

DS #: 4550

APN: 138-28-401-015

PROJECT: Westcliff Pines 2

SUBMITTAL: 1st

SCANNED BY/DATE: _____

CHECKED BY/DATE: _____



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		February 23, 2012
TO: Land Development Services Department of Public Works		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for: Westcliff Pines 2	COPIES TO: L.R. Nelson Consulting Engineers
Cross Streets:	SEQ of Summerlin Pkwy. & Durango Drive	HAND Property Holding Company
File Number:	F:\Depot\DSMemos\DS4550A.doc	Bart Anderson, P.E., DevCo
Parcel Number:	138-28-401-015	
Zoning Action:	SDR-44166	
FEMA Flood Zone	YES NO X	
Proposed Storm Drain	YES NO X	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	2/9/2012	2/23/2012	See Comments Below	\$400.00	273967: \$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.

1. Provide a copy of the zoning/planning conditions associated with this site (**SDR-44166**) 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. Provide a storm drain note as follow in all pertinent grading plans: **ALL ONSITE STORM DRAINS AND THE ASSOCIATED FACILITIES ARE PRIVATELY OWNED AND TO BE PRIVATELY MAINTAINED.**
4. **Sheet GR1:** At the NWC flume inlet, the energy head (per calculation) is 4.64' which will cause the discharge to splash over to the interior driveway before it can be collected into the drop inlet. Provide an apron or wing structure or something equivalent to prevent the splash over to the adjacent driveway. Review and revise accordingly. 1' - splash well.
-2/29/12
5. **Sheet GR1:** Provide a swale in the 15'-landscape strip along the west boundary and bring the flow to the proposed drop inlet for discharge.

6. **Sheet GR1:** Identify an overflow path in the courtyard area in a worst case scenario that the two proposed Jensen grate inlets are completely clogged. — Provide Indemnity Note to CLV on Grading Plan — 2/29/12
7. **Sheet GR1:** Identify an existing storm drain in the adjacent property to the east (*Starfire Estates*) and label with *City of Las Vegas* recorded construction plan number.
8. **Sheet GR1:** Provide a connection detail for the new and existing storm drains at the interface of the subject property and the adjacent *Starfire Estates*.
9. **Sheet GR2:** Reference Comment #4 at the SWC flume inlet.
10. **Sheet GR2:** Reference Comment #5.
11. **Sheet GR2:** Reference Comment #7 at the southeast corner of the site.
12. **Sheet SD1:** As stated in Comment #8, provide a connection detail in the plan view and the profile section.
13. **Sheet DT1:** Detail Section B is to be found nowhere on the grading plans. Identify Detail Section B accordingly.
14. **Sheet DT1:** On Detail Sections C and D, provide a swale (minimum 6"-deep) behind the proposed retaining wall, leave a minimum 1'-bench at the top of the wall.
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*).

In an effort to increase administrative efficiency, the City of Las Vegas Public Works Department requires all soil reports, drainage studies and traffic impact analysis submittals to be accompanied by an electronic copy of the submittal. Electronic documents must be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output replicating your submittal to be used for archival or display purposes. This may be more than one file if necessary. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats, but provided it is a high quality digitized replication of the submittal, other formats may be acceptable. If figures are in color, they must be scanned in color and saved as a separate file. The new submittal requirement is effective on **July 1, 2011**. If there are any questions regarding these new requirements, please contact Albert Sung in the Flood Section at (702) 229-2001 or Rick Schroder in Traffic Engineering at (702) 229-6327.

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

END OF REMARKS
ays

T/R/S: T20S/R60E/28
AREA L-28

LARRY R. NELSON, P.E.
President

- STRUCTURAL
- CIVIL
- SURVEY
- PLANNING

Rec'd: 2/9/12
DS 4550
L-28

NEVADA

**L. R. NELSON
CONSULTING ENGINEERS, INC.**

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\$400-
SDR-49166
2

TECHNICAL DRAINAGE STUDY FOR WESTCLIFF PINES 2

CITY OF LAS VEGAS, NEVADA

Project Number: 818-021-111

February 2011

Prepared For:

Nevada H.A.N.D.
295 Warm Springs Road, Suite 101
Las Vegas, Nevada 89119
Phone: (702) 739-3345
Fax: (702) 739-3305

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: Westcliff Pines 2 Date: Feb. 7, 2012

Location of Development: a) Descriptive (Cross Streets) North/South: Roland Wiley

East/West: Silver Sky

b) Section: 28 Township: 20S Range: 60E

c) APN: 138-28-401-015

Name of Owner: HAND Property Holding Company

Telephone No.: 739-3345 Fax No.: 739-3305 E-Mail Address: _____

Address: 295 E. Warm Springs Road, #101, Las Vegas, NV 89119

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

* E-Mail Address: jon.hayslip@lrneng.com Fax No.: (702) 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: 5.24 ac Being Developed/Disturbed: 5.16 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.): Multi-family residential

5. Approximate upstream land area which drains to the subject site: 10.62 ac (ref. DS3640)

6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Silver Sky Assisted Living, by TRC, 2004 (DS3640)

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Roland Wiley & private offsite storm drains existing d/s of site

8. Briefly describe your proposed schedule for the subject project: As soon as possible.

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

***New Required Field**

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

Revision	Date

Engineer's Seal

Local Entity File No.

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: Westcliff Pines 2

Map ID:

Firm Name: L.R. Nelson Consulting

Engineer:

Address: 6765 West Russell Road, Suite 200

City: Las Vegas

State: NV

Zip: 89118

Phone Number: (702) 798-7978

Fax Number: (702) 451-2296

Property Owner: HAND Property Holding Company

Address: 295 E. Warm Springs Road #101

City: Las Vegas

State: NV

Zip: 89119

Reviewed By:

Date Received:

Date Accepted for Review:

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

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

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

I. GENERAL REQUIREMENT

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

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS

Yes No

- | | |
|----------------|--|
| <u>X</u> _____ | A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated. |
| <u>X</u> _____ | A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated. |
| <u>X</u> _____ | Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |
| <u>X</u> _____ | On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs. |
| <u>X</u> _____ | Vicinity Map with local and major cross streets identified and a north arrow. |

III. DRAINAGE PLAN

Yes No

- | | |
|----------------|---|
| <u>X</u> _____ | Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada. |
| <u>X</u> _____ | Minimum scale: 1" = 60'. |
| <u>X</u> _____ | Project name. |
| <u>X</u> _____ | Vicinity Map with local and major cross streets. |
| <u>X</u> _____ | Revision box. |
| <u>X</u> _____ | North arrow and bar scale. |
| <u>X</u> _____ | Engineer's/consultant's address and phone number. |
| <u>X</u> _____ | Elevation datum and benchmark. |
| <u>X</u> _____ | Legend for symbols and abbreviations. |
| <u>X</u> _____ | Cut/fill scarps, where applicable. |
| <u>X</u> _____ | Street names, grades, widths. |
| <u>X</u> _____ | Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street. |

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes No

- | | |
|-------------------------------------|---|
| <u>X</u> ☐ | Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate. |
| <u>X</u> ☐ | Minimum finish floor elevations with top-of-curb elevations at upstream end of lot. |
| <u>X</u> ☐ | Proposed typical street sections. |
| <u>N/A</u> ☐ | Streets with off-set crowns. |
| <u>X</u> ☐ | Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes. |
| <u>X</u> ☐ | Property lines. |
| <u>X</u> ☐ | Right-of-way lines and widths, existing and proposed. |
| <u>X</u> ☐ | Existing improvements and their elevations. |
| <u>X</u> ☐ | Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points. |
| <u>X</u> ☐ | Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets. |
| <u>X</u> ☐ | Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows. |
| <u>X</u> ☐ | Location and cross-section of street capacity calculations. |
| <u>X</u> ☐ | Cross-sectional detail for channels, including cutoff wall locations. |
| <u>X</u> ☐ | Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations. |
| <u>X</u> ☐ | Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement. |
| <u>X</u> ☐ | Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs. |
| <u>X</u> ☐ | Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc. |

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes No

☒ _____ Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.

☒ _____ Building and/or lot numbers.

☐ N/A _____ Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.

☒ _____ Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

☐ N/A _____ For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE.

☒ _____ Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.

☒ _____ Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.

IV. HYDROLOGIC ANALYSIS

Yes No

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

☒ _____ Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.

☒ _____ Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.

☒ _____ Use of correct precipitation values in and around the McCarran Airport rainfall area.

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

☒ _____ A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.

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

☒ _____ On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes No

N/A

Flow split calculations and supporting documentation or reference for the method of flow split calculations used.

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 ≥ 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.

X

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, which ever 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.

REFERENCE:

STANDARD FORM 2



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

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

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

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

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

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
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.
	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	
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.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

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

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

February 7, 2012

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: Westcliff Pines 2

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 Westcliff Pines 2* 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 *Westcliff Pines 2* development. The site is approximately 5.2 (+/-) acres of apartment property. The proposed development consists of two apartment buildings comprising of 120 units.

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 (CCRCD) *Hydrologic Criteria and Drainage Design Manual* (Reference #2).

B. Location

The project area is within the Southwest Quarter (SW 1/4) of the Southwest Quarter (SW 1/4) of Section 28, Township 20 South, Range 60 East, Mount Diablo Meridian, City of Las Vegas, Nevada. The site is located terminus of Silver Sky Drive west of Roland Wiley Road. See Figure 1, *Vicinity Map*.

The Assessor's Parcel Number (APN) for the proposed apartment development is 138-28-401-015.

C. Existing Site Description

As determined in a site visit, the area is currently undeveloped. The area generally slopes to the east at approximately 4 percent. The site is bordered by Summerlin Parkway to the north, existing Starfire Estates townhomes to the east; Silver Sky Drive cul-de-sac and Ironwood Condominiums to the south; and existing Angel Park Apartments to the west.

There is no sidewalk and curb and gutter located along the southern property line of the site. Currently the Angel Park Apartments discharges runoff onto the site via wall openings on the west property line. A review of the Angel Park Apartments grading plan and site visit confirm there are two (2) wall openings on the located north and south half of the proposed site. Runoff is conveyed by grade through the site in incised areas until reaching the east side where two (2) block wall openings are located within the Starfire Estate development. At this location, runoff is conveyed underground via existing storm drain systems through the Starfire Estate development. The site contains some vegetation near the discharge points of the Angel Park Apartments block wall openings but overall is relatively light covered with other plant species. There is an existing large power transmission pole located near the center of the site. The photo on the following page shows the typical hydrologic cover observed during the site visit on February 3, 2011.

Photo 1: Existing Onsite Condition (looking North towards Summerlin Parkway.)



D. CCRFCD Master Plan Information

As shown on the Figure 3 in Appendix A which references MPU Figure F-25, the site is not adjacent to an existing or proposed Master Plan Flood Control Facility. Figure 4 in Appendix A (MPU Figure H-25) has also been provided showing the site is a part of regional basin W1BB-C.

E. FEMA Flood Plain Information

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community-Panel Number 32003C 2145E, 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. 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 5, *Flood Insurance Rate Map*.

F. City of Las Vegas Northwest Neighborhood Flood Control Master Plan

The City Wide study was referenced for offsite drainage patterns and the 10- and 100- year street flows adjacent to the site based on the information provided by City of Las Vegas Flood Control documents. As shown on Figure 6 in Appendix A (referenced Figure H-12), the site is a part of basin W1BB. The existing and future conditions are the same and show a flow of 58 and 135 cfs for the 10- and 100-year storm events respectively at the eastern watershed boundary. This flow is shown to drain to the east where it is combined with basin W1BC. The site is located within the upper third of basin W1BB. The proposed site is shown on the referenced document in Appendix D.

Figure 7 in Appendix A (referenced CLV FCF Figure F-12) indicates a local storm drain facility identified as *WTC 016*, a 21-in RCP in Silver Sky Drive. The headworks for the existing storm drain is located at the southeast corner of the proposed site. Based upon review of the drainage study and grading plan for the Starfire Estates located adjacent to the site on the east, the 21-in RCP is located within that development. The storm drain system conveys runoff emanating from the west beginning in the Angel Park Apartments across the proposed site to the east property line headworks configuration which consists of 2' 8" (H) by 4' 8" (W) wall opening.

G. Previous Drainage Studies

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

- *Technical Drainage Study for Starfire Estates and addenda*, by John R. Vega, Consulting Engineers, Inc. November 1993, DS1183.
- *Technical Drainage Study for Silver Sky Assisted Living and addenda*, by TRC Nevada September 2004, DS3640.

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 offsite flows entering from the west, while the latter study updated the entire watershed affecting their senior apartment site and adjacent to Starfire Estates on the west. The TRC study includes watershed basins for the proposed site in the existing/interim and ultimate condition denoted as EOF6/EOF7 and DOF6/DOF7. This Study has provided the pertinent portions of these referenced drainage studies and are included in Appendix D.

The existing/interim (onsite) condition referenced in the TRC study (basins EOF6/EOF7) was compared with L.R. Nelsons Consulting Engineer's onsite hydrologic analysis.

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 project site is located within the McCarran Airport Rainfall Area as indicated on Figure 513 of the HC&DDM. The depth-duration-frequency values for the 6-hour, 10- and 100-Year storm events were obtained from Table 505 and are summarized below in Table 1, McCarran Airport Rainfall Values. Since the site encompasses less than 8-square miles a Storm Distribution Number three (SDN #3) was used for the HEC-1 model. No Depth-Area-Reduction factors were used since the onsite watershed area is approximately 0.0082 sq. miles.

Table 1: McCarran Airport Rainfall Values

10-Year 6-Hour (in)	100-Year 6-Hour (in)
1.58	2.77

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_c . The equation for the time of concentration is $TC = t_i + t_c$. 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 *Cave*, Unit 152, HSG is Type 'D'. The onsite areas have been located on the SCS Soils Map shown of Figure 8 in Appendix A. 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 & Proposed CN Values

CURVE NUMBER ANALYSIS

Existing Condition

Soil Name Soil # Description
 Cave 152 Gravelly Fine Sandy Loam
 Cover Type: Desert Shrub in Poor Hydrologic Condition
 Ref: Table 602 (4 of 4) CCRFCD DDM

Soil Sub-Group	HSG	Curve No.	Percent	Weighted
Cave	D	88	85	74.8
Arizo	A	63	5	3.2
Canutio	B	77	5	3.9
Grapevine	B	77	5	3.9
Comp. CN				85.7

Proposed Condition

Soil Name Soil # Description
 Cave 152 Gravelly Fine Sandy Loam
 Cover Type: Commercial and Business
 Ref: Table 602 (1 of 4) CCRFCD DDM

Soil Sub-Group	HSG	Curve No.	Percent	Weighted
Cave	D	95	85	80.8
Arizo	A	89	5	4.5
Canutio	B	92	5	4.6
Grapevine	B	92	5	4.6
Comp. CN				94.4

C. Hydraulic Analysis

The following Bentley Systems FlowMaster computer 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. For the sump condition inlet, the estimated grate opening area was reduced by 50% and the headwater was computed by the standard orifice equation included in this software.

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.

Drop Inlet Analysis capture capacity for the proposed drop inlet utilized the Federal Highway Administration, Hydraulic Toolbox v2.1, July 2011 (HEC-22 3rd Ed.). Inlet calculation clogging factors (CF) are 50% and applied within the software.

III. DRAINAGE BASIN DESCRIPTIONS

A. Existing Drainage Description

Offsite is limited to the runoff generated from the Angel Park Apartments located on the west property line that is conveyed through a series of existing block wall openings. There are two (2) block wall openings located north half and one (1) on the south half of the west boundary wall for the apartments. The northern openings consist of two (2) 6-ft wide by 1 block course while the southern is one (1) 6-ft wide by 1 block course. Flow delivered to these block wall openings traverse the site in an easterly direction. The northern flow path via incised terrain where it is directed to the existing block wall opening and storm drain system constructed as part of the Starfire Estates development based upon the design of John R. Vegas Consulting Engineers (DS1183). The southern flow path follows a graded swale until reaching the area where the future cul-de-sac roadway will be located and turns northeasterly. From there it flows into a block wall opening and storm drain system also part of the Starfire Estates.

The existing residential development to the south is Iron Wood Condominiums which does not directly discharge flow into the parcel, but discharges into the improved half-street cul-de-sac of Silver Sky Drive.

Table 3: Existing Onsite Runoff Summary

HEC-1 ID/ BASIN NAME	10-YR FLOW (cfs)	100-YR FLOW (cfs)
ON1EX	3	6
ON2EX	2	6

The HEC-1 modeling for the onsite existing condition is summarized in the table above. An existing drainage basin map, Figure 9 in Appendix A, shows the onsite basins, offsite referenced flow rates and combined flow rates at the downstream property line entering into the existing Starfire Estates residential development.

The hydrologic analysis provided in the Silver Sky Assisted Living technical drainage study (DS3640) indicates the estimated 10- and 100-Year flow rate in Silver Sky Drive cul-de-sac is 11 and 22 cfs, respectively, and denoted as PT6A on Figure 10 in Appendix A.

B. Future Drainage Description

Under the future condition assumptions the site will be fully developed; all offsite basins are currently constructed and should remain unchanged. Offsite drainage patterns will remain the same as in the existing condition, storm water runoff is conveyed by grade from West to East. Based on the City Wide Study the flows of 58/135 cfs have been quantified within the region to be conveyed east into Summerlin Parkway right-of-way. This referenced document was produced in 1997 and may not accurately reflect the current flow rates within the watershed basin.

The existing offsite flow rates upstream of the project come from the Angel Park Apartments and due to the age of the project, availability of the associated drainage study for the 1989 development, the referenced *Silver Sky Assisted Living Technical Drainage Study* (DS3640) updated the design storm rates that were adopted and concurred with in this Study. These referenced flow rates are provided in Figure 10, in Appendix A.

These referenced offsite flows will be routed into an onsite underground storm drain system where the storm water generated onsite will be combined near the east boundary of the site to be delivered existing Starfire Estates. The onsite flow generated in the north half of the site will be routed 10-ft Type "A" Drop Inlet per Clark County Area Uniform Standard Drawings (CCAUSD) drawing number 410 located on Sheet GR1 on the enclosed improvement plans.

A majority of the surface flow generated in the south half of the development will be routed to low point at the southeast corner of the site. From there it will combine with the southern storm drain outflow and proceed to existing blockwall opening and storm drain constructed with the Starfire Estates development.

The remaining small portion of the onsite area will drain to top of the Silver Sky cul-de-sac and combine with the flows determined in the Silver Sky Assisted Living (DS3640) technical drainage study.

The HEC-1 hydrologic analysis is summarized in the following table and the onsite area is divided into five (5) basins and is shown in Figure 11, *Proposed Onsite Drainage Basin Map*, in Appendix A.

Table 4: Future Onsite Runoff Summary

BASIN NAME / CONCENTRATION POINT	AREA (ac)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
ON1D	0.53	1	2
ON2D	1.97	3	6
ON3D	1.12	2	3
ON4D	1.15	2	4
ON5D	0.41	1	1
COM1	2.38	4	7
COM2	2.27	4	7

These flows combine with offsite flow generated from the existing Angel Park Apartments as noted on Figure 11, *Proposed Onsite Drainage Basin Map*, in Appendix A. The nodes COM1 and COM2 will drain the existing storm drain systems located on Starfire Estates, while the onsite basin ON5D will flow into the public right-of-way at the top of the cul-de-sac of Silver Sky Drive.

Table 5: Future Onsite + Offsite Runoff Summary

CONCENTRATION POINT	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)	REMARKS
ON1D	1	2	Drains to top of cul-de-sac – Silver Sky Drive
COM1	9	18	Drains to Wall Opening in Starfire Estates I @ SEC
COM2	14	28	Drains to Drop Inlet that connects to Starfire Estates I RCP @ NEC

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.

Table 6: Onsite Street Flow Calculations

Street	Slope (%)	Q ₁₀₀ (cfs)	D ₁₀₀ (ft)	V ₁₀₀ (ft/s)	DV
Onsite Street – Sec. 1	0.53	2	0.35	1.61	0.6
Onsite Street – Sec. 2	0.50	6	0.48	2.09	1.0
Onsite Street – Sec. 3	0.50	3	0.44	2.12	0.9
Onsite Street – Sec. 4	0.50	6	0.54	2.25	1.2
Onsite Street – Sec. 5	0.53	1	0.29	1.42	0.4

Based upon the above FlowMaster calculations for the onsite conditions, the computed 100-Year design storm flow rates are contained within the drive aisle areas and the minimum finish floor criterion is met for all the buildings. Depth of flow cross section locations are shown on Figure 11, *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)
Silver Sky – Sec. 6	2.95	12/24	0.46/0.56	4.57/4.95	2.1/2.8	18.1/13.2

The referenced study (DS3640) indicates the estimated 10- and 100-Year flow rate in Silver Sky Drive cul-de-sac is 11 and 22 cfs, respectively, and denoted as PT6A on Figure 10 in Appendix A. The hydrologic analysis for basin ON1D adds an additional 1 and 2 cfs for the 10- and 100-Year design storm for the totals shown in the proceeding table.

The street calculations show that the *CCRFCD Hydrologic Criteria & Drainage Design Manual* criteria for *Velocity times Depth product* of less than 6 and 8 for the 10- and 100-Year design storms along with the *Dry Lane requirements* of 12-ft for the 10-Year design storm for the onsite and offsite streets has been satisfied.

D. Storm Drain Hydraulic Calculations

Northern System

The northern storm drain system will pick up the flow along the west property line from the twin 6-ft wall openings in Angel Park Apartments and deliver them via a concrete flume that will taper to a CCUASD 6-ft Type "A" drop inlet. Due to the steep slope into the inlet, flow hydraulics were assumed to be open channel condition and supporting calculations labeled *NWC FLUME INLET* are provide in Appendix C. At this node, 100-Year flow of 21 cfs is routed within the 24-in RCP along the northern portion of the site and shown on sheet GR1 and PP1 of the enclosed improvement plans.

Approximately mid-point of the storm drain system, two (2) 18-in RCP's are connected to the main line and these laterals serve to drain the courtyard area via twin system between the two (2) northern buildings. Based upon the hydrologic estimate the of the courtyard area approximately one-half ($\frac{1}{2}$) cfs is delivered to each 24-in by 24-in Jensen Precast drop inlet. Headwater depth is computed for these drop inlets and located within the section of Appendix C, *Northern WSPG Analysis*.

The northern storm drain system continues to the east property boundary with 100-Year flow rate of 22 cfs where the remaining surface flow on ON3D and ON4D are directed to the 10-ft wide Type "A" drop inlet as shown on sheet GR1. The drop inlet captures the remaining 6 cfs and where it combines with the storm drain system for a total of 28 cfs. The drop inlet hydraulic calculation is located within the section of Appendix C, *Northern WSPG Analysis*. This flow is routed through the Starfire Estates storm drain system where it daylights onto the existing Silver Sky Assisted Living open channel section.

