EDGECLIFF LANE
42.....VERDE VISTA PLACE
43.....CRESSENT MESA LANE
44.....LEDGESTONE PLACE
45.....EDGE BROOK DRIVE
46.....BOW RIDGE COURT
47.....HUALAPAI WAY
48.....ORIENT EXPRESS COURT
49.....SIR JAMES BRIDGE WAY
50.....CLAIRE LAKE AVENUE
51.....SETHFIELD PLACE
52.....GRANGER FARM WAY
53.....ROBROY AVENUE
54.....WINTER PALACE DRIVE
55.....QUEEN CHARLOTTE DRIVE
56.....BAYSWATER COURT

THIS AREA IS SHOWN ON MAP I

KEY TO NUMBERED

1.....SPRING MOUNTAIN ROAD
46.....ORANGE PIPE COURT
47.....PHANTOM ROCK STREET
91.....KEYMAR DRIVE
92.....LULLINGSTONE

MAP SCALE 1" = 2000'

000 0 2000 4000 FEET

M

0 600 1200

PANEL 2150 E

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY,
NEVADA AND
INCORPORATED AREAS

PANEL 2150 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LAS VEGAS, CITY OF	325276	2150	E
CLARK COUNTY, UNINCORPORATED AREAS	320003	2150	E

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

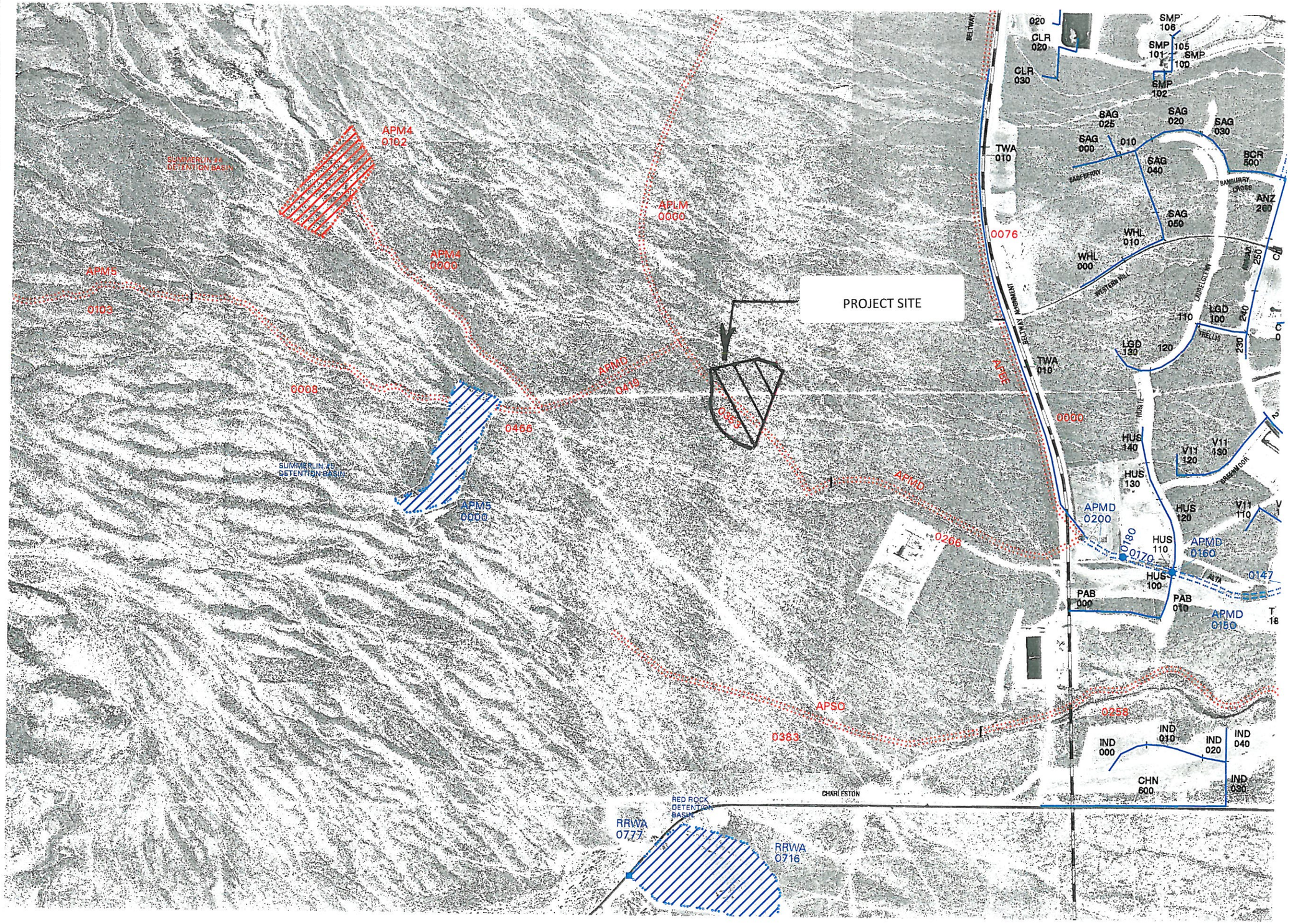
MAP NUMBER
32003C2150 E

MAP REVISED:
SEPTEMBER 27, 2002

Federal Emergency Management Agency

FIGURE 4

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



City of Las Vegas

CITY - WIDE HYDROLOGY ANALYSIS

LEGEND

- EXISTING REGIONAL DETENTION BASINS
- PROPOSED REGIONAL DETENTION BASINS
- EXISTING LOCAL DETENTION BASINS
- EXISTING REGIONAL BRIDGES
- PROPOSED REGIONAL BRIDGES
- EXISTING LOCAL BRIDGES
- EXISTING REGIONAL CULVERT
- PROPOSED REGIONAL CULVERT
- EXISTING LOCAL CULVERT
- EXISTING REGIONAL PIPELINE
- PROPOSED REGIONAL PIPELINE
- EXISTING LOCAL PIPELINE
- EXISTING REGIONAL CHANNEL
- PROPOSED REGIONAL CHANNEL
- EXISTING LOCAL CHANNEL
- EXISTING REGIONAL DIKE/LEVEE
- PROPOSED REGIONAL DIKE/LEVEE
- EXISTING LOCAL DIKE/LEVEE
- EXISTING STORM WATER PUMPING STATION
- PROPOSED BELTWAY ALIGNMENT

FIGURE F-11

	1	2		
	3	4		
	5	6		
7	8	9	10	
11	12	13	14	15
	16	17	18	19

N
W E

FIGURE 5

Scale: 1 inch = 1600 feet

FLOOD CONTROL FACILITIES

PBS&J POST, BUCKLEY, SCHUH & JERNIGAN



EXISTING CONDITION DRAINAGE BASIN MAP

LEGEND

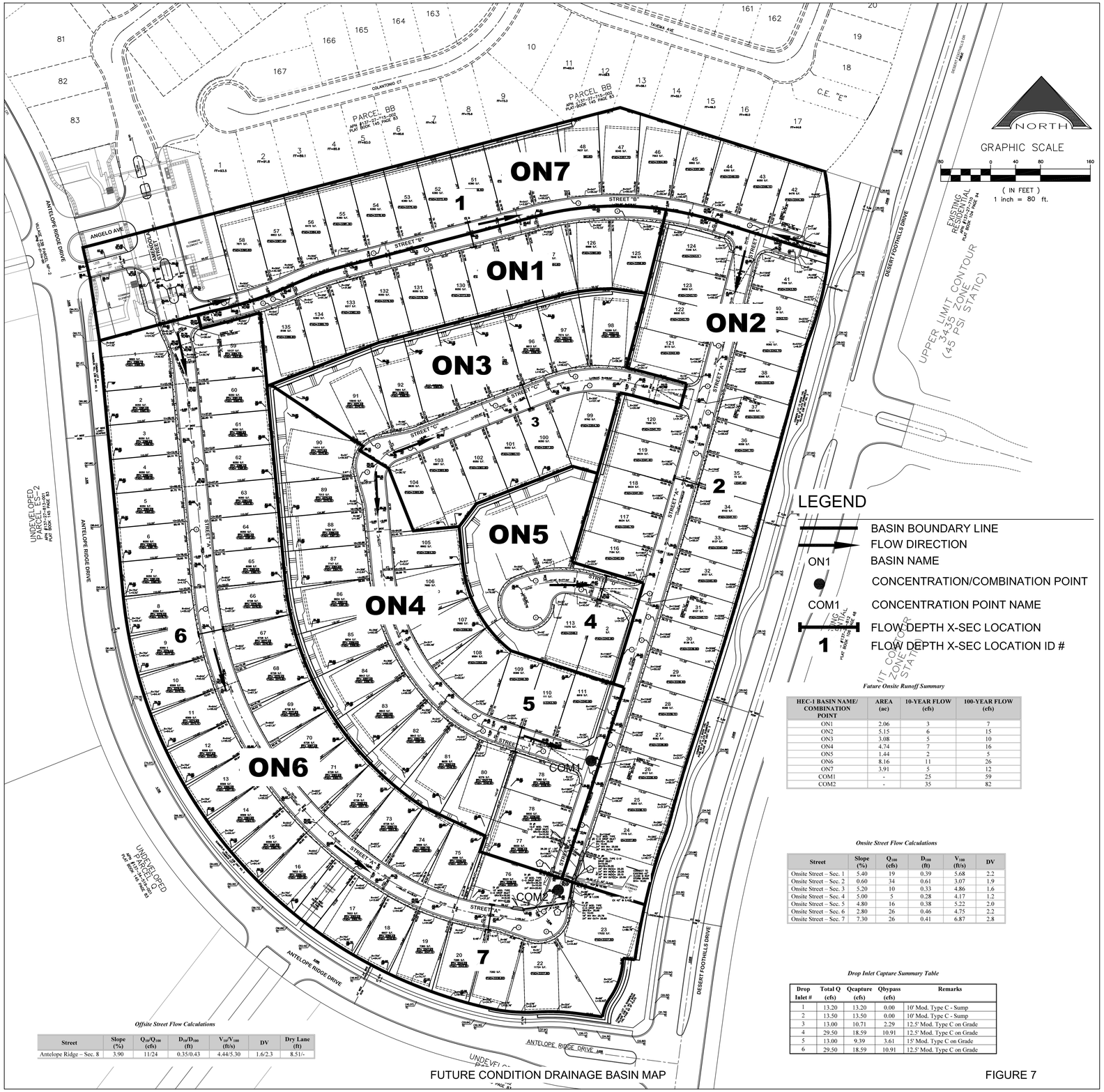
- *BASIN BOUNDARY LINE*
- *FLOW DIRECTION*
- *ON1EX* *BASIN NAME*
- *CONCENTRATION/COMBINATION POINT*
- *COM1* *CONCENTRATION POINT NAME*

Existing Onsite Runoff Summary

HEC-1 ID/ BASIN NAME	AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
ON1EX	10.77	7	23
ON2EX	17.77	11	37
COM1	28.54	19	59

FIGURE 6

Y:\Drawings Realism\CVA_42064_23RHS - Gill - 33\DWG\Proj. 7\29\2014 9:24:49 AM, Adobe PDF



Future Onsite Runoff Summary

HEC-1 BASIN NAME/ COMBINATION POINT	AREA (ac)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
ON1	2.06	3	7
ON2	5.15	6	15
ON3	3.08	5	10
ON4	4.74	7	16
ON5	1.44	2	5
ON6	8.16	11	26
ON7	3.91	5	12
COM1	-	25	59
COM2	-	35	82

Onsite Street Flow Calculations

Street	Slope (%)	Q_{100} (cfs)	D_{100} (ft)	V_{100} (ft/s)	DV
Onsite Street – Sec. 1	5.40	19	0.39	5.68	2.2
Onsite Street – Sec. 2	0.60	34	0.61	3.07	1.9
Onsite Street – Sec. 3	5.20	10	0.33	4.86	1.6
Onsite Street – Sec. 4	5.00	5	0.28	4.17	1.2
Onsite Street – Sec. 5	4.80	16	0.38	5.22	2.0
Onsite Street – Sec. 6	2.80	26	0.46	4.75	2.2
Onsite Street – Sec. 7	7.30	26	0.41	6.87	2.8

Drop Inlet Capture Summary Table

Drop Inlet #	Total Q (cfs)	Qcapture (cfs)	Qbypass (cfs)	Remarks
1	13.20	13.20	0.00	10' Mod. Type C - Sump
2	13.50	13.50	0.00	10' Mod. Type C - Sump
3	13.00	10.71	2.29	12.5' Mod. Type C on Grade
4	29.50	18.59	10.91	12.5' Mod. Type C on Grade
5	13.00	9.39	3.61	15' Mod. Type C on Grade
6	29.50	18.59	10.91	12.5' Mod. Type C on Grade

Offsite Street Flow Calculations

Street	Slope (%)	Q_{10}/Q_{100} (cfs)	D_{10}/D_{100} (ft)	V_{10}/V_{100} (ft/s)	DV	Dry Lane (ft)
Antelope Ridge – Sec. 8	3.90	11/24	0.35/0.43	4.44/5.30	1.6/2.3	8.51/-

FUTURE CONDITION DRAINAGE BASIN MAP

FIGURE 7

T:\Drainage Studies\CUAC\0344-220001 - GB.dwg, 7/29/2014 9:23:45 AM, Adobe PDF

NORTH

GRAPHIC SCALE

30 0 15 30

(IN FEET)

1 inch = 30 ft.

78
6600 S.F.
FF= 3338.83
PAD= 3338.00

74
6866 S.F.
FF= 3351.73
PAD= 3350.90

75
6886 S.F.
FF= 3348.23
PAD= 3347.40

77
6600 S.F.
FF= 3338.43
PAD= 3337.60

76
8523 S.F.
FF= 3338.33
PAD= 3337.50

24
6253 S.F.
FF=3338.93
PAD=3338.10

23
17032 S.F.
FF=3338.33
PAD=3337.50

22
11724 S.F.
FF=3338.63
PAD=3337.80

21
7282 S.F.
FF=3339.43
PAD=3338.60

20
7285 S.F.
FF= 3344.03
PAD= 3343.20

19
7360 S.F.
FF= 3347.93
PAD= 3347.10

WSPG Sta.1113.50* DI-6
12.5' MODIFIED
TYPE C-D DROP INLET
GRATE=35.61
D=10.00
24" INV=26.25

DI-2
12.5' MODIFIED
C-D DROP INLET
GRATE=35.22
D=10.00
24" INV=25.79

DI#2 to DI#1
CulvertMaster
Lat. Calc

WSPG Sta.1163.78** DI-5
12.5' MODIFIED
TYPE C-D DROP INLET
GRATE=36.55
D=10.00
24" INV=28.38

WSPG Sta.1081.76* DI-4
12.5' MODIFIED
TYPE C-D DROP INLET
GRATE= 35.57
D= 10.00
24" INV IN=25.86
30" INV_OUT=25.76

DI-1 WSPG Sta.1048.48*&**
10' MODIFIED
TYPE C-D DROP INLET
GRATE=35.22
D= 10.00
30" INV IN(S)= 25.42
24" INV IN(W)= 25.42
30" INV IN(N)= 25.32
42" INV OUT(E)= 25.22

WSPG Sta.1000**
CONNECT TO
EXISTING 42"
CLASS III RCP
STORM DRAIN
INV= 16.60

DI-3 WSPG Sta.1087.78**
12.5' MODIFIED
TYPE C-D DROP INLET
GRATE= 35.39
D= 10.00
24" INV IN=26.24
30" INV OUT=26.14

26.28 LF -30" @ 1.67%

37.00 LF 24" @ 1.00%

46.48 LF - 42" CLASS III RCP @ 18.55%

28.10 LF 30" @ 3.17%

76.00 LF 24" @ 2.82%

38.74 LF 24" @ 1.00%

COMMON ELEMENT "C"

40' LANDSCAPING

87' WIDE ROW

37' WIDE ROW

NOTE:
* Northern WSPG Model
** Southern WSPG Model

STORM DRAIN LOCATION MAP
SAVONA

FIGURE
8

\\tmf1srv01\Civil\Root\Land Projects\2016 Projects\C\CATCH\Hydrology\20160216 - FIGURE 9.dwg, 7/6/2016 8:53:36 AM, \\tmf1srv01\OCE COPIER

Appendix B: Hydrologic Analysis

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

L. R. Nelson Consulting Engineers, Inc.
File: STD_FORM_4
Project No.: 220-013-131

Project
PARCEL CC - EXISTING CONDITION

CALCULATED BY : STAFF
DATE: 7/10/14

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK URBANIZED BASINS		Tc	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN	K (2)	AREA Ac (3)	AREA Mi^2	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	TOTAL LENGTH Ft (11)	Tc = (L/180)+10 Min (12)	Min (13)	Tlag= 0.6Tc/60 Hours	P10/P100
ON1EX	E	80.7	0.6752	10.77	0.01683	380.0	4.89	8.78	1190	4.92	3.28	6.52	4.30	1570	N/A	13.1	0.131	1.81/3.29
ON2EX	E	80.7	0.6752	17.77	0.02777	470.0	3.43	10.99	1000	5.10	3.34	6.64	3.75	1470	N/A	14.7	0.147	1.81/3.29

Tc = Ti + Tt Tlag = 0.6 Tc
Ti = 1.8 (1.1 - K) L^1/2 / S^1/3
K = 0.0132 (CN) - 0.39

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing V1 = 14.8*(S/100)^1/2 § 602.1
Developed V1 = 20.2*(S/100)^1/2 § 602.1
Existing V2 = 29.4*(S/100)^1/2
Developed V2 = 30.6*(S/100)^1/2

REFERENCE :

STANDARD FORM 4

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   10JUL14  TIME  15:06:11   *
*                                       *
*****************************************
```

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

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

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

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

1 HEC-1 INPUT PAGE 1

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

   1          ID
   2          ID         TECHNICAL DRAINAGE STUDY FOR PARCEL CC - SUMMERLIN
   3          ID              CITY OF LAS VEGAS, CLARK COUNTY, NEVADA
   4          ID
   5          ID    PREPARED BY:      L.R. NELSON CONSULTING ENGINEERS, INC.
   6          ID                        6765 W. RUSSELL ROAD, SUITE 200
   7          ID                             LAS VEGAS, NV  89118
   8          ID
   9          ID    FILENAME:CCE.DAT
  10          ID    JOB# 220-013-131
  11          ID    EXISTING CONDITION
  12          ID    TECHNICAL DRAINAGE STUDY
  13          ID
              *DIAGRAM
  14          IT       5       0       0     300
  15          IO       5
  16          IN       5
  17          JR    PREC    0.55     1.0

  18          KK   ON1EX
  19          KM   EXISTING ONSITE BASIN
  20          BA  .01683
  21          PB    3.29
  22          PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
  23          PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
  24          PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
  25          PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
  26          PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
  27          PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
  28          PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
  29          PC    .998    .999   1.00
  30          LS       0   80.7
  31          UD    .131
              *

  32          KK   ON2EX
  33          KM   EXISTING ONSITE BASIN
  34          BA  .02777
  35          LS       0   80.7
  36          UD    .147
              *

  37          KK    COM1
  38          KM   COMBINE FLOWS FOR EXISTING CONDITION
  39          HC       2
              *
  40          ZZ
```

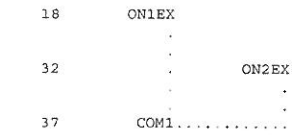
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN  1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   10JUL14  TIME  15:06:11   *
*                                       *
*****************************************
```

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

TECHNICAL DRAINAGE STUDY FOR PARCEL CC - SUMMERLIN
CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

PREPARED BY: L.R. NELSON CONSULTING ENGINEERS, INC.
6765 W. RUSSELL ROAD, SUITE 200
LAS VEGAS, NV 89118

FILENAME:CCE.DAT
JOB# 220-013-131
EXISTING CONDITION
TECHNICAL DRAINAGE STUDY

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

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

                   COMPUTATION INTERVAL      .08 HOURS
                        TOTAL TIME BASE    24.92 HOURS

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

    JP          MULTI-PLAN OPTION
                     NPLAN          1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                    .55      1.00
```

1

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .55	RATIO 2 1.00
HYDROGRAPH AT						
+	ON1EX	.02	1	FLOW	7.	23.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON2EX	.03	1	FLOW	11.	37.
				TIME	3.58	3.58
2 COMBINED AT						
+	COM1	.04	1	FLOW	19.	59.
				TIME	3.58	3.58

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

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

L. R. Nelson Consulting Engineers, Inc.
File: STD_FORM_4
Project No.: 220-013-131

Project
PARCEL CC - PROPOSED CONDITION

CALCULATED BY : Staff
DATE: 7/1/14

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK URBANIZED BASINS		Tc	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN	K (2)	AREA Ac (3)	AREA Mi^2	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	TOTAL LENGTH Ft (11)	Tc = (L/180)+10 Min (12)	Min (13)	Tlag= 0.6Tc/60 Hours	P10/P100
ON1	D	**89.7**	0.7940	2.06	**0.00322**	100.0	1.00	5.51	775	4.65	4.36	6.60	2.61	875	14.9	8.1	**0.081**	1.81/3.29
ON2	D	**89.7**	0.7940	5.15	**0.00805**	110.0	1.00	5.78	1075	0.60	1.56	2.37	9.37	1185	16.6	15.1	**0.151**	1.81/3.29
ON3	D	**89.7**	0.7940	3.08	**0.00481**	100.0	1.00	5.51	525	5.20	4.61	6.98	1.87	625	13.5	7.4	**0.074**	1.81/3.29
ON4	D	**89.7**	0.7940	4.74	**0.00741**	100.0	1.00	5.51	660	4.79	4.42	6.70	2.28	760	14.2	7.8	**0.078**	1.81/3.29
ON5	D	**89.7**	0.7940	1.44	**0.00225**	110.0	1.00	5.78	250	5.00	4.52	6.84	0.92	360	12.0	6.7	**0.067**	1.81/3.29
ON6	D	**89.7**	0.7940	8.16	**0.01274**	100.0	1.00	5.51	1350	5.10	4.56	6.91	3.88	1450	18.1	9.4	**0.094**	1.81/3.29
ON7	D	**89.7**	0.7940	3.91	**0.00610**	100.0	1.00	5.51	1045	4.65	4.36	6.60	3.29	1145	16.4	8.8	**0.088**	1.81/3.29

Tc = Ti + Tt Tlag = 0.6 Tc MF = Multi-Family
Ti = 1.8 (1.1 - K) L^1/2 / S^1/3 Pave = Pavement
K = 0.0132 (CN) - 0.39

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing § 602.1 V1 = 14.8*(S/100)^1/2
Existing V2 = 29.4*(S/100)^1/2
Developed § 602.1 V1 = 20.2*(S/100)^1/2
Developed V2 = 30.6*(S/100)^1/2

REFERENCE :

STANDARD FORM 4

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1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN  1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   21JUL14  TIME  16:52:19   *
*                                       *
*****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

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

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

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

1 HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
   1          ID
   2          ID         TECHNICAL DRAINAGE STUDY FOR PARCEL CC - SUMMERLIN
   3          ID              CITY OF LAS VEGAS, CLARK COUNTY, NEVADA
   4          ID
   5          ID    PREPARED BY:      L.R. NELSON CONSULTING ENGINEERS, INC.
   6          ID                        6765 W. RUSSELL ROAD, SUITE 200
   7          ID                             LAS VEGAS, NV  89118
   8          ID
   9          ID    FILENAME:CCP.DAT
  10          ID    JOB# 220-013-131
  11          ID    PROPOSED CONDITION
  12          ID    TECHNICAL DRAINAGE STUDY
  13          ID
              *DIAGRAM
  14          IT       5       0       0     300
  15          IO       5
  16          IN       5
  17          JR    PREC    0.55     1.0

  18          KK     ON1
  19          KM   DEVELOPED ONSITE BASIN
  20          BA  .00322
  21          PB    3.29
  22          PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
  23          PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
  24          PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
  25          PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
  26          PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
  27          PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
  28          PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
  29          PC    .998    .999   1.00
  30          LS       0   89.7
  31          UD    .081
              *

  32          KK     ON7
  33          KM   DEVELOPED ONSITE BASIN
  34          BA  .00610
  35          LS       0    89.7
  36          UD    .088
              *

  37          KK     CP1
  38          KM   COMBINE FLOW AT TOP OF ON1/ON7
  39          HC       2
              *

  40          KK    RTE1
  41          KM   ROUTE ON1 THROUGH ON2
  42          RD    1195    .006    .016           TRAP      37       0
              *
```

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

  43      KK     ON2
  44      KM   DEVELOPED ONSITE BASIN
  45      BA  .00805
  46      LS       0    89.7
  47      UD    .151
          *

  48      KK     ON3
  49      KM   DEVELOPED ONSITE BASIN
  50      BA  .00481
  51      LS       0    89.7
  52      UD    .074
          *

  53      KK    RTE2
  54      KM   ROUTE ON3 TO LOW POINT
  55      RD     800    .006    .016            TRAP      37       0
          *

  56      KK     ON5
  57      KM   DEVELOPED ONSITE BASIN
  58      BA  .00225
  59      LS       0    89.7
  60      UD    .067
          *

  61      KK    RTE3
  62      KM   ROUTE ON5 TO LOW POINT
  63      RD     460    .006    .016            TRAP      37       0
          *

  64      KK     ON4
  65      KM   DEVELOPED ONSITE BASIN
  66      BA  .00741
  67      LS       0    89.7
  68      UD    .078
          *

  69      KK    COM1
  70      KM    COMBINE FLOW EAST HALF OF SITE
  71      HC       5
          *

  72      KK     ON6
  73      KM   DEVELOPED ONSITE BASIN
  74      BA  .01274
  75      LS       0    89.7
  76      UD    .094
          *
```