The WSPG hydraulic analysis included in Appendix C provides the proposed onsite system and includes the offsite Starfire Estates reach. The offsite reach profile was taken from sheet C-1 of the Starfire Estates grading plan that accompanied the drainage study prepared by John R. Vega Consulting Engineers (DS1183) and grades were adjusted by 2.33 ft to account for the change in datum. A copy of the referenced grading plan is included in Appendix D.

The WSPG hydraulic grade line (HGL) for the northern storm drain system is plotted on sheet PP1 of the enclosed improvement plans. Based upon the HGL profile, the storm drain system conveys the 100-Year design flow and meets the criteria of the HGL being 1-ft or greater below finished grade.

Southern System

The southern storm drain system will pick up the offsite flow along the west property line from the single 6-ft wall opening in Angel Park Apartments and deliver it via a 6-ft wide concrete flume that will tie into a CCUASD 6-ft Type "A" drop inlet. Due to the steep slope into the inlet, flow hydraulics were assumed to be open channel condition and supporting calculations labeled *SWC FLUME INLET* are provide in Appendix C.

No additional flow is added to the system along the southern reach which daylights approximately 13-ft upstream of the existing block wall opening and storm drain system of Starfire Estates. The southern portion of the site has been graded to allow the surface flow to combine with the storm drain outflow prior to entering the existing block wall opening. The tailwater (TW) boundary condition for the southern WSPG hydraulic analysis was based upon the existing block wall opening and storm drain system constructed for Starfire Estates. The existing block wall opening was assumed to have a 50% clogging factor (CF) and it appears the hydraulic analysis indicates the rectangular weir controls; therefore the downstream starting HGL within the WSPG model was based upon this method. The TW rectangular weir calculation is included in Appendix C. Erosion protection at the downstream end of the 24-in RCP outlet will consist of a concrete flume tapered from the RCP to match the width of the block wall opening. The overbank area will consist of grouted rip-rap as shown on sheet G1 of the enclosed improvement plans.

The WSPG hydraulic grade line (HGL) for the southern storm drain system is plotted on sheet PP2 of the enclosed improvement plans. Based upon the HGL profile, the storm drain system conveys the 100-Year design flow and meets the criteria of the HGL being 1-ft or greater below finished grade.

IV. CONCLUSIONS

Based upon a comparison of the original analysis prepared for the Silver Sky Assisted Living ultimate developed condition for the affected watershed, the proposed development shows a small net increase of approximately 1 cfs for the 10- and 100-Year design storm. The comparison has been summarized in the table below and compared with Figure 10, Silver Sky Assisted Living Ultimate Condition, versus Figure 11, Westcliff Pine 2, Drainage Basin Map, both located in Appendix A.

Table 8: Runoff Summary Comparison

CONCENTRATION POINT or LOCATION	10 / 100-YEAR FLOW (cfs)	10 / 100-YEAR FLOW (cfs)	Δ 10 / 100-YEAR FLOW (cfs)
PT2 vs. COM2	13 / 28	14 / 28	1 / 0
PT1 vs. COM1	10 / 21	9 / 18	-1 / -3
PT6A vs. XS1	11 / 22	12 / 24	1 / 2
Totals	34 / 71	35 / 70	1 / -1

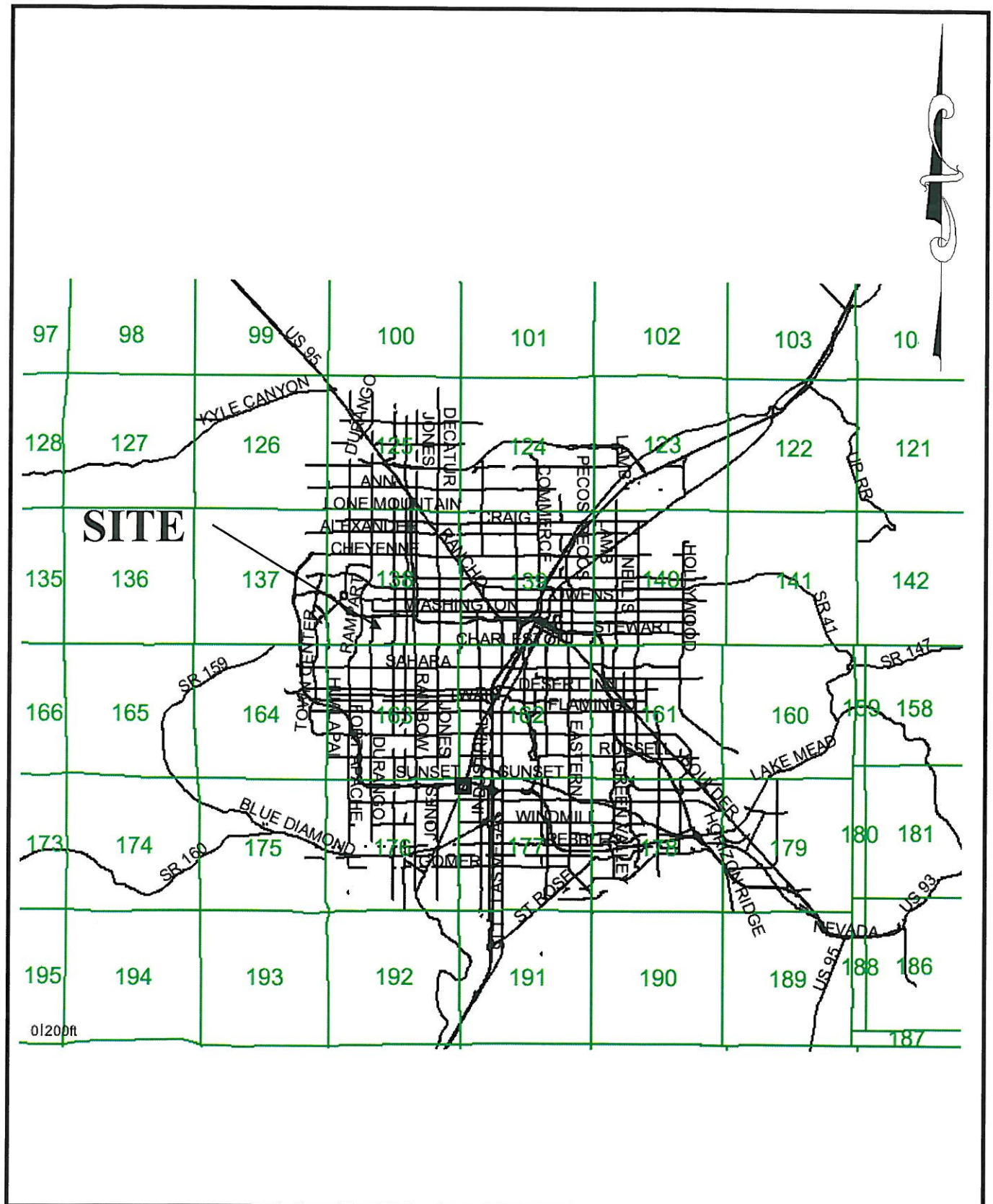
Nuisance flow will be carried onsite within the onsite curb and gutter and be released into the storm drain systems within the site.

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.

Appendix A: Figures



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Consulting Engineers
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Las Vegas, NV 89118

WESTCLIFF PINES 2
NEVADA H.A.N.D.

Figure 1
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 delineated herein. Information on roads and other non-assessed parcels may be obtained from the Road Document Listing in the Assessor's Office.

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

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

ASSESSOR'S PARCELS - CLARK CO., NV.

Michele W. Shafe - Assessor

BOOK **T20S R60E**

SEC. **28**

MAP **S 2 SW 4**

138-28-4

MAP LEGEND

- PARCEL BOUNDARY
- SUB BOUNDARY
- PM/LD BOUNDARY
- ROAD EASEMENT
- MATCH / LEADER LINE
- HISTORIC LOT LINE
- HISTORIC SUB BOUNDARY
- HISTORIC PM/LD BOUNDARY
- SECTION LINE

- CONDOMINIUM UNIT
- AIR SPACE PCL
- RIGHT OF WAY PCL
- SUB-SURFACE PCL

001 ROAD PARCEL NUMBER

001 PARCEL NUMBER

1.00 ACREAGE

202 PARCEL SUB/SEQ NUMBER

PB 24-45 PLAT RECORDING NUMBER

5 BLOCK NUMBER

5 LOT NUMBER

GL5 GOV. LOT NUMBER

Scale: Variable

Rev: 01/05/2011

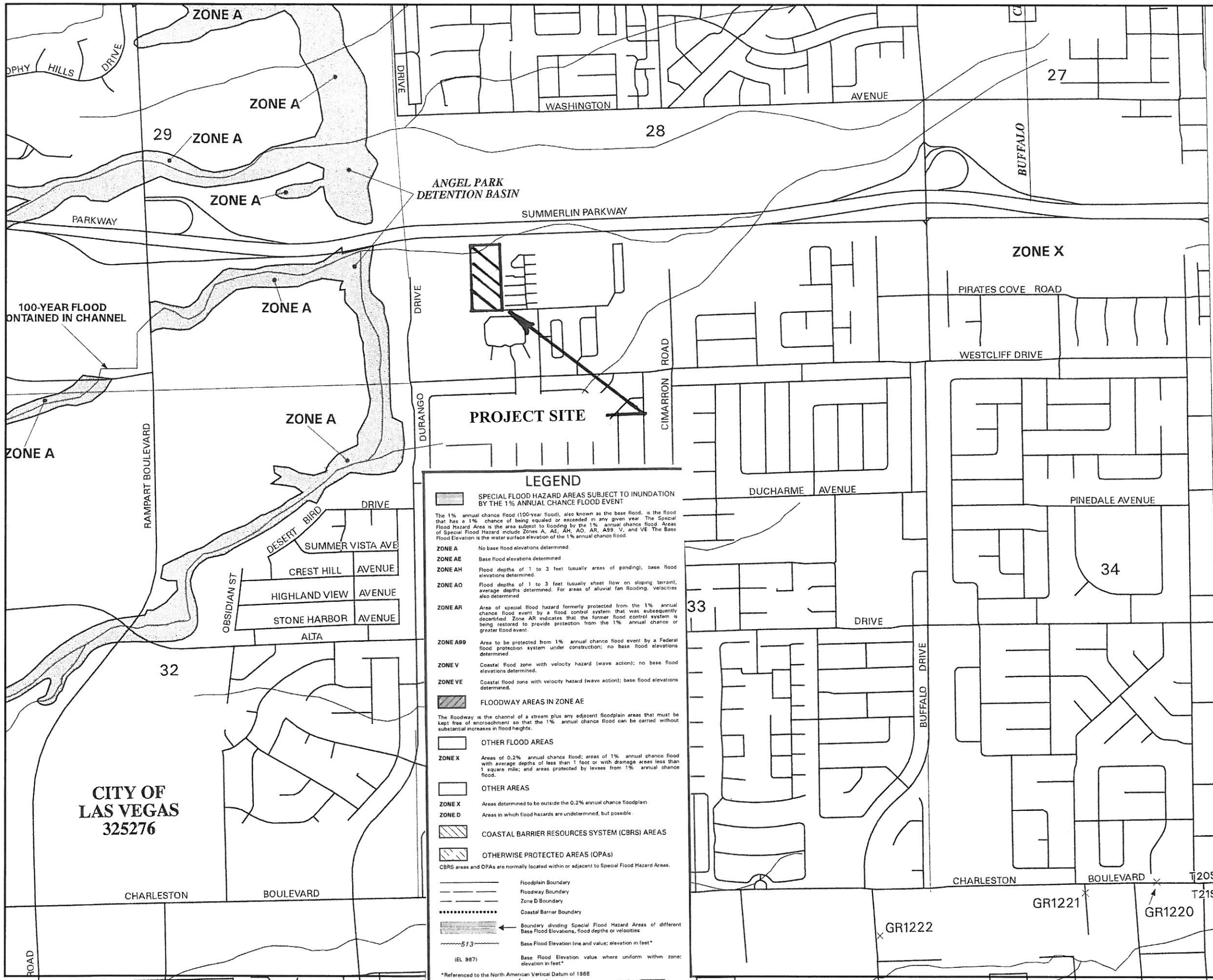
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137	138	139
164	163	162
175	176	177

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



FIGURE 2



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

PANEL 2145 E

FIRM FLOOD INSURANCE RATE MAP

CLARK COUNTY,
NEVADA AND
INCORPORATED AREAS

PANEL 2145 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COMMUNITY	NUMBER	PANEL	SUFFIX
LAS VEGAS, CITY OF	325276	2145	E
CLARK COUNTY, UNINCORPORATED AREAS	320003	2145	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.

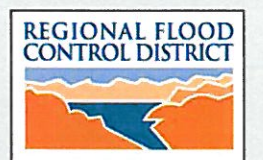
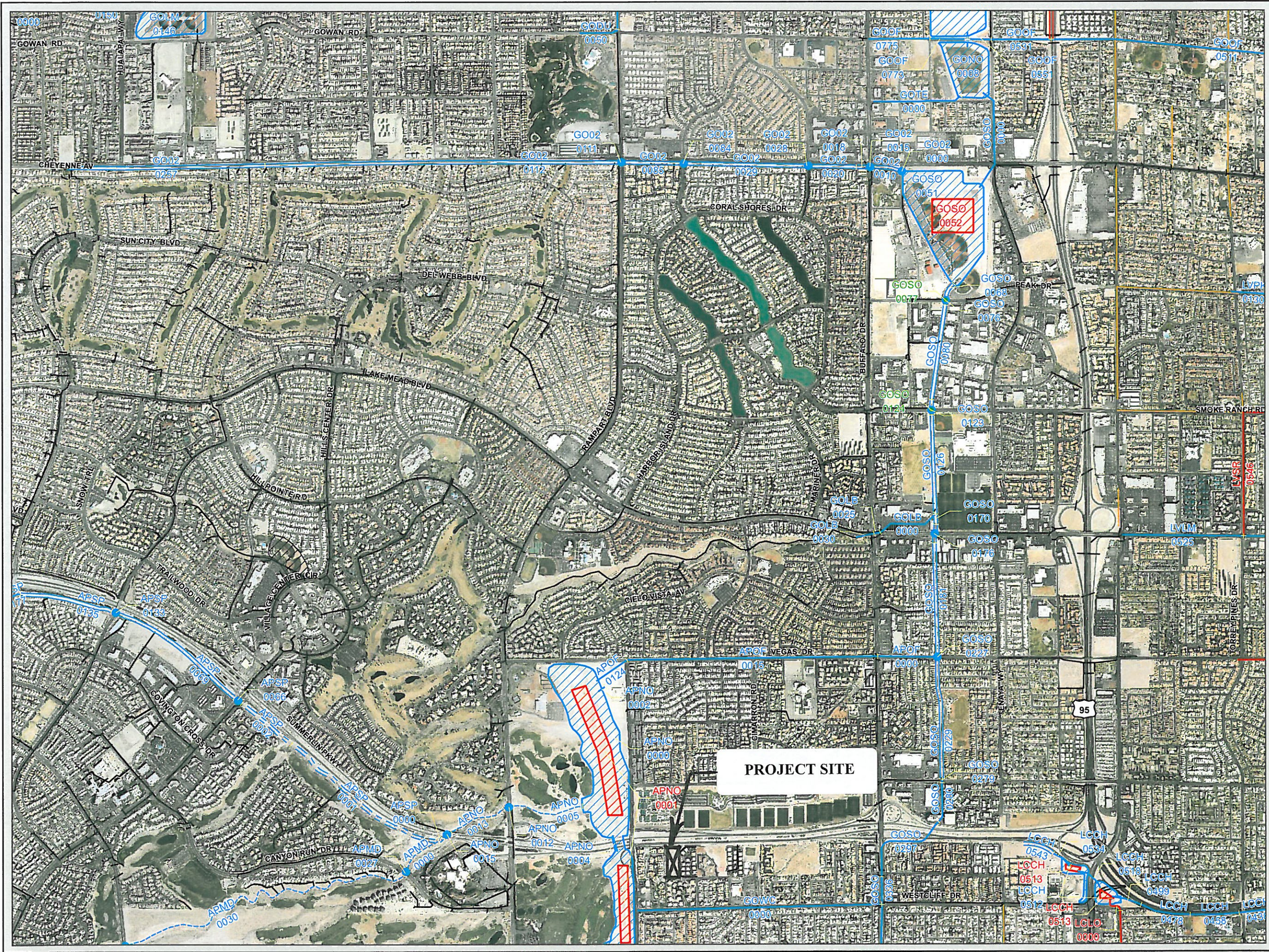
MAP NUMBER
32003C2145 E

MAP REVISED:
SEPTEMBER 27, 2002

Federal Emergency Management Agency

FIGURE 3

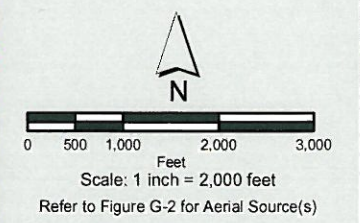
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2008
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

**FIGURE F-25
FLOOD CONTROL FACILITIES**

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



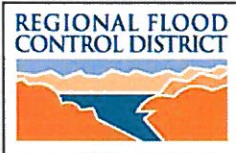
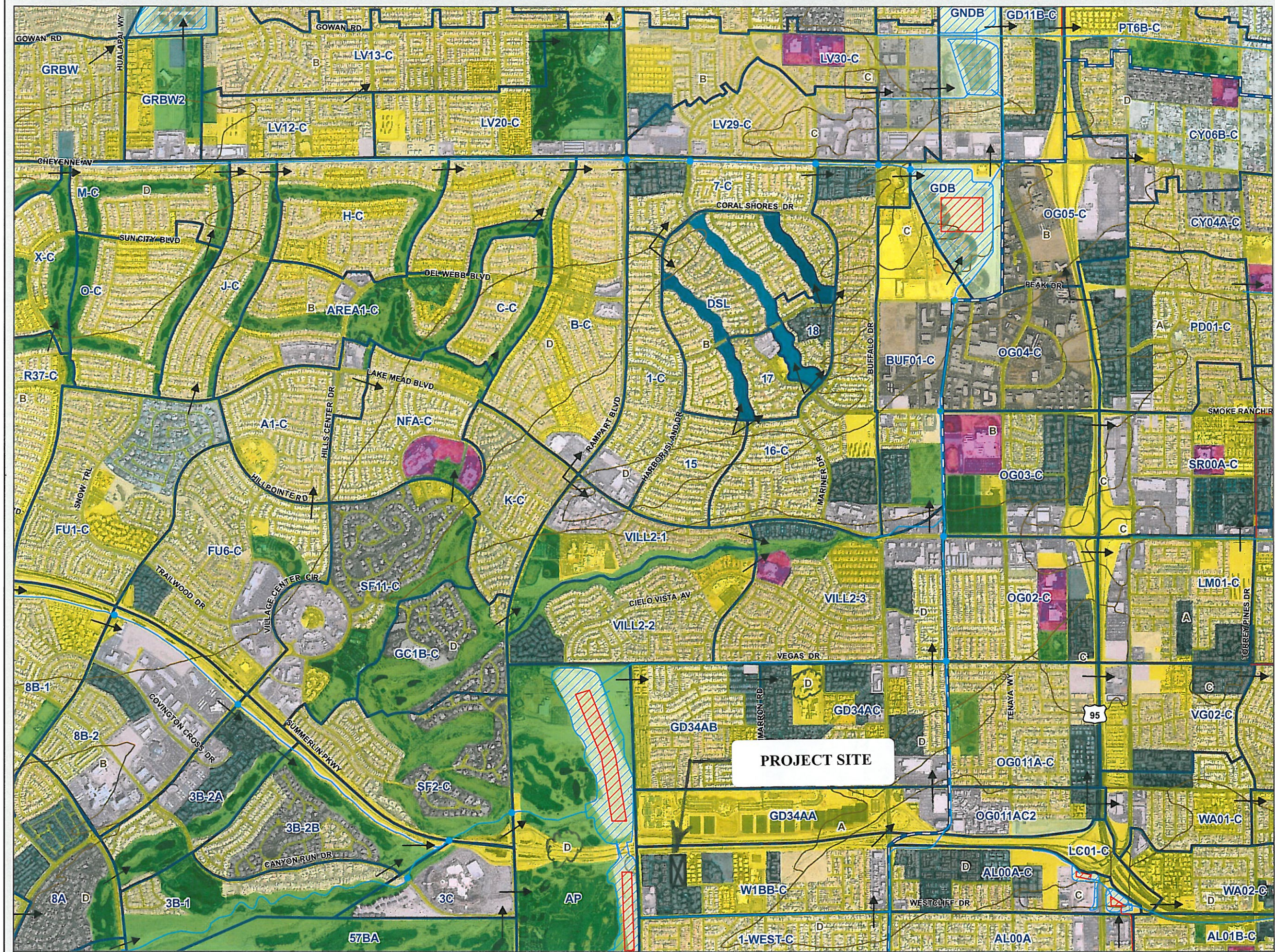
US95

2	3
4	5
7	8
11	12
18	19
24	25
29	30
35	36
41	42
47	48
53	54
57	58

I-15

9	10
13	14
20	21
26	27
31	32
37	38
43	44
49	50
55	56
59	

FIGURE 4



2008
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE
FIGURE H- 25
HYDROLOGIC SUMMARY

LEGEND

- Ultimate Development Boundary
- Watershed Boundary
- Subbasin Boundary
- Drought Ordinance Boundary
- Flow Arrows

Flood Control Facilities

- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Category A Remove & Replace/Parallel Facilities
- Category B Remove & Replace/Parallel Facilities

Type Hydrologic Soil Groups

- A Low Runoff Potential
- B Moderately Low Runoff Potential
- C Moderately High Runoff Potential
- D High Runoff Potential/Rock Outcrops

Typical Land Use

- 1 Undeveloped Land, Open Desert
- 2 Parks, Golf Courses
- 3 Rural
- 4 / 14* Low Density Residential
- 5 / 15* Medium Density Residential
- 6 / 16* High Density Residential
- 7 / 17* Public Facility, Residential
- 8 / 18* Very High Density Residential
- 9 / 19* Commercial, Retail, Casino, High Rise Condominiums
- 10 / 20* Light Industrial
- 11 / 21* Heavy Industrial
- 12 / 22* Schools
- 13 Lakes