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

  77      KK    COM2
  78      KM   COMBINE FLOWS ATLOW POINT
  79      HC       2
          *
  80      ZZ
```

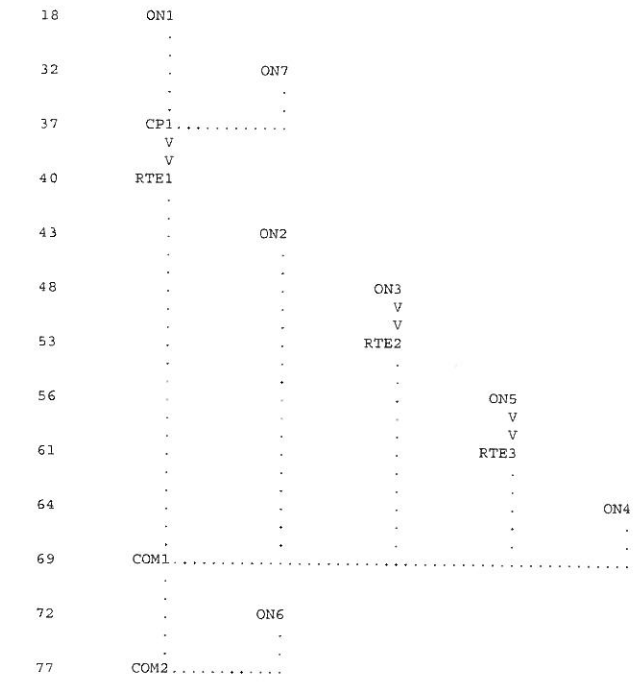
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN  1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   21JUL14  TIME  16:52:19   *
*                                       *
*****************************************
```

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

TECHNICAL DRAINAGE STUDY FOR PARCEL CC - SUMMERLIN
CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

PREPARED BY: L.R. NELSON CONSULTING ENGINEERS, INC.
6765 W. RUSSELL ROAD, SUITE 200
LAS VEGAS, NV 89118

FILENAME:CCP.DAT
JOB# 220-013-131
PROPOSED CONDITION
TECHNICAL DRAINAGE STUDY

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

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

                  COMPUTATION INTERVAL      .08 HOURS
                       TOTAL TIME BASE    24.92 HOURS

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

    JP          MULTI-PLAN OPTION
                      NPLAN          1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                    .55      1.00
```

1

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2
					.55	1.00
HYDROGRAPH AT						
+	ON1	.00	1	FLOW	3.	7.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	ON7	.01	1	FLOW	5.	12.
				TIME	3.50	3.50
2 COMBINED AT						
+	CP1	.01	1	FLOW	8.	19.
				TIME	3.50	3.50
ROUTED TO						
+	RTE1	.01	1	FLOW	8.	18.
				TIME	3.67	3.58
HYDROGRAPH AT						
+	ON2	.01	1	FLOW	6.	15.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON3	.00	1	FLOW	5.	10.
				TIME	3.50	3.50
ROUTED TO						
+	RTE2	.00	1	FLOW	4.	10.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON5	.00	1	FLOW	2.	5.
				TIME	3.50	3.50
ROUTED TO						
+	RTE3	.00	1	FLOW	2.	5.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON4	.01	1	FLOW	7.	16.
				TIME	3.50	3.50
5 COMBINED AT						
+	COM1	.03	1	FLOW	25.	59.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON6	.01	1	FLOW	11.	26.
				TIME	3.50	3.50
2 COMBINED AT						
+	COM2	.04	1	FLOW	35.	82.
				TIME	3.58	3.58

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .00									
RTE1	MANE	5.00	7.98	220.00	.92	5.00	7.98	220.00	.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4548E+00 EXCESS= .0000E+00 OUTFLOW= .4572E+00 BASIN STORAGE= .2320E-02 PERCENT ERROR= -1.0

FOR PLAN = 1 RATIO= .00									
RTE1	MANE	3.50	18.64	217.00	2.24	5.00	18.11	215.00	2.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1108E+01 EXCESS= .0000E+00 OUTFLOW= .1111E+01 BASIN STORAGE= .2988E-02 PERCENT ERROR= -.6

FOR PLAN = 1 RATIO= .00									
RTE2	MANE	4.50	4.07	216.00	.92	5.00	3.93	215.00	.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2344E+00 EXCESS= .0000E+00 OUTFLOW= .2354E+00 BASIN STORAGE= .2083E-02 PERCENT ERROR= -1.3

FOR PLAN = 1 RATIO= .00									
RTE2	MANE	3.50	9.71	217.00	2.24	5.00	9.68	215.00	2.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5723E+00 EXCESS= .0000E+00 OUTFLOW= .5740E+00 BASIN STORAGE= .1870E-02 PERCENT ERROR= -.6

FOR PLAN = 1 RATIO= .00									
RTE3	MANE	4.50	1.95	216.00	.91	5.00	1.91	215.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1097E+00 EXCESS= .0000E+00 OUTFLOW= .1098E+00 BASIN STORAGE= .9215E-03 PERCENT ERROR= -1.0

FOR PLAN = 1 RATIO= .00									
RTE3	MANE	3.50	4.80	213.50	2.24	5.00	4.56	215.00	2.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2679E+00 EXCESS= .0000E+00 OUTFLOW= .2687E+00 BASIN STORAGE= .1085E-02 PERCENT ERROR= -.7

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

Appendix C: Hydraulic Analysis

Cross Section for Onsite X-Section 1 - Q100

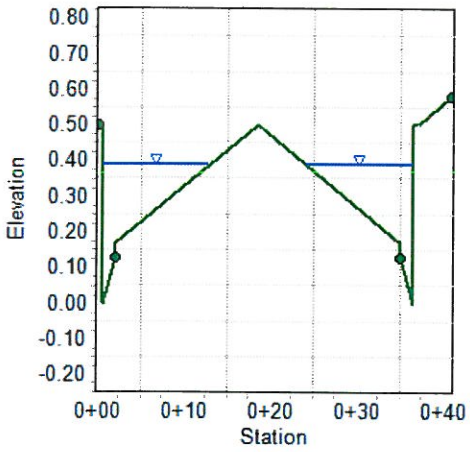
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05400	ft/ft
Normal Depth	0.39	ft
Discharge	19.00	ft³/s

Cross Section Image



Worksheet for Onsite X-Section 1 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05400	ft/ft
Discharge	19.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.50
0+00.50	0.50
0+00.50	0.00
0+02.00	0.13
0+02.00	0.17
0+18.50	0.50
0+35.00	0.17
0+35.00	0.13
0+36.50	0.00
0+36.50	0.50
0+37.00	0.50
0+41.00	0.58

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.50)	(0+02.00, 0.13)	0.013
(0+02.00, 0.13)	(0+35.00, 0.13)	0.016
(0+35.00, 0.13)	(0+41.00, 0.58)	0.013

Options

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

Worksheet for Onsite X-Section 1 - Q100

Results

Normal Depth		0.39	ft
Elevation Range	0.00 to 0.58 ft		
Flow Area		3.35	ft²
Wetted Perimeter		25.67	ft
Hydraulic Radius		0.13	ft
Top Width		24.80	ft
Normal Depth		0.39	ft
Critical Depth		0.52	ft
Critical Slope		0.00632	ft/ft
Velocity		5.68	ft/s
Velocity Head		0.50	ft
Specific Energy		0.89	ft
Froude Number		2.73	
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	0.52	ft
Channel Slope	0.05400	ft/ft
Critical Slope	0.00632	ft/ft

Messages

Notes

Q100 = ON1 + ON7 = 7 + 12 = 19 cfs

Cross Section for Onsite X-Section 2 - Q100

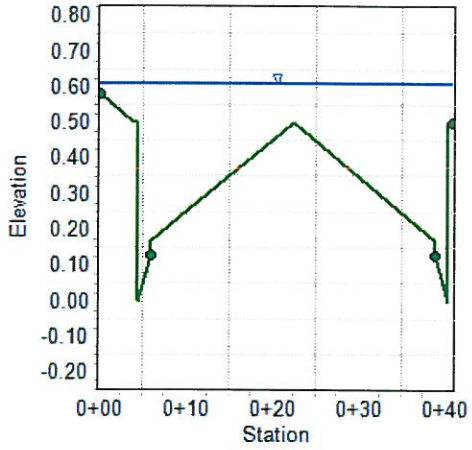
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00600	ft/ft
Normal Depth	0.61	ft
Discharge	34.00	ft^3/s

Cross Section Image



Worksheet for Onsite X-Section 2 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00600	ft/ft
Discharge	34.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.58
0+04.00	0.50
0+04.50	0.50
0+04.50	0.00
0+06.00	0.13
0+06.00	0.17
0+22.50	0.50
0+39.00	0.17
0+39.00	0.13
0+40.50	0.00
0+40.50	0.50
0+41.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.58)	(0+06.00, 0.13)	0.013
(0+06.00, 0.13)	(0+39.00, 0.13)	0.016
(0+39.00, 0.13)	(0+41.00, 0.50)	0.013

Options

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

Worksheet for Onsite X-Section 2 - Q100

Results

Normal Depth		0.61	ft
Elevation Range	0.00 to 0.58 ft		
Flow Area		11.09	ft²
Wetted Perimeter		42.24	ft
Hydraulic Radius		0.26	ft
Top Width		41.00	ft
Normal Depth		0.61	ft
Critical Depth		0.62	ft
Critical Slope		0.00551	ft/ft
Velocity		3.07	ft/s
Velocity Head		0.15	ft
Specific Energy		0.76	ft
Froude Number		1.04	
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	0.61	ft
Critical Depth	0.62	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00551	ft/ft

Messages

Notes

Q100 = ON1 + ON7 + ON3 + 1/3 (ON2) = 7 + 12 + 10 + 1/3*(15) = 34 cfs

Cross Section for Onsite X-Section 3 - Q100

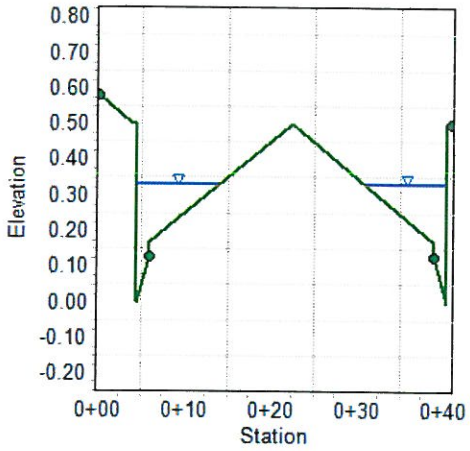
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05200	ft/ft
Normal Depth	0.33	ft
Discharge	10.00	ft³/s

Cross Section Image



Worksheet for Onsite X-Section 3 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05200	ft/ft
Discharge	10.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.58
0+04.00	0.50
0+04.50	0.50
0+04.50	0.00
0+06.00	0.13
0+06.00	0.17
0+22.50	0.50
0+39.00	0.17
0+39.00	0.13
0+40.50	0.00
0+40.50	0.50
0+41.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.58)	(0+06.00, 0.13)	0.013
(0+06.00, 0.13)	(0+39.00, 0.13)	0.016
(0+39.00, 0.13)	(0+41.00, 0.50)	0.013

Options

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

Worksheet for Onsite X-Section 3 - Q100

Results

Normal Depth		0.33	ft
Elevation Range	0.00 to 0.58 ft		
Flow Area		2.06	ft²
Wetted Perimeter		19.66	ft
Hydraulic Radius		0.10	ft
Top Width		18.91	ft
Normal Depth		0.33	ft
Critical Depth		0.43	ft
Critical Slope		0.00680	ft/ft
Velocity		4.86	ft/s
Velocity Head		0.37	ft
Specific Energy		0.70	ft
Froude Number		2.60	
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	0.33	ft
Critical Depth	0.43	ft
Channel Slope	0.05200	ft/ft
Critical Slope	0.00680	ft/ft

Messages

Notes

Q100 = ON3 = 10 cfs

Cross Section for Onsite X-Section 4 - Q100

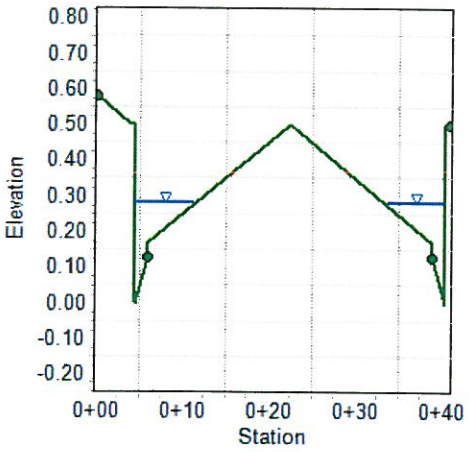
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05000	ft/ft
Normal Depth	0.28	ft
Discharge	5.00	ft³/s

Cross Section Image



Worksheet for Onsite X-Section 4 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05000	ft/ft
Discharge	5.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.58
0+04.00	0.50
0+04.50	0.50
0+04.50	0.00
0+06.00	0.13
0+06.00	0.17
0+22.50	0.50
0+39.00	0.17
0+39.00	0.13
0+40.50	0.00
0+40.50	0.50
0+41.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.58)	(0+06.00, 0.13)	0.013
(0+06.00, 0.13)	(0+39.00, 0.13)	0.016
(0+39.00, 0.13)	(0+41.00, 0.50)	0.013

Options

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

Worksheet for Onsite X-Section 4 - Q100

Results

Normal Depth		0.28	ft
Elevation Range	0.00 to 0.58 ft		
Flow Area		1.20	ft²
Wetted Perimeter		14.28	ft
Hydraulic Radius		0.08	ft
Top Width		13.64	ft
Normal Depth		0.28	ft
Critical Depth		0.35	ft
Critical Slope		0.00728	ft/ft
Velocity		4.17	ft/s
Velocity Head		0.27	ft
Specific Energy		0.55	ft
Froude Number		2.48	
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	0.28	ft
Critical Depth	0.35	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.00728	ft/ft

Messages

Notes

Q100 = ON5 = 5 cfs

Cross Section for Onsite X-Section 5 - Q100

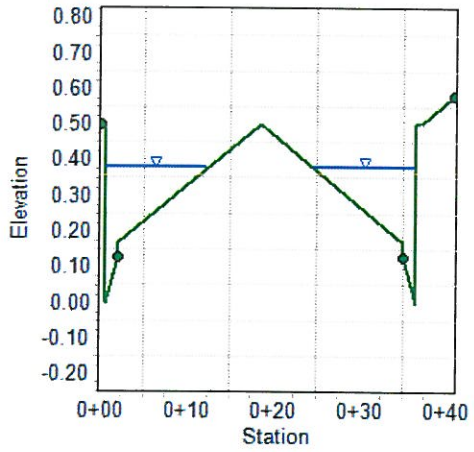
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04800	ft/ft
Normal Depth	0.38	ft
Discharge	16.00	ft³/s

Cross Section Image



Worksheet for Onsite X-Section 5 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04800	ft/ft
Discharge	16.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.50
0+00.50	0.50
0+00.50	0.00
0+02.00	0.13
0+02.00	0.17
0+18.50	0.50
0+35.00	0.17
0+35.00	0.13
0+36.50	0.00
0+36.50	0.50
0+37.00	0.50
0+41.00	0.58

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.50)	(0+02.00, 0.13)	0.013
(0+02.00, 0.13)	(0+35.00, 0.13)	0.016
(0+35.00, 0.13)	(0+41.00, 0.58)	0.013

Options

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

Worksheet for Onsite X-Section 5 - Q100

Results

Normal Depth		0.38	ft
Elevation Range	0.00 to 0.58 ft		
Flow Area		3.06	ft²
Wetted Perimeter		24.49	ft
Hydraulic Radius		0.13	ft
Top Width		23.64	ft
Normal Depth		0.38	ft
Critical Depth		0.49	ft
Critical Slope		0.00646	ft/ft
Velocity		5.22	ft/s
Velocity Head		0.42	ft
Specific Energy		0.80	ft
Froude Number		2.56	
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	0.38	ft
Critical Depth	0.49	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.00646	ft/ft

Messages

Notes

Q100 = ON4 = 16 cfs

Cross Section for Onsite X-Section 6 - Q100

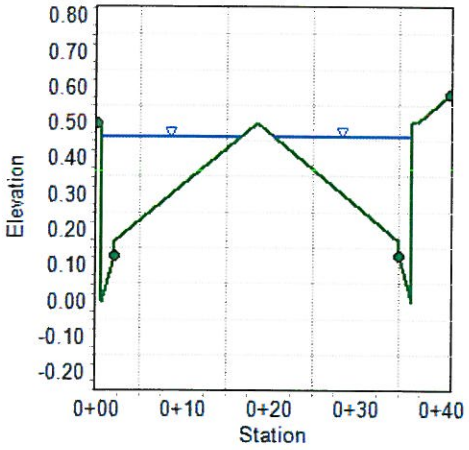
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02800	ft/ft
Normal Depth	0.46	ft
Discharge	26.00	ft^3/s

Cross Section Image



Worksheet for Onsite X-Section 6 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02800	ft/ft
Discharge	26.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.50
0+00.50	0.50
0+00.50	0.00
0+02.00	0.13
0+02.00	0.17
0+18.50	0.50
0+35.00	0.17
0+35.00	0.13
0+36.50	0.00
0+36.50	0.50
0+37.00	0.50
0+41.00	0.58

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.50)	(0+02.00, 0.13)	0.013
(0+02.00, 0.13)	(0+35.00, 0.13)	0.016
(0+35.00, 0.13)	(0+41.00, 0.58)	0.013

Options

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

Worksheet for Onsite X-Section 6 - Q100

Results

Normal Depth		0.46	ft
Elevation Range	0.00 to 0.58 ft		
Flow Area		5.47	ft²
Wetted Perimeter		33.27	ft
Hydraulic Radius		0.16	ft
Top Width		32.25	ft
Normal Depth		0.46	ft
Critical Depth		0.57	ft
Critical Slope		0.00604	ft/ft
Velocity		4.75	ft/s
Velocity Head		0.35	ft
Specific Energy		0.81	ft
Froude Number		2.04	
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	0.46	ft
Critical Depth	0.57	ft
Channel Slope	0.02800	ft/ft
Critical Slope	0.00604	ft/ft

Messages

Notes

Q100 = ON6 = 26 cfs

CROSS SECTION DEPTH OF FLOW AT THE FLATEST SLOPE.

Cross Section for Onsite X-Section 7 - Q100

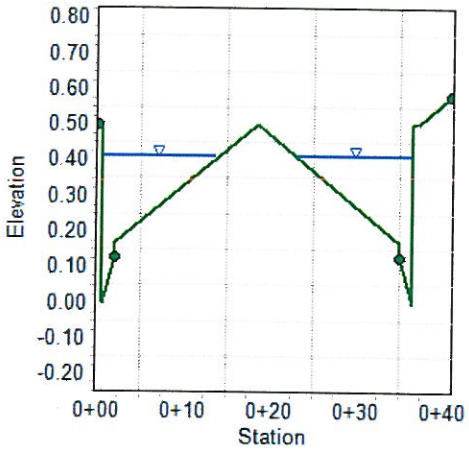
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07300	ft/ft
Normal Depth	0.41	ft
Discharge	26.00	ft³/s

Cross Section Image



Worksheet for Onsite X-Section 7 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07300	ft/ft
Discharge	26.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.50
0+00.50	0.50
0+00.50	0.00
0+02.00	0.13
0+02.00	0.17
0+18.50	0.50
0+35.00	0.17
0+35.00	0.13
0+36.50	0.00
0+36.50	0.50
0+37.00	0.50
0+41.00	0.58

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.50)	(0+02.00, 0.13)	0.013
(0+02.00, 0.13)	(0+35.00, 0.13)	0.016
(0+35.00, 0.13)	(0+41.00, 0.58)	0.013

Options

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

Worksheet for Onsite X-Section 7 - Q100

Results

Normal Depth		0.41	ft
Elevation Range	0.00 to 0.58 ft		
Flow Area		3.78	ft²
Wetted Perimeter		27.42	ft
Hydraulic Radius		0.14	ft
Top Width		26.51	ft
Normal Depth		0.41	ft
Critical Depth		0.57	ft
Critical Slope		0.00599	ft/ft
Velocity		6.87	ft/s
Velocity Head		0.73	ft
Specific Energy		1.14	ft
Froude Number		3.21	
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	0.41	ft
Critical Depth	0.57	ft
Channel Slope	0.07300	ft/ft
Critical Slope	0.00599	ft/ft

Messages

Notes

Q100 = ON6 = 26 cfs

CROSS SECTION DEPTH OF FLOW AT THE FLATEST SLOPE.

Cross Section for ARD - Section 8 - Q10

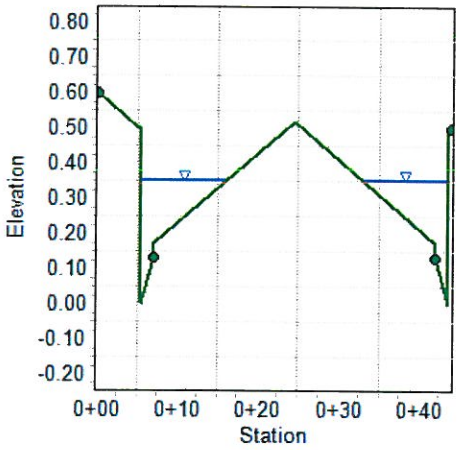
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03900	ft/ft
Normal Depth	0.35	ft
Discharge	11.00	ft³/s

Cross Section Image



Worksheet for ARD - Section 8 - Q10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03900	ft/ft
Discharge	11.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.60
0+05.00	0.50
0+05.50	0.50
0+05.50	0.00
0+07.00	0.13
0+07.00	0.17
0+24.50	0.52
0+42.00	0.17
0+42.00	0.13
0+43.50	0.00
0+43.50	0.50
0+44.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.60)	(0+07.00, 0.13)	0.013
(0+07.00, 0.13)	(0+42.00, 0.13)	0.016
(0+42.00, 0.13)	(0+44.00, 0.50)	0.013

Options

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

Worksheet for ARD - Section 8 - Q10

Results

Normal Depth		0.35	ft
Elevation Range	0.00 to 0.60 ft		
Flow Area		2.48	ft²
Wetted Perimeter		21.81	ft
Hydraulic Radius		0.11	ft
Top Width		21.01	ft
Normal Depth		0.35	ft
Critical Depth		0.44	ft
Critical Slope		0.00675	ft/ft
Velocity		4.44	ft/s
Velocity Head		0.31	ft
Specific Energy		0.66	ft
Froude Number		2.28	
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	0.35	ft
Critical Depth	0.44	ft
Channel Slope	0.03900	ft/ft
Critical Slope	0.00675	ft/ft

Messages

Notes

Depth of Flow at the Entrance @ Antelope Ridge Drive Q10
= ST2 (FOXHILL) + 1/3 of ST4 (ANTELOPE RIDGE DRIVE) = 8 + (1/3)*10 = 11 cfs

Flow rates take from approved Village 23B drainage study.

Cross Section for ARD - Section 8 - Q100

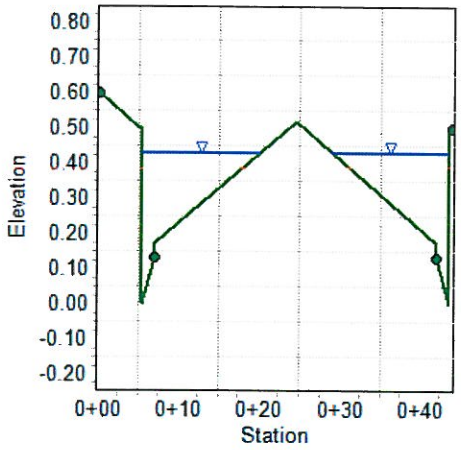
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03900	ft/ft
Normal Depth	0.43	ft
Discharge	24.00	ft^3/s

Cross Section Image



Worksheet for ARD - Section 8 - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03900	ft/ft
Discharge	24.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.60
0+05.00	0.50
0+05.50	0.50
0+05.50	0.00
0+07.00	0.13
0+07.00	0.17
0+24.50	0.52
0+42.00	0.17
0+42.00	0.13
0+43.50	0.00
0+43.50	0.50
0+44.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.60)	(0+07.00, 0.13)	0.013
(0+07.00, 0.13)	(0+42.00, 0.13)	0.016
(0+42.00, 0.13)	(0+44.00, 0.50)	0.013

Options

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

Worksheet for ARD - Section 8 - Q100

Results

Normal Depth		0.43	ft
Elevation Range	0.00 to 0.60 ft		
Flow Area		4.53	ft²
Wetted Perimeter		30.15	ft
Hydraulic Radius		0.15	ft
Top Width		29.19	ft
Normal Depth		0.43	ft
Critical Depth		0.56	ft
Critical Slope		0.00616	ft/ft
Velocity		5.30	ft/s
Velocity Head		0.44	ft
Specific Energy		0.87	ft
Froude Number		2.37	
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	0.43	ft
Critical Depth	0.56	ft
Channel Slope	0.03900	ft/ft
Critical Slope	0.00616	ft/ft

Messages

Notes

Depth of Flow at the Entrance @ Antelope Ridge Drive Q100
= ST2 (FOXHILL) + 1/3 of ST4 (ANTELOPE RIDGE DRIVE) = 17 + (1/3)*21 = 24 cfs

Flow rates take from approved Village 23B drainage study.

Drop Inlet Analysis

Worksheet for Combination Inlet In Sag-DI #1

Project Description

Solve For	Spread

Input Data

Discharge		13.20	ft³/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.020	ft/ft
Local Depression		2.00	in
Local Depression Width		1.50	ft
Grate Width		1.50	ft
Grate Length		10.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		10.00	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Throat Incline Angle		90.00	degrees

Options

Calculation Option	Use Both

Results

Spread	20.29	ft
Depth	0.51	ft
Gutter Depression	0.10	ft
Total Depression	0.27	ft
Open Grate Area	6.75	ft²
Active Grate Weir Length	11.50	ft

Worksheet for Combination Inlet In Sag-DI #2

Project Description

Solve For	Spread

Input Data

Discharge		13.50	ft³/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.020	ft/ft
Local Depression		2.00	in
Local Depression Width		1.50	ft
Grate Width		1.50	ft
Grate Length		10.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		10.00	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Throat Incline Angle		90.00	degrees

Options

Calculation Option	Use Both

Results

Spread	20.60	ft
Depth	0.51	ft
Gutter Depression	0.10	ft
Total Depression	0.27	ft
Open Grate Area	6.75	ft²
Active Grate Weir Length	11.50	ft

Worksheet for Combination Inlet On Grade - DI #3

Project Description

Solve For	Efficiency

Input Data

Discharge	13.00	ft³/s
Slope	0.00500	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.0867	ft/ft
Road Cross Slope	0.020	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.00	in
Local Depression Width	1.50	ft
Grate Width	1.50	ft
Grate Length	10.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	12.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	82.42	%
Intercepted Flow	10.71	ft³/s
Bypass Flow	2.29	ft³/s
Spread	21.20	ft
Depth	0.52	ft
Flow Area	4.57	ft²
Gutter Depression	0.10	ft
Total Depression	0.27	ft
Velocity	2.85	ft/s
Splash Over Velocity	13.09	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.45	
Grate Flow Ratio	0.21	
Equivalent Cross Slope	0.05702	ft/ft
Active Grate Length	5.00	ft
Length Factor	0.31	
Total Interception Length	23.97	ft

Worksheet for Combination Inlet On Grade - DI #3

Messages

Messages	Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).
Notes	

Q100 = 13 cfs (1/2 of ON6 (26 cfs))

Worksheet for Combination Inlet On Grade - DI #5

Project Description

Solve For	Efficiency

Input Data

Discharge	13.00	ft³/s
Slope	0.04530	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.0867	ft/ft
Road Cross Slope	0.020	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.00	in
Local Depression Width	1.50	ft
Grate Width	1.50	ft
Grate Length	12.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	15.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	72.23	%
Intercepted Flow	9.39	ft³/s
Bypass Flow	3.61	ft³/s
Spread	13.76	ft
Depth	0.38	ft
Flow Area	1.97	ft²
Gutter Depression	0.10	ft
Total Depression	0.27	ft
Velocity	6.60	ft/s
Splash Over Velocity	15.63	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.23	
Grate Flow Ratio	0.33	
Equivalent Cross Slope	0.07820	ft/ft
Active Grate Length	6.25	ft
Length Factor	0.23	
Total Interception Length	38.41	ft

Worksheet for Combination Inlet On Grade - DI #5

Messages

Messages	Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).
Notes	

Q100 = 13 cfs (1/2 of ON6 (26 cfs))

Worksheet for Combination Inlet On Grade - DI #4 & #6

Project Description

Solve For	Efficiency

Input Data

Discharge	29.50	ft³/s
Slope	0.00700	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.0867	ft/ft
Road Cross Slope	0.020	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.00	in
Local Depression Width	1.50	ft
Grate Width	1.50	ft
Grate Length	10.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	12.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	63.00	%
Intercepted Flow	18.59	ft³/s
Bypass Flow	10.91	ft³/s
Spread	27.20	ft
Depth	0.64	ft
Flow Area	7.48	ft²
Gutter Depression	0.10	ft
Total Depression	0.27	ft
Velocity	3.95	ft/s
Splash Over Velocity	13.09	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.31	
Grate Flow Ratio	0.16	
Equivalent Cross Slope	0.04842	ft/ft
Active Grate Length	5.00	ft
Length Factor	0.18	
Total Interception Length	41.26	ft

Worksheet for Combination Inlet On Grade - DI #4 & #6

Messages

Messages	Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).
Notes	

Q100 = 20.5 cfs (COM1) + 6 cfs (ON7) = 29.5 cfs

Southern WSPGW Analysis

```
T1 Parcel CC - Savona                                                                                                0
T2 Main Line Connection
T3 Job No.: 220-013-131
SO    1000.000   16.600  1                                                16.600
R     1046.480   25.220  1        .013                                                    .000     .000 0
JX    1048.480   25.420  3  2   3.013    13.500    37.200   25.420   25.150    .0 90.0     .000
JX    1049.480   25.420  3  2    .013    13.200             25.420             .0 90.0     .000
R     1080.860   26.140  3        .013                                        .000     .000 1
JX    1087.780   26.240  3  5    .013    10.700             35.590              .0          .000
R     1163.780   28.380  4        .013                                        .000     .000 0
SH    1163.780   28.380  4                                                35.920
CD    1  4   1     .000     3.500      .000  .000  .000    .00
CD    2  4   1     .000     2.000      .000  .000  .000    .00
CD    3  4   1     .000     2.500      .000  .000  .000    .00
CD    4  4   1     .000     2.000      .000  .000  .000    .00
CD    5  4   1     .000     1.500      .000  .000  .000    .00
CD    6  4   1     .000     1.500      .000  .000  .000    .00
CD    7  4   1     .000     1.500      .000  .000  .000    .00
CD    8  3   0     .000     4.000     8.000  .000  .000    .00
CD    9  4   1     .000     6.000      .000  .000  .000    .00
Q              9.400    .0
```

FILE: cc-main3.WSW W S P G W - EDIT LISTING - Version 14.06 Date: 7-28-2014 Time:11: 5:44

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING PAGE 1

CARD CODE	SECT NO	CHN TYPE	NO OF PIER/PIP	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	4	1		3.500														
CD	2	4	1		2.000														
CD	3	4	1		2.500														
CD	4	4	1		2.000														
CD	5	4	1		1.500														
CD	6	4	1		1.500														
CD	7	4	1		1.500														
CD	8	3	0	.000	4.000	8.000	.000	.000	.00										
CD	9	4	1		6.000														

W S P G W PAGE NO 1

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

Parcel CC - Savona

HEADING LINE NO 2 IS -

Main Line Connection

HEADING LINE NO 3 IS -

Job No.: 220-013-131

W S P G W PAGE NO 2

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	1000.000	16.600	1	16.600

ELEMENT NO 2 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1046.480	25.220	1	.013	.000	.000	.000	0

ELEMENT NO 3 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1048.480	25.420	3	2	3	.013	13.500	37.200	25.420	25.150	.000	90.000

RADIUS	ANGLE
.000	.000

ELEMENT NO 4 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1049.480	25.420	3	2	0	.013	13.200	.000	25.420	.000	.000	90.000

RADIUS	ANGLE
.000	.000

THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING
THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING

ELEMENT NO 5 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1080.860	26.140	3	.013	.000	.000	.000	1

ELEMENT NO 6 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1087.780	26.240	3	5	0	.013	10.700	.000	35.590	.000	.000	.000

RADIUS	ANGLE
.000	.000

WARNING - ADJACENT SECTIONS ARE NOT IDENTICAL - SEE SECTION NUMBERS AND CHANNEL DEFINITIONS

ELEMENT NO 7 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1163.780	28.380	4	.013	.000	.000	.000	0

ELEMENT NO 8 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	1163.780	28.380	4	35.920

W S P G W PAGE NO 3

WATER SURFACE PROFILE - ELEMENT CARD LISTING

Parcel CC - Savona
Main Line Connection
Job No.: 220-013-131

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1000.000	16.600	1.331	17.931	84.00	25.01	9.71	27.64	.00	2.86	3.40	3.500	.000	.00	1 .0
1.902	.1855					.0727	.14	1.33	4.43	1.04	.013	.00	.00	PIPE
1001.902	16.953	1.343	18.295	84.00	24.72	9.49	27.78	.00	2.86	3.40	3.500	.000	.00	1 .0
6.880	.1855					.0672	.46	1.34	4.36	1.04	.013	.00	.00	PIPE
1008.782	18.229	1.391	19.620	84.00	23.57	8.62	28.24	.00	2.86	3.43	3.500	.000	.00	1 .0
5.797	.1855					.0589	.34	1.39	4.07	1.04	.013	.00	.00	PIPE
1014.579	19.304	1.442	20.746	84.00	22.47	7.84	28.59	.00	2.86	3.45	3.500	.000	.00	1 .0
4.936	.1855					.0518	.26	1.44	3.80	1.04	.013	.00	.00	PIPE
1019.515	20.219	1.495	21.714	84.00	21.42	7.13	28.84	.00	2.86	3.46	3.500	.000	.00	1 .0
4.234	.1855					.0455	.19	1.49	3.55	1.04	.013	.00	.00	PIPE
1023.749	21.004	1.550	22.554	84.00	20.43	6.48	29.03	.00	2.86	3.48	3.500	.000	.00	1 .0
3.652	.1855					.0399	.15	1.55	3.31	1.04	.013	.00	.00	PIPE
1027.401	21.682	1.608	23.289	84.00	19.48	5.89	29.18	.00	2.86	3.49	3.500	.000	.00	1 .0
3.161	.1855					.0351	.11	1.61	3.09	1.04	.013	.00	.00	PIPE
1030.562	22.268	1.668	23.936	84.00	18.57	5.35	29.29	.00	2.86	3.50	3.500	.000	.00	1 .0
2.742	.1855					.0309	.08	1.67	2.88	1.04	.013	.00	.00	PIPE
1033.304	22.776	1.731	24.507	84.00	17.71	4.87	29.38	.00	2.86	3.50	3.500	.000	.00	1 .0
2.379	.1855					.0272	.06	1.73	2.68	1.04	.013	.00	.00	PIPE

Parcel CC - Savona
Main Line Connection
Job No.: 220-013-131

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1035.683	23.218	1.797	25.015	84.00	16.88	4.43	29.44	.00	2.86	3.50	3.500	.000	.00	1 .0
2.061	.1855					.0240	.05	1.80	2.49	1.04	.013	.00	.00	PIPE
1037.744	23.600	1.867	25.466	84.00	16.10	4.02	29.49	.00	2.86	3.49	3.500	.000	.00	1 .0
1.781	.1855					.0211	.04	1.87	2.32	1.04	.013	.00	.00	PIPE
1039.525	23.930	1.940	25.870	84.00	15.35	3.66	29.53	.00	2.86	3.48	3.500	.000	.00	1 .0
1.532	.1855					.0187	.03	1.94	2.16	1.04	.013	.00	.00	PIPE
1041.058	24.214	2.017	26.231	84.00	14.63	3.33	29.56	.00	2.86	3.46	3.500	.000	.00	1 .0
1.307	.1855					.0165	.02	2.02	2.00	1.04	.013	.00	.00	PIPE
1042.365	24.457	2.098	26.555	84.00	13.95	3.02	29.58	.00	2.86	3.43	3.500	.000	.00	1 .0
1.104	.1855					.0146	.02	2.10	1.86	1.04	.013	.00	.00	PIPE
1043.469	24.662	2.184	26.846	84.00	13.30	2.75	29.59	.00	2.86	3.39	3.500	.000	.00	1 .0
.917	.1855					.0129	.01	2.18	1.72	1.04	.013	.00	.00	PIPE
1044.386	24.832	2.276	27.107	84.00	12.68	2.50	29.61	.00	2.86	3.34	3.500	.000	.00	1 .0
.743	.1855					.0115	.01	2.28	1.59	1.04	.013	.00	.00	PIPE
1045.130	24.970	2.374	27.343	84.00	12.09	2.27	29.61	.00	2.86	3.27	3.500	.000	.00	1 .0
.579	.1855					.0102	.01	2.37	1.46	1.04	.013	.00	.00	PIPE
1045.709	25.077	2.479	27.555	84.00	11.53	2.06	29.62	.00	2.86	3.18	3.500	.000	.00	1 .0
.420	.1855					.0091	.00	2.48	1.34	1.04	.013	.00	.00	PIPE

WATER SURFACE PROFILE LISTING

Date: 7-28-2014 Time:11: 5:50

Parcel CC - Savona
Main Line Connection
Job No.: 220-013-131

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1046.128	25.155	2.592	27.747	84.00	10.99	1.88	29.62	.00	2.86	3.07	3.500	.000	.00	1 .0
.260	.1855					.0082	.00	2.59	1.23	1.04	.013	.00	.00	PIPE
1046.388	25.203	2.717	27.920	84.00	10.48	1.71	29.63	.00	2.86	2.92	3.500	.000	.00	1 .0
.092	.1855					.0074	.00	2.72	1.11	1.04	.013	.00	.00	PIPE
1046.480	25.220	2.857	28.077	84.00	9.99	1.55	29.63	.00	2.86	2.71	3.500	.000	.00	1 .0
JUNCT STR	.1000					.0068	.01	2.86	1.00		.013	.00	.00	PIPE

---------- WARNING - Junction Analysis - Large Lateral Flow(s)----------

1048.480	25.420	5.261	30.681	33.30	6.78	.71	31.40	.00	1.96	.00	2.500	.000	.00	1 .0
JUNCT STR	.0000					.0045	.00	5.26	.00		.013	.00	.00	PIPE
1049.480	25.420	5.823	31.243	20.10	4.09	.26	31.50	.00	1.52	.00	2.500	.000	.00	1 .0
31.380	.0229					.0024	.08	5.82	.00	.98	.013	.00	.00	PIPE
1080.860	26.140	5.191	31.331	20.10	4.09	.26	31.59	.00	1.52	.00	2.500	.000	.00	1 .0
JUNCT STR	.0145					.0015	.01	5.19	.00		.013	.00	.00	PIPE
1087.780	26.240	5.508	31.748	9.40	2.99	.14	31.89	.00	1.10	.00	2.000	.000	.00	1 .0
76.000	.0282					.0017	.13	5.51	.00	.68	.013	.00	.00	PIPE
1163.780	28.380	3.499	31.879	9.40	2.99	.14	32.02	.00	1.10	.00	2.000	.000	.00	1 .0

Northern WSPGW Analysis