* Drought Ordinance Applied

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

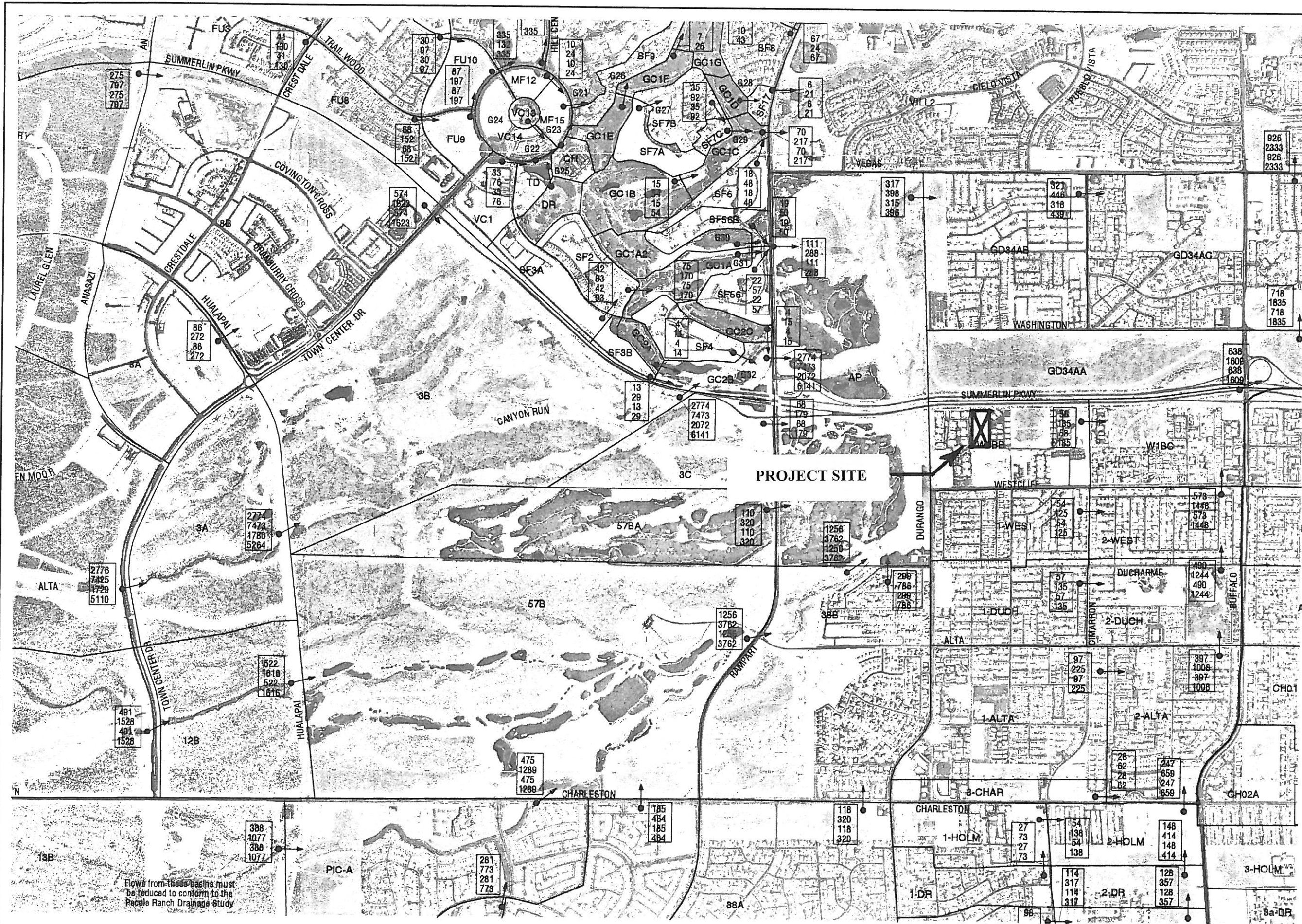
Scale: 1 inch = 2,000 feet

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



FIGURE 5



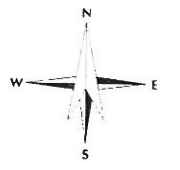


CITY WIDE HYDROLOGY STUDY UPDATE - 1997

LEGEND

- SUB-BASIN BOUNDARY
- FLOW ARROW
- 250 10-YEAR EXISTING FLOW
- 500 100-YEAR EXISTING FLOW
- 300 10-YEAR ULTIMATE FLOW
- 800 100-YEAR ULTIMATE FLOW
- (FLOWS IN CFS)

NOTE:
Facility flows must be subtracted from flows shown to determine surface flows.
(See "F" sheets for facility flows)



1 INCH = 1600 FEET

FIGURE H-12

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

FIGURE 6

1997 CITY OF LAS VEGAS
CITY-WIDE HYDROLOGY ANALYSIS

LEGEND

REGIONAL STREAM NAME DESIGNATOR	AABB
PARENT STREAM NAME	
STREAM NAME	
REGIONAL ID / RIVER MILE	0000
DISTANCE ABOVE	
CONFLUENCE WITH PARENT STREAM	
MILES	
TENTHS OF A MILE	
LOCAL STREAM NAME DESIGNATOR	AAB
LOCAL ID NUMBER	000
EXISTING FACILITY	E
PROPOSED OR MODIFIED FACILITY	P
CONTINGENCY LEVEL:	
MASTER PLAN	P1
FACILITY PLAN	P2
PRELIMINARY DESIGN	P3
DESIGN	P4
BOTTOM WIDTH	W
DEPTH	D
SIDE SLOPE, H:V	SS
CORRUGATED METAL PIPE CULVERT	CMP
CORRUGATED METAL ARCH PIPE CULVERT	CMA
REINFORCED CONCRETE BOX	RCB
RCB CULVERT	RCBC
REINFORCED CONCRETE PIPE	RCP
RCP CULVERT	RCPC
REINFORCED CONCRETE ARCH PIPE CULVERT	RCACP
GENERAL COMMENT	G1
FACILITY SPECIFIC COMMENT	S1

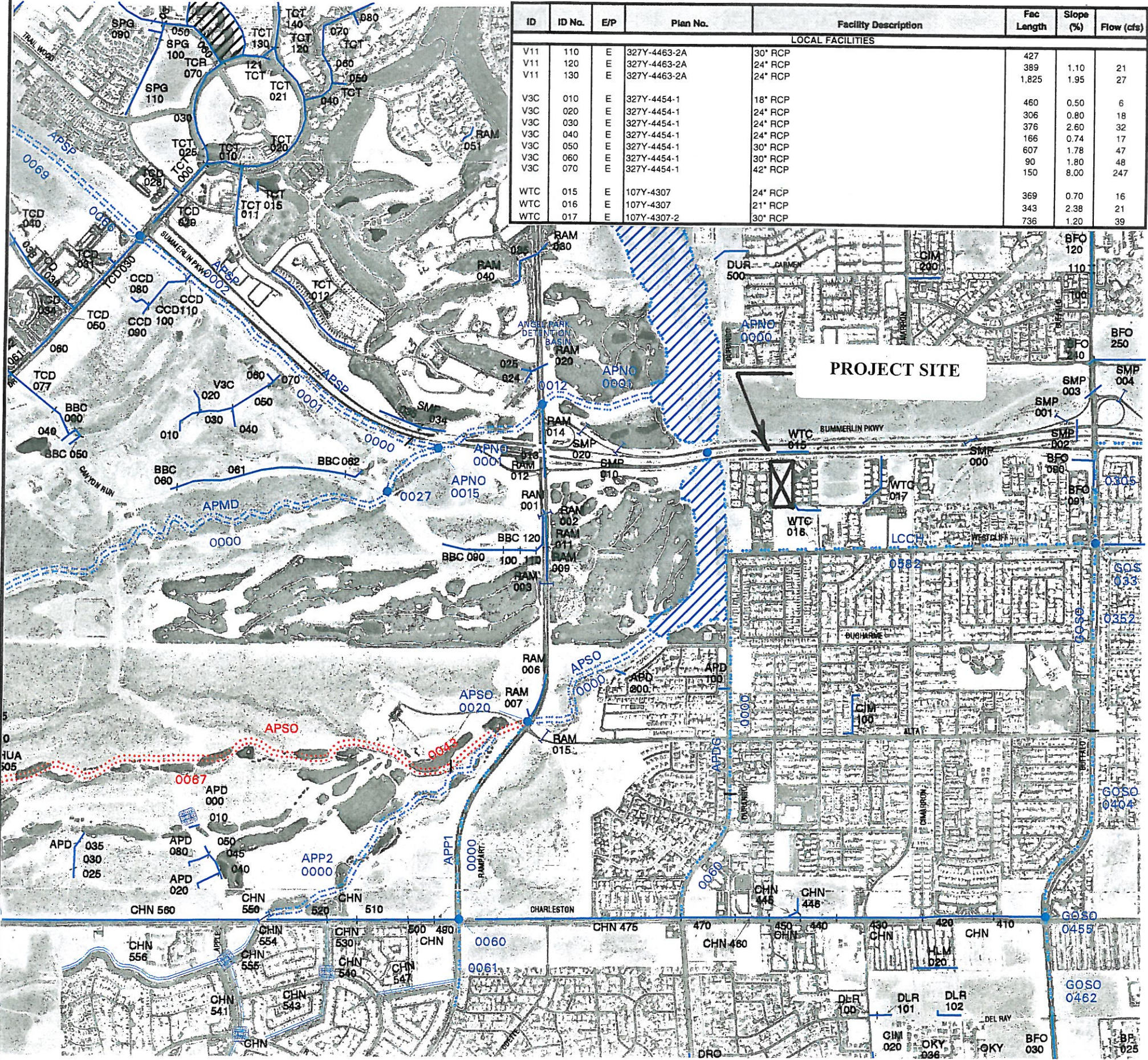
NOTES:

FLOW = 100 YEAR DESIGN FLOW
(REGIONAL FACILITIES)
FLOW = FACILITY CAPACITY
(LOCAL FACILITIES)

FLOOD CONTROL FACILITIES
INVENTORY

SHEET F-12

PBS&J, INC



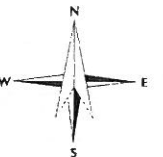
City of Las Vegas
CITY - WIDE HYDROLOGY
ANALYSIS

LEGEND

	EXISTING REGIONAL DETENTION BASIN
	PROPOSED REGIONAL DETENTION BASIN
	EXISTING LOCAL DETENTION BASIN
	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-12

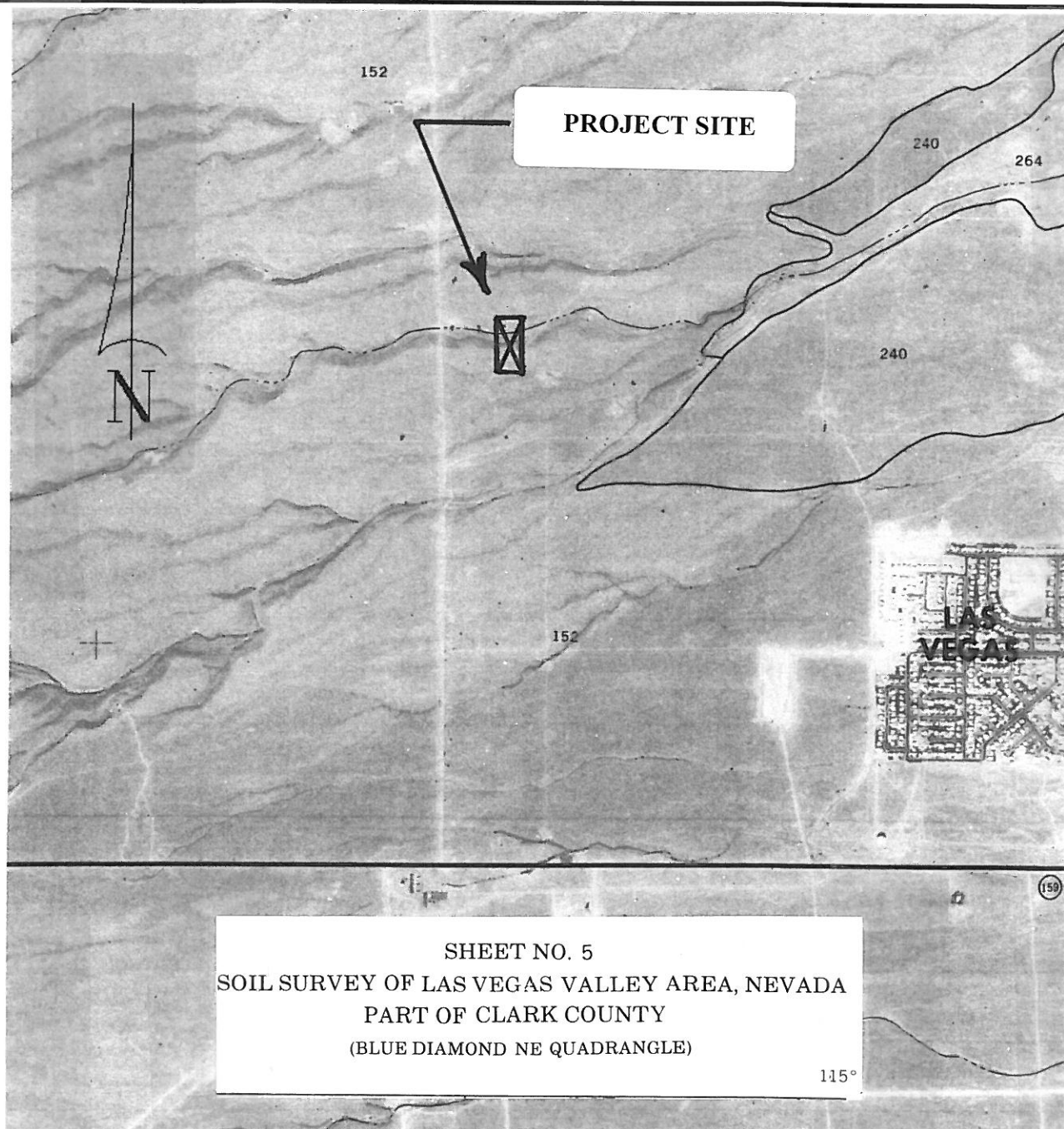
1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18



Scale: 1 inch = 1600 feet

FLOOD CONTROL FACILITIES

FIGURE 7



L.R. Nelson
 Consulting Engineers
 6765 W. Russell Rd., Suite 200
 Las Vegas, NV 89118

WESTCLIFF PINES 2
 NEVADA H.A.N.D.

Figure 8
 Soils Map

Appendix B: Hydrologic Analysis

CN ANALYSIS

CURVE NUMBER ANALYSIS				
Existing Condition				
Soil Name	Soil #	Description		
Cave	152	Gravelly Fine Sandy Loam		
Cover Type: Desert Shrub in Poor Hydrologic Condition				
Ref: Table 602 (4 of 4) CCRFCD DDM				
Soil Sub-Group	HSG	Curve No.	Percent	Weighted
Cave	D	88	85	74.8
Arizo	A	63	5	3.2
Canutio	B	77	5	3.9
Grapevine	B	77	5	3.9
Comp. CN				85.7

Proposed Condition				
Soil Name	Soil #	Description		
Cave	152	Gravelly Fine Sandy Loam		
Cover Type: Commercial and Business				
Ref: Table 602 (1 of 4) CCRFCD DDM				
Soil Sub-Group	HSG	Curve No.	Percent	Weighted
Cave	D	95	85	80.8
Arizo	A	89	5	4.5
Canutio	B	92	5	4.6
Grapevine	B	92	5	4.6
Comp. CN				94.4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (SEMIARID RANGELANDS¹)

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

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

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

Fair: 30 to 70% ground cover.

Good: >70% ground cover.

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

Revision	Date

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

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

See Table 602A

Developing urban areas

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

- 1 Average runoff condition, and $I_p = 0.2S$.
- 2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.
- 3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
- 4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
- 5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

WRC
ENGINEERING

REFERENCE:
SCS TR-55, USDA, June 1986.

TABLE 602
1 of 4

Project

DATE: 2/14/11

818-021-111

[illegible]

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1*****
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* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 14FEB11 TIME 11:03:56
*
*****

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

```

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

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

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

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID
2 ID TECHNICAL DRAINAGE STUDY FOR WESTCLIFF PINES 2
3 ID CITY OF LAS VEGAS, 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:WP2EX.DAT
10 ID JOB# 818-021-111
11 ID EXISTING CONDITION
12 ID TECHNICAL DRAINAGE STUDY
13 ID
14 *DIAGRAM
15 IT 5 0 0 300
16 IO 5
17 IN 5
18 JR PREC 0.57 1.0
19
20 KK ONLEX
21 KM UNDEVELOPED NORTH BASIN
22 BA .00401
23 PB 2.77
24 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
25 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
26 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
27 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
28 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
29 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
30 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
31 LS 0 85.7
32 UD .053
33
34 KK ON2EX
35 KM UNDEVELOPED SOUTH BASIN
36 BA .00418
37 LS 0 85.7
38 UD .089
39
40 ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

18 ONLEX

32 ON2EX

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION


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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 14FEB11 TIME 11:03:56
*
*****

```

```

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

```

TECHNICAL DRAINAGE STUDY FOR WESTCLIFF PINES 2
CITY OF LAS VEGAS, NEVADA

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

FILENAME:WP2EX.DAT
JOB# 818-021-111
EXISTING CONDITION
TECHNICAL DRAINAGE STUDY

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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
.57 1.00

1

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION	
				RATIO 1	RATIO 2
				.57	1.00
HYDROGRAPH AT					
+	ON1EX	.00	1	FLOW	3. 6.
				TIME	3.50 3.50
HYDROGRAPH AT					
+	ON2EX	.00	1	FLOW	2. 6.
				TIME	3.50 3.50

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

Project

DATE: 1/25/12

[illegible]


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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 25JAN12 TIME 14:04:10
*
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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 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

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1          ID
2          ID      TECHNICAL DRAINAGE STUDY FOR WESTCLIFF PINES
3          ID      CITY OF LAS VEGAS, 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:WPDEV2R2.DAT
10         ID      JOB# 818-018-111
11         ID      DEVELOPED CONDITION
12         ID      TECHNICAL DRAINAGE STUDY
13         ID      RATIOS APPLIED FOR 10-YEAR (0.57) AND 100-YEAR (1.0) DESIGN STORM
14         ID
15         *DIAGRAM
16         IT      5      0      0      300
17         IO      5
18         IN      5
19         JR      PREC      0.57      1.0
20
21         KK      ON2D
22         KM      DEVELOPED ONSITE BASIN ON2D
23         BA      .00307
24         PB      2.77
25         PC      .000      .020      .057      .070      .087      .108      .124      .130      .130      .130
26         PC      .130      .130      .130      .133      .140      .142      .148      .158      .172      .181
27         PC      .190      .197      .199      .200      .201      .204      .214      .229      .241      .249
28         PC      .251      .256      .270      .278      .281      .283      .295      .322      .352      .409
29         PC      .499      .590      .710      .744      .781      .812      .819      .835      .851      .856
30         PC      .860      .868      .876      .888      .910      .926      .937      .950      .970      .976
31         PC      .982      .985      .987      .989      .990      .993      .993      .994      .995      .998
32         LS      0      94.4
33         UD      .089
34         *
35
36         KK      RTE1
37         KM      ROUTE ON2D THROUGH ON5D
38         RD      130      .005      .013      TRAP      24      0
39         *
40
41         KK      ON5D
42         KM      DEVELOPED ONSITE BASIN ON5D - Tc SET TO 5 MIN SINCE CALC'D = 4.9 MIN
43         BA      .00064
44         LS      0      94.4
45         UD      .050
46         *
47
48         KK      COM1
49         KM      COMBINE BASIN FLOW INTO SUMP
50         HC      2
51         *

```

LINE	ID	1	2	3	4	5	6	7	8	9	10
44	KK	ON1D									
45	KM	DEVELOPED ONSITE BASIN ON1D - DRAINS TO SILVER SKY									
46	BA	.00080									
47	LS	0	94.4								
48	UD	.06									
	*										
49	KK	ON3D									
50	KM	DEVELOPED ONSITE BASIN ON3D									
51	BA	.00175									
52	LS	0	94.4								
53	UD	.079									
	*										
54	KK	RTE2									
55	KM	ROUTE ON3D TO SUMP DROP INLET IN ON4D									
56	RD	220	.005	.013	TRAP	24				0	
	*										
57	KK	ON4D									
58	KM	DEVELOPED ONSITE BASIN ON4D									
59	BA	.00180									
60	LS	0	94.4								
61	UD	.057									
	*										
62	KK	COM2									
63	KM	COMBINE BASINS IN SUMP DROP INLET IN ON4D									
64	HC	2									
	*										
65	ZZ										

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
19	ON2D	
	V	
	V	
33	RTE1	
	.	
	.	
36	ON5D	
	.	
	.	
41	COM1.....	
	.	
	.	
44	ON1D	
	.	
	.	
49	ON3D	
	V	
	V	
54	RTE2	
	.	
	.	
57	ON4D	
	.	
	.	
62	COM2.....	

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 25JAN12 TIME 14:04:10
*
*****

```

```

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

```

TECHNICAL DRAINAGE STUDY FOR WESTCLIFF PINES
CITY OF LAS VEGAS, NEVADA

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

FILENAME:WPDEV2R2.DAT
JOB# 818-018-111
DEVELOPED CONDITION
TECHNICAL DRAINAGE STUDY
RATIOS APPLIED FOR 10-YEAR (0.57) AND 100-YEAR (1.0) DESIGN STORM

```

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

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

```

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.57 1.00

1

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION	
				RATIO 1	RATIO 2
				.57	1.00
HYDROGRAPH AT					
+	ON2D	.00	1	FLOW TIME	3. 3.50 6. 3.50
ROUTED TO					
+	RTE1	.00	1	FLOW TIME	3. 3.50 6. 3.50
HYDROGRAPH AT					
+	ON5D	.00	1	FLOW TIME	1. 3.50 1. 3.50
2 COMBINED AT					
+	COM1	.00	1	FLOW TIME	4. 3.50 7. 3.50
HYDROGRAPH AT					
+	ON1D	.00	1	FLOW TIME	1. 3.50 2. 3.50
HYDROGRAPH AT					
+	ON3D	.00	1	FLOW TIME	2. 3.50 3. 3.50
ROUTED TO					
+	RTE2	.00	1	FLOW TIME	2. 3.50 3. 3.50
HYDROGRAPH AT					
+	ON4D	.00	1	FLOW TIME	2. 3.50 4. 3.50
2 COMBINED AT					
+	COM2	.00	1	FLOW TIME	4. 3.50 7. 3.50

1

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

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL		
							PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1	RATIO=	.00							
RTE1	MANE	1.13	2.90	211.64	1.04	5.00	2.81	210.00	1.04
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1700E+00 EXCESS= .0000E+00 OUTFLOW= .1700E+00 BASIN STORAGE= .2182E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
RTE1	MANE	.86	5.80	210.86	2.17	5.00	5.68	210.00	2.17
CONTINUITY SUMMARY (AC-FT) - INFLOW= .3548E+00 EXCESS= .0000E+00 OUTFLOW= .3548E+00 BASIN STORAGE= .1997E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
RTE2	MANE	2.36	1.70	212.65	1.04	5.00	1.59	210.00	1.04
CONTINUITY SUMMARY (AC-FT) - INFLOW= .9696E-01 EXCESS= .0000E+00 OUTFLOW= .9702E-01 BASIN STORAGE= .3273E-03 PERCENT ERROR= -.4									
FOR PLAN = 1	RATIO=	.00							
RTE2	MANE	1.80	3.33	212.32	2.17	5.00	3.23	210.00	2.17
CONTINUITY SUMMARY (AC-FT) - INFLOW= .2022E+00 EXCESS= .0000E+00 OUTFLOW= .2023E+00 BASIN STORAGE= .3736E-03 PERCENT ERROR= -.2									