```
T1 Parcel CC - Savona
T2 Lateral Line Connection to North                                                                                    0
T3 Job No.: 220-013-131
SO    1048.480   25.320   1                                                  31.243
R     1074.760   25.760   1        .013                                                    .000    90.000 0
JX    1081.760   25.860   3   2    .013    18.600                  25.860      90.0                .000
R     1113.500   26.250   3        .013                                                    .000    90.000 0
SH    1113.500   26.250   3                                                  26.250
CD    1   4    1     .000     2.500       .000   .000   .000     .00
CD    2   4    1     .000     4.000       .000   .000   .000     .00
CD    3   4    1     .000     2.000       .000   .000   .000     .00
Q              18.600    .0
```

FILE: cc-12.WSW

W S P G W - EDIT LISTING - Version 14.06

Date: 7-28-2014 Time:10:12:33

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

CARD CODE	SECT NO	CHN TYPE	NO OF PIER/PIP	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	4	1		2.500														
CD	2	4	1		4.000														
CD	3	4	1		2.000														

W S P G W

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

Parcel CC - Savona

HEADING LINE NO 2 IS -

Lateral Line Connection to North

HEADING LINE NO 3 IS -

Job No.: 220-013-131

W S P G W

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	1048.480	25.320	1	31.243

ELEMENT NO 2 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1074.760	25.760	1	.013	.000	.000	90.000	0

ELEMENT NO 3 IS A JUNCTION * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1081.760	25.860	3	2	0	.013	18.600	.000	25.860	.000	90.000	.000

RADIUS	ANGLE
.000	.000

ELEMENT NO 4 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1113.500	26.250	3	.013	.000	.000	90.000	0

ELEMENT NO 5 IS A SYSTEM HEADWORKS *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	1113.500	26.250	3	26.250

Parcel CC - Savona
Lateral Line Connection to North
Job No.: 220-013-131

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1048.480	25.320	5.923	31.243	37.20	7.58	.89	32.13	.00	2.06	.00	2.500	.000	.00	1 .0
26.280	.0167					.0082	.22	5.92	.00	1.54	.013	.00	.00	PIPE
1074.760	25.760	5.964	31.724	37.20	7.58	.89	32.62	.00	2.06	.00	2.500	.000	.00	1 .0
JUNCT STR	.0143					.0075	.05	5.96	.00		.013	.00	.00	PIPE
1081.760	25.860	7.242	33.102	18.60	5.92	.54	33.65	.00	1.55	.00	2.000	.000	.00	1 .0
31.740	.0123					.0068	.21	7.24	.00	1.28	.013	.00	.00	PIPE
1113.500	26.250	7.228	33.478	18.60	5.92	.54	34.02	.00	1.55	.00	2.000	.000	.00	1 .0

Lateral Culvert Analysis

Culvert Calculator Report
DI#2 Lateral to DI#1

Comments: TW = 31.24 from WSPG Sta. 1049.48 of CC-MAIN1 model.

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	35.22 ft	Headwater Depth/Height	3.09
Computed Headwater Elev	31.80 ft	Discharge	13.50 cfs
Inlet Control HW Elev.	31.24 ft	Tailwater Elevation	31.24 ft
Outlet Control HW Elev.	31.80 ft	Control Type	Outlet Control

Grades			
Upstream Invert	25.62 ft	Downstream Invert	25.25 ft
Length	37.00 ft	Constructed Slope	0.010000 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	5.99 ft
Slope Type	N/A	Normal Depth	1.11 ft
Flow Regime	N/A	Critical Depth	1.32 ft
Velocity Downstream	4.30 ft/s	Critical Slope	0.005922 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	31.80 ft	Upstream Velocity Head	0.29 ft
Ke	0.50	Entrance Loss	0.14 ft

Inlet Control Properties			
Inlet Control HW Elev.	31.24 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	3.1 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Submerged Weir Estimate

SAVONA (aka Parcel CC)
Curb Headwater Depth via
SUBMERGED WEIR ESTIMATE

These equations are taken from the 7th Edition of Handbook of Hydraulics *by Brater, King, Horace and Wei (1996)*

Submerged depth may be estimated by using:

$$Q_S = Q_1 \times \left[1 - \left(\frac{H_2}{H_1}\right)^{\frac{3}{2}}\right]^{0.385} \qquad \text{Eq. 5.50}$$

Where:

Q_S = Submerged Discharge (cfs)
Q_1 = Free-flow Discharge at the Same Upstream Head, H1 (cfs)
H_1 = Head at Point of Measurement, Relative to the Crest Elevation
H_2 = Head Downstream, Relative to the Crest Elevation via Normal Depth

and

$$Q = C * L * H^{\frac{3}{2}} \qquad \text{Eq. 5.31}$$

Broadcrested Weir Equation may be estimated using:

Where:

Q = Free-flow Discharge at the Same Upstream Head, H1 (cfs) = Q1
C = Weir Coefficient
L = Weir Length (ft)
H = Free-flow Head Elevation (ft) = H1

Iteration Number	Q_1 (cfs)	C	L (ft/ft)	H_1 (ft)	H_2 (cfs)	Q_S (cfs)	Is Qs > Q1? (cfs)
1	82	3	50	0.67	0.34	68.9	NO
2	89	3	50	0.71	0.34	76.1	NO
3	95	3	50	0.74	0.34	82.2	YES

Note: **Interation 1 is the Q100 (Q1) design flow rate used as the test to determine final submerged depth above crest H1 (i.e. curb).**

Appendix D: Referenced Information

62023B-100

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM			DATE: July 24, 2013
TO: **Land Development Services** Department of Public Works			FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	**Conceptual Drainage Study** for: **Summerlin Village 23B – Update #3**		**COPIES TO:** G.C. Wallace Inc.
Cross Streets:	NWC of Alta Drive & Desert Foothills Drive		Howard Hughes Corp.
File Number:	F:\Depot\DSMEMOS\DS3420F.doc		Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-015		CCRFCD
Zoning Action:	TMP-46270		
FEMA Flood Zone	YES	NO X	
Proposed Storm Drain	YES X	NO	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1st Submittal	9/15/2003	9/29/2003	Not Approved	$250.00	110938: $250
2nd Submittal	10/10/2003	10/24/2003	Conditionally Approved	$400.00	112511: $400
CCRFCD	11/25/2003	12/9/2003	Concurrence	N/C	N/C
3rd Submittal	7/26/2012	8/9/2012	Approved	$100.00	291144: $100
4th Submittal	1/28/2013	2/11/2013	Approved	$100.00	308821: $100
5th Submittal	7/11/2013	7/24/2013	See Comments Below	$100.00	325901: $100
			TOTAL FEES (LDDRS):	**$950.00**	----

REMARKS:

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

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

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.

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

END OF REMARKS

B&H/ays

T/R/S: T20S/R59E/22

AREA K-22

UPDATE #3 TO THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 23B

62023B-100

July 2013

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., #300
Las Vegas, Nevada 89135
Phone: (702) 791-4200
Fax: (702) 791-4450

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

62023B-100

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Summerlin Village 23B Date: July 2013

Location of Development a) Descriptive (Cross Streets) North/South: Sky Vista Drive / Desert Foothills Drive

East/West: Alta Drive / Far Hills Avenue

b) Section: 22 Township: 20 S Range: 59 E

c) APN: 137-22-000-015

Name of Owner: The Howard Hughes Company, LLC

Telephone No.: (702) 791-4200 Fax No. (702) 791-4450 E-Mail Address: Not available

Address: 10801 W. Charleston Blvd Ste. 300; Las Vegas, Nevada 89135

Contact Person-Name: Grant Tokumi **Telephone No.:** (702) 804-2000

* **E-Mail Address:** gtokumi@gcwallace.com **Fax No.:** (702) 804-2299

Firm: G. C. WALLACE COMPANIES

Address: 1555 S. Rainbow Blvd; Las Vegas, NV 89146

Type of Land Development/Land Disturbance

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

1. Total Owned Land Area: At Site: +/- 2.700 acres Being Developed/Disturbed: +/- 0 acres
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ **Yes**** ☒ **No**
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☒ **Yes**** ☐ **No**
4. Proposed type of development (Residential, Commercial, Etc.): Residential
5. Approximate upstream land area which drains to the subject site: +/- 9 sq. mi.
6. Has the site drainage been evaluated in the past? ☒ **Yes** ☐ **No** If yes, please identify documentation: *Update #2 to the Technical Drainage Study for Summerlin Village 23A/23B Alta Drive Street Improvements (Alta Drive Interim Grading), 2012, GCW; Summerlin West Planning Area Flood Control Master Plan, 2006, GCW; Update to the Technical Drainage Study for Summerlin Village 23B Rough Grading, 2006, GCW; Technical Drainage Study for Summerlin Village 23A/23B Alta Drive RCB Regional Drainage Improvements, 2003, GCW; Conceptual Drainage Study for Summerlin Village 23B, 2003, GCW; Update To The Conceptual Drainage Study for Summerlin Village 23B, 2012; Update #2 to the Conceptual Drainage Study for Summerlin Village 23B, 2013.*
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Existing CCRFCD 16' x 8' RCAP storm drain in Far Hills Avenue/Desert Foothills Drive; Existing CCRFCD 11' x 8' RCAP storm drain in Alta Drive/Desert Foothills Drive.
8. Briefly describe your proposed schedule for the subject project: ASAP



Engineer's Seal

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

*New Required Field

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

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

Updated 05/01/2008

CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA
STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 06/06/01)

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 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 Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (Design Manual).

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.)
x		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.

II. GRADING PLAN INFORMATION		
Yes	No	
x		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
x		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.)
x		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.

II. GRADING PLAN INFORMATION		
Yes	No	
	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.
	N/A	The limits of the flood zones and the base flood elevations (BFE) must be shown on all grading plans for all developments within a Special Flood Hazard Zone A, AO, AE, etc.
	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.
	NA	Lots with "B and C Type Drainage" shall be required to install an underground nuisance drainage system or a 2-foot valley gutter through the lot. 16" x 24" minimum block wall openings are required for both options.
	NA	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.

- An appointment must be made to preview this checklist in conjunction with Clark County Regional Flood Control District Manual Standard Form 2 prior to the City accepting a new Drainage Study for review. The engineer may contact the Flood Control Section at 229-6541.

- Following the acceptance of the Drainage Study (meeting the minimum acceptable information above), there will be a charge of $250 for each Drainage Study review submittal. These fees are payable at the time the Grading Permit is obtained.
- The Drainage Study must be accepted prior to submitting grading plans to the Land Development Section 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.

F:\Depot\DOCS\Memos\CHKLIST7.doc
9-Jul-13

UPDATE #3 TO THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 23B

62023B-100

July 2013

Prepared for:

The Howard Hughes Company, LLC
10801 W. Charleston Blvd., #300
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G. C. WALLACE, INC.

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62023B-100

July 11, 2013

Albert Y. Sung, PE
Flood Control Project Manager
City of Las Vegas - Land Development Services
Department of Public Works
333 N. Rancho Drive
Las Vegas, Nevada 89106

Re: **Update #3 to the Conceptual Drainage Study for Summerlin Village 23B**

Dear Mr. Sung:

The purpose of this letter is to serve as the 3rd Update to the subject project. The *Conceptual Drainage Study for Summerlin Village 23B* (hereinafter referred to as the Conceptual Study), *Update to the Conceptual Drainage Study for Summerlin Village 23B* (hereinafter referred to as the First Update), and *Update #2 to the Conceptual Drainage Study for Summerlin Village 23B* (hereinafter referred to as the Second Update) were approved by the City of Las Vegas Public Works Department (CLV) on October 24, 2003, August 9, 2012, and February 11, 2013 respectively.

Changes to the development plan for the site have occurred since approval of the Second Update. Please refer to the revised drainage (Figure 6U3) and facility (Figure 7U3) maps included in Appendix A. Descriptions of the changes are as follows:

The boundaries for Pods NP-2, ES-2, Q1 and COS-5 have been revised, resulting in slight changes to peak 100-year flow rates generated by the pods. Storm drain flow rates were revised and storm drain laterals shifted to accommodate the revised pod delineation. Pods NP-2 and ES-2 have reduced in size by approximately 1.5 and 3.8 acres respectively. Pods Q1 and COS-5 have increased in size by approximately 3.0 and 2.3 acres respectively.

Figure 6U3 depicts the overall subbasins and drainage patterns used in the ultimate conditions hydrologic analysis. Lag time calculations for the onsite drainage basins are included in Appendix A on Standard Form 4. The results of the revised HEC-1 model have been summarized in Table 1. A copy of the revised HEC-1 model has been included in Appendix A.

TABLE 1
SUMMARY OF ULTIMATE CONDITIONS HEC-1 MODEL

SB OR CP*	AREA (AC)	100 YR (CFS)	10 YR (CFS)
5-9A1	38.58	126	60
5-10AR	61.64	191	86
AA	18.52	63	31
BB	32.03	97	42
C-47	-	***662***	***283***
C-47A	-	***2626***	***1651***
CC	28.57	83	36

PROJECT SITE FLOW RATE

TABLE 1
SUMMARY OF ULTIMATE CONDITIONS HEC-1 MODEL

SB OR CP*	AREA (AC)	100 YR (CFS)	10 YR (CFS)
C-CR	-	2212	1569
CCSWFH-7	-	3625	1806
COS-5	***12.32***	***18***	***4***
CP-AL	-	2276	1598
CP-FH	-	952	417
CSWAA-1	-	2184	1560
CSWFH-5	-	870	376
ES-2	***10.86***	***40***	***19***
NP-2	***11.25***	***20***	***4***
P	24.03	67	29
PT0	-	139	61
PT1	-	211	93
PT10	-	***395***	***171***
PT11	-	169	70
PT12	-	***564***	***239***
PT13	-	***631***	***268***
PT2	-	282	123
PT3	-	309	136
PT3A	-	***2247***	***1583***
PT4	-	***2260***	***1588***
PT5	-	***2264***	***1590***
PT5A	-	***2270***	***1594***
PT6	-	***150***	***67***
PT7	-	167	74
PT8	-	***177***	***77***
PT9A	-	***162***	***71***
PT9B	-	***327***	***143***
PT9C	-	***377***	***164***
Q1	***17.93***	***57***	***24***
Q2	13.34	40	17
R-S	41.82	127	54
ST1	8.30	27	13
ST2	4.25	17	8
ST3	4.12	17	9
ST4	5.98	21	10
ST-AL	13.03	43	21
ST-CR	16.43	48	24
ST-DF	12.14	33	16
ST-FH	13.14	44	22
SUM5OT	-	2149	1548
SWAA-1R	81.90	176	64

TABLE 1 SUMMARY OF ULTIMATE CONDITIONS HEC-1 MODEL			
SB OR CP*	AREA (AC)	100 YR (CFS)	10 YR (CFS)
T	29.70	87	38
U	25.15	75	33
V	25.45	77	33
W	23.78	74	32
X	23.31	70	30
Y	29.18	91	40
Z	20.13	66	29

BOLD: Values revised with this update.

All proposed storm drain facilities are shown and labeled on Figure 7U3. Calculations for the facilities impacted by the revisions are included in Appendix B. The revised facilities include the following:

SUMMARY OF REVISED STORM DRAIN CALCULATIONS			
Facility	Original Flow / Revised Flow (cfs)	Slope (%)	Diameter (in)
10	14 / 18	6.5	30
15	22 / 20	2.0	30
16	179 / 177	2.1	54
17	53 / 40	2.0	36
20	127 / 127	2.0	48
21	127 / 127	2.9	48
22	221 / 162	2.1	54
23	344 / 327	3.8	60
24	46 / 57	2.0	36
25	385 / 377	5.1	60
26	409 / 395	5.1	60
30 RCB	578 / 564	1.0	7x6
32 RCB	669 / 662	1.0	7x7

The included storm drain calculations indicate that the revised 100-year design flows do not result in a change in storm drain sizes. In general, the approved drainage patterns are consistent with the previously approved referenced drainage studies and the proposed site plan and storm drain facilities do not significantly alter existing peak flows or the character of flows downstream of the development and do not pose any negative impacts on downstream facilities or development.

If you have any questions or require additional information, please contact me at 804-2015.

Cordially,
G. C. WALLACE, INC.

Grant Y. Tokumi, PE
Project Manager
Flood Control Division

gyt/vlr
c: Chris Anderson, THHC
Calvin Black, GCW
Ryan Belsick, GCW
Mark Fakler, GCW
Josh Johnson, GCW
Rachael Dennis, GCW

UPDATE #3 TO THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 23B
APPENDIX LAYOUT

Appendix A. Hydrologic Calculations and Information

1. Figure 6U3 – Ultimate Conditions Drainage Basin Map
2. Figure 7U3 – Drainage Facilities Map - Ultimate Conditions
3. Soils Exhibit
4. Curve Number Calculations
5. Ultimate Conditions Standard Form 4
6. Ultimate Conditions HEC-1 Model

Appendix B. Hydraulic Calculations and Information

1. Storm Drain Sizing Calculations

Appendix C. Referenced Materials (On CD)

1. CLV Zoning an Planning Conditions

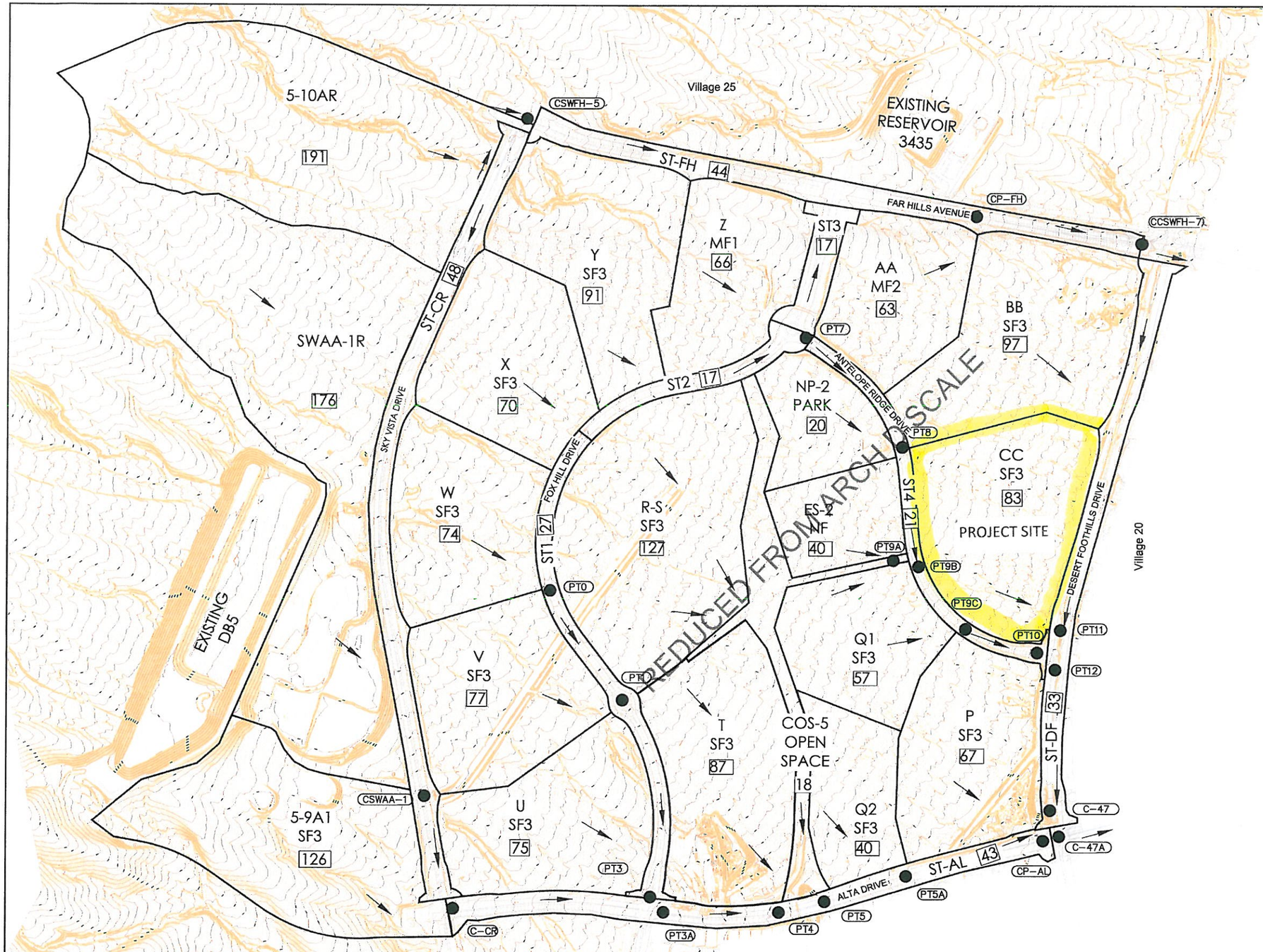
2. 2008 Las Vegas Valley Flood Control Master Plan Update
   a) Figure F-24 – Flood Control Facilities/Facility Inventory
   b) Figure F-29 – Flood Control Facilities/Facility Inventory
   c) Figure H-24 – Hydrologic Summary (Offsite Basins)
   d) Figure H-29 – Hydrologic Summary
   e) Gowan Watershed Standard Form 4
   f) Gowan Watershed USBR
   g) Gowan Watershed HEC-1 Model

3. 2006 Summerlin West Planning Area Flood Control Master Plan
   a) CLV Approval Letter
   b) CN Calculations
   c) DB5/Alta Drive Standard Form 4
   d) Gowan Watershed HEC-1 Model
   e) Conceptual Land Use Plan
   f) Figure 8R – Proposed Condition Drainage Map

4. Update #2 Summerlin Village 23B (Conceptual)
   a) CLV Approval Letter
   b) Figure 6U – Interim Drainage Map
   c) Figure 7U – Interim Drainage Map
   d) Soil Exhibit
   e) CN Calculations
   f) Ultimate Conditions Standard Form 4
   g) Ultimate Conditions HEC-1 Model

APPENDIX A

Hydrologic Calculations



NORTH

SCALE 1" = 300'

GRAPHIC SCALE

300 0 150 300

(IN FEET)

1 inch = 300 ft.

SUMMARY OF ULTIMATE CONDITIONS HEC-1 MODEL

SB OR CP	AREA (AC)	100 YR (CFS)	10 YR (CFS)
5-9A1	38.58	126	60
5-10AR	61.64	191	86
AA	18.62	63	31
BB	32.03	97	42
C-47	-	662	283
C-47A	-	2626	1651
CC	28.57	83	36
C-CR	-	2212	1569
CCSWFH-7	-	3625	1806
COS-5	12.32	18	4
CP-AL	-	2276	1598
CP-FH	-	952	417
CSWAA-1	-	2184	1560
CSWFH-5	-	870	376
ES-2	10.86	40	19
NP-2	11.25	20	4
P	24.03	67	29
PT0	-	139	61
PT1	-	211	93
PT10	-	395	171
PT11	-	169	70
PT12	-	564	239
PT13	-	631	268
PT2	-	282	123
PT3	-	309	136
PT3A	-	2247	1583
PT4	-	2260	1598
PT5	-	2264	1590
PT5A	-	2270	1594
PT6	-	150	67
PT7	-	167	74
PT8	-	177	77
PT8A	-	162	71
PT9B	-	327	143
PT9C	-	377	164
Q1	17.93	57	24
Q2	13.34	40	17
R-S	41.82	127	54
ST1	8.30	27	13
ST2	4.25	17	6
ST3	4.12	17	9
ST4	5.98	21	10
ST-AL	13.03	43	21
ST-CR	16.43	48	24
ST-DF	12.14	33	16
ST-FH	13.14	44	22
SUM50T	-	2149	1548
SWAA-1R	61.90	176	64
T	29.70	87	38
U	25.15	75	33
V	25.45	77	33
W	23.78	74	32
X	23.31	70	30
Y	29.18	91	40
Z	20.13	66	29

LEGEND

- A / SF3 — PARCEL NAME / PARCEL DENSITIES
- 13 — MAXIMUM DISCHARGE FROM PARCEL
- PT1 — CONCENTRATION POINT
- SUBBASIN BOUNDARY

DESIGN:
DRAWN:
CHECK:
ISSUE DATE:
ISSUE EDITOR:
PLOT DATE: 07-10-13
PLOT TIME: 14:04:41

NO.	DESCRIPTION	DATE	APP'D	DATE
			AGN'L APP	

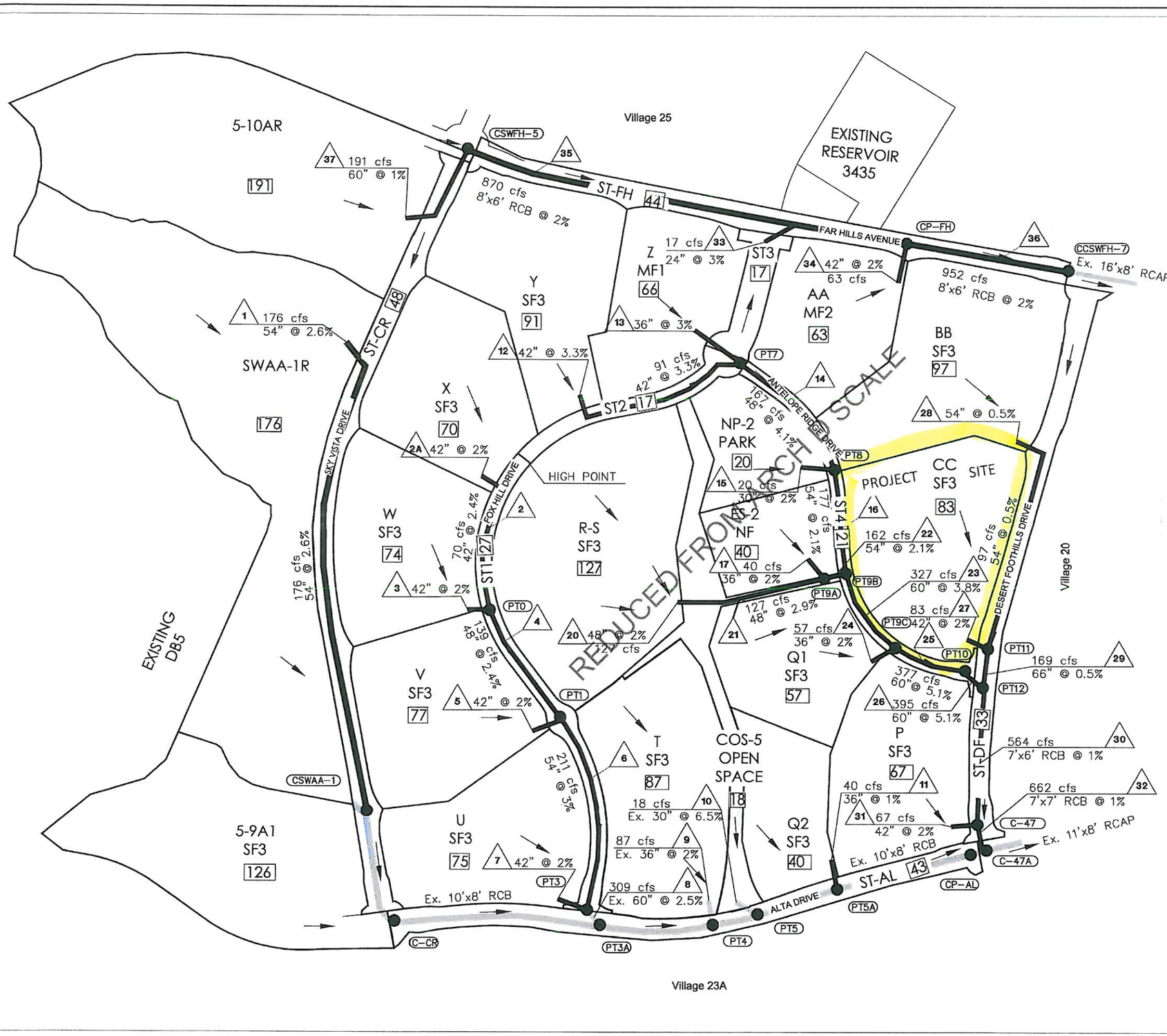
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(702) 804-2100 FAX (702) 804-2111
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SUMMERLIN VILLAGE 28B

CONCEPTUAL DRAINAGE STUDY UPDATE #3

ULTIMATE CONDITIONS DRAINAGE BASIN MAP

SHEET
FIG 6U3



NORTH
SCALE 1" = 300'

GRAPHIC SCALE
300 0 150 300
(IN FEET)
1 inch = 300 ft.

LEGEND

A / SF3	PARCEL NAME / PARCEL DENSITIES
13	MAXIMUM DISCHARGE FROM PARCEL
	PROPOSED STORM DRAIN
PT1	CONCENTRATION POINT
	EXISTING STORM DRAIN
	SUBBASIN BOUNDARY
8	FACILITY IDENTIFIER

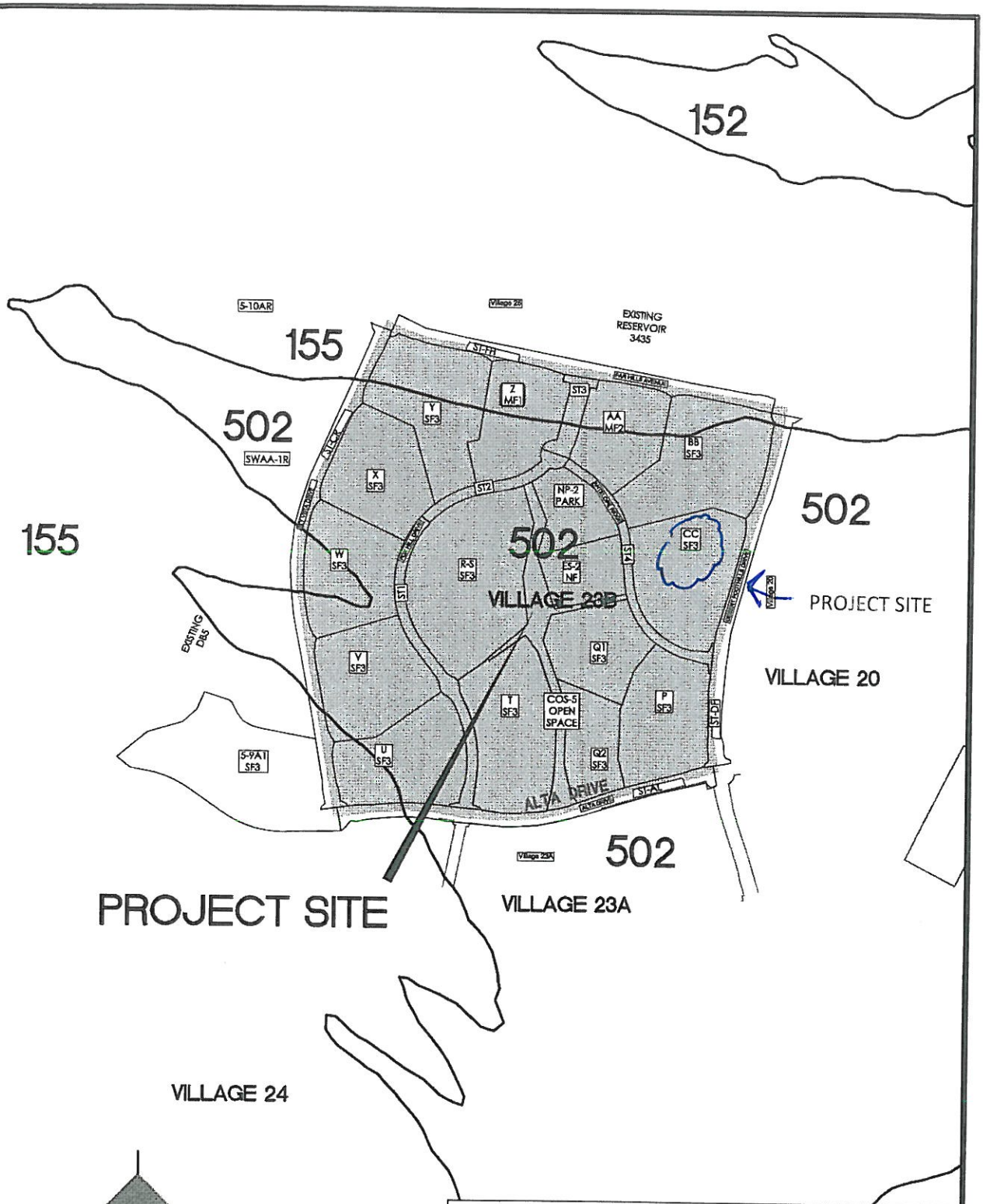
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SUMMERLIN VILLAGE 23B
CONCEPTUAL DRAINAGE STUDY UPDATE #3
DRAINAGE FACILITIES MAP - ULTIMATE CONDITIONS

SHEET
FIG 7U3



UPDATE #3 TO THE
CONCEPTUAL DRAINAGE STUDY FOR
SUMMERLIN VILLAGE 23B

SOIL

EXHIBIT

G.C. WALLACE, INC.
Engineers/Planning/Surveyors

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Summerlin Village 23B

WEIGHTED CURVE NUMBERS AND PRECIPITATION VALUES

Ultimate Conditions

Basin	Soil	Percent	CN	Land Use	WCN	PREC
AA	502	51.0%	93.1	Apt/Condo/Comm	93.8	3.29
	155	49.0%	94.6			
BB	502	81.4%	89.7	Residential <6,000 ft2 lots	90.2	3.29
	155	18.6%	92.2			
CC	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
COS-5	502	100.0%	74.0	Open Space	74.0	3.29
ES-2	502	100.0%	93.1	Commercial	93.1	3.29
NP-2	502	100.0%	74.0	Open Space	74.0	3.29
P	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
Q1	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
Q2	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
R	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
S	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
T	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
U	502	70.6%	89.7	Residential <6,000 ft2 lots	90.4	3.29
	155	29.4%	92.2			
X	502	100.0%	89.7	Residential <6,000 ft2 lots	89.7	3.29
ST1[1]	502	100.0%	98.0	Streets	98.0	3.29
[1]Streets						
ST1[2]	502	100.0%	80.7	Natural Desert Landscaping	80.7	3.29
[2]Natural Desert Landscaping						
ST1[2]	Streets	80.0%	98.0		94.5	3.29
	Lndscape	20.0%	80.7			
ST2[1]	502	100.0%	98.0	Streets	98.0	3.29
[1]Streets						
ST2[2]	502	100.0%	80.7	Natural Desert Landscaping	80.7	3.29
[2]Natural Desert Landscaping						
ST2	Streets	80.0%	98.0		94.5	3.29
	Lndscape	20.0%	80.7			
ST3[1]	502	30.7%	98.0	Streets	98.0	3.29
	155	69.3%	98.0			
[1]Streets						
ST3[2]	502	30.7%	80.7	Natural Desert Landscaping	84.5	3.29
	155	69.3%	86.2			
[2]Natural Desert Landscaping						
ST3[2]	Streets	80.0%	98.0		95.3	3.29
	Lndscape	20.0%	84.5			
ST4[1]	502	100.0%	98.0	Streets	98.0	3.29
[1]Streets						
ST4[2]	502	100.0%	80.7	Natural Desert Landscaping	80.7	3.29
[2]Natural Desert Landscaping						
ST4[2]	Streets	80.0%	98.0		94.5	3.29
	Lndscape	20.0%	80.7			

REF. CN & P VALUES

V	502	96.9%	89.7	Residential <6,000 ft2 lots	89.8	3.29
	155	3.1%	92.2			
W	502	74.4%	89.7	Residential <6,000 ft2 lots	90.3	3.29
	155	25.6%	92.2			
Y	502	58.1%	89.7	Residential <6,000 ft2 lots	90.7	3.29
	155	41.9%	92.2			
Z	502	47.5%	89.7	Residential <6,000 ft2 lots	91.0	3.29
	155	52.5%	92.2			
ST-AL[1]	502	83.0%	98.0	Streets	98.0	3.29
	155	17.0%	98.0			
[1]Streets						
ST-AL[2]	502	83.0%	80.7	Natural Desert Landscaping	81.6	3.29
	155	17.0%	86.2			
[2]Natural Desert Landscaping						
ST-AL[2]	Streets	80.0%	98.0		94.7	3.29
	Lndscape	20.0%	81.6			
ST-DF[1]	502	96.0%	98.0	Streets	98.0	3.29
	155	4.0%	98.0			
[1]Streets						
ST-DF[2]	502	96.0%	80.7	Natural Desert Landscaping	80.9	3.29
	155	4.0%	86.2			
[2]Natural Desert Landscaping						
ST-DF[2]	Streets	80.0%	98.0		94.6	3.29
	Lndscape	20.0%	80.9			
ST-CR[1]	502	55.0%	98.0	Streets	98.0	3.29
	155	45.0%	98.0			
[1]Streets						
ST-CR[2]	502	55.0%	80.7	Natural Desert Landscaping	83.2	3.29
	155	45.0%	86.2			
[2]Natural Desert Landscaping						
ST-CR[2]	Streets	80.0%	98.0		95.0	3.29
	Lndscape	20.0%	83.2			
ST-FH[1]	155	100.0%	98.0	Streets	98.0	3.29
[1]Streets						
ST-FH[2]	155	100.0%	86.2	Natural Desert Landscaping	86.2	3.29
[2]Natural Desert Landscaping						
ST-FH[2]	Streets	80.0%	98.0		95.6	3.29
	Lndscape	20.0%	86.2			
5-9A1	155	100.0%	92.2	Residential <6,000 ft2 lots	92.2	3.43
5-10AR	155	100.0%	88.8	Summerlin West	88.8	3.43
SWAA-1R	155	100.0%	84.3	2008 MPU Landuses	84.3	3.44

HYDROLOGIC CRITERIA AND DESIGN MANUAL

TIME OF CONCENTRATION

G. C. WALLACE COMPANIES
Engineers/Planners/Surveyors

SUMMERLIN VILLAGE 23B
CONCEPTUAL DRAINAGE STUDY UPDATE #3
ULTIMATE CONDITIONS

Project No: 62023B-100
Date: 16-Jan-13
Calculated by:

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK URBANIZED BASINS		Tc	Tlag	REMARKS
DESIG:	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Sq Mi	INITIAL LENGTH Feet	SLOPE %	TI Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY fps	V2 VELOCITY fps	Tt Min	TOTAL LENGTH Feet	Tc = (L/180)+10 Min	Min	Tlag = 0.6Tc/60 Hours	Remarks:
(1)		(16)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(11)	(12)	(13)	(14)	(15)	
U	D	90.4	0.8033	25.15	0.03929	100	1.0	5.3	1820	3.7	3.9	5.9	5.9	1920	20.7	11.2	0.112	
V	D	89.8	0.7954	25.45	0.03977	100	1.0	5.5	1535	3.8	3.9	5.9	5.0	1635	19.1	10.5	0.105	
W	D	90.3	0.8020	23.78	0.03716	100	1.0	5.4	1480	4.3	4.2	6.3	4.6	1580	18.8	9.9	0.099	
X	D	89.7	0.7940	23.31	0.03642	100	1.0	5.5	1500	3.7	3.9	5.9	5.0	1600	18.9	10.5	0.105	
Y	D	91.0	0.8112	29.18	0.04560	100	1.0	5.2	1715	4.0	4.1	6.1	5.4	1815	20.1	10.6	0.106	
Z	D	91.0	0.8112	20.13	0.03146	100	1.0	5.2	1130	3.3	3.7	5.6	4.1	1230	16.8	9.3	0.093	
AA	D	93.8	0.8482	18.52	0.02894	100	1.0	4.5	1375	2.6	3.3	5.0	5.5	1475	18.2	10.0	0.100	
BB	D	90.2	0.8006	32.03	0.05005	100	1.0	5.4	1550	3.6	3.8	5.8	5.2	1650	19.2	10.6	0.106	
CC	D	89.7	0.7940	28.57	0.04464	100	1.0	5.5	1915	2.9	3.5	5.2	6.9	2015	21.2	12.4	0.124	
ST1	D	94.5	0.8574	8.30	0.01297	21	2.0	1.6	3185	2.3	3.1	4.7	12.3	3206	27.8	13.9	0.139	
ST2	D	94.5	0.8574	4.25	0.00663	21	2.0	1.6	1500	3.6	3.8	5.8	5.0	1521	18.5	6.6	0.066	
ST3	D	95.3	0.8680	4.12	0.00643	21	2.0	1.5	830	3.6	3.8	5.8	3.1	851	14.7	4.6	0.050	
ST4	D	94.5	0.8574	5.98	0.00934	21	2.0	1.6	2840	4.2	4.1	6.3	8.2	2861	25.9	9.8	0.098	
NP-2*	D	74.0	0.5868	11.25	0.01758	100	6.0	5.1	900	5.0	4.5	6.9	2.8	1000	15.6	7.9	0.079	
ES-2*	D	93.1	0.8389	10.86	0.01697	100	1.0	4.7	900	4.4	4.2	6.4	3.0	1000	15.6	7.7	0.077	
T	D	89.7	0.7940	30.12	0.04707	100	1.0	5.5	2015	3.3	3.7	5.6	6.8	2115	21.8	12.3	0.123	
R-S	D	89.7	0.7940	41.82	0.06534	100	1.0	5.5	1505	4.4	4.2	6.4	4.6	1605	18.9	10.1	0.101	
Q1*	D	89.7	0.7940	17.93	0.02802	100	1.0	5.5	1000	3.4	3.7	5.6	3.7	1100	16.1	9.2	0.092	
Q2	D	89.7	0.7940	13.34	0.02084	100	1.0	5.5	1390	3.3	3.7	5.6	4.9	1490	18.3	10.4	0.104	
P	D	89.7	0.7940	24.03	0.03754	100	1.0	5.5	1380	2.8	3.4	5.1	5.3	1480	18.2	10.8	0.108	
COS-5*	D	74.0	0.5868	12.32	0.01925	50	2.0	5.2	3260	3.0	3.5	5.3	11.1	3310	28.4	16.3	0.163	
ST-FH	D	95.6	0.8719	13.14	0.02052	80	2.0	2.9	3900	5.3	4.6	7.0	9.9	3980	32.1	12.8	0.128	
ST-AL	D	94.7	0.8600	13.03	0.02036	30	2.0	1.9	3745	3.6	3.8	5.8	11.5	3775	31.0	13.4	0.134	
ST-DF	D	94.6	0.8587	12.14	0.01897	40	2.0	2.2	3550	0.9	1.9	2.9	21.9	3590	29.9	24.0	0.240	
ST-CR	D	95.0	0.8640	16.43	0.02567	50	2.0	2.4	4930	2.1	2.9	4.4	19.5	4980	37.7	21.9	0.219	
5-9A1	D	92.2	0.8270	38.58	0.06028	100	1.0	4.9	2320	3.8	3.9	6.0	7.2	2420	23.4	12.1	0.121	
5-10AR	D	90.8	0.8086	61.64	0.09631	200	2.0	5.9	3580	5.5	4.7	7.2	8.9	3780	31.0	14.8	0.148	
SWAA-1R	D	84.3	0.7228	81.90	0.12797	100	1.0	6.8	8300	3.3	3.7	5.6	25.7	8400	56.7	32.4	0.324	
* Revised for this update																		

SITE DATA

Tc = Ti + Tt Tlag = 0.6 Tc
Ti = 1.8 (1.1 - K) $L^{1/2}$ / $S^{1/3}$
K = 0.0132 (CN) - 0.39

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing: V1 = 14.8*(S/100)$^{1/2}$ V2 = 29.4*(S/100)$^{1/2}$

Developed: V1 = 20.2*(S/100)$^{1/2}$ V2 = 30.6*(S/100)$^{1/2}$

REFERENCE:

STANDARD FORM 4

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN  1998                *
 *           VERSION 4.1                 *
 *                                       *
 *  RUN DATE   08JUL13  TIME  08:34:30   *
 *                                       *
 *****************************************
```