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

Appendix C: Hydraulic Analysis

Cross Section for Onsite Section 1 - Q100

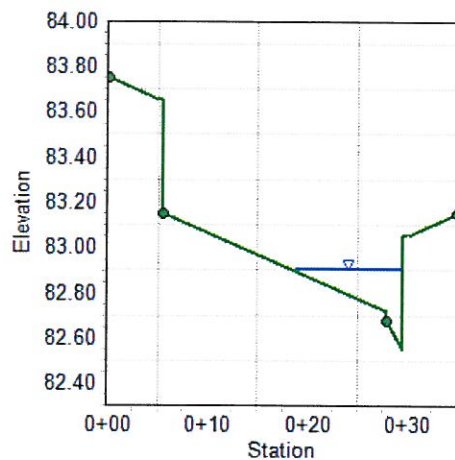
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00530	ft/ft
Normal Depth	0.35	ft
Discharge	2.00	ft ³ /s

Cross Section Image



Worksheet for Onsite Section 1 - Q100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00530 ft/ft
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	83.75
0+05.00	83.65
0+05.50	83.65
0+05.50	83.15
0+28.00	82.72
0+28.00	82.68
0+29.50	82.55
0+29.50	83.05
0+30.00	83.05
0+35.00	83.15

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 83.75)	(0+05.50, 83.15)	0.013
(0+05.50, 83.15)	(0+28.00, 82.68)	0.016
(0+28.00, 82.68)	(0+35.00, 83.15)	0.013

Options

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

Results

Normal Depth 0.35 ft

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Worksheet for Onsite Section 1 - Q100

Results

Elevation Range	82.55 to 83.75 ft	
Flow Area	1.24	ft ²
Wetted Perimeter	11.15	ft
Hydraulic Radius	0.11	ft
Top Width	10.75	ft
Normal Depth	0.35	ft
Critical Depth	0.33	ft
Critical Slope	0.00776	ft/ft
Velocity	1.61	ft/s
Velocity Head	0.04	ft
Specific Energy	0.39	ft
Froude Number	0.84	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.33	ft
Channel Slope	0.00530	ft/ft
Critical Slope	0.00776	ft/ft

Messages

Notes

Q100 = 2 CFS FROM ON1D

Cross Section for Onsite Section 2 - Q100

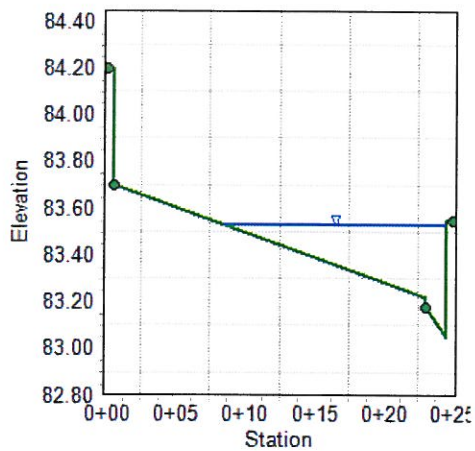
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.48	ft
Discharge	6.00	ft ³ /s

Cross Section Image



Worksheet for Onsite Section 2 - Q100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00500 ft/ft
Discharge 6.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	84.20
0+00.50	84.20
0+00.50	83.70
0+23.00	83.22
0+23.00	83.18
0+24.50	83.05
0+24.50	83.55
0+25.00	83.55

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 84.20)	(0+00.50, 83.70)	0.013
(0+00.50, 83.70)	(0+23.00, 83.18)	0.016
(0+23.00, 83.18)	(0+25.00, 83.55)	0.013

Options

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

Results

Normal Depth 0.48 ft
Elevation Range 83.05 to 84.20 ft
Flow Area 2.88 ft²

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Worksheet for Onsite Section 2 - Q100

Results

Wetted Perimeter	16.56	ft
Hydraulic Radius	0.17	ft
Top Width	16.03	ft
Normal Depth	0.48	ft
Critical Depth	0.46	ft
Critical Slope	0.00675	ft/ft
Velocity	2.09	ft/s
Velocity Head	0.07	ft
Specific Energy	0.55	ft
Froude Number	0.87	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.46	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00675	ft/ft

Messages

Notes

Q100 = 6 cfs from ON2D

Cross Section for Onsite Section 3 - Q100

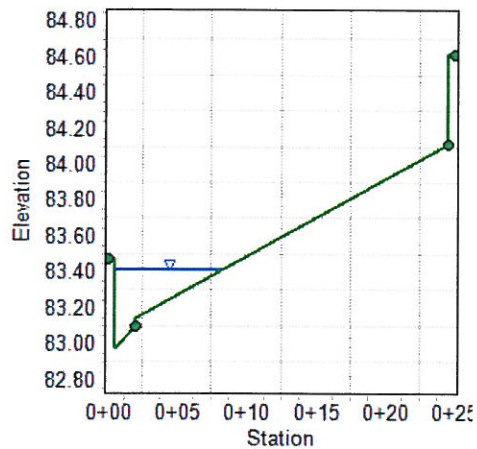
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.44	ft
Discharge	3.00	ft ³ /s

Cross Section Image



Project Description

Input Data

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

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 83.47)	(0+02.00, 83.10)	0.013
(0+02.00, 83.10)	(0+24.50, 84.12)	0.016
(0+24.50, 84.12)	(0+25.00, 84.62)	0.013

Results

2/1/2012 2:22:16 PM Bentley Systems, Inc. Haestad Methods Software 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Bentley FlowMaster V8i (SELECTseries 1) [08.11.01.03] Page 1 of 2

Cross Section for Onsite Section 5 - Q100

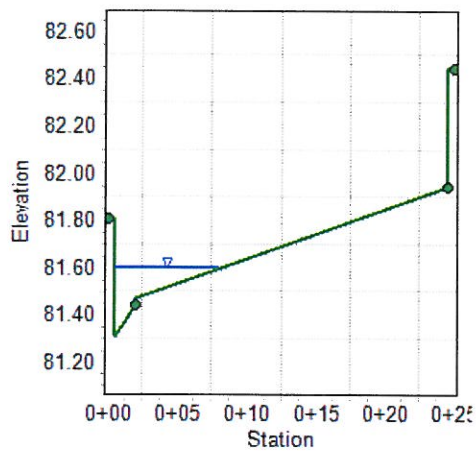
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00530	ft/ft
Normal Depth	0.29	ft
Discharge	1.00	ft ³ /s

Cross Section Image



Worksheet for Onsite Section 5 - Q100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00530 ft/ft
Discharge 1.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	81.81
0+00.50	81.81
0+00.50	81.31
0+02.00	81.44
0+02.00	81.47
0+24.50	81.94
0+24.50	82.44
0+25.00	82.44

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 81.81)	(0+02.00, 81.44)	0.013
(0+02.00, 81.44)	(0+24.50, 81.94)	0.016
(0+24.50, 81.94)	(0+25.00, 82.44)	0.013

Options

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

Results

Normal Depth 0.29 ft
Elevation Range 81.31 to 82.44 ft
Flow Area 0.71 ft²

L. R. Nelson Consulting Engineers, Inc.

Worksheet for Onsite Section 5 - Q100

Results

Wetted Perimeter	7.81	ft
Hydraulic Radius	0.09	ft
Top Width	7.49	ft
Normal Depth	0.29	ft
Critical Depth	0.27	ft
Critical Slope	0.00820	ft/ft
Velocity	1.42	ft/s
Velocity Head	0.03	ft
Specific Energy	0.32	ft
Froude Number	0.82	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.27	ft
Channel Slope	0.00530	ft/ft
Critical Slope	0.00820	ft/ft

Messages

Notes

Q100 = 1 cfs (ON5D)

Project Description

Manning Formula

Normal Depth

12.00 ft³/s

Worksheet for Silver Sky Drive - Q10 PROPOSED - SECTION 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02950	ft/ft
Discharge	12.00	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	80.70
0+05.00	80.60
0+05.50	80.60
0+05.50	80.10
0+07.00	80.23
0+07.00	80.27
0+30.00	80.74
0+53.00	80.08
0+53.00	80.04
0+54.50	79.91
0+54.50	80.41
0+55.00	80.41
0+60.00	80.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.70)	(0+07.00, 80.23)	0.013
(0+07.00, 80.23)	(0+53.00, 80.04)	0.016
(0+53.00, 80.04)	(0+60.00, 80.51)	0.013

Options

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

Worksheet for Silver Sky Drive - Q10 PROPOSED - SECTION 6

Results

Normal Depth		0.46	ft
Elevation Range	79.91 to 80.74 ft		
Flow Area		2.62	ft²
Wetted Perimeter		18.89	ft
Hydraulic Radius		0.14	ft
Top Width		18.06	ft
Normal Depth		0.46	ft
Critical Depth		0.57	ft
Critical Slope		0.00617	ft/ft
Velocity		4.57	ft/s
Velocity Head		0.33	ft
Specific Energy		0.79	ft
Froude Number		2.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	0.57	ft
Channel Slope	0.02950	ft/ft
Critical Slope	0.00617	ft/ft

Messages

Notes

Q100 = 11 cfs from PT6A (DS3640) + 1 cfs (ON1D) = 12 cfs

Cross Section for Silver Sky Drive - Q100 PROPOSED - SECTION 6

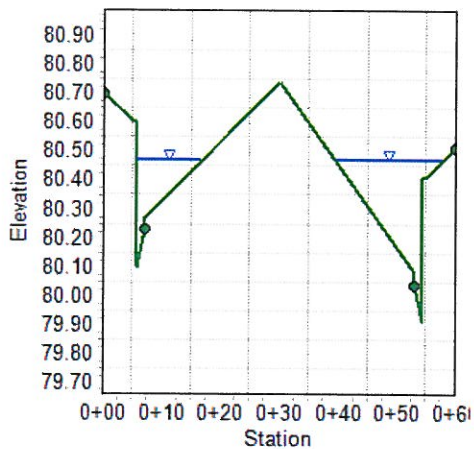
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02950	ft/ft
Normal Depth	0.56	ft
Discharge	24.00	ft ³ /s

Cross Section Image



Worksheet for Silver Sky Drive - Q100 PROPOSED - SECTION 6

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.02950 ft/ft
Discharge 24.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	80.70
0+05.00	80.60
0+05.50	80.60
0+05.50	80.10
0+07.00	80.23
0+07.00	80.27
0+30.00	80.74
0+53.00	80.08
0+53.00	80.04
0+54.50	79.91
0+54.50	80.41
0+55.00	80.41
0+60.00	80.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.70)	(0+07.00, 80.23)	0.013
(0+07.00, 80.23)	(0+53.00, 80.04)	0.016
(0+53.00, 80.04)	(0+60.00, 80.51)	0.013

Options

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

Worksheet for Onsite Section 3 - Q100

Results

Wetted Perimeter	8.25	ft
Hydraulic Radius	0.17	ft
Top Width	7.75	ft
Normal Depth	0.44	ft
Critical Depth	0.42	ft
Critical Slope	0.00669	ft/ft
Velocity	2.12	ft/s
Velocity Head	0.07	ft
Specific Energy	0.51	ft
Froude Number	0.87	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.44	ft
Critical Depth	0.42	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00669	ft/ft

Messages

Notes

Q100 = 3 cfs from ON3D

Cross Section for Onsite Section 4 - Q100

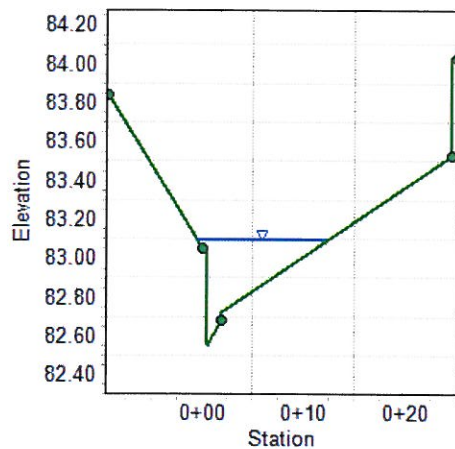
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.54	ft
Discharge	6.00	ft ³ /s

Cross Section Image



Worksheet for Onsite Section 4 - Q100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00500 ft/ft
Discharge 6.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-0+09.21	83.84
0+00.00	83.05
0+00.50	83.05
0+00.50	82.55
0+02.00	82.68
0+02.00	82.72
0+24.50	83.53
0+24.50	84.03
0+25.00	84.03

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+09.21, 83.84)	(0+00.00, 83.05)	0.025
(0+00.00, 83.05)	(0+02.00, 82.68)	0.013
(0+02.00, 82.68)	(0+24.50, 83.53)	0.016
(0+24.50, 83.53)	(0+25.00, 84.03)	0.013

Options

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

Results

Normal Depth 0.54 ft

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Worksheet for Onsite Section 4 - Q100

Results

Elevation Range	82.55 to 84.03 ft	
Flow Area	2.66	ft ²
Wetted Perimeter	13.35	ft
Hydraulic Radius	0.20	ft
Top Width	12.80	ft
Normal Depth	0.54	ft
Critical Depth	0.52	ft
Critical Slope	0.00670	ft/ft
Velocity	2.25	ft/s
Velocity Head	0.08	ft
Specific Energy	0.62	ft
Froude Number	0.87	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.52	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00670	ft/ft

Messages

Notes

Q100 = 3 cfs (ON3D) + 4 cfs (ON4D) - 1 cfs (Jensen Precast Grate Inlets capture Q) = 6 cfs

Cross Section for Silver Sky Drive - Q10 PROPOSED - SECTION 6

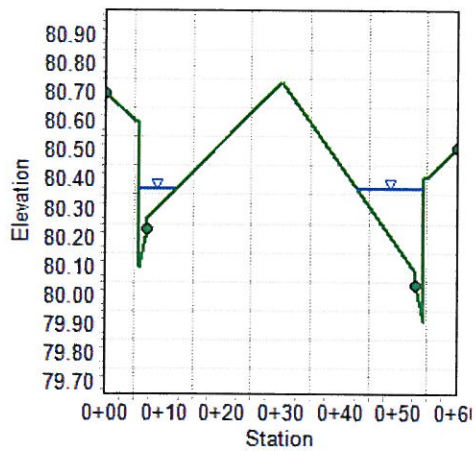
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02950	ft/ft
Normal Depth	0.46	ft
Discharge	12.00	ft ³ /s

Cross Section Image



Worksheet for Silver Sky Drive - Q10 PROPOSED - SECTION 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02950	ft/ft
Discharge	12.00	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	80.70
0+05.00	80.60
0+05.50	80.60
0+05.50	80.10
0+07.00	80.23
0+07.00	80.27
0+30.00	80.74
0+53.00	80.08
0+53.00	80.04
0+54.50	79.91
0+54.50	80.41
0+55.00	80.41
0+60.00	80.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.70)	(0+07.00, 80.23)	0.013
(0+07.00, 80.23)	(0+53.00, 80.04)	0.016
(0+53.00, 80.04)	(0+60.00, 80.51)	0.013

Options

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

Worksheet for Silver Sky Drive - Q10 PROPOSED - SECTION 6

Results

Normal Depth		0.46	ft
Elevation Range	79.91 to 80.74 ft		
Flow Area		2.62	ft ²
Wetted Perimeter		18.89	ft
Hydraulic Radius		0.14	ft
Top Width		18.06	ft
Normal Depth		0.46	ft
Critical Depth		0.57	ft
Critical Slope		0.00617	ft/ft
Velocity		4.57	ft/s
Velocity Head		0.33	ft
Specific Energy		0.79	ft
Froude Number		2.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	0.57	ft
Channel Slope	0.02950	ft/ft
Critical Slope	0.00617	ft/ft

Messages

Notes

Q100 = 11 cfs from PT6A (DS3640) + 1 cfs (ON1D) = 12 cfs

Cross Section for Silver Sky Drive - Q100 PROPOSED - SECTION #6

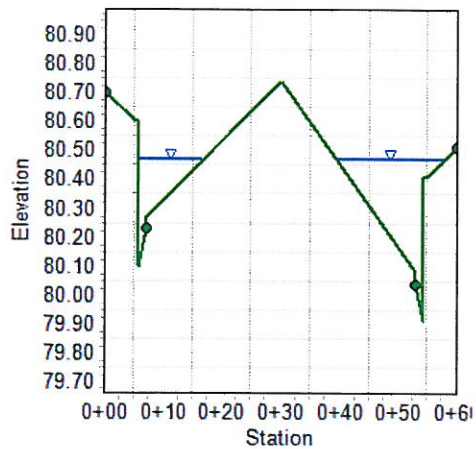
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02950	ft/ft
Normal Depth	0.56	ft
Discharge	24.00	ft ³ /s

Cross Section Image



Worksheet for Silver Sky Drive - Q100 PROPOSED - SECTION #6

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.02950 ft/ft
Discharge 24.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	80.70
0+05.00	80.60
0+05.50	80.60
0+05.50	80.10
0+07.00	80.23
0+07.00	80.27
0+30.00	80.74
0+53.00	80.08
0+53.00	80.04
0+54.50	79.91
0+54.50	80.41
0+55.00	80.41
0+60.00	80.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.70)	(0+07.00, 80.23)	0.013
(0+07.00, 80.23)	(0+53.00, 80.04)	0.016
(0+53.00, 80.04)	(0+60.00, 80.51)	0.013

Options

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

Worksheet for Silver Sky Drive - Q100 PROPOSED - SECTION #6

Results

Normal Depth		0.56	ft
Elevation Range	79.91 to 80.74 ft		
Flow Area		4.85	ft ²
Wetted Perimeter		30.41	ft
Hydraulic Radius		0.16	ft
Top Width		29.44	ft
Normal Depth		0.56	ft
Critical Depth		0.67	ft
Critical Slope		0.00579	ft/ft
Velocity		4.95	ft/s
Velocity Head		0.38	ft
Specific Energy		0.94	ft
Froude Number		2.15	
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	0.56	ft
Critical Depth	0.67	ft
Channel Slope	0.02950	ft/ft
Critical Slope	0.00579	ft/ft

Messages

Notes

Q100 = 22 cfs from PT6A (DS3640) + 2 cfs (ON1D) = 24 cfs

Northern WSPG Analysis

WATER SURFACE PROFILE LISTING

Date: 1-31-2012 Time: 1:51:35

Westcliff Pines 2
Onsite Storm Drain System - North
Job NO. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1000.000	63.830	1.828	65.658	28.00	9.30	1.34	67.00	.00	1.83	1.12	2.000	.000	.00	1 .0
10.519	.0079					.0139	.15	1.83	1.00	2.00	.013	.00	.00	PIPE
1010.519	63.914	2.000	65.914	28.00	8.91	1.23	67.15	.00	1.83	.00	2.000	.000	.00	1 .0
223.481	.0079					.0149	3.32	2.00	.00	2.00	.013	.00	.00	PIPE
1234.000	65.690	3.706	69.396	28.00	8.91	1.23	70.63	.00	1.83	.00	2.000	.000	.00	1 .0
135.000	.0084					.0153	2.07	3.71	.00	2.00	.013	.00	.00	PIPE
1369.000	66.830	4.859	71.689	28.00	8.91	1.23	72.92	.00	1.83	.00	2.000	.000	.00	1 .0
1.309	.7960					.0153	.02	4.86	.00	.50	.013	.00	.00	PIPE
1370.309	67.872	3.836	71.707	28.00	8.91	1.23	72.94	.00	1.83	.00	2.000	.000	.00	1 .0
HYDRAULIC JUMP														
1370.309	67.872	.971	68.842	28.00	18.52	5.32	74.17	.00	1.83	2.00	2.000	.000	.00	1 .0
.066	.7960					.0670	.00	.97	3.75	.50	.013	.00	.00	PIPE
1370.375	67.924	.977	68.902	28.00	18.35	5.23	74.13	.00	1.83	2.00	2.000	.000	.00	1 .0
.597	.7960					.0623	.04	.98	3.70	.50	.013	.00	.00	PIPE
1370.972	68.400	1.015	69.414	28.00	17.50	4.75	74.17	.00	1.83	2.00	2.000	.000	.00	1 .0
.530	.7960					.0549	.03	1.01	3.45	.50	.013	.00	.00	PIPE
1371.502	68.822	1.054	69.876	28.00	16.68	4.32	74.20	.00	1.83	2.00	2.000	.000	.00	1 .0
.471	.7960					.0484	.02	1.05	3.21	.50	.013	.00	.00	PIPE

Westcliff Pines 2
Onsite Storm Drain System - North
Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top	Height/	Base Wt/	No Wth
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZL
													Type Ch
1371.973	69.197	1.095	70.291	28.00	15.91	3.93	74.22	.00	1.83	1.99	2.000	.000	.00
.417	.7960					.0427	.02	1.09	2.98	.50	.013	.00	.00
1372.390	69.528	1.138	70.666	28.00	15.17	3.57	74.24	.00	1.83	1.98	2.000	.000	.00
.368	.7960					.0377	.01	1.14	2.77	.50	.013	.00	.00
1372.758	69.821	1.184	71.005	28.00	14.46	3.25	74.25	.00	1.83	1.97	2.000	.000	.00
.324	.7960					.0334	.01	1.18	2.57	.50	.013	.00	.00
1373.081	70.079	1.232	71.311	28.00	13.79	2.95	74.26	.00	1.83	1.95	2.000	.000	.00
.283	.7960					.0296	.01	1.23	2.38	.50	.013	.00	.00
1373.365	70.304	1.283	71.588	28.00	13.15	2.68	74.27	.00	1.83	1.92	2.000	.000	.00
.246	.7960					.0262	.01	1.28	2.20	.50	.013	.00	.00
1373.610	70.500	1.338	71.838	28.00	12.53	2.44	74.28	.00	1.83	1.88	2.000	.000	.00
.211	.7960					.0233	.00	1.34	2.03	.50	.013	.00	.00
1373.822	70.668	1.397	72.065	28.00	11.95	2.22	74.28	.00	1.83	1.84	2.000	.000	.00
.178	.7960					.0208	.00	1.40	1.86	.50	.013	.00	.00
1374.000	70.810	1.460	72.270	28.00	11.39	2.02	74.29	.00	1.83	1.78	2.000	.000	.00
.542	.0780					.0194	.01	1.46	1.71	.93	.013	.00	.00
1374.542	70.852	1.477	72.329	28.00	11.26	1.97	74.30	.00	1.83	1.76	2.000	.000	.00
1.810	.0780					.0181	.03	1.48	1.67	.93	.013	.00	.00

Westcliff Pines 2
Onsite Storm Drain System - North
Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt Or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1376.352	70.993	1.548	72.541	28.00	10.73	1.79	74.33	.00	1.83	1.67	2.000	.000	.00	1 .0
1.362	.0780					.0164	.02	1.55	1.52	.93	.013	.00	.00	PIPE
1377.714	71.100	1.626	72.726	28.00	10.23	1.63	74.35	.00	1.83	1.56	2.000	.000	.00	1 .0
.914	.0780					.0149	.01	1.63	1.36	.93	.013	.00	.00	PIPE
1378.627	71.171	1.716	72.887	28.00	9.76	1.48	74.37	.00	1.83	1.40	2.000	.000	.00	1 .0
.373	.0780					.0138	.01	1.72	1.20	.93	.013	.00	.00	PIPE
1379.000	71.200	1.828	73.028	28.00	9.30	1.34	74.37	.00	1.83	1.12	2.000	.000	.00	1 .0
WALL ENTRANCE														
1379.000	71.200	4.393	75.593	28.00	.64	.01	75.60	.00	.62	10.00	9.800	10.000	.00	0 .0
JUNCT STR	.9714							4.39	.05		.013	.00	.00	BOX
1384.590	76.630	.532	77.162	22.00	4.14	.27	77.43	.00	.53	10.00	9.800	10.000	.00	0 .0
WALL EXIT														
1384.590	76.630	.532	77.162	22.00	4.14	.27	77.43	.00	.53	10.00	9.800	10.000	.00	0 .0
1384.590	76.630	1.547	78.177	22.00	8.44	1.11	79.28	.00	1.68	1.67	2.000	.000	.00	1 .0
15.386	.0102					.0108	.17	1.55	1.19	1.58	.013	.00	.00	PIPE
1399.976	76.787	1.527	78.313	22.00	8.55	1.13	79.45	.00	1.68	1.70	2.000	.000	.00	1 .0
32.657	.0102					.0115	.38	1.53	1.22	1.58	.013	.00	.00	PIPE
1432.632	77.119	1.458	78.577	22.00	8.97	1.25	79.83	.00	1.68	1.78	2.000	.000	.00	1 .0
22.708	.0102					.0129	.29	1.46	1.34	1.58	.013	.00	.00	PIPE

Westcliff Pines 2
Onsite Storm Drain System - North
Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1455.340	77.350	1.395	78.745	22.00	9.40	1.37	80.12	.00	1.68	1.84	2.000	.000	.00	1 .0
JUNCT STR	.0400					.0128	.03	1.40	1.47		.013	.00	.00	PIPE
1457.840	77.450	1.466	78.916	22.00	8.91	1.23	80.15	.00	1.68	1.77	2.000	.000	.00	1 .0
1.122	.0400					.0116	.01	1.47	1.33	.98	.013	.00	.00	PIPE
1458.962	77.495	1.515	79.010	22.00	8.62	1.15	80.16	.00	1.68	1.71	2.000	.000	.00	1 .0
1.020	.0400					.0106	.01	1.51	1.24	.98	.013	.00	.00	PIPE
1459.982	77.536	1.590	79.125	22.00	8.22	1.05	80.17	.00	1.68	1.62	2.000	.000	.00	1 .0
.358	.0400					.0096	.00	1.59	1.12	.98	.013	.00	.00	PIPE
1460.340	77.550	1.675	79.225	22.00	7.83	.95	80.18	.00	1.68	1.48	2.000	.000	.00	1 .0
3.659	.0052					.0088	.03	1.68	1.00	2.00	.013	.00	.00	PIPE
1463.999	77.569	1.775	79.344	22.00	7.47	.87	80.21	.00	1.68	1.26	2.000	.000	.00	1 .0
17.762	.0052					.0083	.15	1.77	.86	2.00	.013	.00	.00	PIPE
1481.762	77.661	1.909	79.570	22.00	7.12	.79	80.36	.00	1.68	.83	2.000	.000	.00	1 .0
19.435	.0052					.0086	.17	1.91	.65	2.00	.013	.00	.00	PIPE
1501.197	77.762	2.000	79.762	22.00	7.00	.76	80.52	.00	1.68	.00	2.000	.000	.00	1 .0
61.493	.0052					.0092	.56	2.00	.00	2.00	.013	.00	.00	PIPE
1562.690	78.080	2.286	80.366	22.00	7.00	.76	81.13	.00	1.68	.00	2.000	.000	.00	1 .0
JUNCT STR	.0400					.0092	.02	2.29	.00		.013	.00	.00	PIPE

Westcliff Pines 2
Onsite Storm Drain System - North
Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.	Base Wt/I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1565.190	78.180	2.278	80.458	21.50	6.84	.73	81.18	.00	1.66	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.500	.0400					.0090	.02	2.28	.00	.97	.013	.00	.00	PIPE
1567.690	78.280	2.200	80.480	21.50	6.84	.73	81.21	.00	1.66	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26.000	.0062					.0090	.23	2.20	.00	2.00	.013	.00	.00	PIPE
1593.690	78.440	2.311	80.751	21.50	6.84	.73	81.48	.00	1.66	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JUNCT STR	.0400					.0088	.02	2.31	.00		.013	.00	.00	PIPE
1596.190	78.540	2.300	80.840	21.00	6.68	.69	81.53	.00	1.64	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.500	.0400					.0086	.02	2.30	.00	.96	.013	.00	.00	PIPE
1598.690	78.640	2.222	80.862	21.00	6.68	.69	81.56	.00	1.64	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
106.840	.0052					.0086	.92	2.22	.00	2.00	.013	.00	.00	PIPE
1705.530	79.200	2.787	81.987	21.00	6.68	.69	82.68	.00	1.64	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JUNCT STR	.0400					.0086	.02	2.79	.00		.013	.00	.00	PIPE
1708.030	79.300	2.708	82.008	21.00	6.68	.69	82.70	.00	1.64	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.500	.0400					.0086	.02	2.71	.00	.96	.013	.00	.00	PIPE
1710.530	79.400	2.630	82.030	21.00	6.68	.69	82.72	.00	1.64	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
106.975	.0145					.0085	.91	2.63	.00	1.32	.013	.00	.00	PIPE
1817.505	80.952	2.000	82.952	21.00	6.68	.69	83.65	.00	1.64	.00	2.000	.000	.00	1 .0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.275	.0145					.0083	.01	2.00	.00	1.32	.013	.00	.00	PIPE

Date: 1-31-2012 Time: 1:51:35

Westcliff Pines 2
Onsite Storm Drain System - North
Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd. El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia. - FT	Base wt or I.D.	No Wth ZL	Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1818.780	80.970	1.990	82.960	21.00	6.69	.69	83.66	.00	1.64	.28	2.000	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Cross Section for NWC FLUME INLET

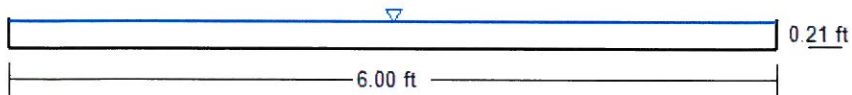
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.19510	ft/ft
Normal Depth	0.21	ft
Bottom Width	6.00	ft
Discharge	21.00	ft ³ /s

Cross Section Image



V: 1
H: 1

Worksheet for NWC FLUME INLET

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.19510	ft/ft
Bottom Width	6.00	ft
Discharge	21.00	ft ³ /s

Results

Normal Depth	0.21	ft
Flow Area	1.24	ft ²
Wetted Perimeter	6.41	ft
Hydraulic Radius	0.19	ft
Top Width	6.00	ft
Critical Depth	0.72	ft
Critical Slope	0.00366	ft/ft
Velocity	16.89	ft/s
Velocity Head	4.44	ft
Specific Energy	4.64	ft
Froude Number	6.54	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.72	ft
Channel Slope	0.19510	ft/ft
Critical Slope	0.00366	ft/ft

L. R. Nelson Consulting Engineers, Inc.

Worksheet for NWC FLUME INLET

Messages

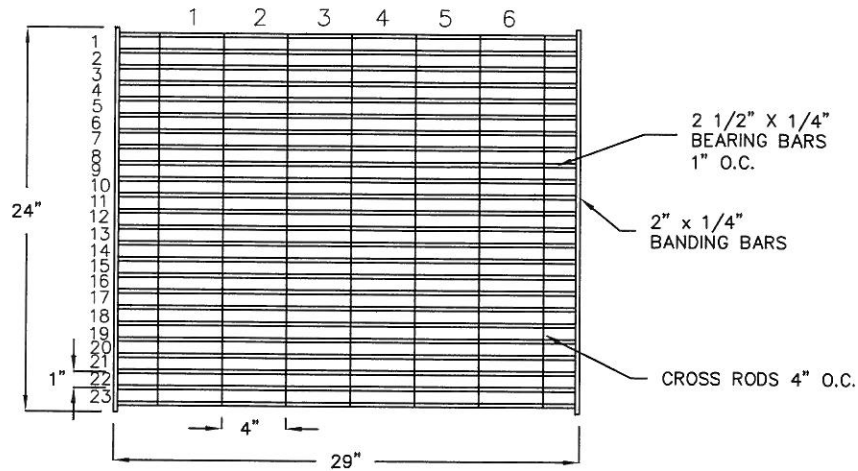
Notes

Q100 (21 cfs) REFERENCED FROM SILVER SKY ASSISTED LIVING TDS (DS3640)

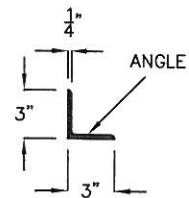
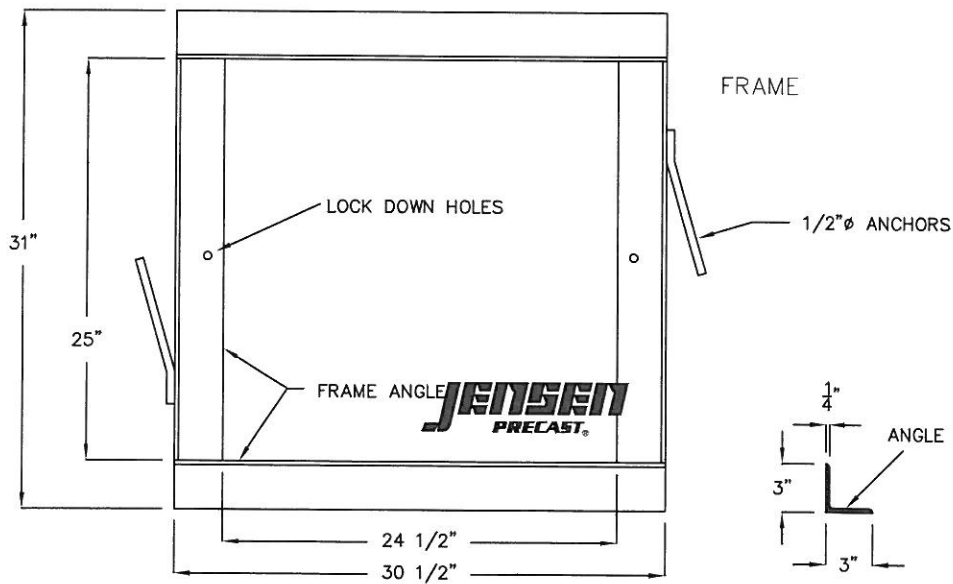
FRAME & GRATE

2424 DROP INLETS
H-20 TRAFFIC RATED

GRATE AREA OPENING ESTIMATE



0.0208 square ft.
 $23 \times 6 = 138$
 openings at
 0.0208 sq. ft.
 each
 Total = 2.875 sq. ft.



Worksheet for JENSEN 24" x 24" GRATE

Project Description

Solve For Headwater Elevation

Input Data

Discharge	0.50	ft ³ /s
Centroid Elevation	2585.00	ft
Tailwater Elevation	2584.00	ft
Discharge Coefficient	0.60	
Opening Area	1.44	ft ²

Results

Headwater Elevation	2585.01	ft
Headwater Height Above Centroid	0.01	ft
Tailwater Height Above Centroid	-1.00	ft
Velocity	0.35	ft/s

Messages

Notes

Standard Jensen Precast 24" by 24" grate opening:
23 x 6 = 138 openings at 0.0208 sq. ft. each is a total = 2.875 sq. ft.

Assuming Clogging Factor (CF) is 1/2 the total opening = 1.4375 sq. ft.

Hydraulic Analysis Report

Project Data

Project Title: Onsite
Designer: Staff
Project Date: Thursday, February 02, 2012
Project Units: U.S. Customary Units
Notes: Design - final

Curb and Gutter Analysis: Curb Analysis - 10 ft Type "A"

Notes:

Gutter Input Parameters

Longitudinal Slope of Road:	0.0050 (ft/ft)
Cross-Slope of Pavement:	0.0542 (ft/ft)
Depressed Gutter Geometry	
Cross-Slope of Gutter:	0.0867 (ft/ft)
Manning's n:	0.0160
Gutter Width:	1.5000 (ft)
Design Flow:	6.0000 (cfs)

Gutter Result Parameters

Width of Spread:	8.4907 (ft)
Gutter Depression:	0.5850 (in)
Area of Flow:	1.9903 (ft ²)
Eo (Gutter Flow to Total Flow):	0.4284
Gutter Depth at Curb:	6.1074 (in)

Inlet Input Parameters

Inlet Location:	Inlet in Sag
Percent Clogging:	50.0000 %
Inlet Type:	Curb Opening
Length of Inlet:	10.0000 (ft)
Curb opening height:	6.0000 (in)
Local Depression:	2.0000 (in)

Inlet Result Parameters

Perimeter:	12.7000 (ft)
Effective Perimeter:	6.3500 (ft)
Area: 6.6667 (ft ²)	
Effective Area: 3.3333 (ft ²)	
Depth at curb face (upstream of local depression):	0.5526 (ft)
Computed Width of Spread at Sag:	9.2966 (ft)
Flow type:	Weir Flow
Efficiency:	1.0000

Southern WSPG Analysis

Cross Section for SWC FLUME INLET

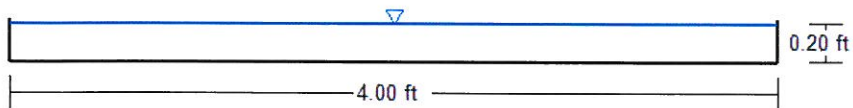
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.14410	ft/ft
Normal Depth	0.20	ft
Bottom Width	4.00	ft
Discharge	11.00	ft ³ /s

Cross Section Image



V: 1
H: 1

Worksheet for SWC FLUME INLET

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.14410	ft/ft
Bottom Width	4.00	ft
Discharge	11.00	ft ³ /s

Results

Normal Depth	0.20	ft
Flow Area	0.79	ft ²
Wetted Perimeter	4.40	ft
Hydraulic Radius	0.18	ft
Top Width	4.00	ft
Critical Depth	0.62	ft
Critical Slope	0.00414	ft/ft
Velocity	13.87	ft/s
Velocity Head	2.99	ft
Specific Energy	3.19	ft
Froude Number	5.49	
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	0.20	ft
Critical Depth	0.62	ft
Channel Slope	0.14410	ft/ft
Critical Slope	0.00414	ft/ft

Worksheet for SWC FLUME INLET

Messages

Notes

OFFSITE Q100 = 11 CFS PER CLV REFERENCE - DS3640

Westcliff Pines 2
Onsite Storm Drain System - South Side
Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top	Height/Dia.	Base Wt or I.D.	ZL	No Wth
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1000.000	75.150	2.550	77.700	11.00	6.22	.60	78.30	.00	1.27	.00	1.500	.000	.00	1 .0
70.670	.0103					.0110	.77	2.55	.00	1.27	.013	.00	.00	PIPE
1070.670	75.880	2.708	78.588	11.00	6.22	.60	79.19	.00	1.27	.00	1.500	.000	.00	1 .0
JUNCT STR	.0400					.0110	.05	2.71	.00		.013	.00	.00	PIPE
1075.670	76.080	2.562	78.642	11.00	6.22	.60	79.24	.00	1.27	.00	1.500	.000	.00	1 .0
91.110	.0105					.0110	1.00	2.56	.00	1.26	.013	.00	.00	PIPE
1166.780	77.040	2.715	79.755	11.00	6.22	.60	80.36	.00	1.27	.00	1.500	.000	.00	1 .0
JUNCT STR	.0400					.0110	.05	2.72	.00		.013	.00	.00	PIPE
1171.780	77.240	2.570	79.810	11.00	6.22	.60	80.41	.00	1.27	.00	1.500	.000	.00	1 .0
115.000	.0096					.0110	1.26	2.57	.00	1.37	.013	.00	.00	PIPE
1286.780	78.340	2.827	81.167	11.00	6.22	.60	81.77	.00	1.27	.00	1.500	.000	.00	1 .0
JUNCT STR	.0400					.0110	.05	2.83	.00		.013	.00	.00	PIPE
1291.780	78.540	2.682	81.222	11.00	6.22	.60	81.82	.00	1.27	.00	1.500	.000	.00	1 .0
12.222	.0602					.0110	.13	2.68	.00	.68	.013	.00	.00	PIPE
1304.002	79.276	2.086	81.362	11.00	6.22	.60	81.96	.00	1.27	.00	1.500	.000	.00	1 .0
HYDRAULIC JUMP														
1304.002	79.276	.761	80.037	11.00	12.22	2.32	82.36	.00	1.27	1.50	1.500	.000	.00	1 .0
1.665	.0602					.0418	.07	.76	2.78	.68	.013	.00	.00	PIPE

Westcliff Pines 2
Onsite Storm Drain System - South Side
Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1305.667	79.376	.761	80.137	11.00	12.22	2.32	82.46	.00	1.27	1.50	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
8.667	.0602					.0393	.34	.76	2.78	.68	.013	.00	.00	PIPE
1314.334	79.898	.790	80.689	11.00	11.65	2.11	82.80	.00	1.27	1.50	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
6.285	.0602					.0346	.22	.79	2.59	.68	.013	.00	.00	PIPE
1320.619	80.277	.821	81.098	11.00	11.11	1.92	83.01	.00	1.27	1.49	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
4.779	.0602					.0306	.15	.82	2.40	.68	.013	.00	.00	PIPE
1325.398	80.565	.854	81.418	11.00	10.59	1.74	83.16	.00	1.27	1.49	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
3.739	.0602					.0270	.10	.85	2.23	.68	.013	.00	.00	PIPE
1329.136	80.790	.888	81.678	11.00	10.10	1.58	83.26	.00	1.27	1.47	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2.967	.0602					.0239	.07	.89	2.07	.68	.013	.00	.00	PIPE
1332.103	80.968	.924	81.892	11.00	9.63	1.44	83.33	.00	1.27	1.46	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2.366	.0602					.0212	.05	.92	1.92	.68	.013	.00	.00	PIPE
1334.469	81.111	.962	82.073	11.00	9.18	1.31	83.38	.00	1.27	1.44	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1.883	.0602					.0188	.04	.96	1.77	.68	.013	.00	.00	PIPE
1336.352	81.224	1.003	82.228	11.00	8.76	1.19	83.42	.00	1.27	1.41	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1.475	.0602					.0167	.02	1.00	1.64	.68	.013	.00	.00	PIPE
1337.827	81.313	1.047	82.361	11.00	8.35	1.08	83.44	.00	1.27	1.38	1.500	.000	.00	1 .0
- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1.122	.0602					.0149	.02	1.05	1.50	.68	.013	.00	.00	PIPE

Westcliff Pines 2
 Onsite Storm Drain System - South Side
 Job No. 818-021-011

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top	Height/Dia.	Base Wt/I.D.	ZL	No Wth
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1338.949	81.381	1.095	82.476	11.00	7.96	.98	83.46	.00	1.27	1.33	1.500	.000	.00	1 .0
.805	.0602					.0133	.01	1.09	1.38	.68	.013	.00	.00	PIPE
1339.754	81.429	1.147	82.576	11.00	7.59	.89	83.47	.00	1.27	1.27	1.500	.000	.00	1 .0
.498	.0602					.0120	.01	1.15	1.25	.68	.013	.00	.00	PIPE
1340.252	81.459	1.204	82.663	11.00	7.24	.81	83.48	.00	1.27	1.19	1.500	.000	.00	1 .0
.178	.0602					.0109	.00	1.20	1.13	.68	.013	.00	.00	PIPE
1340.430	81.470	1.270	82.740	11.00	6.89	.74	83.48	.00	1.27	1.08	1.500	.000	.00	1 .0

Cross Section for OUTLET-SOUTH SD

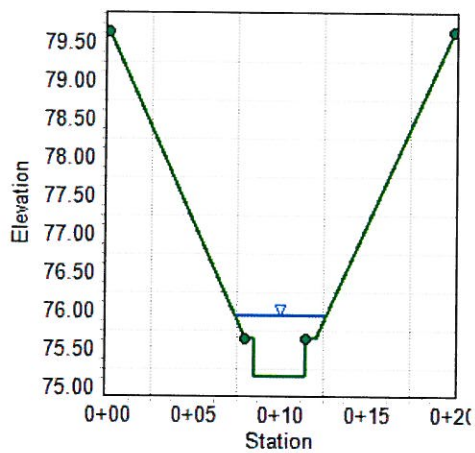
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01170	ft/ft
Normal Depth	0.81	ft
Discharge	18.00	ft ³ /s

Cross Section Image



Worksheet for OUTLET-SOUTH SD

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.01170 ft/ft
Discharge 18.00 ft³/s
Section Definitions

Station (ft)

Elevation (ft)

0+00.00	79.65
0+08.00	75.65
0+08.50	75.65
0+08.50	75.15
0+10.00	75.14
0+11.50	75.15
0+11.50	75.65
0+12.00	75.65
0+20.00	79.65

Roughness Segment Definitions

Start Station

Ending Station

Roughness Coefficient

(0+00.00, 79.65)	(0+08.00, 75.65)	0.030
(0+08.00, 75.65)	(0+11.50, 75.65)	0.013
(0+11.50, 75.65)	(0+20.00, 79.65)	0.030

Options

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

Results

Normal Depth 0.81 ft
Elevation Range 75.14 to 79.65 ft

L. R. Nelson Consulting Engineers, Inc.

Worksheet for OUTLET-SOUTH SD

Results

Flow Area	2.91	ft ²
Wetted Perimeter	6.36	ft
Hydraulic Radius	0.46	ft
Top Width	5.21	ft
Normal Depth	0.81	ft
Critical Depth	0.99	ft
Critical Slope	0.00513	ft/ft
Velocity	6.18	ft/s
Velocity Head	0.59	ft
Specific Energy	1.41	ft
Froude Number	1.46	
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	0.81	ft
Critical Depth	0.99	ft
Channel Slope	0.01170	ft/ft
Critical Slope	0.00513	ft/ft

Worksheet for SEC WALL OPENING - WEIR

Project Description

Solve For Headwater Elevation

Input Data

Discharge	18.00	ft ³ /s
Crest Elevation	75.00	ft
Tailwater Elevation	77.38	ft
Weir Coefficient	3.00	US
Crest Length	3.11	ft
Number Of Contractions	2	

Results

Headwater Elevation	77.72	ft
Headwater Height Above Crest	2.72	ft
Tailwater Height Above Crest	2.38	ft
Flow Area	8.47	ft ²
Velocity	2.12	ft/s
Wetted Perimeter	8.56	ft
Top Width	3.11	ft

Messages

Notes

TW assumed to be top of pipe in Starfire Estates where original RCP INV ELEV = 73.3 (DS1183) + 2.33' (datum update) + 1.75' (21" RCP) = 77.38

Wall opening crest length = 4'-8" (4.67'); when reduced by 50% for clogging factor => $4.67 \div 1.5 = 3.11$ ft

Appendix D: Referenced Information

CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		October 7, 2004
TO: Land Development Services Department of Public Works		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
	Silver Sky Assisted Living	TRC (BV Engineering)
Cross Streets:	NWQ of Cimarron Road & Westcliff Drive	Affirmative Investments
File Number:	F:\Depot\DSMemos\DS3640B.doc	Bart Anderson, P.E., DevCo
Parcel Number:	138-28-401-014	
Zoning Action:	ZON-4529; SDR-4572	
FEMA Flood Zone	YES NO X	
Proposed Storm Drain	YES X NO	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1 st Submittal	9/2/2004	9/17/2004	Not Approved	\$400.00	9027: \$400
2 nd Submittal	9/24/2004	10/6/2004	See Comments Below	\$400.00	10012: \$400
TOTAL FEES (LDDRS):				\$800.00	----

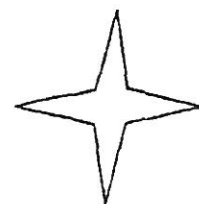
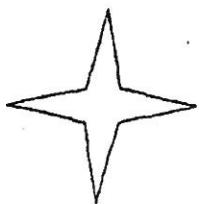
REMARKS:

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.