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

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

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

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

1 HEC-1 INPUT PAGE 1

```
          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
                    *DIAGRAM
*** FREE ***
               1    ID   ************************************************************
               2    ID   * ......................................................... *
               3    ID   * :                SUMMERLIN VILLAGE 23B                  : *
               4    ID   * :                CONCEPTUAL STUDY UPDATE #3             : *
               5    ID   * :                DEVELOPED ONSITE                       : *
               6    ID   * :                DEVELOPED OFFSITE                      : *
               7    ID   * :.....................................................: *
               8    ID   * :             RETURN PERIOD_ _ _ _10 & 100-YEAR         : *
               9    ID   * :             DISTRIBUTION_ _ _ _ 6-HOUR SDN3           : *
              10    ID   * :             PROJECT NO_ _ _ _ _ 62023B.100            : *
              11    ID   * :             FILENAME_ _ _ _ _ _ V23B-ULTR.H1          : *
              12    ID   * :             DATE_ _ _ _ _ _ _ 07/05/2013              : *
              13    ID   * :             MODELED BY_ _ _ _ _ GYT                   : *
              14    ID   * :.....................................................: *
              15    ID   * :                                                     : *
              16    ID   * :.....................................................: *
              17    ID   ************************************************************
              18    ID
              19    ID    JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
              20    ID
              21    ID                                  AREA      DARF
              22    ID                              SQ.MI.
              23    ID
              24    ID                             0.0 - 0.5    1.000
              25    ID                             0.5 - 1.0    0.975
              26    ID                             1.0 - 2.0    0.950
              27    ID                             2.0 - 3.0    0.925
              28    ID                             3.0 - 4.0    0.915
              29    ID                             4.0 - 5.0    0.908
              30    ID                             5.0 - 7.0    0.895
              31    ID                             7.0 - 8.0    0.885
              32    ID
              33    IT       5       0       0     200
              34    IO       5       0
              35    IN       5       0       0
              36    JR    PREC     1.0   0.975    0.95   0.925   0.915   0.908   0.895   0.885    0.55
                    *
                    * BASIN PARAMETERS FOR OFFSITE BASINS TAKEN
                    * DIRECTLY FROM 2008 MPU:
                    *
                    * THE FOLLOWING SECTION OF HYDROLOGY WAS DEVELOPED BASED ON G.C. WALLACE'S
                    * 2006 SUMMERLIN WEST: EXISTING OFFSITE/PROPOSED ONSITE DRAINAGE CONDITION
                    * HYDROLOGIC MODEL (11-20-06); THE HYDROLOGY WAS REVISEED IN ORDER TO
                    * INCORPORATE ALL EXISTING/PROPOSED MPU FACILITIES
                    *
              37    KK  DB54-1
              38    BA   2.222
              39    PB   3.72
              40    PC  0.000   .0200   .0570   .0700   .0870   .1080   .1240   .1300   .1300   .1300
              41    PC   .1300  .1300   .1300   .1330   .1400   .1420   .1480   .1580   .1720   .1810
              42    PC   .1900  .1970   .1990   .2000   .2010   .2040   .2140   .2290   .2410   .2490
              43    PC   .2510  .2560   .2700   .2780   .2810   .2830   .2950   .3220   .3520   .4090
```

1 HEC-1 INPUT PAGE 2

```
          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
              44    PC   .4990  .5900   .7100   .7440   .7810   .8120   .8190   .8350   .8510   .8560
              45    PC   .8600  .8680   .8760   .8880   .9100   .9260   .9370   .9500   .9700   .9760
              46    PC   .9820  .9850   .9870   .9890   .9900   .9930   .9930   .9940   .9950   .9980
              47    PC   .9980  .9990  1.000
              48    LS      0   87.2
              49    UD  0.495
                    *
```

```
 477          KM              CN    93.1
 478          BA  .01697
 479          LS       0    93.1
 480          UD    .077
              *

 481          KK     R-S
 482          KM
 483          KM            AREA   41.82      AC
 484          KM            Tlag    10.8     MIN
 485          KM              CN    89.7
 486          BA  .06534
 487          LS       0    89.7
 488          UD    .101
              *

 489          KK   R/R-S
 490          KM   ROUTE THROUGH EASEMENT TO PT9B
 491          RD    1180   0.034   0.016       0    CIRC       5
              *

 492          KK    PT9A
 493          KM   COMBINE ES-2 AND R-S
 494          HC       2
              *

 495          KK    PT9B
 496          KM   COMBINE PT8 AND PT9A
 497          HC       2
              *

 498          KK  R/PT9B
 499          KM   ROUTE THROUGH ST4 (SPOKE B ROAD) TO PT9C
 500          RD     440   0.043   0.016       0    TRAP       0      50
              *

 501          KK      Q1
 502          KM
 503          KM            AREA   17.93      AC
 504          KM            Tlag     9.2     MIN
 505          KM              CN    89.7
 506          BA  .02802
 507          LS       0    89.7
 508          UD    .092
              *
```



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

 509          KK    PT9C
 510          KM   COMBINE Q1 AND PT9B
 511          HC       2
              *

 512          KK  R/PT9C
 513          KM   ROUTE THROUGH ST4 (SPOKE ROAD) TO PT10
 514          RD     555   0.056   0.016       0    TRAP       0      50
              *

 515          KK     ST4
 516          KM
 517          KM            AREA    5.98      AC
 518          KM            Tlag     9.8     MIN
 519          KM              CN    94.5
 520          BA  .00934
 521          LS       0    94.5
 522          UD    .098
              *

 523          KK    PT10
 524          KM   COMBINE PT9 AND ST4
 525          HC       2
              *

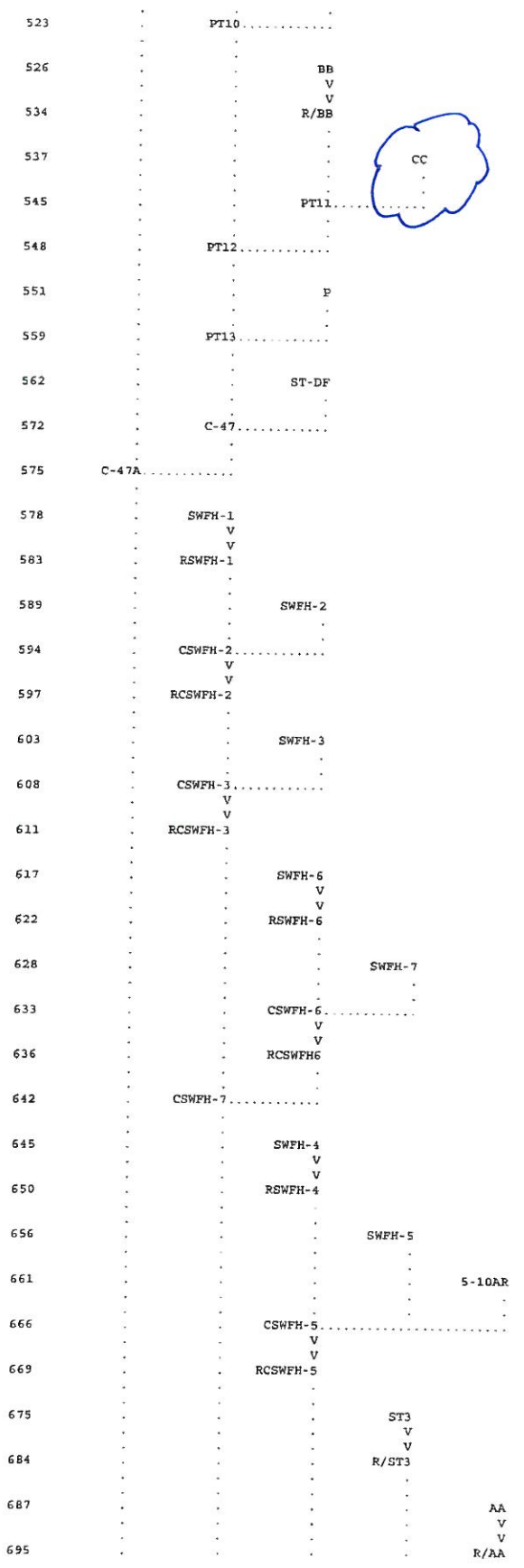
 526          KK      BB
 527          KM
 528          KM            AREA   32.03      AC
 529          KM            Tlag    10.6     MIN
 530          KM              CN    90.2
 531          BA  .05005
 532          LS       0    90.2
 533          UD    .106
              *

 534          KK    R/BB
 535          KM   ROUTE THROUGH DESERT FOOTHILLS
 536          RD    2505   0.009   0.016       0    TRAP       0      50
              *