1. The wrought iron fence proposed on the north side of the drainage easement must utilize Detail 421B. Contact Rosa Cortez at 229-6171 for the AutoCAD details (421 series) to be included with the improvement plans.
2. The engineer has provided 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.*
3. This site accepts offsite flows and conveys them through the site. There are two, "20-foot wide Public Drainage Easement to be Privately Maintained" drainage easements shown on the grading plans. *Public drainage easements must be recorded by separate document prior to the final acceptance of the improvement plans unless they are to be recorded by parcel or final map. Provide legal descriptions and exhibits to the Flood Control and Right-of-Way Sections for review and approval.*

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.



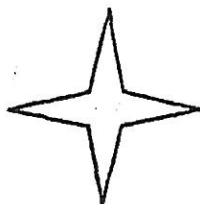
DS # 3640

DS INDEX:

APN: 138 - 28 - 401 - 014

PROJECT: Silver Sky Assisted Living

SUBMITTAL 1st Submittal



TECHNICAL DRAINAGE STUDY

FOR

SILVER SKY ASSISTED LIVING

Located northwest of Summerlin Parkway
Cimarron Road intersection
SE ¼, SW ¼, Sec. 28, T20S, R60E
APN. 138-28-401-014
Las Vegas, Nevada
TRC Job # 609.003
September 2004

DS3640
L28
400
9/2/04

Prepared by:

TRC

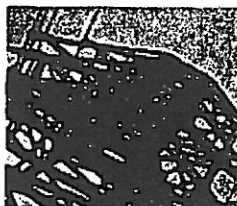
Customer-Focused Solutions

BV Engineering Nevada

8395 W. Sunset Road, Suite 190
Las Vegas, Nevada 89113
Phone (702) 650-0572, Fax (702) 307-4222



INFRASTRUCTURE



ENERGY



ENVIRONMENTAL



LAND DEVELOPMENT

Prepared for:

Affirmative Investments
33 Union Street
Boston, MA 02108
Phone: (617) 367-4300 Fax: (617) 367-1333

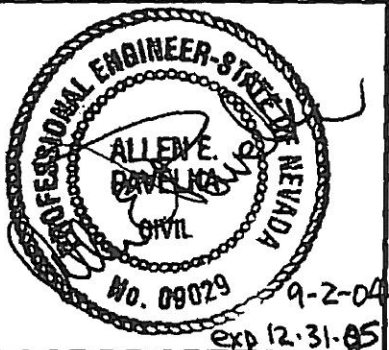
HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Silver Sky Assisted Living Date: September 2, 2004Location of Development: a) Descriptive (Cross Streets) NWC Roland Wiley & Silver Sky Circleb) Sect. 28 Twn. 20S Rng. 60EName of Owner: Affirmative Investments Assessors Parcel No. 138-28-401-014Telephone No: (617) 367-4300 Facsimile No: (617) 367-1333Address: 33 Union Street Boston MA 02108Contact Person-Name: David Yancy Telephone No: (702) 650-0572Firm: TRC - BV EngineeringAddress: 8395 W. Sunset Rd., Suite 190 Las Vegas, Nevada 89113

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: ± 10 Acres Being Developed/Disturbed: ± 10 Acres2. Is a portion of 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 (Condominiums)5. Approximate upstream land area which drains to the subject site? ±15 acres6. Has the site drainage been evaluated in the past? Yes ☐ No ☒ If yes, please identify documentation:7. If known, please briefly identify the proposed discharge point(s) of runoff from the site:
Historic path- Summerlin Parkway; Silver Sky Circle8. Briefly describe your proposed schedule for the subject project: ASAP

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

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

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

west of Durango will not impact the site. Currently, flow from existing offsite basins EOF2 and EOF6 combine and are piped through the northern portion of Starfire Estates, also known as basin EOF13. This flow in addition to the flow generated by basin EOF13 is discharged into basin EON1, which is the northern portion of the proposed project site. Flow generated by basins EOF3 and EOF7 combine at an existing 24" RCP inlet and the flow is conveyed to onsite basin EON3. Basin EOF14 discharges onto the street but is conveyed back onto EON3. The total flow from basins EOF3, EOF7, and EOF14 combine with runoff generated by basin EON3 and drain to an existing blockwall opening at the eastern portion of the site. This opening transitions to a 30" storm drain RCP that conveys the flow through Starfire Estates II.

While the above mentioned basins contribute to flow impacting the project site, all other offsite basins delineated on the drainage map that are south of the Silver Sky Drive centerline contribute to flow that reaches a drainage easement at the Silver Sky Drive cul-de-sac. Flow generated by on-site and offsite basins in the existing condition may be found in **Table 1**. Please see **Figure 5** in Appendix A for the existing drainage map.

2.3 INTERIM CONDITION DRAINAGE BASINS

The interim condition consists of 7 on-site basins and the original 16 existing offsite basins as shown on **Figure 6**. It should be noted that although the offsite basins are known to be in existing condition, the existing condition of all but 2 of the basins are developed. The basins were derived from topographic information for the area.

Upon development, basins DON1, DON2, DON3 and DON4 maintain their historic drainage path and combine with basins EOF2, EOF6 and EOF13 which ultimately drain to an existing swale just south of the Summerlin Parkway alignment. Basins EOF2, EOF6 and EOF13 will drain onto basin DON1. Velocities from the offsite basins that drain onto DON1 exceed 5 fps, therefore; the flow will be conveyed in a riprap channel to wall openings that are provided to allow the flow to drain to its historic path, which is Summerlin Parkway. Blockwall opening calculations are included in the appendix for the above-mentioned openings. The 24" RCP that conveys flows from basins EOF3 and EOF7 is extended underneath basin DON5 where the flow daylights in basin DON6. DON6 is graded to drain into the existing wall opening east of the site where the flow will be conveyed downstream through the existing 24" RCP. It should be noted that while in the existing scenario, the flow generated by basin EOF14, was conveyed back onto basin EON1, upon development of the project site, the flow from basin EOF14 will be conveyed east on Silver Sky Drive where it will drain to the existing drainage easement. This additional flow will be captured downstream in a proposed inlet where it will be conveyed back to the existing wall opening so that the existing drainage easement will not exceed the flow that it receives in the existing condition. Refer to section 4 of the report for a detailed explanation regarding the existing easement and proposed inlet.

All offsite basins south of the Silver Sky Drive centerline drain to the exiting roadway and ultimately to the drainage easement. Flow generated by on-site and offsite basins in the interim condition may be found in **Table 2**. Please see **Figure 6** in Appendix A for the interim drainage map.

2.4 ULTIMATE CONDITION DRAINAGE BASINS

The ultimate condition consists of all on-site and offsite basins as developed. **Figure 7** shows the ultimate condition drainage map. It must be noted that the ultimate condition assumes that offsite basins that did not contain development are developed and retain their historic drainage pattern as shown in the existing condition. By making this assumption, a conservative approach is taken in the design of the site. This will ensure that the site is designed to assume the worst case impact to the project site in terms of runoff. Due to the fact that all basins except for two were developed, the ultimate analysis does not vary much from the interim condition analysis. Upon development of DOF7 and DOF6, it is assumed that the development will continue to utilize the existing 24" RCP's that are in place to drain the flow into our project site. All flow patterns remain unchanged from the interim condition drainage analysis.

Flow patterns for the basins that were described above can be found on **Figure 7** and **Table 3** contains flows generated by each site in the ultimate condition.

3.0 HYDROLOGIC ANALYSIS

3.1 HYDROLOGIC METHODOLOGY AND CRITERIA

The methodology in this study is in compliance with the CCRFCD Hydrologic Criteria and Drainage Design Manual (Reference 1, hereafter referred to as *HCDDM*). All drainage improvements shall be designed to meet the requirements of the *HCDDM*.

The watersheds were modeled using the SCS unit hydrograph method within the U.S. Army Corps of Engineers HEC-1 Flood Hydrograph Package (Reference 4)

3.1.1 Time of Concentration

The procedure for determining the Lag Time (T_L) and Time of Concentration (T_c) is outlined in Section 602 of the *HCDDM*. This study uses the T_L and T_c from the Standard Form 4 to determine the appropriate peak flows.

3.1.2 Precipitation

The project site lies within the McCarran Airport Rainfall Area. The rainfall depths for the 6-hour, 10-year and 100-year storm events were determined from the *HCDDM*. The subject site has a maximum rainfall depth of 1.58 inches and 2.77 inches, respectively, during the 10-year and 100-year 6-hour storm duration. Since the site encompasses less than 8-square miles a Storm Distribution Number three (SDN #3) was used for the HEC-1 model. HEC-1 parameters are included in the appendix and **Tables 1, 2 & 3**. Refer to Table 505 from the *HCDDM* in the appendix for rainfall values.

3.2 HYDROLOGIC RESULTS

The storm flow summary for the existing conditions is summarized in **Table 1**. The Hec-1 analysis is included in Appendix A. In the existing condition the off-site and on-site basins are in their existing condition.

TABLE 1 EXISTING STORM FLOW SUMMARY			
Basin	Area (ac)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
EON1	0.94	1	2
EON2	2.54	2	6
EON3	7.00	6	16

TABLE 1 EXISTING STORM FLOW SUMMARY			
Basin	Area (ac)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
PT9	----	25	51
PT10	----	31	65
PT11	----	17	40

The storm flow summary for the interim development conditions is summarized in Table 2. The Hec-1 analysis is included in Appendix A. In the interim condition the off-site basins are in the existing condition and the onsite basins are analyzed as developed.

TABLE 2 INTERIM STORM FLOW SUMMARY			
Basin	Area (ac)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
DON1	0.71	1	2
DON2	1.27	2	4
DON3	1.77	3	6
DON4	2.75	4	9
DON5	2.90	4	9
DON6	0.56	1	2
DON7	0.56	1	2
EOFF2	6.91	10	21
EOFF3	3.71	5	11
EOFF4	3.14	5	10
EOFF5	2.87	5	10
EOFF6	2.21	2	5
EOFF7	2.98	3	7
EOFF8	0.77	1	3

TABLE 2 INTERIM STORM FLOW SUMMARY			
Basin	Area (ac)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
EOFF9	5.57	8	16
EOFF10	0.69	1	3
EOFF11	3.97	5	11
EOFF12	4.25	6	12
EOFF13	2.80	5	9
EOFF14	2.42	4	8
EOFF15	0.31	1	1
EOFF16	0.22	0	1
EOFF17	0.23	1	1
PT2	----	12	25
PT3	----	16	34
PT4	----	16	35
PT5	----	24	52
PT6	----	10	20
PT6A	----	11	22
PT7	----	24	49
PT8	----	29	60
PT9	----	40	83
PT9A	----	33	69
PT10	----	8	17
PT11	----	8	18

The storm flow summary for the ultimate future development condition is summarized in **Table 3**. The Hec-1 analysis is included in Appendix A. In the Future condition, the site is assumed to be developed, all streets are at full build out,

and all surrounding development is assumed to be in place. The resulting 10-year and 100-year discharge values are listed in **Table 3**.

TABLE 3 FUTURE STORM FLOW SUMMARY			
Basin	Area (ac)	Q₁₀ (cfs)	Q₁₀₀ (cfs)
DON1	0.71	1	2
DON2	1.27	2	4
DON3	1.77	3	6
DON4	2.75	4	9
DON5	2.90	4	9
DON6	0.56	1	2
DON7	0.56	1	2
DOFF2	6.91	10	21
DOFF3	3.71	5	11
DOFF4	3.14	5	10
DOFF5	2.87	5	10
DOFF6	2.21	4	7
DOFF7	2.98	5	10
DOFF8	0.77	1	3
DOFF9	5.57	8	16
DOFF10	0.69	1	3
DOFF11	3.97	5	11
DOFF12	4.25	6	12
DOFF13	2.80	5	9
DOFF14	2.42	4	8
DOFF15	0.31	1	1
DOFF16	0.22	0	1

TABLE 3 FUTURE STORM FLOW SUMMARY			
Basin	Area (ac)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
DOFF17	0.23	1	1
PT2	----	13	28
PT3	----	18	36
PT4	----	18	38
PT5	----	26	54
PT6	----	10	20
PT6A	----	11	22
PT7	----	24	49
PT8	----	29	60
PT9	----	40	83
PT9A	----	33	69
PT10	----	10	21
PT11	----	10	21

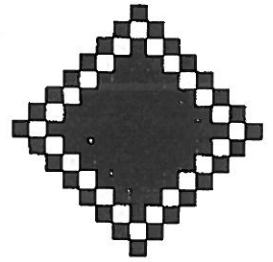
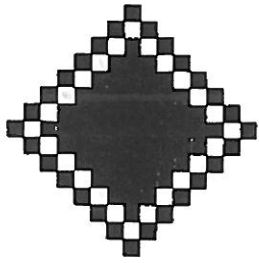


Facilities proposed with this development will see the worst case flows in the ultimate condition. For this reason, inlets, riprap, and all facilities proposed with this site are sized using the most conservative flow from the analysis.

3.2.1 Street Flow

All CCRFCD criteria for the minor and major storm events will be met for the proposed streets. CCRFCD requires that in a 10-year storm event, a major street is required to maintain a velocity (V) times depth (D) of less than 6 in addition to maintaining a 19-foot (12-foot lane plus 7-feet in the center lane) dry lane and in a 100-year storm event a velocity (V) times depth (D) of less than 8 must be maintained. A minor street is required to maintain a velocity (V) times depth (D) of less than 6.

Silver Sky Drive is a 60-foot right-of-way. In the interim and future condition, Silver Sky Drive will have full street improvements adjacent to the site. Street sections for Silver Sky Drive and interior street sections are summarized below in **Table 4**. Dry lane criteria is not applicable for any of the streets listed below.



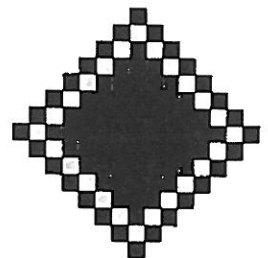
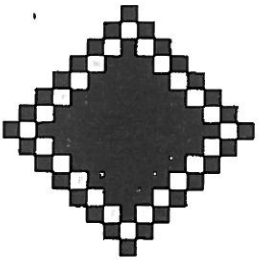
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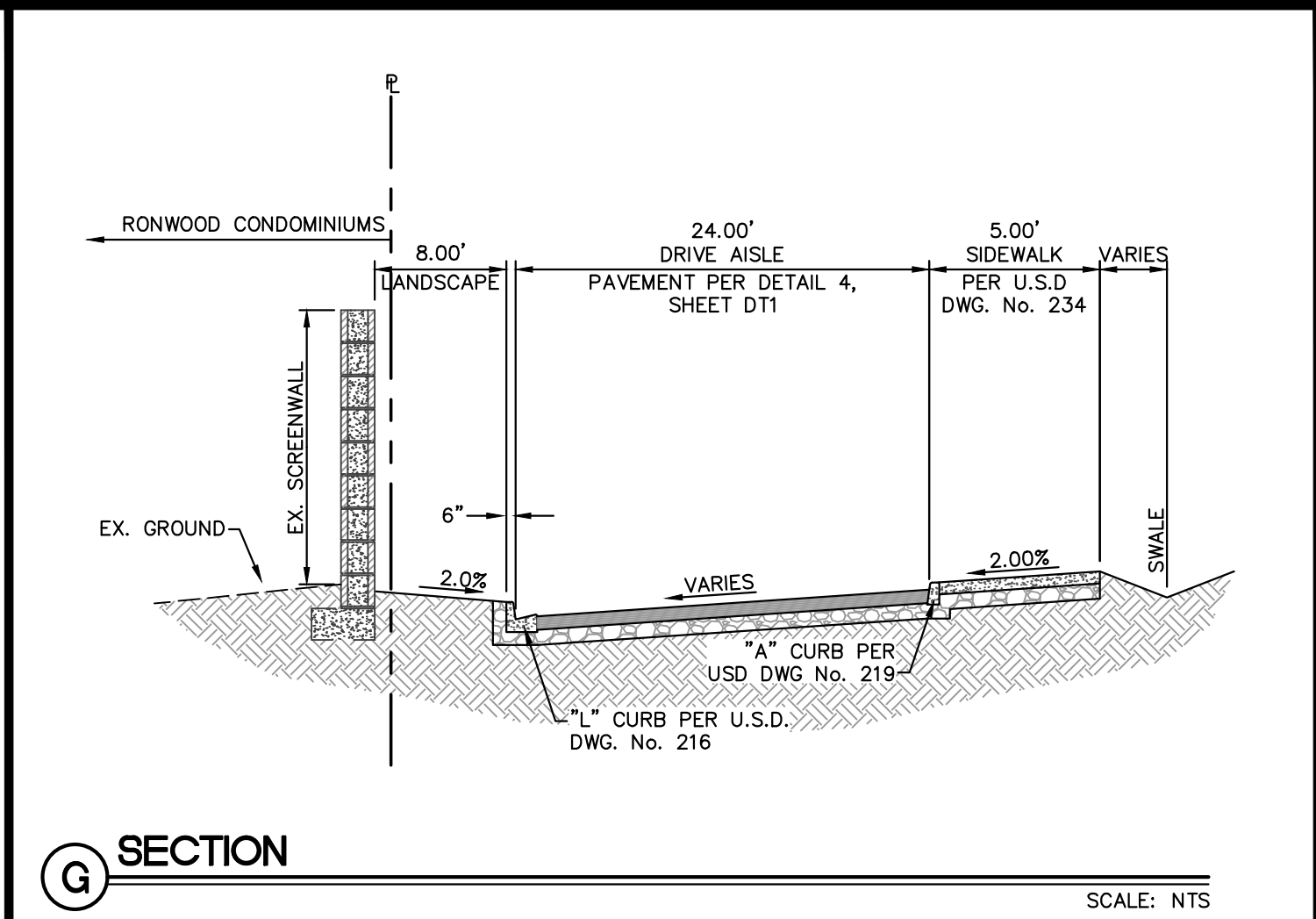
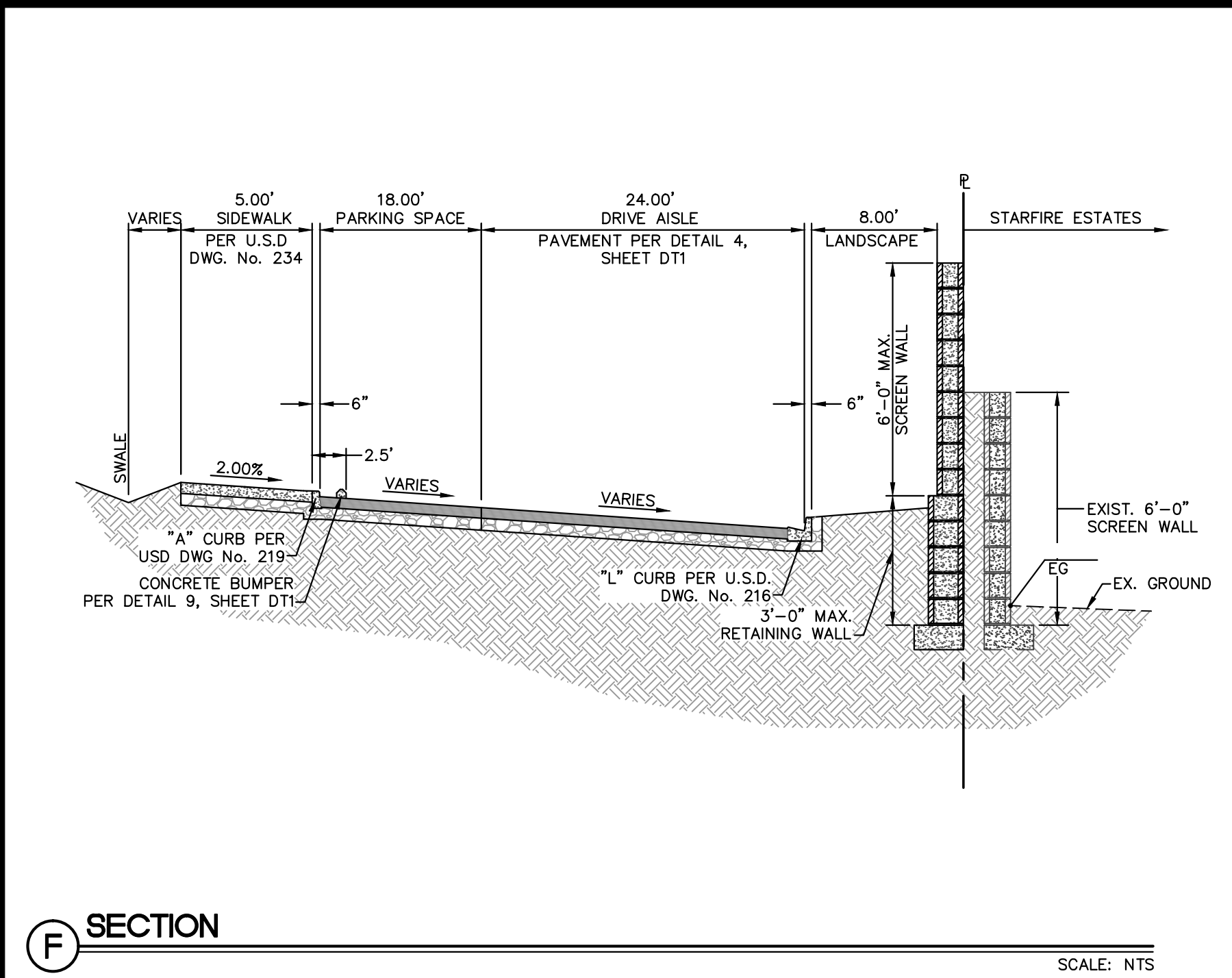
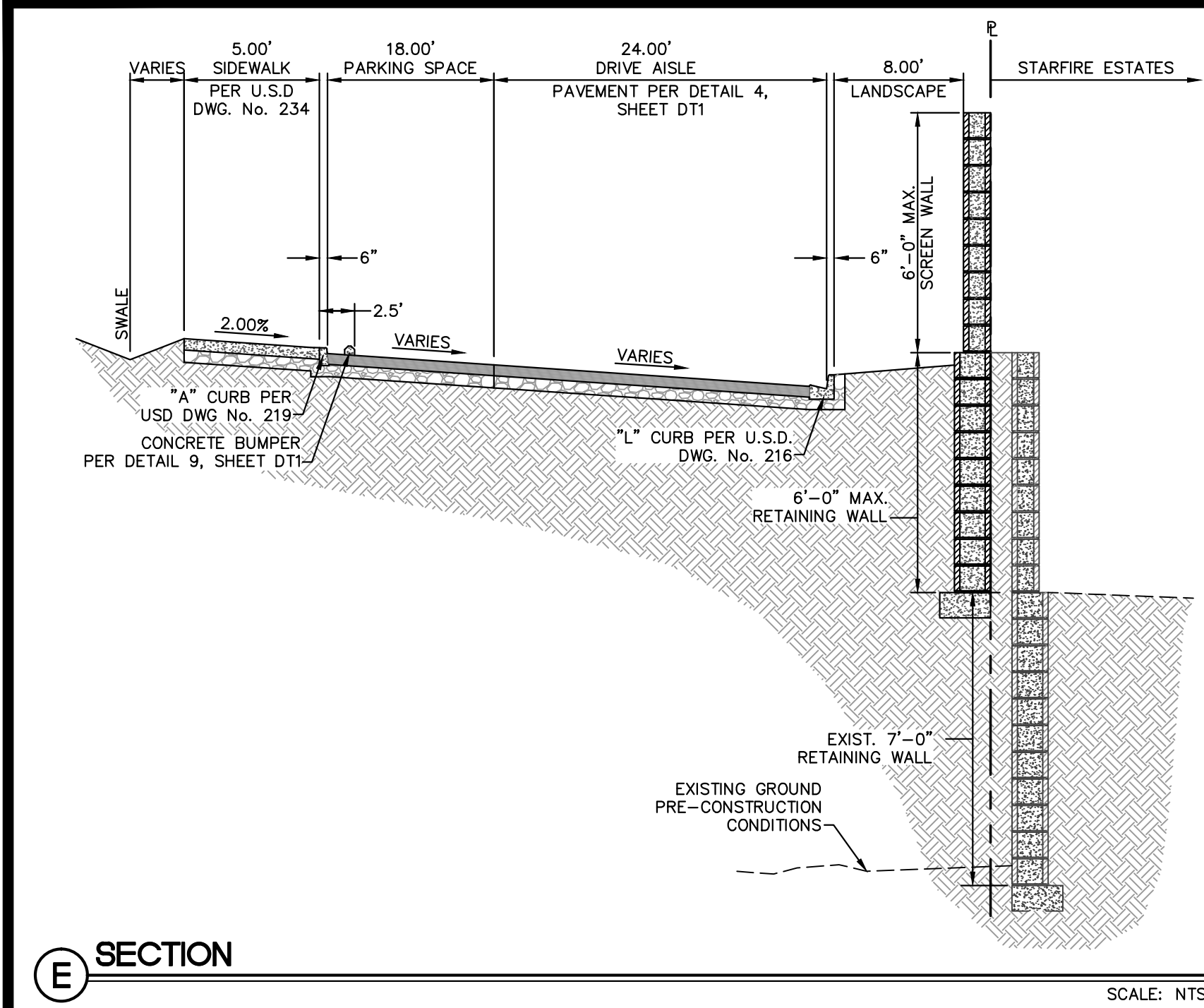
DS INDEX: _____