 537          KK      CC
 538          KM
 539          KM            AREA   28.57      AC
 540          KM            Tlag    12.4     MIN
 541          KM              CN    89.7
 542          BA  .04464
 543          LS       0    89.7
 544          UD    .124
              *
```

SITE & BASIN DATA


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



SITE IS SINGLE BASIN

100-YR

10-YR

+	R/PT9C	.21	1	FLOW	376.	364.	352.	340.	335.	332.	325.	321.	162.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	ST4	.01	1	FLOW	21.	20.	20.	19.	19.	19.	19.	18.	10.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT													
+	PT10	.22	1	FLOW	395.	383.	370.	358.	352.	349.	342.	338.	171.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	BB	.05	1	FLOW	97.	94.	91.	88.	87.	86.	84.	83.	42.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO													
+	R/BB	.05	1	FLOW	95.	92.	89.	87.	86.	85.	84.	82.	42.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	CC	.04	1	FLOW	83.	81.	78.	75.	74.	74.	72.	71.	36.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	PT11	.09	1	FLOW	169.	163.	157.	151.	149.	148.	145.	142.	70.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT													
+	PT12	.32	1	FLOW	564.	546.	528.	509.	502.	497.	486.	480.	239.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	P	.04	1	FLOW	67.	65.	63.	61.	60.	59.	58.	57.	29.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	PT13	.35	1	FLOW	631.	610.	590.	570.	561.	556.	544.	537.	268.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	ST-DF	.02	1	FLOW	33.	32.	31.	30.	30.	30.	29.	29.	16.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	C-47	.37	1	FLOW	662.	641.	620.	599.	590.	584.	572.	565.	283.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	C-47A	7.60	1	FLOW	2965.	2896.	2830.	2754.	2724.	2703.	2659.	2626.	1651.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	4.58
HYDROGRAPH AT													
+	SWFH-1	.56	1	FLOW	893.	863.	833.	803.	791.	782.	766.	754.	362.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RSWFH-1	.56	1	FLOW	887.	859.	828.	796.	784.	776.	760.	748.	355.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	SWFH-2	.53	1	FLOW	929.	901.	873.	846.	835.	827.	812.	801.	430.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CSWFH-2	1.09	1	FLOW	1816.	1760.	1701.	1642.	1619.	1603.	1572.	1549.	785.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RCSWFH-2	1.09	1	FLOW	1805.	1749.	1690.	1632.	1609.	1592.	1562.	1538.	775.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	SWFH-3	.15	1	FLOW	321.	312.	303.	294.	291.	288.	284.	280.	160.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CSWFH-3	1.25	1	FLOW	2092.	2029.	1962.	1896.	1870.	1851.	1816.	1790.	921.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RCSWFH-3	1.25	1	FLOW	2080.	2014.	1950.	1881.	1857.	1837.	1804.	1775.	907.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	SWFH-6	.25	1	FLOW	489.	475.	460.	446.	440.	436.	428.	422.	227.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RSWFH-6	.25	1	FLOW	479.	464.	450.	436.	430.	426.	418.	413.	219.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	SWFH-7	.31	1	FLOW	629.	611.	593.	575.	568.	563.	553.	546.	302.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CSWFH-6	.56	1	FLOW	1108.	1076.	1043.	1011.	998.	989.	971.	959.	521.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCSWFH6	.56	1	FLOW	1094.	1062.	1029.	998.	984.	976.	958.	946.	512.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													

REF. FLOW RATES

Appendix E: CLV SDR Related Information

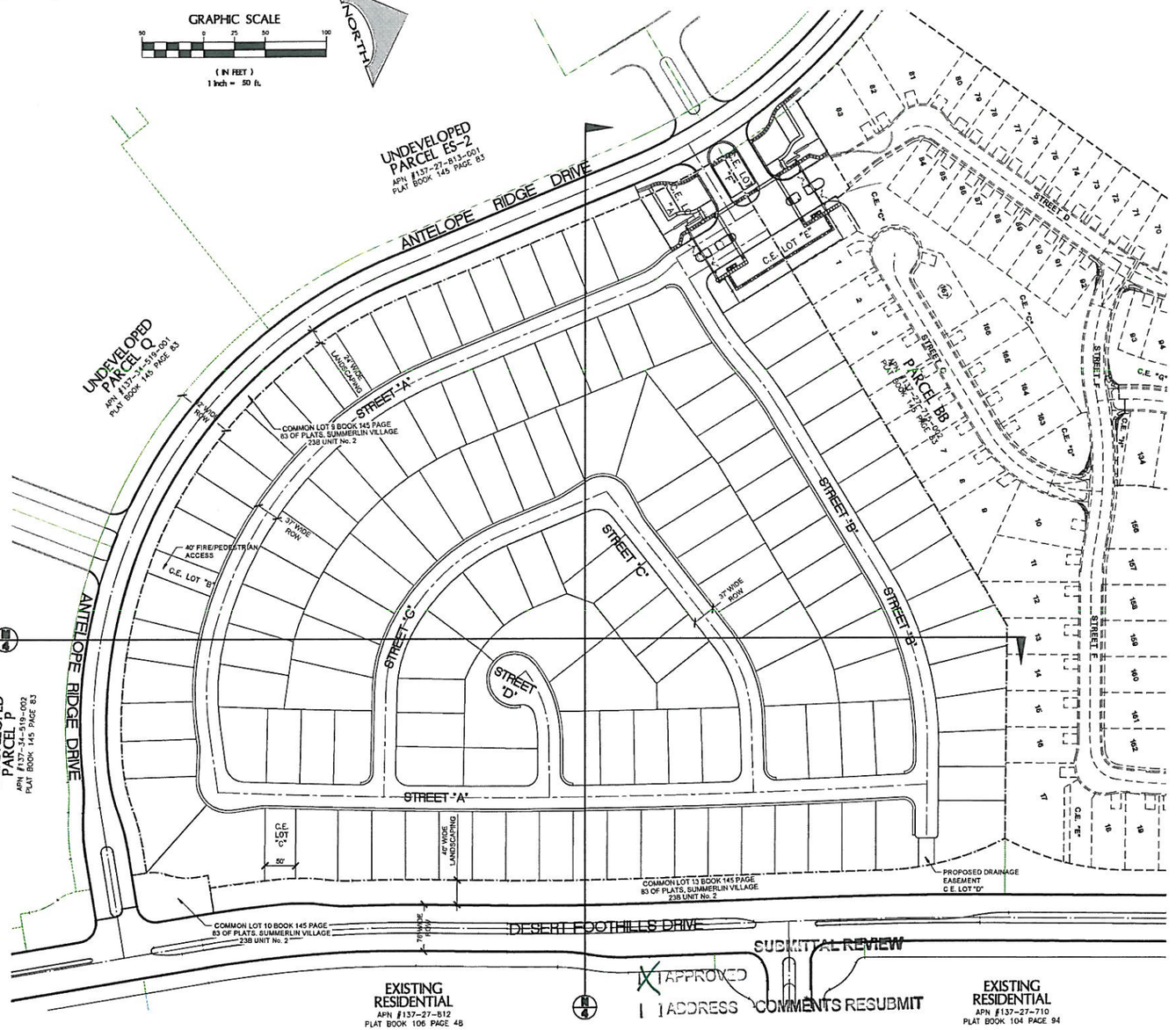
SAVONA
AT SUMMERLIN

LEGEND AND ABBREVIATIONS

PROPOSED		EXISTING	
	PROPERTY / BOUNDARY LINE		LOTLINE
	CENTERLINE		RIGHT-OF-WAY
	LOTLINE		BLOCK WALL
	RIGHT-OF-WAY		RETAINING WALL
	CURB, GUTTER & SIDEWALK		EDGE OF PAVEMENT
	EDGE OF PAVEMENT		INDEX CONTOUR
x	CHAIN LINK FENCE		INTERMEDIATE CONTOUR
	SEWER MAIN & MANHOLE		SEWER MAIN & MANHOLE
	WATER MAIN & MANHOLE		WATER MAIN & MANHOLE

GRAPHIC SCALE
50 0 25 50 100
(IN FEET)
1 inch = 50 ft.

NORTH



GENERAL NOTES

1. ALL IMPROVEMENTS SHALL COMPLY WITH THE CLARK COUNTY STANDARDS AND SPECIFICATIONS
2. UTILITY SERVICE IS AS FOLLOWS:
   - WATER ..... LAS VEGAS VALLEY WATER DISTRICT
   - ELECTRIC ..... NEVADA POWER COMPANY, A NEVADA CORPORATION D/B/A NV ENERGY
   - GAS ..... SOUTHWEST GAS CORPORATION
   - SEWER ..... CITY OF LAS VEGAS SEWER
   - SOLID WASTE DISPOSAL ..... REPUBLIC SERVICES
   - TELEPHONE ..... CENTURYLINK
   - CABLE ..... COX COMMUNICATIONS LAS VEGAS, INC
3. UTILITY EASEMENTS TO BE DEDICATED TO RESPECTIVE AGENCIES
4. STORM WATER TO SURFACE DRAIN ON STREETS
5. THIS SUBJECT PROPERTY DOES NOT RESIDE WITHIN THE 100-YEAR FLOOD PLAIN
6. SUBJECT PROPERTY IS TO BE USED AS SHOWN ON THIS MAP
7. THERE ARE NO KNOWN, MAPPED OR OBSERVABLE FAULTS ACROSS THIS PARCEL
8. ALL GROUNDWATER DEPTHS ARE HISTORICALLY BELOW 20 FEET IN THIS AREA
9. ALL ABOVE GROUND UTILITY BOXES WILL NOT BE LOCATED WITHIN TRAIL CORRIDORS
10. ALL ONSITE STREETS ARE PRIVATE STREETS AND PUBLIC UTILITY EASEMENTS

LEGAL DESCRIPTION

PARCEL CC AS SHOWN ON THE FINAL MAP OF SUMMERLIN VILLAGE 23B UNIT NO. 2, A COMMON-INTEREST COMMUNITY, FILE IN BOOK 145 OF PLATS, PAGE 83 LYING WITHIN SECTION 27, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

BASIS OF BEARINGS

FOOTHILLS DRIVE AS SHOWN ON THE PLAT OF SUMMERLIN VILLAGE 23B UNIT NO. 2, ON FILE IN THE CLARK COUNTY, NEVADA RECORDER'S OFFICE AS BOOK 145, PAGE 83 OF PLATS.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK 7LV09 275E6
A RIVET AND PLATE IN THE TOP OF CURB AT THE NORTHEAST CORNER OF MOUNTAIN SHADOW ROAD AND DESERT FOOTHILLS.

ELEVATION = 1013.556 METERS (3325.31 FEET) NAVD 1988 DATUM

OWNER

APN 137-27-813-002
HOWARD HUGHES COMPANY LLC
10801 WEST CHARLESTON BLVD., SUITE 300
LAS VEGAS, NEVADA 89135

DEVELOPER

WOODSIDE HOMES OF NEVADA, LLC
4670 SOUTH FORT APACHE ROAD, SUITE 200
LAS VEGAS, NEVADA 89147
(702)889-7810

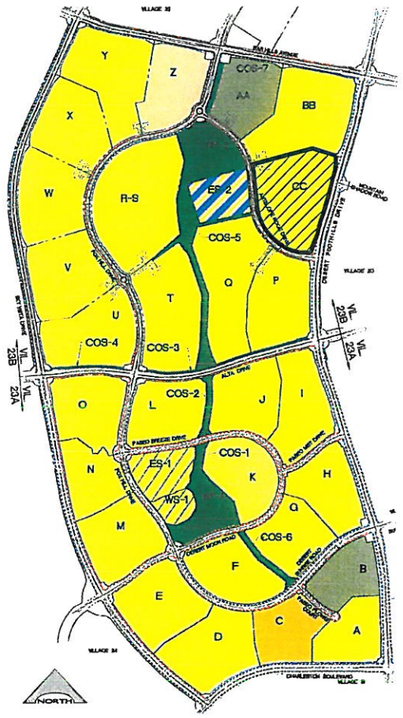
SUBMITTAL REVIEW

[X] APPROVED
[ ] ADDRESS COMMENTS RESUBMIT
[ ] DENIED

7/17/2014
SUMMERLIN RESIDENTIAL DESIGN REVIEW COMMITTEE (SDRC)

BY: 7/17/2014
SUMMERLIN APPROVAL DATE

THE PASEOS
A SUMMERLIN VILLAGE



VICINITY MAP

NOT TO SCALE

PROJECT DATA

SITE AREA (GROSS)	
A.P.N.	137-27-813-002
ZONING (EXISTING) ZONING (PROPOSED)	P-C P-C
NUMBER OF UNITS	135
DENSITY	4.73 (GROSS)
CONNECTIVITY RATIO	
EQUATION = LINKS/NODES	(11.5 LINKS)/(8.5 NODES) = 1.4

SITE SETBACKS

THE PASEOS DESIGN CRITERIA - TABLE 4-A - 55'x100' LOTS

FRONT	
FRONT ENTRY GARAGE	23'
SIDE ENTRY GARAGE	18'
BUILDING FACE	18'
PORCH	18'
REAR	
PERIMETER AND INTERIOR	20'
SIDE	
INTERIOR LOTS	5'
PERIMETER LOTS	5'/10'
CORNER LOTS	15'
BALCONIES	
REAR	15'
COURTYARD WALLS	
FRONT	8'
CORNER SIDE	8'
PATIO COVERS	
REAR	15'

CONCEPTUAL LAYOUT #001

PROFESSIONAL ENGINEER - STATE OF NEVADA
VERNON R. HARKINS
EXP 6/30/15
CIVIL
No. 009668

DESIGNED BY:	MGB	DRAWN BY:	MGB	CHKD BY:			
JOB NUMBER:	220-016-141	DATE:	9-11-13				
NO.	REVISION			DATE	APPR.		

L. R. NELSON CONSULTING ENGINEERS, INC.
• STRUCTURAL
• CIVIL
• PLANNING
• SURVEY
6765 West Russell Road, Suite 200
Las Vegas, Nevada 89118
(702) 798-7978
(702) 451-2296 FAX

Woodside Homes
BETTER BY DESIGN

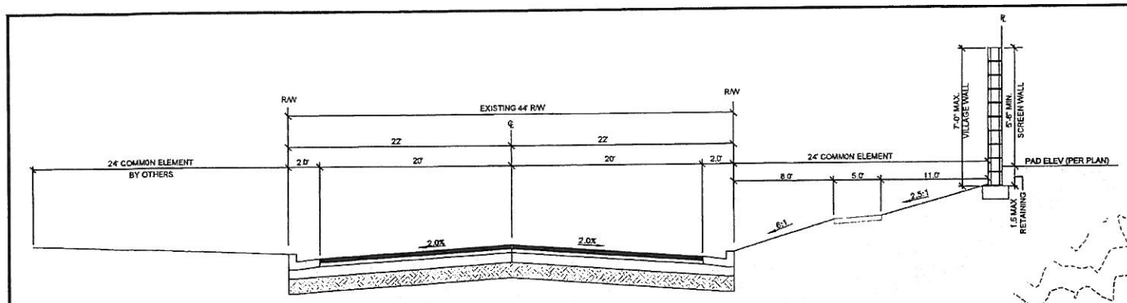
TENTATIVE MAP OF
SAVONA
AT SUMMERLIN
CITY OF LAS VEGAS NEVADA

SHEET NUMBER
1
OF 4 SHEETS
220-016-141

SAVONA
AT SUMMERLIN

GRAPHIC SCALE
50 0 25 50 100
(IN FEET)
1 inch = 50 ft.

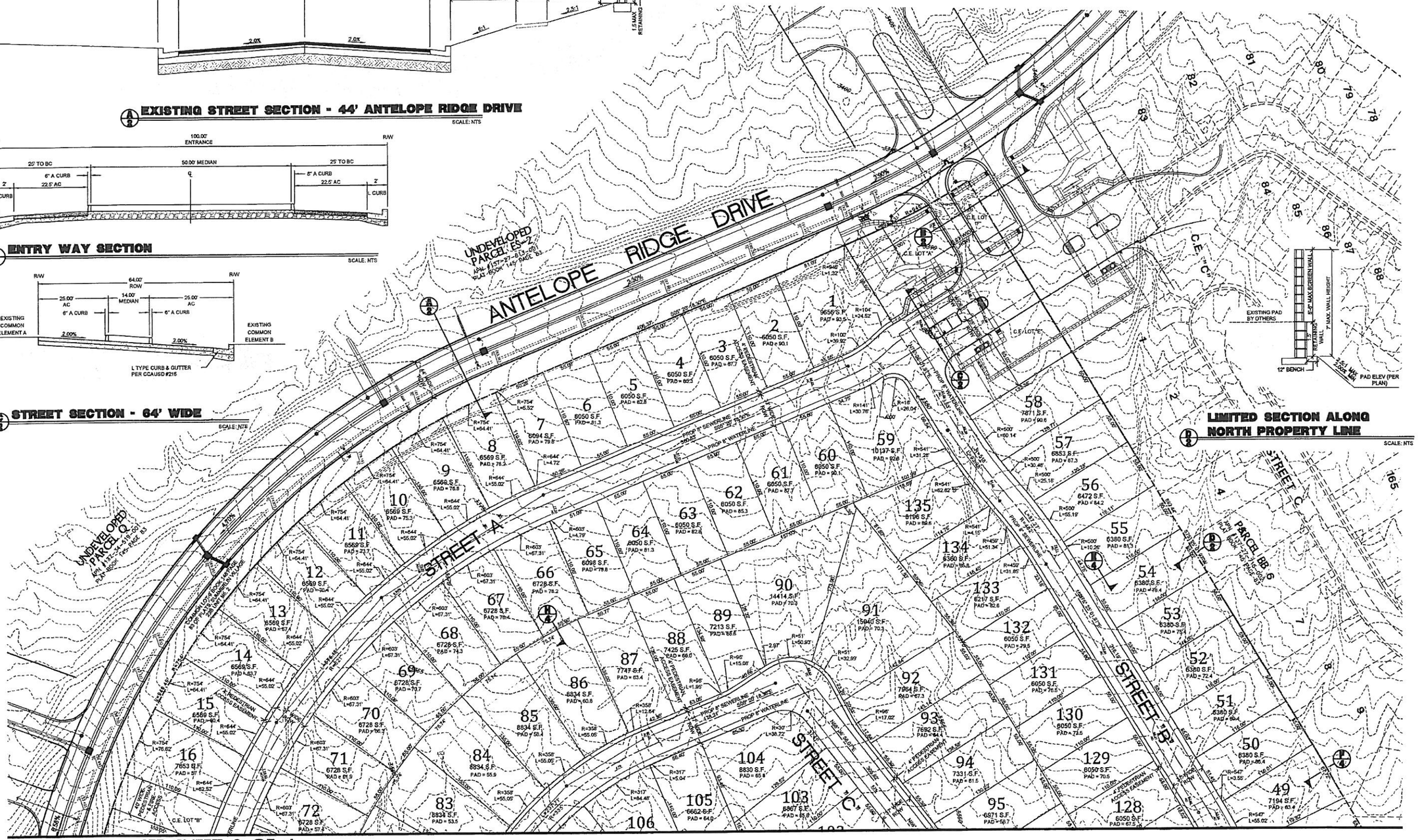
NORTH



EXISTING STREET SECTION - 44' ANTELOPE RIDGE DRIVE
SCALE: NTS

ENTRY WAY SECTION
SCALE: NTS

STREET SECTION - 64' WIDE
SCALE: NTS



LIMITED SECTION ALONG NORTH PROPERTY LINE
SCALE: NTS

MATCHLINE – SEE SHEET 3 OF 4

BY: _____ DATE _____
SUMMERLIN APPROVAL

PROFESSIONAL ENGINEER STATE OF NEVADA
VERNON R. HARKINS
EXP 6/30/15
CIVIL
No. 009698

DESIGNED BY:	MGB	DRAWN BY:	MGB	CHKD BY:	
JOB NUMBER:	220-016-141	DATE:	9-11-13		
NO.	REVISION			DATE	APPR.

L. R. NELSON CONSULTING ENGINEERS, INC.
6785 West Russell Road, Suite 200
Las Vegas, Nevada 89118
STRUCTURAL
CIVIL (702) 798-7978
PLANNING (702) 451-2296 FAX
SURVEY

Woodside Homes
BETTER BY DESIGN

TENTATIVE MAP OF
SAVONA
AT SUMMERLIN
CITY OF LAS VEGAS NEVADA

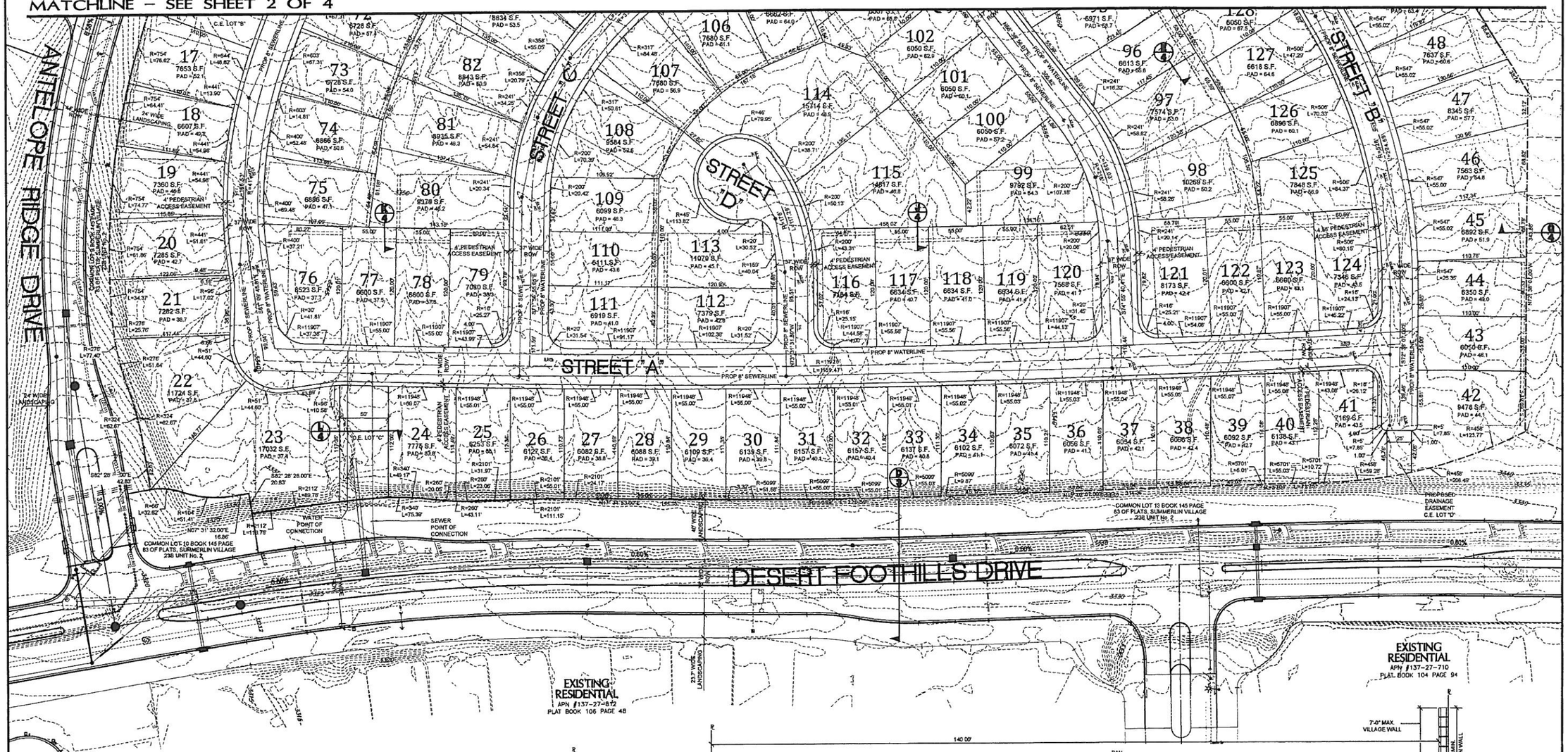
SHEET NUMBER
2
OF 4 SHEETS
220-016-141

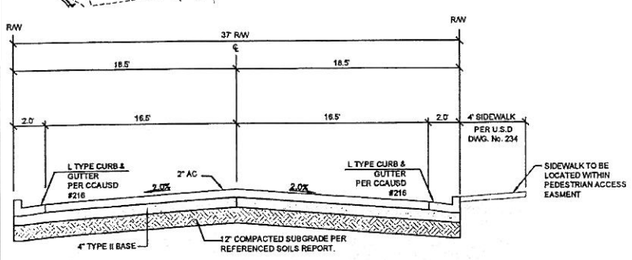
SAVONA
AT SUMMERLIN

GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.

NORTH

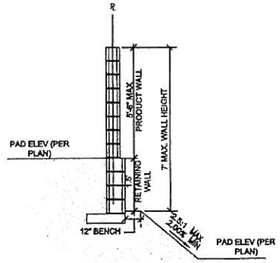
MATCHLINE – SEE SHEET 2 OF 4





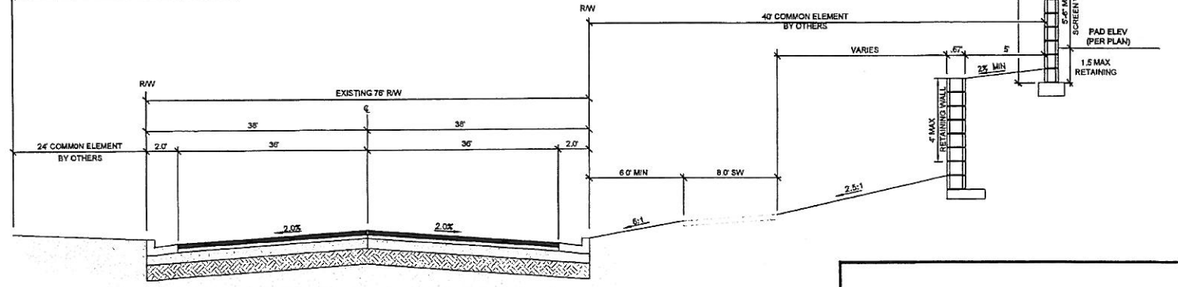
37' TYPICAL STREET SECTION W/4' PEDESTRIAN ACCESS EASEMENT

SCALE: NTS



TYPICAL WALL/SCARP DETAIL SECTION

SCALE: NTS



(D/3) EXISTING STREET SECTION - 76' DESERT FOOTHILLS DRIVE

SCALE: NTS

BY: _____ DATE _____

SUMMERLIN APPROVAL

PROFESSIONAL ENGINEER - STATE OF NEVADA
VERNON R. HARKINS
EXP: 6/30/15
CIVIL
No. 009698

DESIGNED BY:	MGB	DRAWN BY:	MGB	CHKD BY:	
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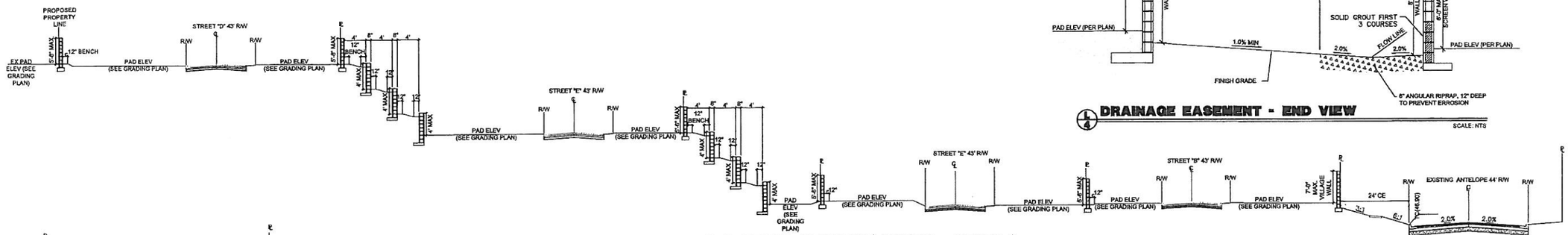
L. R. NELSON CONSULTING ENGINEERS, INC.
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Las Vegas, Nevada 89118
(702) 798-7978
(702) 451-2236 FAX
• STRUCTURAL
• CIVIL
• PLANNING
• SURVEY

Woodside Homes
BETTER BY DESIGN

TENTATIVE MAP OF
SAVONA
AT SUMMERLIN
CITY OF LAS VEGAS NEVADA

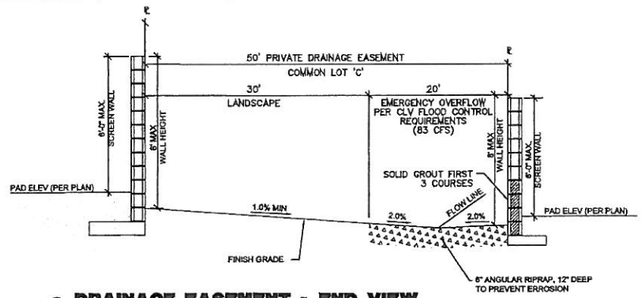
SHEET NUMBER
3
OF 4 SHEETS
220-016-141

SAVONA
AT SUMMERLIN

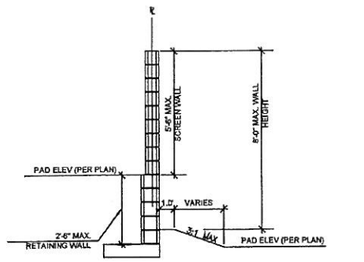


TYPICAL CROSS SECTION (NORTH - SOUTH)
SCALE: NTS

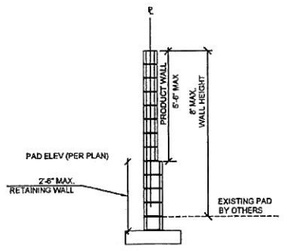
TYPICAL CROSS SECTION (EAST - WEST)
SCALE: NTS



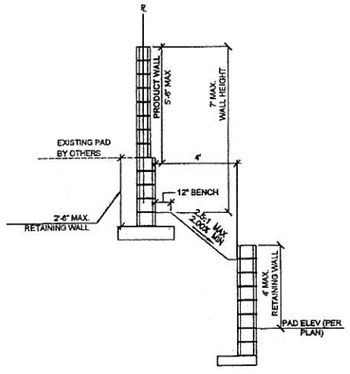
DRAINAGE EASEMENT - END VIEW
SCALE: NTS



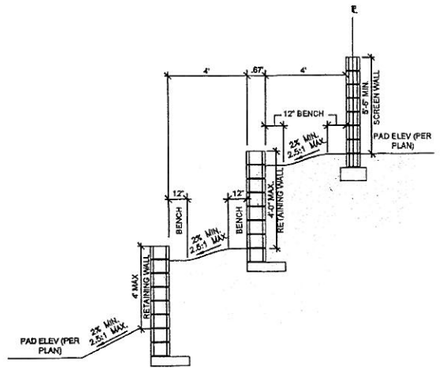
SIDE YARD RETAINING WALL
SCALE: NTS



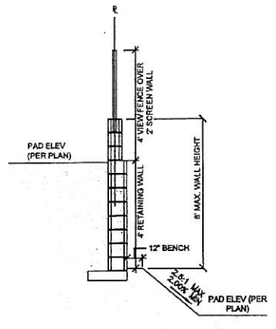
LIMITED SECTION ALONG NORTH PROPERTY LINE
SCALE: NTS



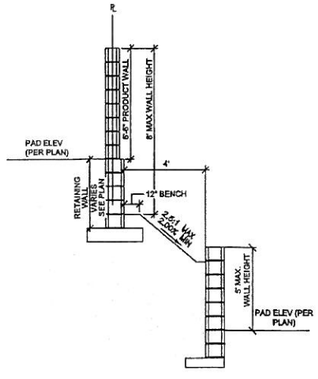
LIMITED SECTION ALONG NORTH PROPERTY LINE
SCALE: NTS



REAR YARD 2 TIER RETAINING WALLS
SCALE: NTS



REAR YARD 1 TIER RETAINING WALLS
SCALE: NTS



SIDE YARD TO REAR YARD SECTION
SCALE: NTS

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OR
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-7544

Avoid overhead power line contact
Call before you OVERHEAD
1-702-227-2929
NEVADA POWER ENVIRONMENT AND SAFETY SERVICES DEPARTMENT

CALL BEFORE YOU DO UNDERGROUND
Call before you Underground
1-702-455-7011
CLARK COUNTY TRAFFIC DEPARTMENT
OR
1-702-643-3305
LAS VEGAS AREA COMMUNITIES TRAFFIC DEPT.

BY: _____ DATE _____
SUMMERLIN APPROVAL

NO.	REVISION	DATE	APPR.

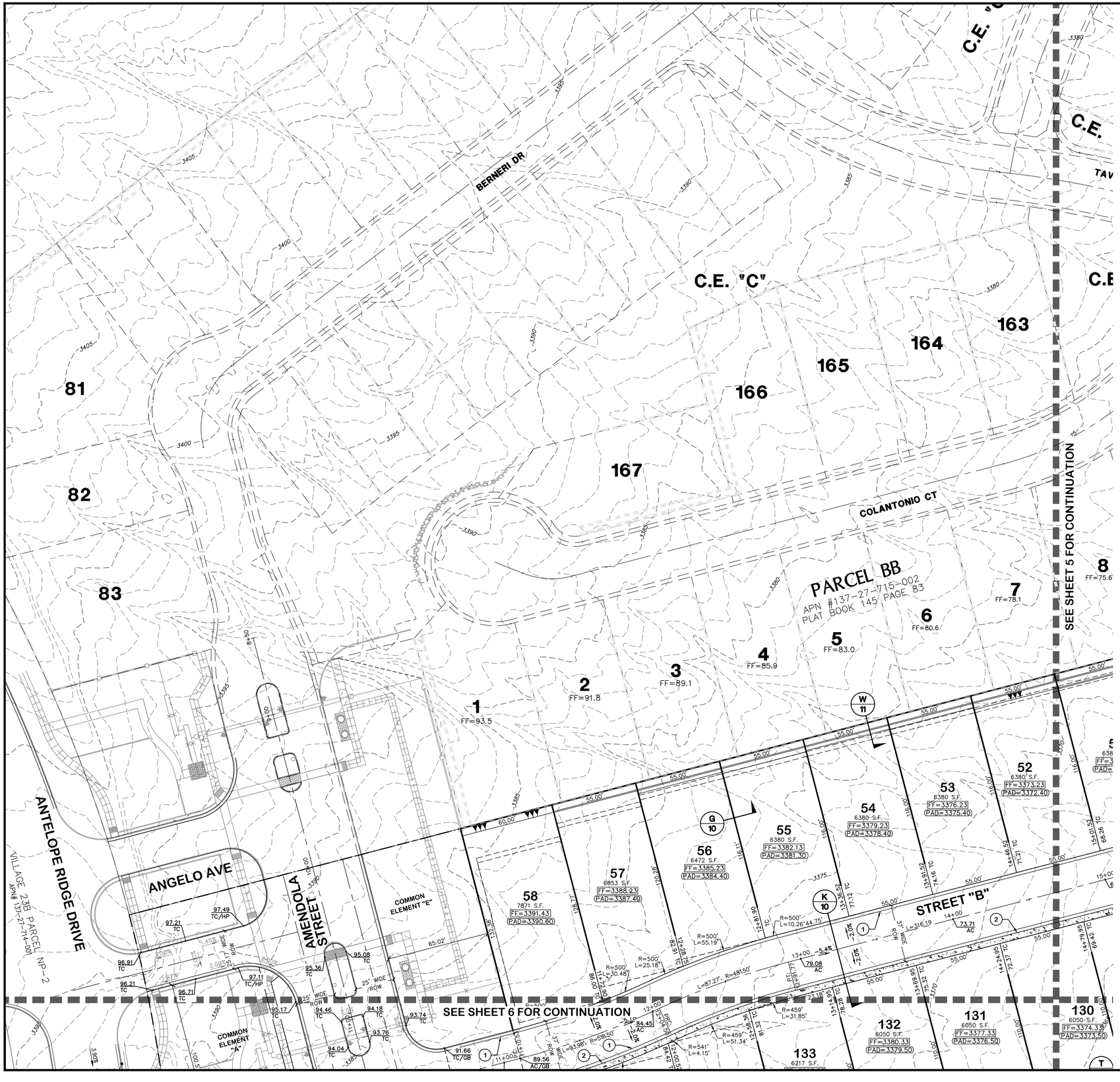
DESIGNED BY: MGB | DRAWN BY: MGB | CHKD BY
JOB NUMBER: 220-016-141 | DATE: 9-11-13

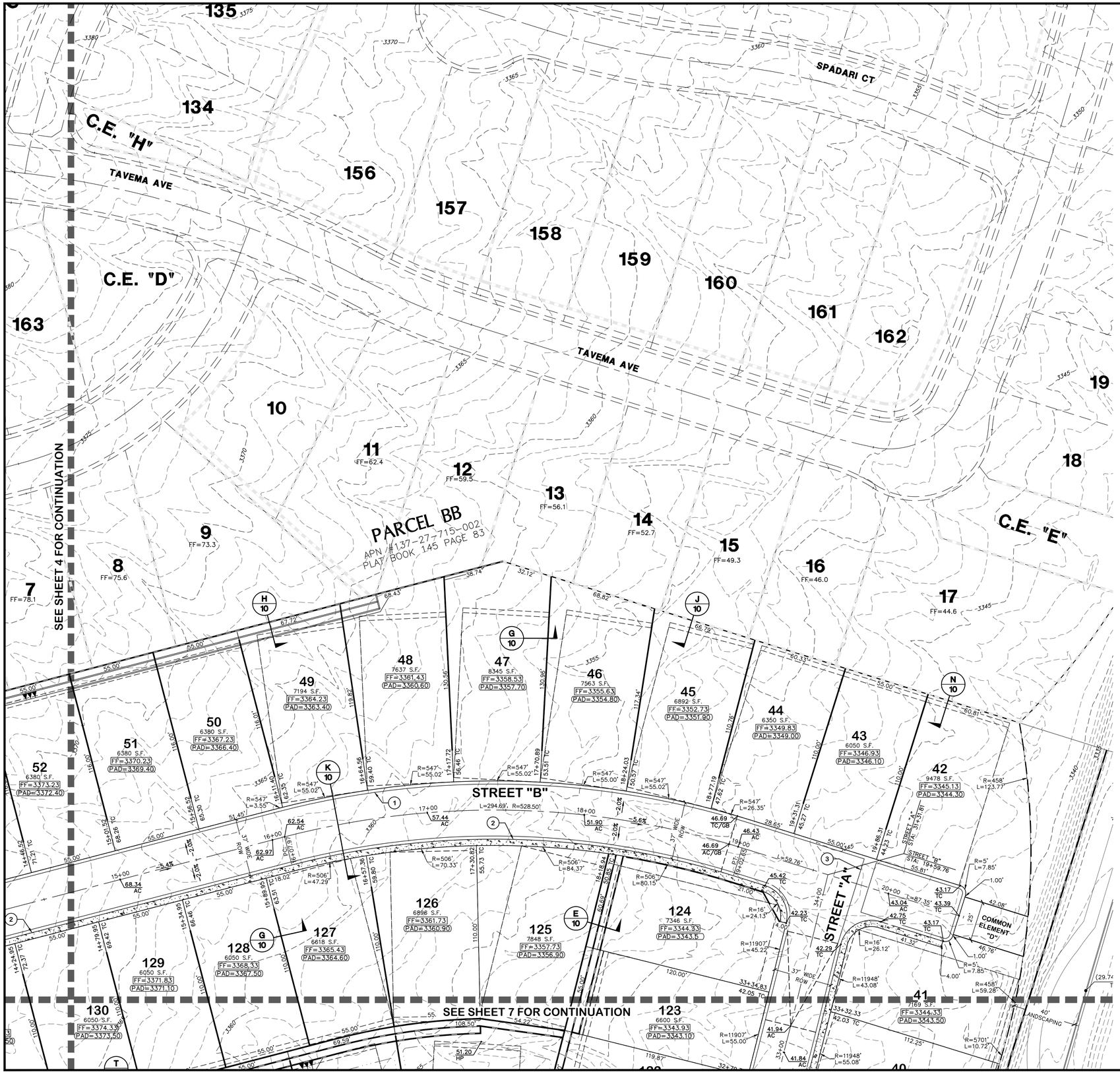
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TENTATIVE MAP OF SAVONA AT SUMMERLIN
CITY OF LAS VEGAS NEVADA

SHEET NUMBER 4 OF 4 SHEETS
220-016-141


C.E. "C"
C.E.
C.E.
BERNERI DR
ANTELOPE RIDGE DRIVE
ANGELO AVE
AMENDOLA STREET
COLANTONIO CT
STREET "B"
PARCEL BB
APN #137-27-715-002
PLAT BOOK 145 PAGE 83
VILLAGE 23B PARCEL NP-2
APN# 137-27-714-001
COMMON ELEMENT "E"
COMMON ELEMENT "A"
SEE SHEET 6 FOR CONTINUATION
SEE SHEET 5 FOR CONTINUATION
81
82
83
1
2
3
4
5
6
7
8
58
57
56
55
54
53
52
163
164
165
166
167
130
131
132
133
FF=93.5
FF=91.8
FF=89.1
FF=85.9
FF=83.0
FF=80.6
FF=78.1
FF=75.6
58 7871 S.F. FF=3391.43 (PAD=3390.60)
57 6853 S.F. FF=3388.23 (PAD=3387.40)
56 6472 S.F. FF=3385.23 (PAD=3384.40)
55 6380 S.F. FF=3382.13 (PAD=3381.30)
54 6380 S.F. FF=3379.23 (PAD=3378.40)
53 6380 S.F. FF=3376.23 (PAD=3375.40)
52 6380 S.F. FF=3373.23 (PAD=3372.40)
133 6217 S.F.
132 6050 S.F. FF=3380.33 (PAD=3379.50)
131 6050 S.F. FF=3377.33 (PAD=3376.50)
130 6050 S.F. FF=3374.33 (PAD=3373.50)
W 11
G 10
K 10
T
79.08 AC
73.71 AC
84.45 AC
91.66 TC/GB
89.56 AC/GB
97.49 TC/HP
97.21 TC
96.91 TC
96.21 TC
96.71 TC
97.11 TC/HP
95.08 TC
95.36 TC
95.17 TC
94.46 TC
94.18 TC
93.74 TC
93.76 TC
94.04 TC
3405
3400
3395
3390
3385
3380
3375
3370
60.00'
55.00'
65.02'
100.00'
116.00'
88.26'
128.71'
88.00'
86.00'
25' WIDE ROW
37' ROW WIDE
R=500' L=30.48'
R=500' L=25.18'
R=500' L=55.19'
R=500' L=10.26'44.75"
L=87.27', R=481.50'
R=459' L=31.85'
R=459' L=51.34'
R=541' L=4.15'
R=98.50'
-5.4%
-2.0%
-1.8%
-1.5%
-1.2%
-1.0%
-0.7%
-0.5%
-0.2%
+0.2%
+0.5%
+0.7%
+1.0%
+1.2%
+1.5%
+1.8%
+2.0%
+2.3%
+2.5%
+2.8%
+3.0%
+3.3%
+3.5%
+3.8%
+4.0%
+4.3%
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+4.8%
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+8.3%
+8.5%
+8.8%
+9.0%
+9.3%
+9.5%
+9.8%
+10.0%
+10.3%
+10.5%
+10.8%
+11.0%
+11.3%



NORTH

GRAPHIC SCALE

30 0 15 30

(IN FEET)
1 inch = 30 ft.



LOCATION MAP

CONSTRUCTION NOTES

1. CONSTRUCT "L" TYPE CURB & GUTTER (CCAUSD #216)
2. CONSTRUCT 4' CONCRETE SIDEWALK (CCAUSD #234)
3. CONSTRUCT 8' CROSS GUTTER (CCAUSD #228)

STORM DRAIN CONSTRUCTION NOTES

1. CONSTRUCT MODIFIED TYPE C-D DROP INLET (CCAUSD #412A) (SEE SHEET 12 FOR STORM DRAIN PLAN & PROFILES)

BASIS OF BEARINGS

NORTH 15°02'07" EAST, BEING THE BEARING OF THE CENTERLINE OF DESERT FOOTHILLS DRIVE AS SHOWN ON THE PLAT OF SUMMERLIN VILLAGE 23B UNIT NO. 2, ON FILE IN THE CLARK COUNTY, NEVADA RECORDER'S OFFICE AS BOOK 145, PAGE 83 OF PLATS.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK 7LV09 27SE6

A RIVET AND PLATE IN THE TOP OF CURB AT THE NORTHEAST CORNER OF MOUNTAIN SHADOW ROAD AND DESERT FOOTHILLS.

ELEVATION = 1013.556 METERS (3325.31 FEET) NAVD 1988 DATUM.

LEGAL DESCRIPTION

PARCEL CC AS SHOWN ON THE FINAL MAP OF SUMMERLIN VILLAGE 23B UNIT NO. 2, A COMMON INTEREST COMMUNITY, ON FILE IN BOOK 145 OF PLATS, PAGE 83 LYING WITHIN SECTION 27, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.

FEMA FLOOD PLAIN INFORMATION

ACCORDING TO THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM) COMMUNITY-PANEL NUMBER 32003C 2150E, EFFECTIVE DATE SEPTEMBER 27, 2002, THE SITE IS LOCATED WITHIN A ZONE 'X' AND SHADED ZONE 'X'. A ZONE 'X' IS DESCRIBED BY FEMA AS AN AREA OUTSIDE THE 0.20% ANNUAL CHANCE FLOOD PLAIN. A SHADED ZONE 'X' IS DESCRIBED BY FEMA AS AN AREA WITHIN THE 0.2% CHANCE FLOOD PLAIN. THERE ARE NO ADDITIONAL LETTERS OF MAP REVISION (LOMR) ISSUED FOR THIS FEMA FIRM PANEL.

ESTIMATED EARTHWORK QUANTITIES

CUT:	76,852 CY
FILL:	87,982 CY
NET FILL:	11,130 CY

THESE QUANTITIES ARE FOR ESTIMATING PURPOSE ONLY. THE FILL FIGURE INCLUDES A 15% AVERAGE SHRINKAGE FACTOR. OTHER CONSIDERATIONS SUCH AS OVEREXCAVATION, CALICHE, BOULDERS, ETC. WILL LIKELY AFFECT THE ACTUAL FIELD FILL AND CUT QUANTITIES. IT IS RECOMMENDED THAT THE CONTRACTOR CONSULT WITH THE SOILS ENGINEER AND PROVIDE HIS OWN FINAL QUANTITIES PRIOR TO BIDDING THE PROJECT. THE CIVIL ENGINEER ACCEPTS NO LIABILITY FOR VARIATIONS IN THE ACTUAL EARTHWORK QUANTITIES.

DRAINAGE STUDY

WE CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT._____.

VERNON R. HARKINS, PE# 009898 DATE

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Call 811 or 1-800-227-2600 and CLARK COUNTY TRAFFIC OPERATIONS 1-702-455-6000

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1-702-227-2929
NEVADA POWER ENVIRONMENT AND SAFETY SERVICES DEPARTMENT

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CALL BEFORE YOU DO UNDERGROUND
Call before you Underground
1-702-455-6000 CLARK COUNTY TRAFFIC OPERATIONS AND 1-702-430-5300 LAS VEGAS AREA COMPUTERIZED TRAFFIC SYSTEM

PROFESSIONAL ENGINEER — STATE OF NEVADA
VERNON R. HARKINS
EXP 6/30/15
CIVIL
No. 009898

NO.	REVISION	DATE	APPL

DESIGNED BY: MGB
JOB NUMBER: 220-016-141
DRAWN BY: MGB
DATE: July 2014
CHKD BY: VRH

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Woodside Homes
BETTER BY DESIGN

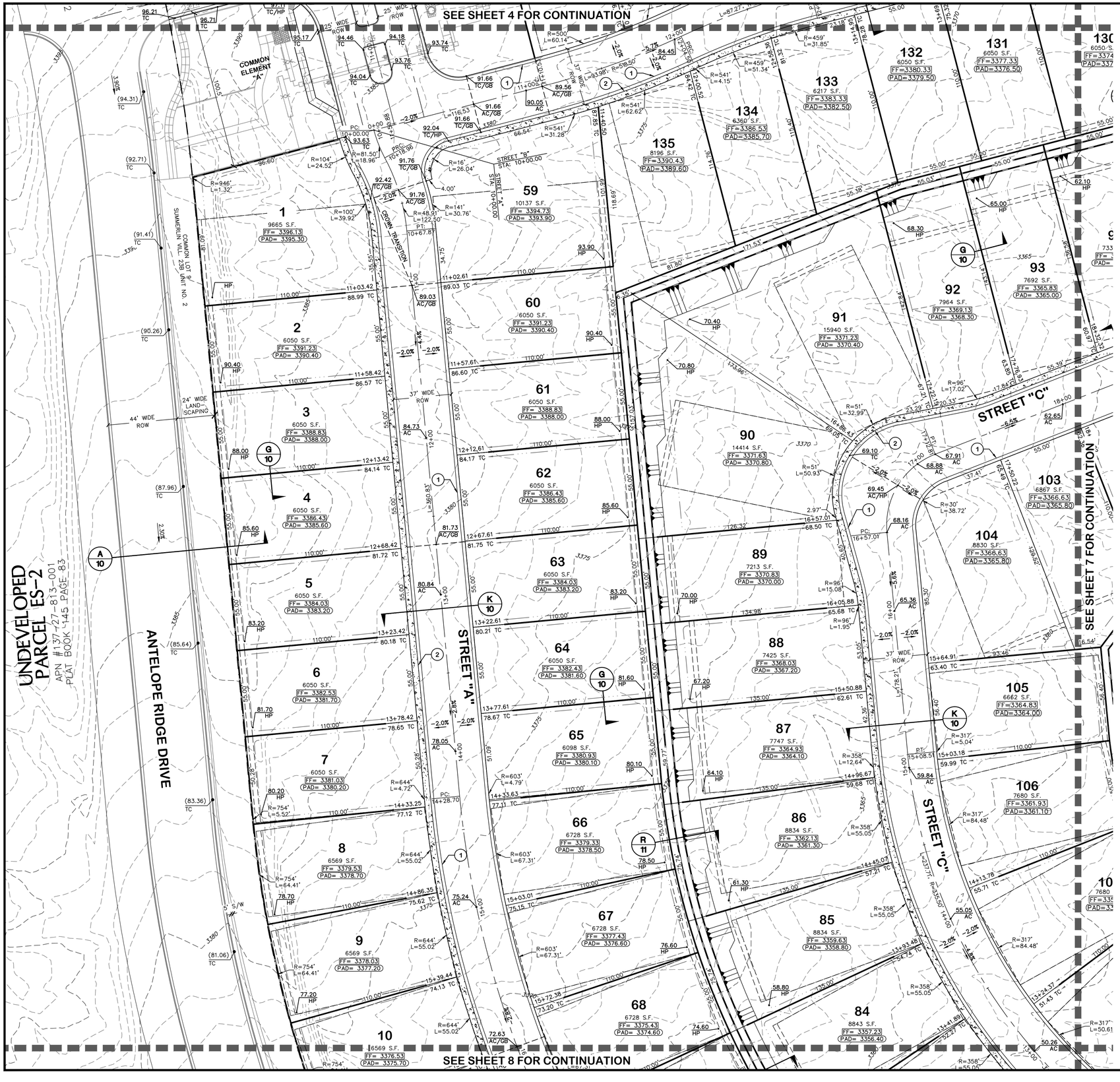
GRADING PLAN 2

SAVONA IMPROVEMENT PLANS

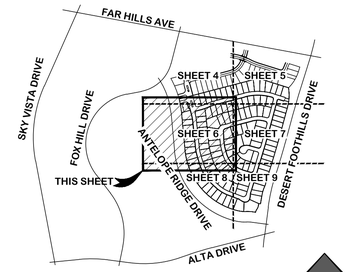
NEVADA

CITY OF LAS VEGAS

SHEET NUMBER
5
OF 28 SHEETS
CVL# --







LOCATION MAP

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VERNON R. HARKINS, PE# 009898 DATE

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JOB NUMBER: 220-016-141			
NO.	REVISION	DATE	APPL

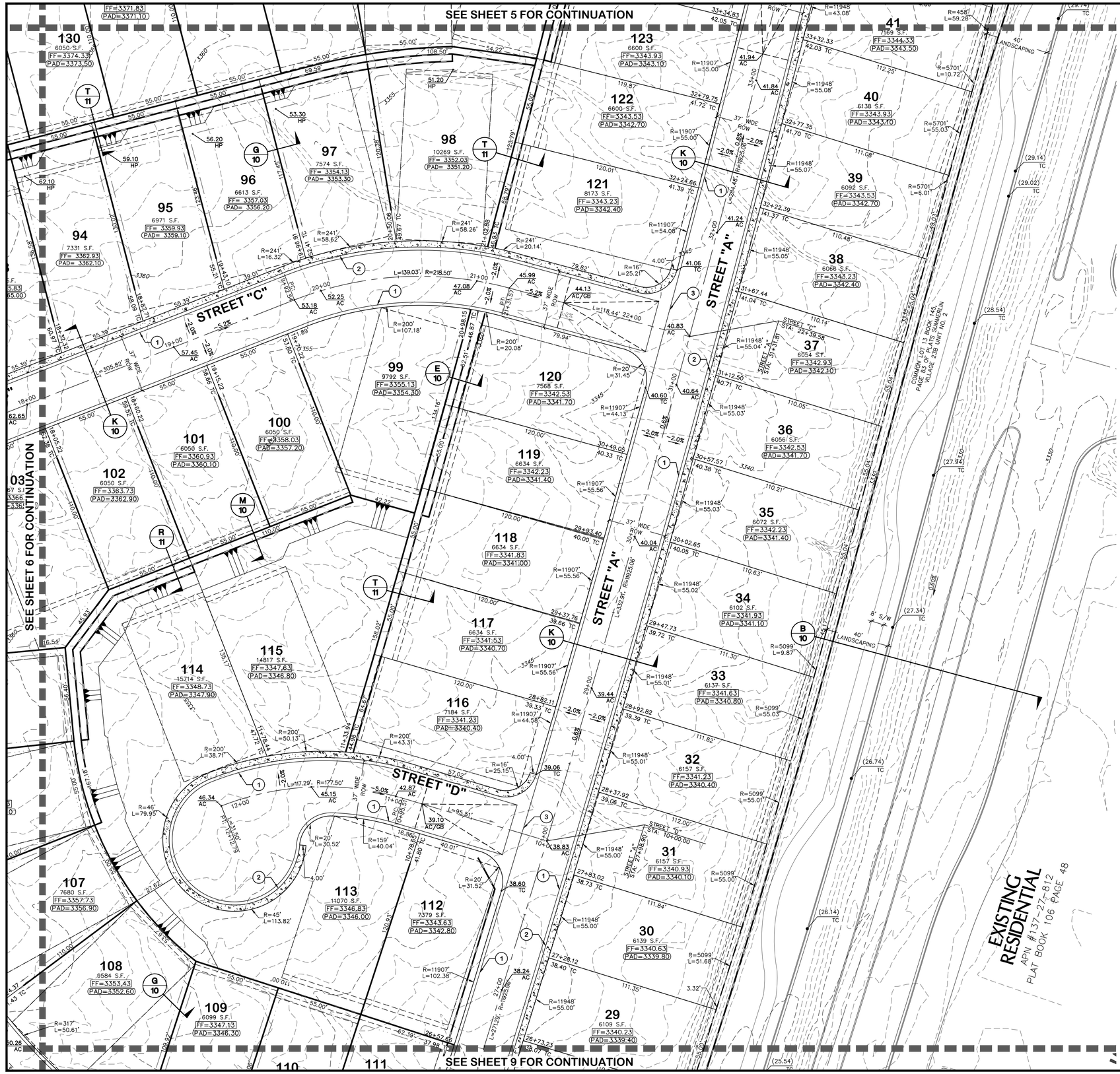
Woodside Homes
BETTER BY DESIGN

GRADING PLAN 3

SAVONA
IMPROVEMENT PLANS

CITY OF LAS VEGAS NEVADA

SHEET NUMBER 6
OF 28 SHEETS
CVL# --



LOCATION MAP

CONSTRUCTION NOTES

1. CONSTRUCT "L" TYPE CURB & GUTTER (CCAUSD #216)
2. CONSTRUCT 4' CONCRETE SIDEWALK (CCAUSD #234)
3. CONSTRUCT 8' CROSS GUTTER (CCAUSD #228)

STORM DRAIN CONSTRUCTION NOTES

1. CONSTRUCT MODIFIED TYPE C-D DROP INLET (CCAUSD #412A) (SEE SHEET 12 FOR STORM DRAIN PLAN & PROFILES)

BASIS OF BEARINGS

NORTH 15°02'07" EAST, BEING THE BEARING OF THE CENTERLINE OF DESERT FOOTHILLS DRIVE AS SHOWN ON THE PLAT OF SUMMERLIN VILLAGE 23B UNIT NO. 2, ON FILE IN THE CLARK COUNTY, NEVADA RECORDER'S OFFICE AS BOOK 145, PAGE 83 OF PLATS.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK 7LV09 27SE6