APN: 138-28-401-003

PROJECT: Starfive Estates

SUBMITTAL: Drainage and Grading





WALL NOTE:

ALL RETAINING AND FENCE WALLS SHALL BE REVIEWED BY THE BUILDING DEPARTMENT. WALL PERMITS ARE ISSUED THROUGH THE BUILDING DEPARTMENT.

SOILS REPORT

GEOTEK, INC. - NEVADA
DATED FEBRUARY 3, 2011
PROJECT No. 10251-LV6

REV No.	REVISION DESCRIPTION	APPD BY/DATE APPD

NEVADA H.A.N.D.
295 EAST WARM SPRINGS ROAD SUITE 101
LAS VEGAS, NEVADA 89118
TEL: (702) 739-3345 CONTACT: ROBERT FEGLEMAN

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

DETAILS SHEET 2

WESTCLIFF PINES 2

ROLAND WILEY ROAD and SILVER SKY DRIVE

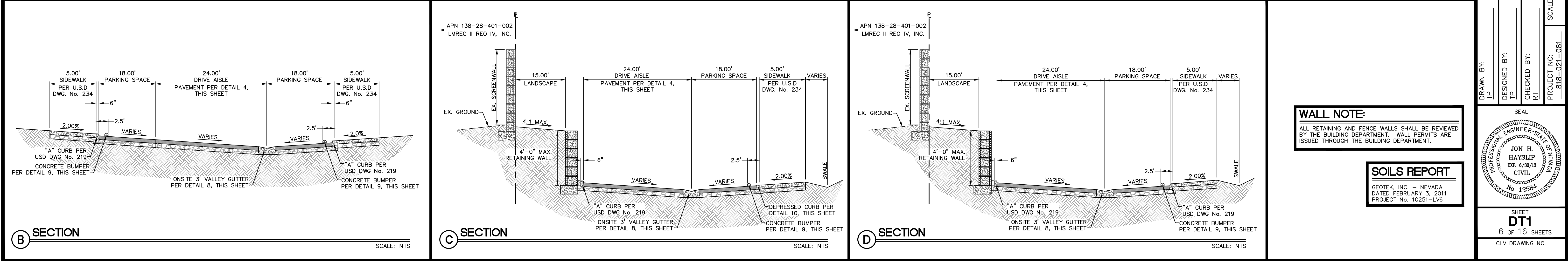
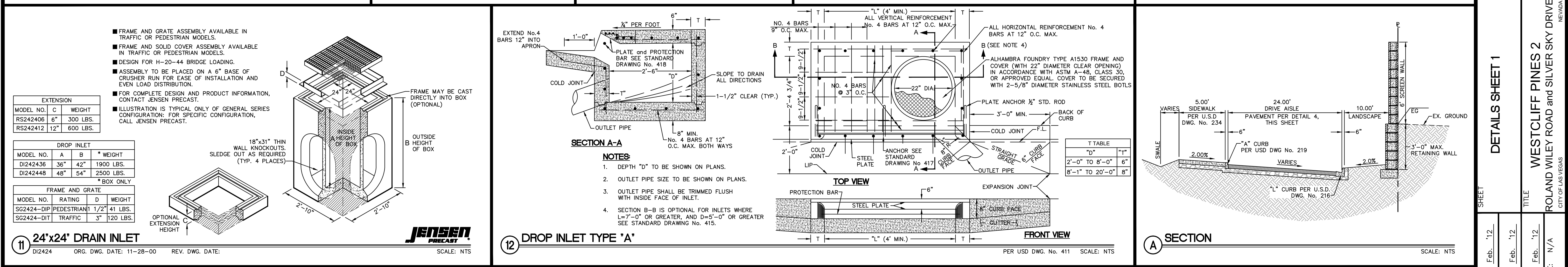
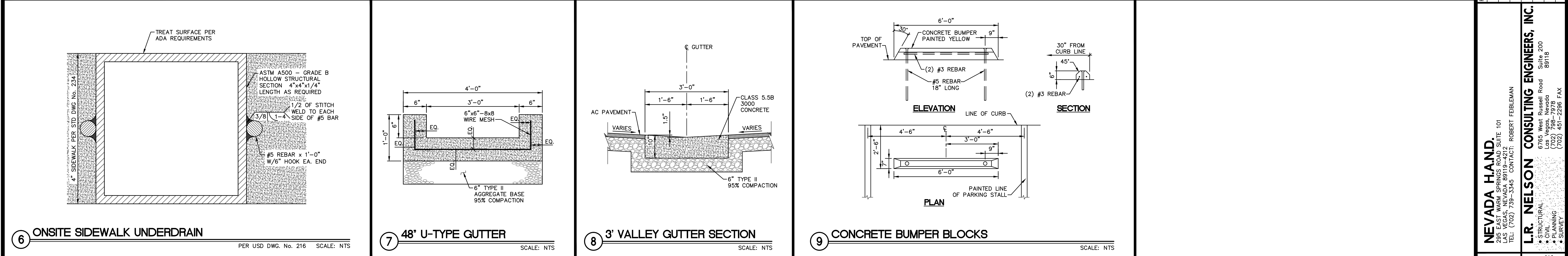
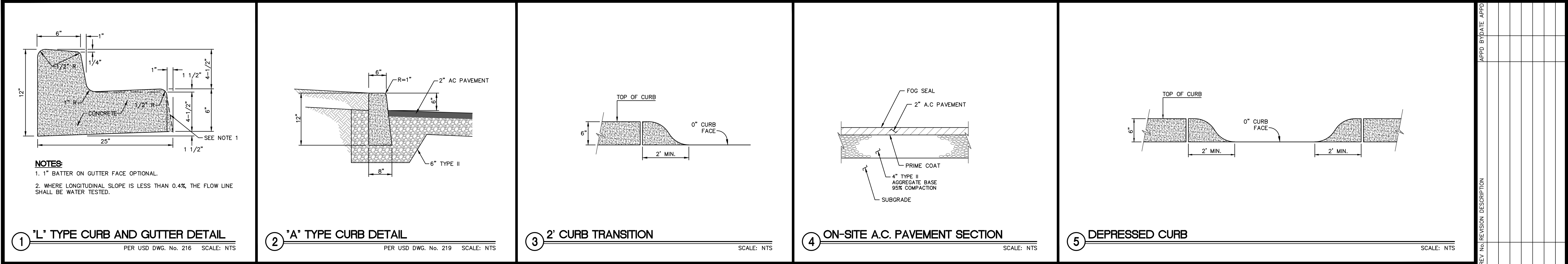
CITY OF LAS VEGAS

SHEET	TITLE	DATE	SCALE

PROFESSIONAL ENGINEER - STATE OF NEVADA

JON H. HAYSLIP
EXP. 6/30/13
CIVIL
No. 12584

SHEET
DT2
7 OF 16 SHEETS
CLV DRAWING NO.



APPD BY DATE APPD

REV No. REVISION DESCRIPTION

NEVADA HAND.
295 EAST WARM SPRINGS ROAD SUITE 101
LAS VEGAS, NEVADA 89118
TEL: (702) 739-3345 CONTACT: ROBERT FIELEMAN

L.R. NELSON CONSULTING ENGINEERS, INC.
STRUCTURAL
CIVIL
PLANNING
SURVEY
6785 West Russell Road Suite 200
Las Vegas, Nevada 89118
(702) 798-7978
(702) 451-2286 FAX

DETAILS SHEET 1

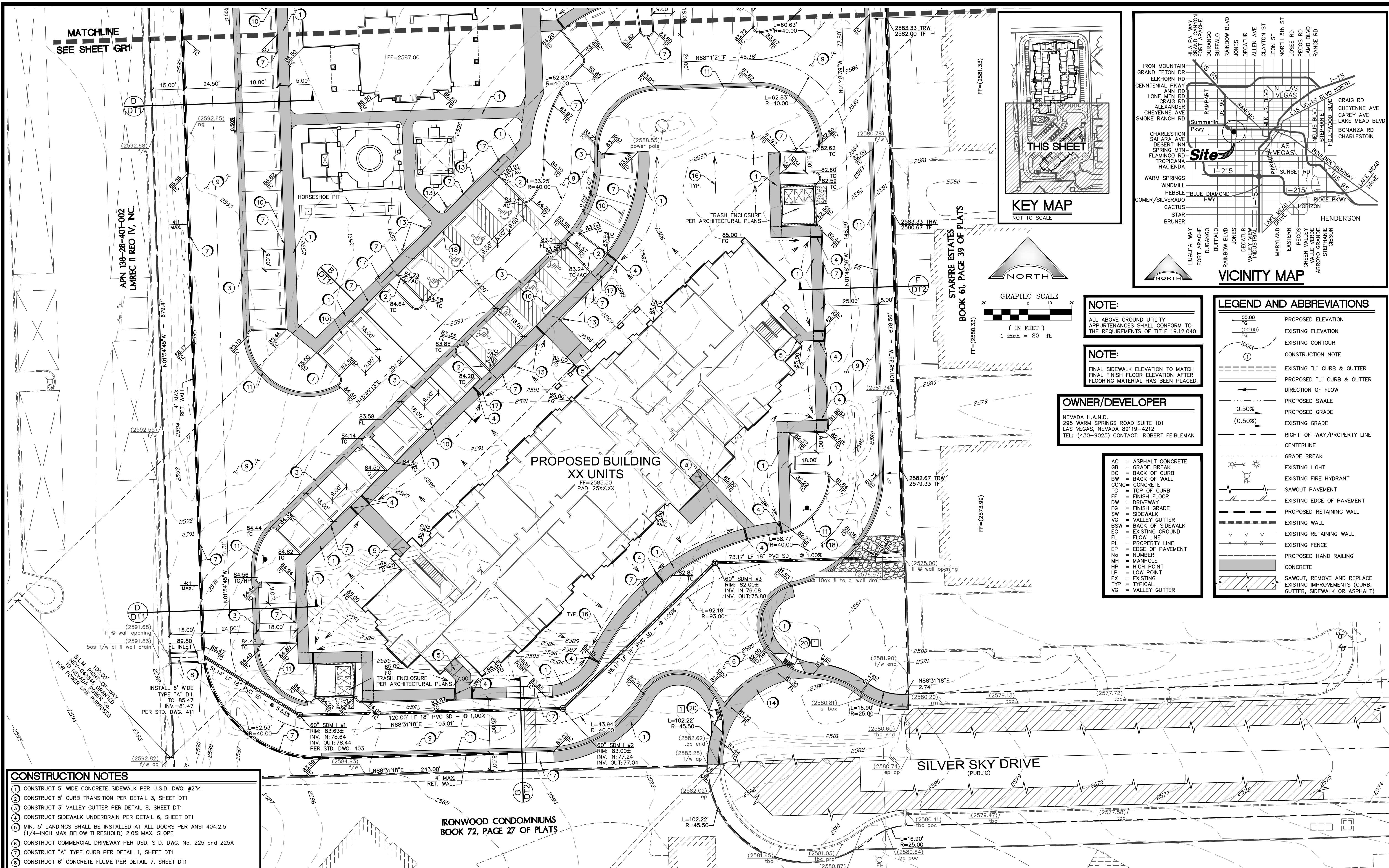
TITLE
WESTCLIFF PINES 2
ROLAND WILEY ROAD and SILVER SKY DRIVE
CITY OF LAS VEGAS

DRAWN BY: Feb. '12
DESIGNED BY: Feb. '12
CHECKED BY: Feb. '12
PROJECT NO.: N/A
SCALE: N/A
SHEET
DT1
6 OF 16 SHEETS
CLV DRAWING NO.

WALL NOTE:
ALL RETAINING AND FENCE WALLS SHALL BE REVIEWED BY THE BUILDING DEPARTMENT. WALL PERMITS ARE ISSUED THROUGH THE BUILDING DEPARTMENT.

SOILS REPORT
GEOTEK, INC. - NEVADA
DATED FEBRUARY 3, 2011
PROJECT No. 10251-LV8

PROFESSIONAL ENGINEER - STATE OF NEVADA
JON H. HAYSLIP
EXP. 6/30/13
CIVIL
No. 12584



- CONSTRUCTION NOTES**
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 13. CONSTRUCT 8" CONCRETE CROSS GUTTER PER STD. DWG. 228
 14. 24"x24" JENSEN DROP INLET OR EQUIVALENT
 15. CONSTRUCT DRAINAGE SWALE @ 1.0% MIN.
 16. RAMP @ 1:12 MAX. (TYP.)
 17. CONSTRUCT DEPRESSED CURB PER DETAIL 5, SHEET DT1
 18. INSTALL ADA HAND RAILING PER ADA STANDARDS
 19. CONSTRUCT SIDEWALK RAMPS USING ARMOR TILE TRUNCATED DOMES OR EQUIVALENT PER CCAUD No. 235 (CASE 1)

SOILS REPORT

GEOTEK, INC. - NEVADA
DATED FEBRUARY 3, 2011
PROJECT NO. 10251-LV6

BENCHMARK

FOUND RIVET AND PLATE IN THE TOP OF CURB AT THE NW CORNER OF WESTCLIFF AND CIMARRON

#909 OLVOO 2854
777.8633 (m) 2552.04 (ft)

I CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT (DS).

JON H. HAYSLIP P.E. NO. 12584 DATE

WHEELCHAIR RAMP DATA

No.	"A"	"B"
1	8.0'	8.0'

BASIS OF BEARING

NORTH 88°31'18" EAST, BEING THE BEARING OF THE SOUTH LINE OF THE NORTHWEST QUARTER (NW 1/4) OF THE SOUTHEAST QUARTER (SE 1/4) OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 28, TOWNSHIP 20 SOUTH, RANGE 60 EAST, M.D.M., AS SHOWN ON A MAP ON FILE IN THE CLARK COUNTY, NEVADA RECORDER'S OFFICE AS FILE 109, PAGE 2 OF PARCEL MAPS.

FEMA FLOOD PLAIN INFORMATION

ACCORDING TO THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM) COMMUNITY-PANE NUMBERS 32003C 2145E, DATE SEPTEMBER 27, 2002, THE SITE IS LOCATED WITHIN A ZONE "X". A ZONE "X" IS DESCRIBED BY FEMA AS AN AREA OUTSIDE OF THE 0.2% ANNUAL CHANCE FLOODPLAIN.

DISCLAIMER NOTE

UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UNDERGROUND AND OVERHEAD UTILITIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HEREON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN OR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION.

Call before you Dig
Avoid cutting underground utility lines. It's costly.

Call 811
OR
1-800-227-2600
AND
CLARK COUNTY TYPIC OPERATIONS
1-702-455-7544

Avoid overhead power line contact
CALL BEFORE YOU DO OVERHEAD

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

AVOID HITTING UNDERGROUND TRAFFIC SIGNAL SYSTEMS AND STREET LIGHT SYSTEMS. IT'S COSTLY!
CALL BEFORE YOU DO UNDERGROUND

Call before you Underground
1-702-455-7511
CLARK COUNTY TRAFFIC OPERATIONS
1-702-452-5300
LAS VEGAS AREA COMPUTERIZED TRAFFIC SYSTEM

NOTE:

ALL ABOVE GROUND UTILITY APPURTENANCES SHALL CONFORM TO THE REQUIREMENTS OF TITLE 19.12.040

NOTE:

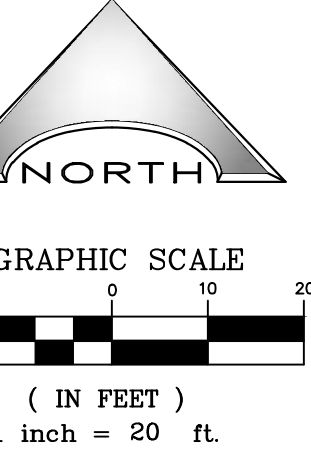
FINAL SIDEWALK ELEVATION TO MATCH FINAL FINISH FLOOR ELEVATION AFTER FLOORING MATERIAL HAS BEEN PLACED.

OWNER/DEVELOPER

NEVADA H.A.N.D.
295 WARM SPRINGS ROAD SUITE 101
LAS VEGAS, NEVADA 89119-4212
TEL: (430-9025) CONTACT: ROBERT FEIBLEMAN

- AC = ASPHALT CONCRETE
CB = GRADE BREAK
BC = BACK OF CURB
BW = BACK OF WALL
CONC = CONCRETE
TC = TOP OF CURB
FF = FINISH FLOOR
DW = DRIVEWAY
FG = FINISH GRADE
SW = SIDEWALK
VG = VALLEY GUTTER
BSW = BACK OF SIDEWALK
EG = EXISTING GROUND
FL = FLOW LINE
PL = PROPERTY LINE
EP = EDGE OF PAVEMENT
No = NUMBER
MH = MANHOLE
HP = HIGH POINT
LP = LOW POINT
EX = EXISTING
TYP = TYPICAL
VG = VALLEY GUTTER

- LEGEND AND ABBREVIATIONS**
- PROPOSED ELEVATION
 - EXISTING ELEVATION
 - EXISTING CONTOUR
 - CONSTRUCTION NOTE
 - EXISTING "L" CURB & GUTTER
 - PROPOSED "L" CURB & GUTTER
 - DIRECTION OF FLOW
 - PROPOSED SWALE
 - PROPOSED GRADE
 - EXISTING GRADE
 - RIGHT-OF-WAY/PROPERTY LINE
 - CENTERLINE
 - GRADE BREAK
 - EXISTING LIGHT
 - EXISTING FIRE HYDRANT
 - SAWCUT PAVEMENT
 - EXISTING EDGE OF PAVEMENT
 - PROPOSED RETAINING WALL
 - EXISTING WALL
 - EXISTING RETAINING WALL
 - EXISTING FENCE
 - PROPOSED HAND RAILING
 - CONCRETE
 - SAWCUT, REMOVE AND REPLACE EXISTING IMPROVEMENTS (CURB, GUTTER, SIDEWALK OR ASPHALT)



KEY MAP

NOT TO SCALE



NEVADA H.A.N.D.
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LAS VEGAS, NEVADA 89119-4212
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GRADING PLAN 2

WESTCLIFF PINES 2
ROLAND WILEY ROAD AND SILVER SKY DRIVE
CITY OF LAS VEGAS

CONSTRUCTION NOTES

1. CONSTRUCT 5' WIDE CONCRETE SIDEWALK PER U.S.D. DWG. #234
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19. CONSTRUCT SIDEWALK RAMPS USING ARMOR TILE TRUNCATED DOMES OR EQUIVALENT PER CCAUD No. 235 (CASE 1)

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9. CONSTRUCT ASPHALT PER PAVEMENT DETAIL 4, SHEET DT1
10. INSTALL CONCRETE BUMPERS PER DETAIL 9, SHEET DT1
11. CONSTRUCT "L" TYPE CURB & GUTTER PER USD. #216. WHERE LONGITUDINAL SLOPE IS LESS THAN 0.4%, THE FLOW LINE SHALL BE WATER TESTED. CONSTRUCT STEPS AS NEEDED
12. INSTALL HANDICAP SIGNAGE PER U.B.C. 1103.2.4.1, 1108.3 AND ANSI 4.3 AND 4.28
13. CONSTRUCT 8" CONCRETE CROSS GUTTER PER STD. DWG. 228
14. 24"x24" JENSEN DROP INLET OR EQUIVALENT
15. CONSTRUCT DRAINAGE SWALE @ 1.0% MIN.
16. RAMP @ 1:12 MAX. (TYP.)
17. CONSTRUCT DEPRESSED CURB PER DETAIL 5, SHEET DT1
18. INSTALL ADA HAND RAILING PER ADA STANDARDS
19. CONSTRUCT SIDEWALK RAMPS USING ARMOR TILE TRUNCATED DOMES OR EQUIVALENT PER CCAUD No. 235 (CASE 1)

CONSTRUCTION NOTES

1. CONSTRUCT 5' WIDE CONCRETE SIDEWALK PER U.S.D. DWG. #234
2. CONSTRUCT 5' CURB TRANSITION PER DETAIL 3, SHEET DT1
3. CONSTRUCT 3' VALLEY GUTTER PER DETAIL 8, SHEET DT1
4. CONSTRUCT SIDEWALK UNDERDRAIN PER DETAIL 6, SHEET DT1
5. MIN. 5' LANDINGS SHALL BE INSTALLED AT ALL DOORS PER ANSI 404.2.5 (1/4-INCH MAX BELOW THRESHOLD) 2.0% MAX. SLOPE
6. CONSTRUCT COMMERCIAL DRIVEWAY PER USD. STD. DWG. No. 225 and 225A
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19. CONSTRUCT SIDEWALK

00.00

PROPOSED ELEVATION

FG

(00.00)

EXISTING ELEVATION

XXXX

EXISTING CONTOUR

EXISTING "L" CURB & GUTTER

PROPOSED "L" CURB & GUTTER

DIRECTION OF FLOW

PROPOSED SWALE

PROPOSED GRADE

(0.50%)

EXISTING GRADE

RIGHT-OF-WAY/PROPERTY LINE

CENTERLINE

GRADE BREAK

EXISTING LIGHT

EXISTING FIRE HYDRANT

SAWCUT PAVEMENT

EXISTING EDGE OF PAVEMENT

PROPOSED RETAINING WALL

EXISTING WALL

EXISTING RETAINING WALL

EXISTING FENCE

CONCRETE

SAWCUT, REMOVE AND REPLACE EXISTING IMPROVEMENTS (CURB, GUTTER, SIDEWALK OR ASPHALT)

BENCHMARK

FOUND RIVET AND PLATE IN THE TOP OF CURB AT THE NW CORNER OF WESTCLIFF AND CIMARRON

#909 OLVOO 2854

777.8633 (m) 2552.04 (ft)

OWNER/DEVELOPER

NEVADA H.A.N.D.