A RIVET AND PLATE IN THE TOP OF CURB AT THE NORTHEAST CORNER OF MOUNTAIN SHADOW ROAD AND DESERT FOOTHILLS.

ELEVATION = 1013.556 METERS (3325.31 FEET) NAVD 1988 DATUM.

LEGAL DESCRIPTION

PARCEL CC AS SHOWN ON THE FINAL MAP OF SUMMERLIN VILLAGE 23B UNIT NO. 2, A COMMON INTEREST COMMUNITY, ON FILE IN BOOK 145 OF PLATS, PAGE 83 LYING WITHIN SECTION 27, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.

FEMA FLOOD PLAIN INFORMATION

ACCORDING TO THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM) COMMUNITY-PANEL NUMBER 32003C 2150E, EFFECTIVE DATE SEPTEMBER 27, 2002, THE SITE IS LOCATED WITHIN A ZONE 'X' AND SHADED ZONE 'X'. A ZONE 'X' IS DESCRIBED BY FEMA AS AN AREA OUTSIDE THE 0.20% ANNUAL CHANCE FLOOD PLAIN, A SHADED ZONE 'X' IS DESCRIBED BY FEMA AS AN AREA WITHIN THE 0.2% CHANCE FLOOD PLAIN. THERE ARE NO ADDITIONAL LETTERS OF MAP REVISION (LOMR) ISSUED FOR THIS FEMA FIRM PANEL.

ESTIMATED EARTHWORK QUANTITIES

CUT:	76,852 CY
FILL:	87,982 CY
NET FILL:	11,130 CY

THESE QUANTITIES ARE FOR ESTIMATING PURPOSE ONLY. THE FILL FIGURE INCLUDES A 15% AVERAGE SHRINKAGE FACTOR. OTHER CONSIDERATIONS SUCH AS OVEREXCAVATION, CAUCHE, BOULDERS, ETC. WILL LIKELY AFFECT THE ACTUAL FIELD FILL AND CUT QUANTITIES. IT IS RECOMMENDED THAT THE CONTRACTOR CONSULT WITH THE SOILS ENGINEER AND PROVIDE HIS OWN FINAL QUANTITIES PRIOR TO BIDDING THE PROJECT. THE CIVIL ENGINEER ACCEPTS NO LIABILITY FOR VARIATIONS IN THE ACTUAL EARTHWORK QUANTITIES.

DRAINAGE STUDY

WE CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT._____.

VERNON R. HARKINS, PE# 009898 DATE

DISCLAIMER NOTE

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PROFESSIONAL ENGINEER — STATE OF NEVADA — VERNON R. HARKINS — EXP 6/30/15 — CIVIL — No. 009898

DESIGNED BY: MGB	DRAWN BY: MGB	DATE: July 2014	CHKD BY: VRH
JOB NUMBER: 220-016-141			

NO.	REVISION	DATE	APPD.

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Woodside Homes — BETTER BY DESIGN

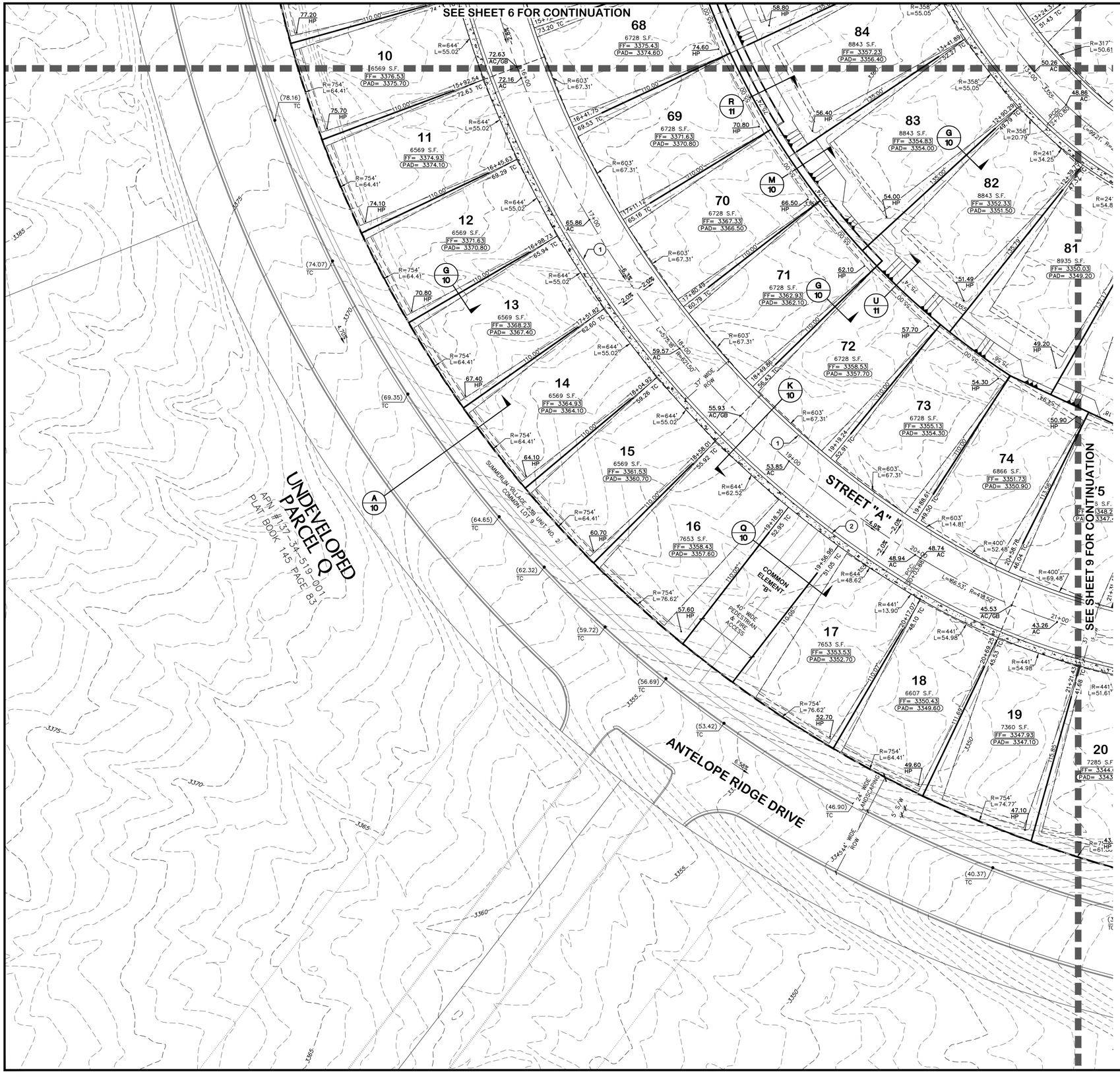
GRADING PLAN 4

SAVONA IMPROVEMENT PLANS

CITY OF LAS VEGAS NEVADA

SHEET NUMBER 7 OF 28 SHEETS

CVL# --

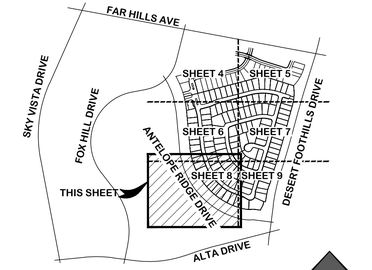


NORTH

GRAPHIC SCALE

30 0 15 30

(IN FEET)
1 inch = 30 ft.



LOCATION MAP

CONSTRUCTION NOTES

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BENCHMARK

CITY OF LAS VEGAS BENCHMARK 7LV09 27SE6

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DRAINAGE STUDY

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VERNON R. HARKINS, PE# 009898 DATE

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PROFESSIONAL ENGINEER — STATE OF NEVADA
VERNON R HARKINS
EXP 6/30/15
CIVIL
No. 009898

DESIGNED BY: MGB	DRAWN BY: MGB	CHKD BY: VRH
JOB NUMBER: 220-016-141	DATE: July 2014	

NO.	REVISION	DATE	APPD.

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Woodside Homes
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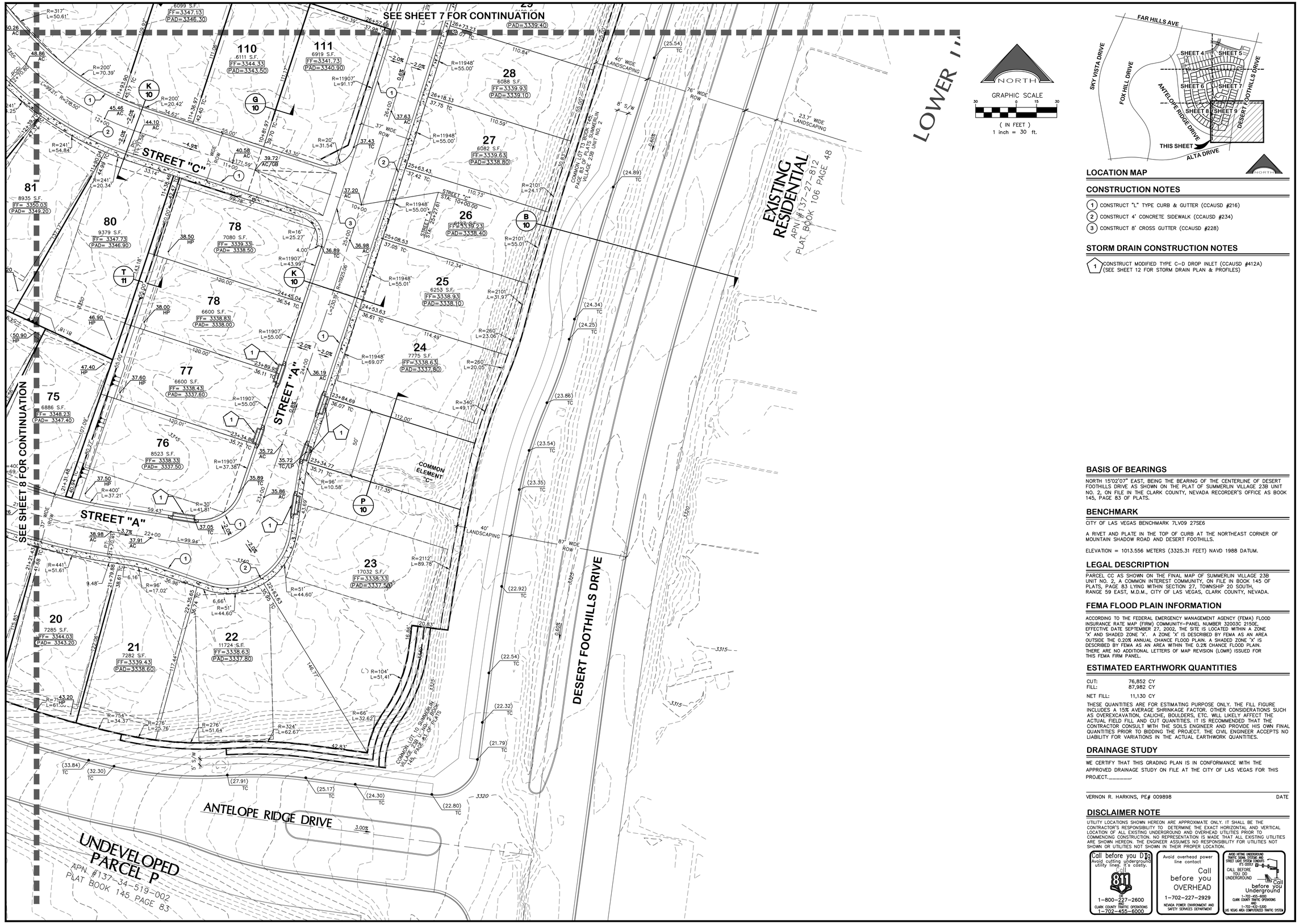
GRADING PLAN 5

SAVONA IMPROVEMENT PLANS

NEVADA

CITY OF LAS VEGAS

SHEET NUMBER
8
OF 28 SHEETS
CVL# --



LOCATION MAP

CONSTRUCTION NOTES

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LAS VEGAS AREA COMPUTERIZED TRAFFIC SYSTEM

PROFESSIONAL ENGINEER STATE OF NEVADA
VERNON R HARKINS
EXP 6/30/15
CIVIL
No. 009898

DESIGNED BY: MGB	DRAWN BY: MGB	CHKD BY: VRH
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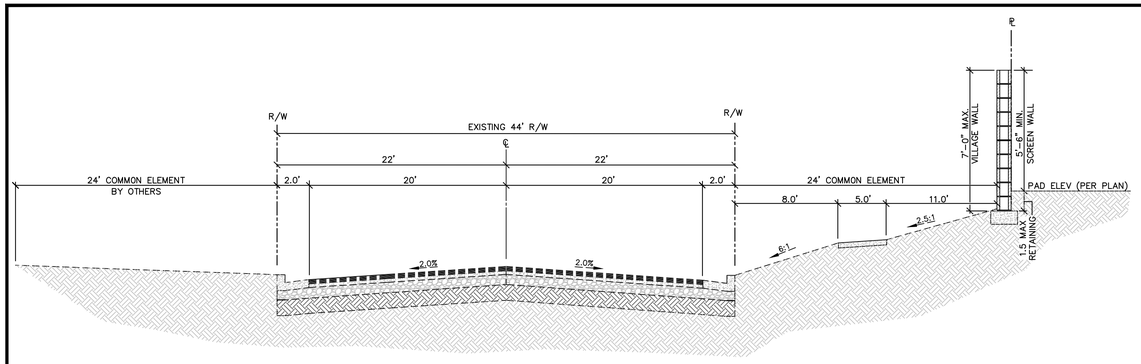
Woodside Homes
BETTER BY DESIGN

GRADING PLAN 6

SAVONA IMPROVEMENT PLANS

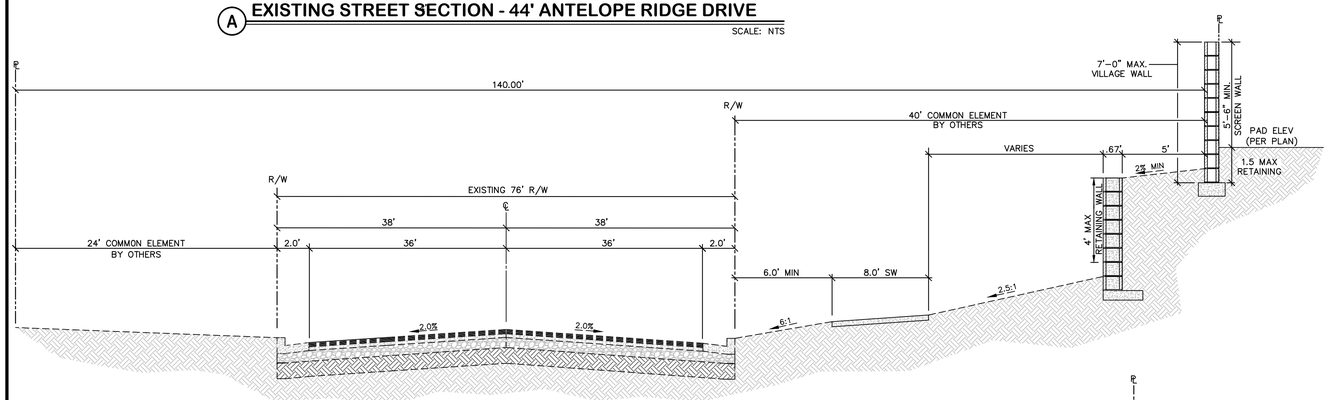
CITY OF LAS VEGAS NEVADA

SHEET NUMBER
9
OF 28 SHEETS
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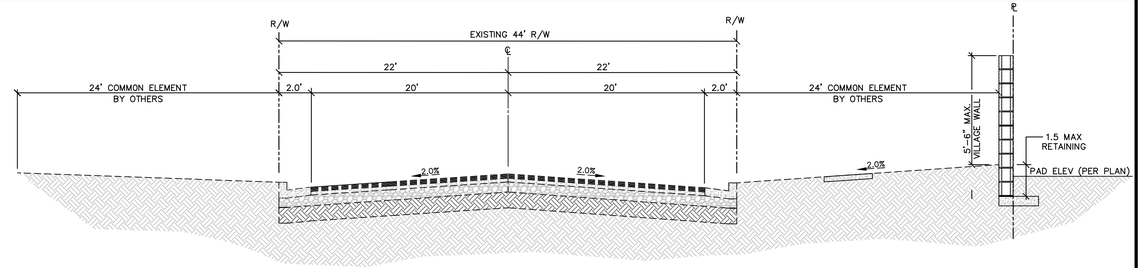
A EXISTING STREET SECTION - 44' ANTELOPE RIDGE DRIVE

SCALE: NTS



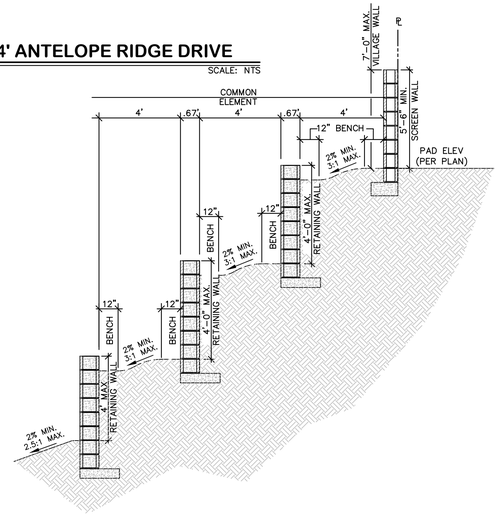
B EXISTING STREET SECTION - 76' DESERT FOOTHILLS DRIVE

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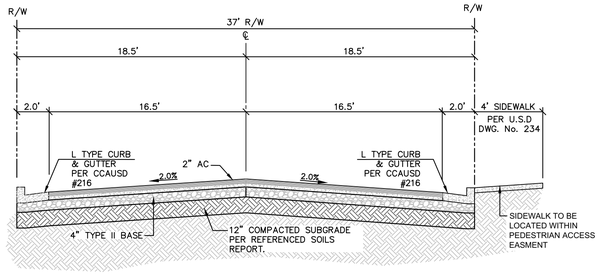
C EXISTING STREET SECTION - 44' ANTELOPE RIDGE DRIVE

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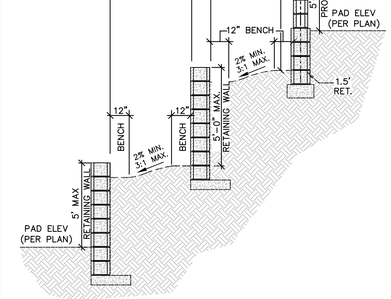
D SECTION 3 TIER RETAINING WALLS

SCALE: NTS



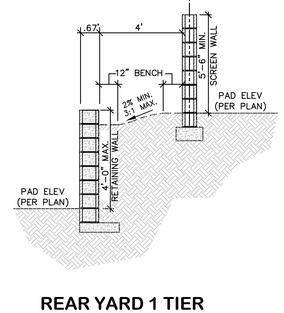
K 37' TYPICAL STREET SECTION W/4' PEDESTRIAN ACCESS EASEMENT

SCALE: NTS



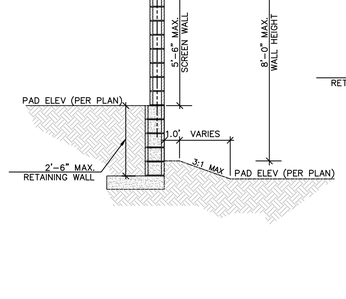
E REAR YARD 2 TIER RETAINING WALLS

SCALE: NTS



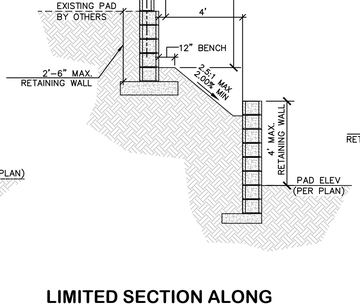
F REAR YARD 1 TIER RETAINING WALLS

SCALE: NTS



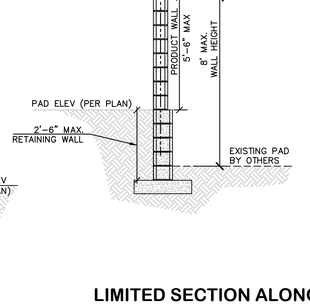
G SIDE YARD RETAINING WALL

SCALE: NTS



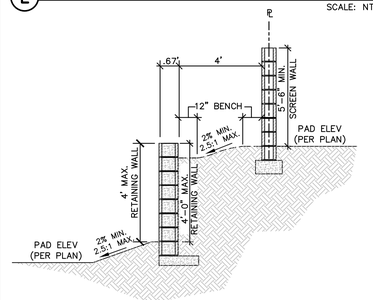
H LIMITED SECTION ALONG NORTH PROPERTY LINE

SCALE: NTS



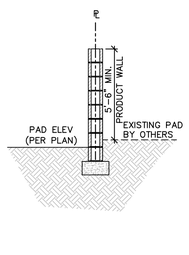
J LIMITED SECTION ALONG NORTH PROPERTY LINE

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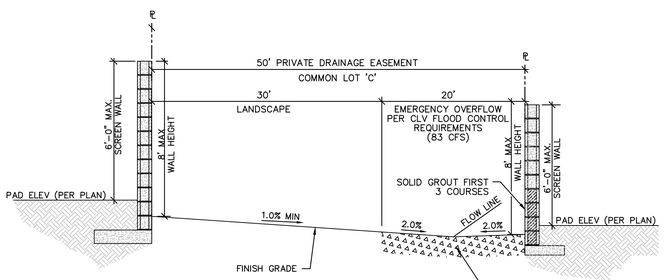
M REAR YARD 1 TIER RETAINING WALLS

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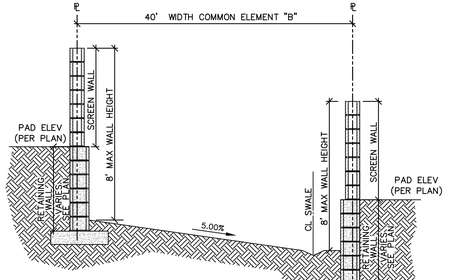
N LIMITED SECTION ALONG NORTH PROPERTY LINE

SCALE: NTS



P COMMON ELEMENT "C" - DRAINAGE EASEMENT

SCALE: NTS



Q COMMON ELEMENT "B" PEDESTRIAN & FIRE ACCESS

SCALE: NTS

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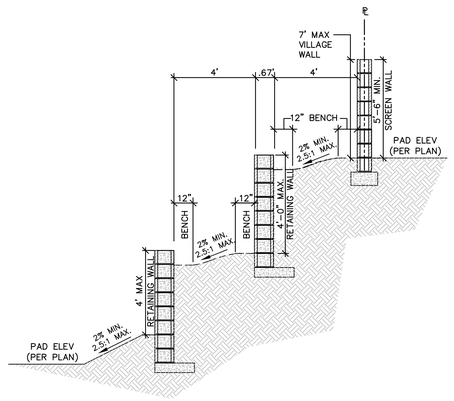
Woodside Homes
BETTER BY DESIGN

DETAIL SHEET 1

SAVONA
IMPROVEMENT PLANS

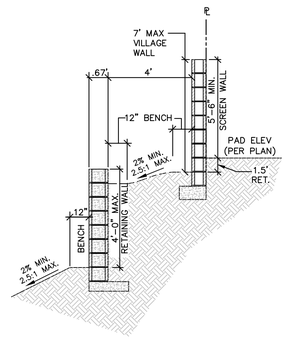
CITY OF LAS VEGAS NEVADA

SHEET NUMBER
10
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CVL# --



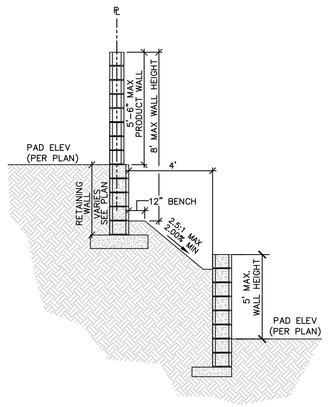
R REAR YARD 2 TIER RETAINING WALLS

SCALE: NTS



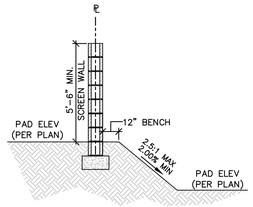
S SECTION 2 TIER RETAINING WALLS

SCALE: NTS



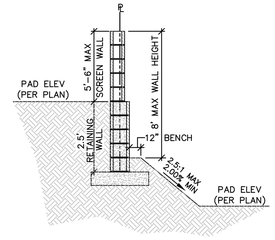
T SIDE YARD TO REAR YARD SECTION

SCALE: NTS



U REAR YARD TO REAR YARD SECTION

SCALE: NTS



V REAR YARD TO REAR YARD SECTION

SCALE: NTS

LIMITED SECTION ALONG NORTH PROPERTY LINE

SCALE: NTS

X REAR YARD 1 TIER RETAINING WALLS

SCALE: NTS

Y REAR YARD 2 TIER RETAINING WALLS

SCALE: NTS

Z REAR YARD 2 TIER RETAINING WALLS

SCALE: NTS

DRAINAGE EASEMENT END VIEW

REMOVABLE BOLLARD DETAIL

ZZ DRAINAGE EASEMENT

SCALE: NTS

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811
or
1-800-227-2600
AND
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-6000

Avoid overhead power line contact
Call before you OVERHEAD
1-702-227-2929
NEVADA POWER ENVIRONMENT AND SAFETY SERVICES DEPARTMENT

AVOID HITTING UNDERGROUND TRAFFIC SIGNAL CONDUCTOR AND STREET LIGHT SYSTEM CONDUITS IT'S COSTLY
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LAS VEGAS AREA COMPUTERIZED TRAFFIC SYSTEM

STATE OF NEVADA
PROFESSIONAL ENGINEER
VERNON R. HARKINS
EXP 6/30/15
CIVIL
No. 009898

DESIGNED BY: MGB	DRAWN BY: MGB	CHKD BY: VRH
JOB NUMBER: 220-016-141	DATE: July 2014	

NO.	REVISION	DATE	APPL

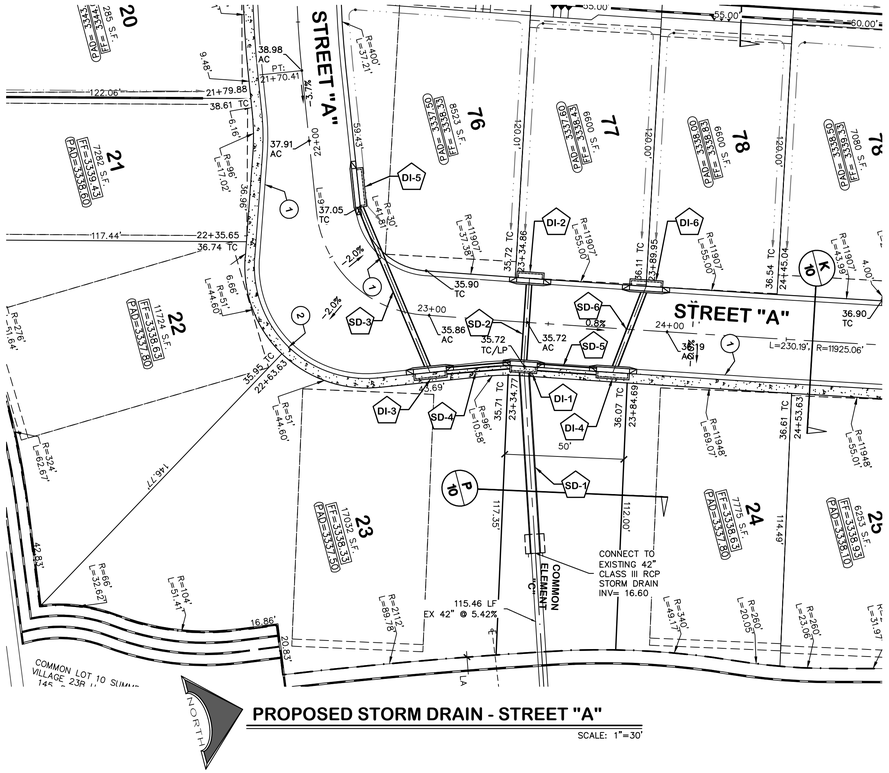
L. R. NELSON CONSULTING ENGINEERS, INC.
• STRUCTURAL • CIVIL • PLANNING • SURVEY
6765 West Russell Road, Suite 200
Las Vegas, Nevada 89118
(702) 798-7978
(702) 451-2296 FAX

Woodside Homes
BETTER BY DESIGN

DETAIL SHEET 2

SAVONA
IMPROVEMENT PLANS
CITY OF LAS VEGAS NEVADA

SHEET NUMBER
11
OF 28 SHEETS
CVL# --



PROPOSED STORM DRAIN - STREET "A"

SCALE: 1"=30'

STORM DRAIN SCHEDULE

DI-1 10' MODIFIED TYPE C-D DROP INLET
D=10.00
GRATE=35.22
24" INV IN(S)= 25.42
24" INV IN(W)= 25.42
30" INV IN(N)= 25.32
42" INV OUT(E)= 25.22

DI-2 10' MODIFIED TYPE C-D DROP INLET
GRATE=35.22
D=10.00
24" INV=25.79

DI-3 12.5' MODIFIED TYPE C-D DROP INLET
GRATE= 35.39
D= 10.00
18" INV IN= 26.24
24" INV OUT= 26.14

DI-4 12.5' MODIFIED TYPE C-D DROP INLET
GRATE= 35.57
D= 10.00
24" INV IN= 25.86
30" INV OUT= 25.76

DI-5 15' MODIFIED TYPE C-D DROP INLET
GRATE=36.55
D=10.00
18" INV=28.38

DI-6 12.5' MODIFIED TYPE C-D DROP INLET
GRATE=35.61
D=10.00
24" INV=26.25

SD-1 46.48 LF – 42" CLASS III RCP @ 18.55%

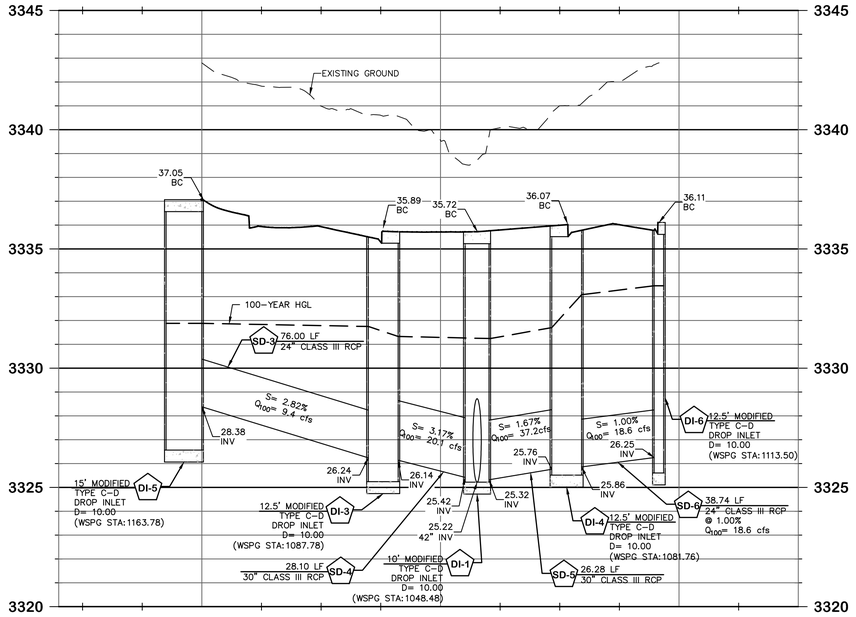
SD-2 37.00 LF – 24" CLASS III RCP @ 1.00%

SD-3 76.00 LF – 24" CLASS III RCP @ 2.82%

SD-4 28.10 LF – 30" CLASS III RCP @ 3.17%

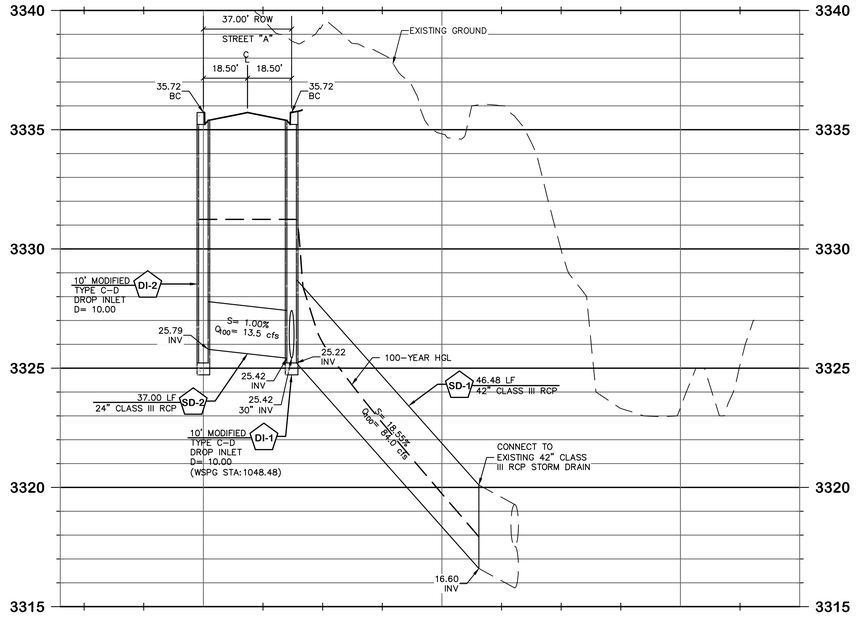
SD-5 26.28 LF – 30" CLASS III RCP @ 1.67%

SD-6 38.74 LF – 24" CLASS III RCP @ 1.00%



PROPOSED STORM DRAIN PROFILE- STREET "A" (DI-5 THROUGH DI-6)

SCALE: HORIZ: 1"=30'
VERT: 1"=3'



PROPOSED STORM DRAIN PROFILE- STREET "A" (DI-2 THROUGH DI-1 TO EXISTING CONNECTION)

SCALE: HORIZ: 1"=30'
VERT: 1"=3'

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DETAIL SHEET 3

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