295 WARM SPRINGS ROAD, SUITE 101

LAS VEGAS, NEVADA 89119-4212

TEL: (430-9025) CONTACT: ROBERT FEIBLEMAN

BASIS OF BEARING

NORTH 88°31'18" EAST, BEING THE BEARING OF THE SOUTH LINE OF THE NORTHWEST QUARTER (NW 1/4) OF THE SOUTHEAST QUARTER (SE 1/4) OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 28, TOWNSHIP 20 SOUTH, RANGE 60 EAST, M.D.M., AS SHOWN ON A MAP ON FILE IN THE CLARK COUNTY, NEVADA RECORDER'S OFFICE AS FILE 109, PAGE 2 OF PARCEL MAPS.

DISCLAIMER NOTE

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Call before you Dig

Avoid cutting underground utility lines. It's costly.

811

1-800-227-2600
AND
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-7544

Avoid overhead power line contact

CALL BEFORE YOU DO OVERHEAD

1-702-227-2929

NEVADA POWER ENVIRONMENT AND SAFETY SERVICES DEPARTMENT

AVOID HITTING UNDERGROUND TRAFFIC SIGNAL SYSTEMS AND STREET LIGHT SYSTEM CONDUITS IT'S COSTLY

CALL BEFORE YOU DO UNDERGROUND

before you Undergound

1-702-455-7511
CLARK COUNTY TRAFFIC OPERATIONS
AND
1-702-432-5300
LAS VEGAS AREA COMPUTERIZED TRAFFIC SYSTEM

REV NO.

REVISION

DESCRIPTION

APPROVED

DATE

NEVADA H.A.N.D.

295 EAST WARM SPRINGS ROAD SUITE 101

LAS VEGAS, NEVADA 89119

TEL: (702) 739-3345 CONTACT: ROBERT FEIBLEMAN

L.R. NELSON CONSULTING ENGINEERS, INC.

6785 West Russell Road Suite 200

Las Vegas, Nevada 89118

(702) 798-7978

(702) 451-2286 FAX

• CIVIL ENGINEERING

• PLANNING

• SURVEY

SHEET

12

Feb. '12

DESIGNED BY:

TP

12

Feb. '12

CHECKED BY:

RT

12

Feb. '12

PROJECT NO.:

818-021-081

SCALE:

1"= 20'

STORM DRAIN PLAN AND PROFILE 1

WESTCLIFF PINES 2

ROLAND WILEY ROAD and SILVER SKY DRIVE

CITY OF LAS VEGAS

SEAL

PROFESSIONAL ENGINEER - STATE OF NEVADA

JON H. HAYSLIP

EXP. 6/30/13

CIVIL

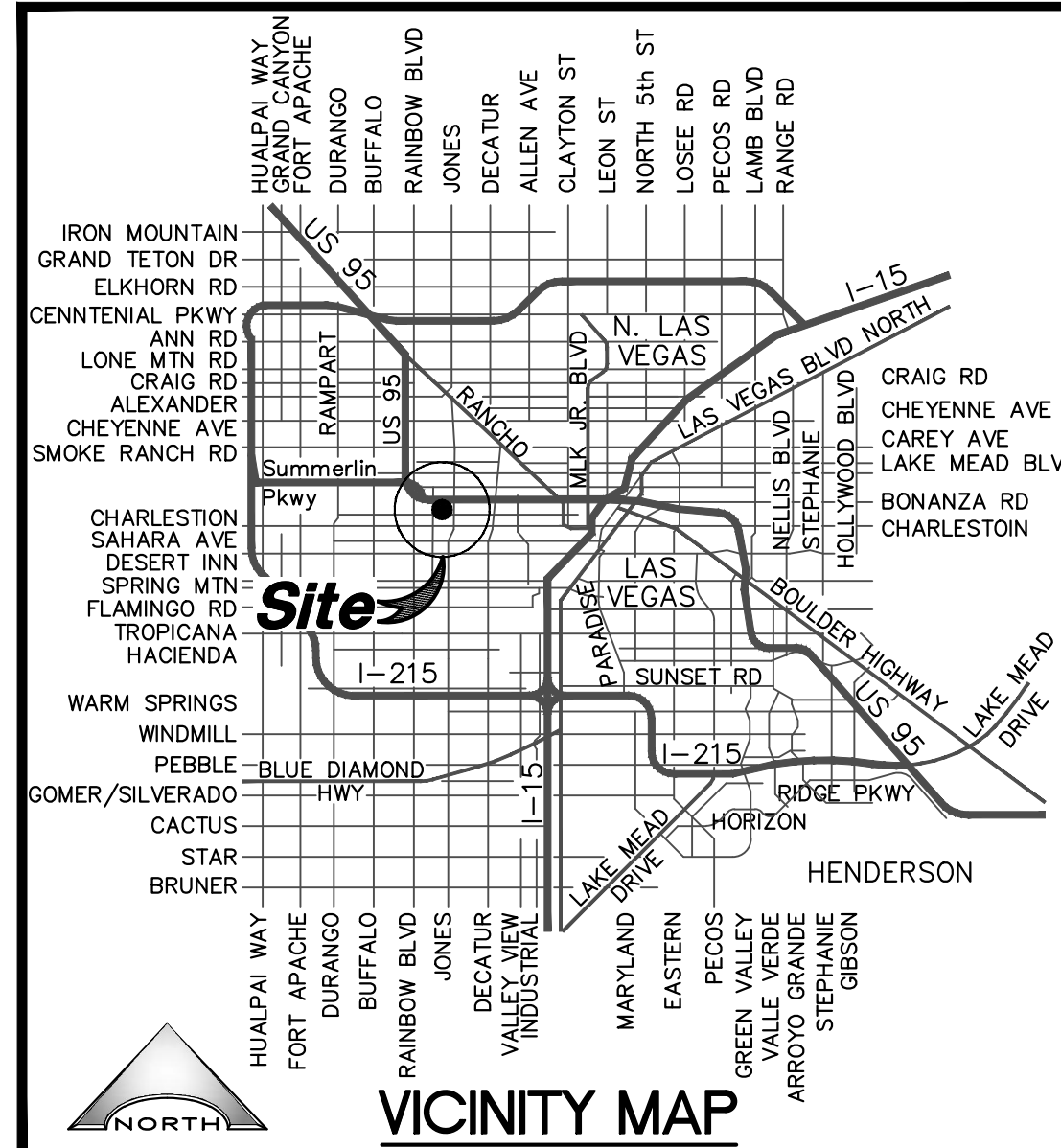
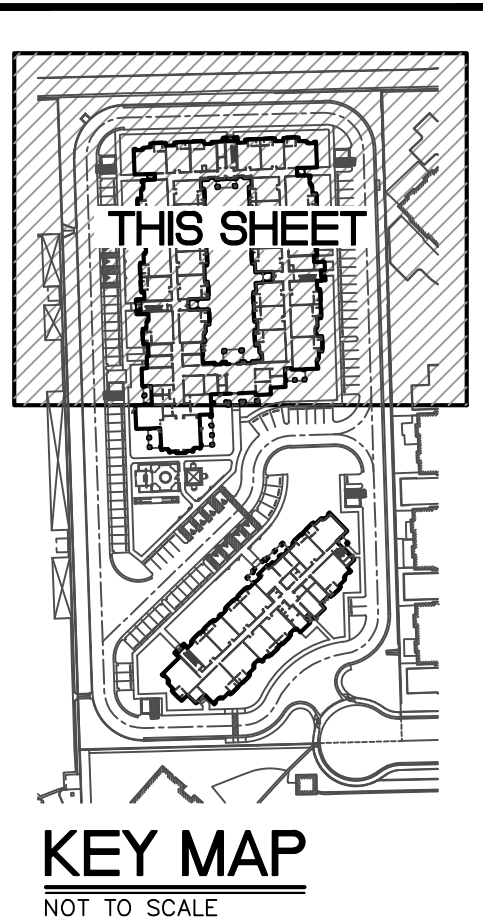
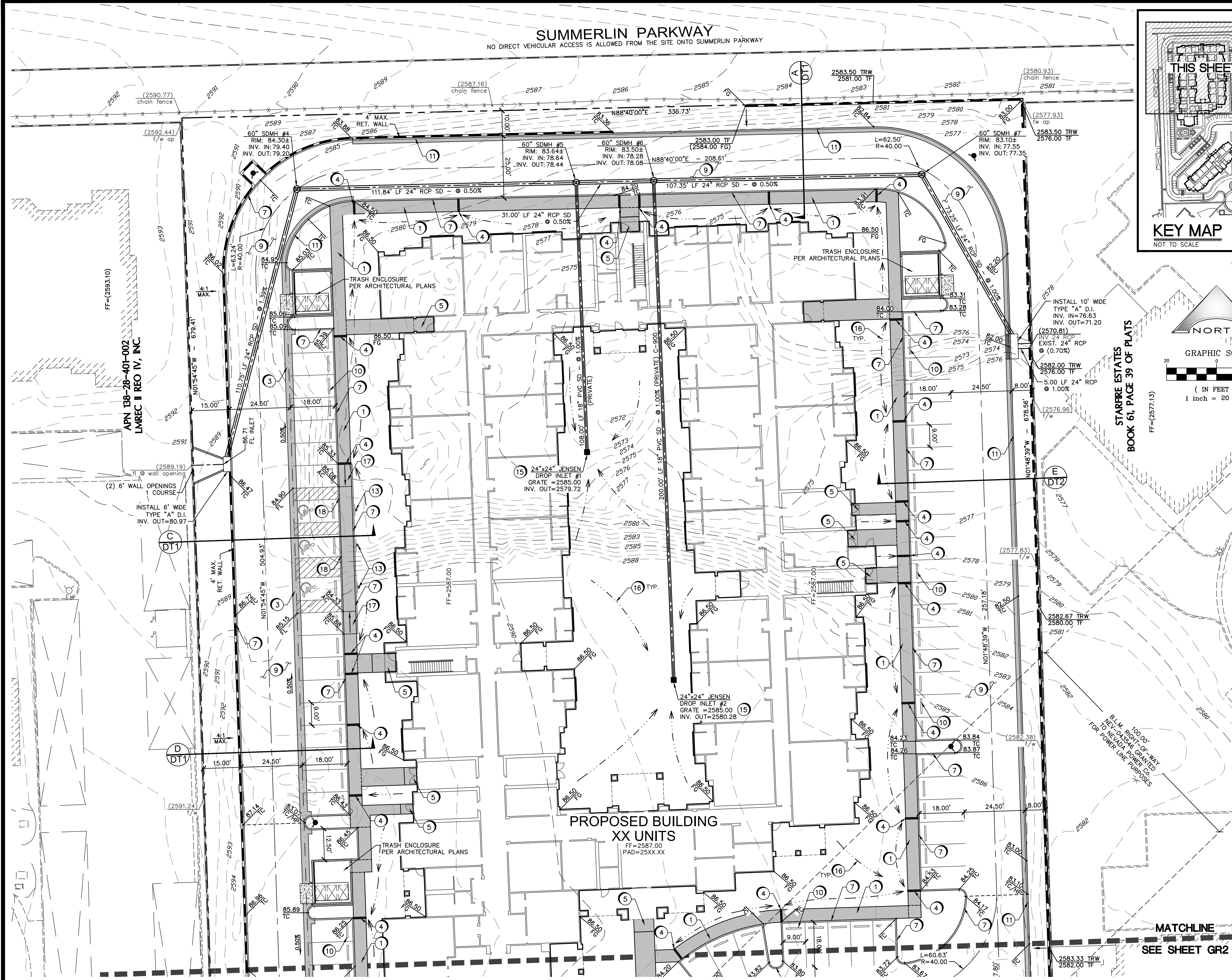
No. 12584

SHEET

SD1

14 OF 16 SHEETS

CLV DRAWING NO.



- ### CONSTRUCTION NOTES
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- ### LEGEND AND ABBREVIATIONS
- | | |
|------|--------------------|
| AC | = ASPHALT CONCRETE |
| GB | = GRADE BREAK |
| BC | = BACK OF CURB |
| BW | = BACK OF WALL |
| CONC | = CONCRETE |
| TC | = TOP OF CURB |
| FF | = FINISH FLOOR |
| DW | = DRIVEWAY |
| FG | = FINISH GRADE |
| SW | = SIDEWALK |
| VG | = VALLEY GUTTER |
| BSW | = BACK OF SIDEWALK |
| EG | = EXISTING GROUND |
| FL | = FLOW LINE |
| PL | = PROPERTY LINE |
| EP | = EDGE OF PAVEMENT |
| No | = NUMBER |
| MH | = MANHOLE |
| HP | = HIGH POINT |
| LP | = LOW POINT |
| EX | = EXISTING |
| TYP | = TYPICAL |
| VG | = VALLEY GUTTER |

SOILS REPORT

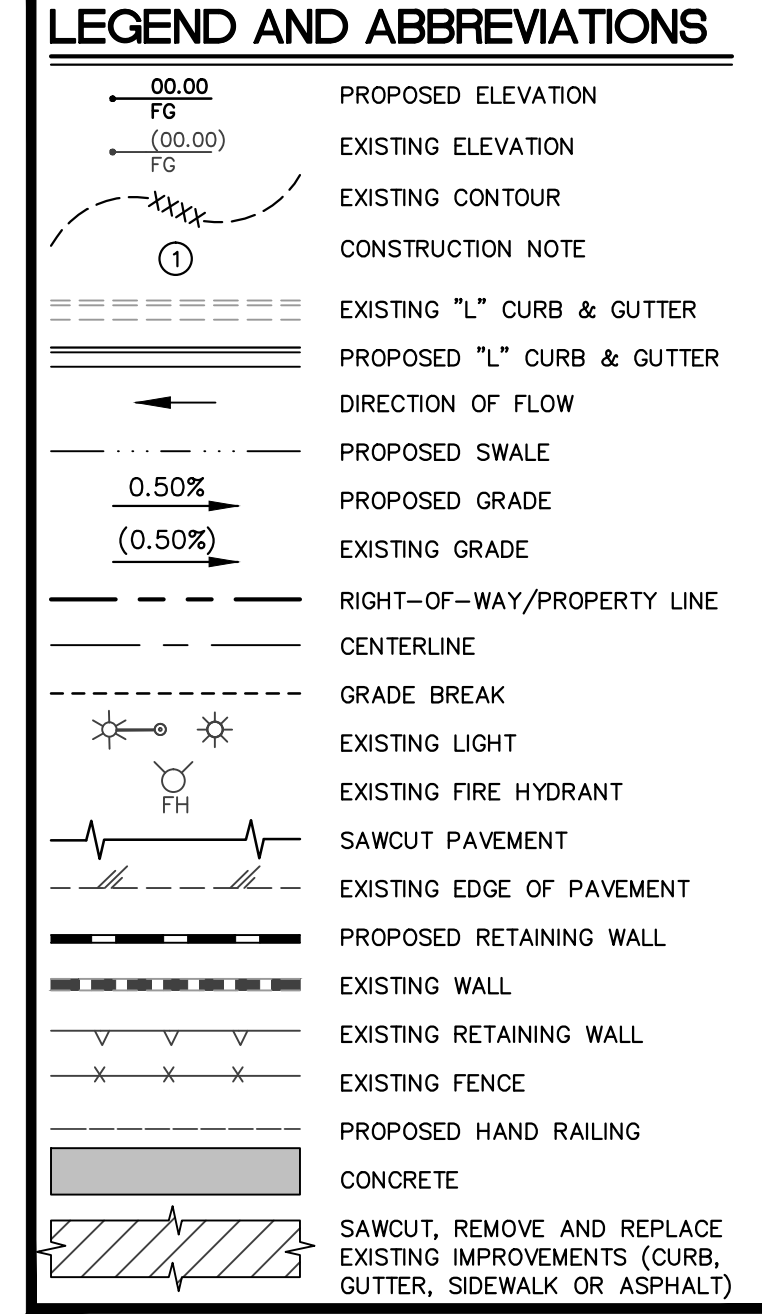
GEOTEK, INC. - NEVADA
DATED FEBRUARY 3, 2011
PROJECT NO. 10251-LV6

NOTE:

ALL ABOVE GROUND UTILITY APPURTENANCES SHALL CONFORM TO THE REQUIREMENTS OF TITLE 19.12.040

NOTE:

FINAL SIDEWALK ELEVATION TO MATCH FINAL FINISH FLOOR ELEVATION AFTER FLOORING MATERIAL HAS BEEN PLACED.



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811

OR
1-800-227-2600
AND
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-7544

Avoid overhead power line contact
CALL BEFORE YOU DO OVERHEAD

1-702-227-2929

NEVADA POWER ENVIRONMENT AND SAFETY SERVICES DEPARTMENT

Avoid hitting underground traffic signal systems and street light system conduits. It's costly.

CALL BEFORE YOU DO UNDERGROUND

before you Call

1-702-455-7511
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-5300
LAS VEGAS AREA COMPUTERIZED TRAFFIC SYSTEM

BENCHMARK

FOUND RIVET AND PLATE IN THE TOP OF CURB AT THE NW CORNER OF WESTCLIFF AND CIMARRON

#909 OLVOO 2854
777.8633 (m) 2552.04 (ft)

I CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT (DS).

JON H. HAYSLIP P.E. NO. 12584 DATE

OWNER/DEVELOPER

NEVADA H.A.N.D.
295 WARM SPRINGS ROAD SUITE 101
LAS VEGAS, NEVADA 89119-4212
TEL: (430-9025) CONTACT: ROBERT FEIBLEMAN

FEMA FLOOD PLAIN INFORMATION

ACCORDING TO THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM) COMMUNITY-PANE NUMBERS 32003C 2145E, DATE: SEPTEMBER 27, 2002, THE SITE IS LOCATED WITHIN A ZONE "X". A ZONE "X" IS DESCRIBED BY FEMA AS AN AREA OUTSIDE OF THE 0.2% ANNUAL CHANCE FLOODPLAIN.

BASIS OF BEARING

NORTH 88°31'18" EAST, BEING THE BEARING OF THE SOUTH LINE OF THE NORTHWEST QUARTER (NW 4) OF THE SOUTHEAST QUARTER (SE 4) OF THE SOUTHWEST QUARTER (SW 4) OF SECTION 28, TOWNSHIP 20 SOUTH, RANGE 60 EAST, M.D.M., AS SHOWN ON A MAP ON FILE IN THE CLARK COUNTY, NEVADA RECORDER'S OFFICE AS FILE 109, PAGE 2 OF PARCEL MAPS.

ENGINEER'S OPINION OF CUT AND FILL QUANTITIES

TOTAL	CUT	0	CUBIC YARDS
	FILL	0	CUBIC YARDS
	NET FILL	0	CUBIC YARDS

NOTE: THIS OPINION OF CUT & FILL QUANTITIES IS PROVIDED AS REQUIRED BY THE CLARK COUNTY BUILDING CODE AND SHOULD NOT BE USED FOR BIDDING PURPOSES. ALL CONTRACTORS ARE RESPONSIBLE FOR THEIR OWN QUANTITIES. ALL GRADING SHALL CONFORM TO RECOMMENDATIONS OF THE SOILS ENGINEER AS CONTAINED IN THE GEOTECHNICAL EVALUATION REPORTS PREPARED BY GEOTEK, INC. - NEVADA, DATED XXXXXXXX 0, 0000, GEOTEK PROJECT #XXXXX-LVX, UPDATED JXXXXX XX, XXXX.

APPD BY/DATE	APPD	
REV NO/REVISION DESCRIPTION	REV	
SHEET		
DRAWN BY: Feb. '12		
DESIGNED BY: Feb. '12		
CHECKED BY: Feb. '12		
PROJECT NO.: SCALE: 1"= 20'		
PROJECT NO.: 818-021-081		
SHEET		
GR1		
4 OF 16 SHEETS		
CLV DRAWING NO.		

NEVADA H.A.N.D.

295 EAST WARM SPRINGS ROAD SUITE 101
LAS VEGAS, NEVADA 89118
TEL: (702) 739-3345 CONTACT: ROBERT FEIBLEMAN

L.R. NELSON CONSULTING ENGINEERS, INC.

6785 West Russell Road Suite 200
Las Vegas, Nevada 89118
TEL: (702) 798-7978
FAX: (702) 451-2286

WESTCLIFF PINES 2

ROLAND WILEY ROAD and SILVER SKY DRIVE
CITY OF LAS VEGAS

GRADING PLAN 1