Technical Drainage Study

for

DURANGO AND GRAND MONTECITO

Date Prepared:
May 2024

Prepared for:
Lennar Corporation
5505 Waterford District Drive
Miami, FL 33126
305.229.6400

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

Kimley»Horn

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Durango and Grand Montecito Date: May 2024

Location of Development: a) Descriptive (Cross Streets) North/South: Grand Montecito Parkway

East/West: Durango Drive

b) Section: 29 Township: 19 Range: 60

c) APN : 125-29-512-015

Name of Owner: Greystone Nevada, LLC

Telephone No.: 702.821.4603 Fax No.: E-Mail Address: jeanette.jeffery@lennar.com

Address: 9275 W. Russel Road, Suite 400

Contact Person-Name: Michael Schwab, P.E. **Telephone No.:** 702.790.0206

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

Firm: KIMLEY-HORN

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

Type of Land Development/Land Disturbance Process:

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

1. Total Owned Land Area: At Site: +/- 8.8 acres Being Developed/Disturbed: +/- 8.8 acres
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ **Yes**** ☒ **No**
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☐ **Yes**** ☒ **No**
4. Proposed type of development (Residential, Commercial, Etc.): Residential
5. Approximate upstream land area which drains to the subject site: N/A
6. Has the site drainage been evaluated in the past? ☒ **YES** ☐ **NO** If yes, please identify documentation: TDS for Durango & Grand Montecito (DS5570)
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Grand Montecito Parkway
8. Briefly describe your proposed schedule for the subject project: ASAP

Engineer's Seal

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

*New Required Field

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

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

Updated 05/01/2008

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name:	**Durango and Grand Montecito**	Map ID:	
Firm Name:	**Kimley-Horn**	Engineer:	**Michael Schwab, P.E.**
Address:	**6671 Las Vegas Boulevard South, Suite 320**		
City:	**Las Vegas** State: **Nevada**	Zip:	**89119**
Phone No.:	**(702) 862-3600**	Fax No.	
Property Owner:	**Greystone Nevada, LLC**		
Address:	**9275 W. Russel Road, Suite 400**		
City:	**Las Vegas** State: **NV**	Zip:	**89148**

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

II. MAPS AND EXHIBITS

YES	NO	N/A	
☒	☐	☐	A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.
☒	☐	☐	A copy of the current CCRCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.
☒	☐	☐	Off-site drainage basin maps for existing, interim, and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.

II. MAPS AND EXHIBITS (CONTINUED)

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

III. DRAINAGE PLAN

YES	NO	N/A	
☒	☐	☐	Sheet size: 24”x36” sealed by a registered engineer in the State of Nevada.
☒	☐	☐	Minimum scale: 1”=60’
☒	☐	☐	Project name.
☒	☐	☐	Vicinity Map with local and major cross streets.
☒	☐	☐	Revision box.
☒	☐	☐	North arrow and bar scale.
☒	☐	☐	Engineer’s/consultant’s address and phone number.
☒	☐	☐	Elevation datum and benchmark.
☒	☐	☐	Legend for symbols and abbreviations.
☐	☐	☒	Cut/Fill scarps, where applicable.
☒	☐	☐	Street names, grades, widths.
☒	☐	☐	Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street.
☒	☐	☐	Existing contours encompassing the site and 100-feet beyond with spot elevations for important locations, where appropriate.
☒	☐	☐	Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
☒	☐	☐	Proposed typical street sections.
☐	☐	☒	Streets with offset crowns.
☒	☐	☐	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
☒	☐	☐	Property lines.
☒	☐	☐	Right-of-way lines and widths, existing and proposed.
☒	☐	☐	Existing improvements and their elevations.
☒	☐	☐	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year peak flows at basin concentration points.
☒	☐	☐	Concentration points and drainage flow directions with Q_{100} and V_{100} and D_{100} in streets.
☒	☐	☐	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
☒	☐	☐	Location and cross-section of street capacity calculations.
☐	☐	☒	Cross-sectional detail for channels, including cutoff wall locations.

III. DRAINAGE PLAN (CONTINUED)

YES	NO	N/A	
☒	☐	☐	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk ditches, swales, storm drain systems, unimproved channels, and culverts, etc.) stating size, material shape, and slope with plan and profile and HGL calculations.
☐	☐	☒	Existing and proposed drainage easements and widths shown with sufficient detail. A cross-sectional detail must be provided that shows appropriate lining and reinforcement.
☐	☐	☒	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16"x48". Wrought iron gate is required for flows > 10 cfs.
☐	☐	☒	Location and detail of flood-wall(s) illustrating depth of flow, proposed grouting height, etc.
☐	☐	☒	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
☐	☐	☒	Building and/or lot numbers.
☐	☐	☒	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☐	☐	☒	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.
☐	☐	☒	For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE.
☐	☐	☒	Appropriately elevated "humps" 6 inches above the 100-year water surface elevation at the accesses where the intent is to protect the site from the Q_{100} flows.
☒	☐	☐	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
☐	☐	☒	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required)

IV. HYDROLOGIC ANALYSIS

YES	NO	N/A	
☒	☐	☐	Appropriate soil information and Soils Map for existing and future conditions with sub-basins and property delineated.
☒	☐	☐	Input and Output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒	☐	☐	Input and Output information for proposed conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒	☐	☐	Use of correct precipitation values in and around the McCarran Airport rainfall area.
☒	☐	☐	A discussion in the text of the hydrologic analysis justifying sub-basin boundaries and cutoffs, supporting assumptions, and calculations.
☒	☐	☐	A summary table of stormwater flows showing basin area Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.

IV. HYDROLOGIC ANALYSIS (CONTINUED)

☒	☐	☐	Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
☒	☐	☐	On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
☒	☐	☐	Calculation for impervious area for parking lots and LIDs (if required)

V. HYDRAULIC ANALYSIS

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

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May 2024
KH Project #092935040

Kimley»Horn

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INTRODUCTION

Lennar Homes has contracted with Kimley-Horn (KH) to provide design services for the **Durango & Grand Montecito** improvements northwest of Durango Drive and Grand Montecito Parkway. Lennar Homes is proposing to develop an **8.8± acre residential subdivision**. In general, existing drainage patterns will be maintained throughout the site.

The purpose of this report is to accompany the grading plans and to provide detailed hydrologic and hydraulic analyses for the proposed residential site. The following tasks were performed in the preparation of this report:

1. Identify previous drainage studies for the project site and surrounding areas.
2. Identify the FEMA floodplain designation for the project site.
3. Identify existing and proposed regional drainage facilities adjacent to the site.
4. Estimate runoff generated for the peak 100-year and 10-year return period storms for existing and proposed conditions.
5. Verify proposed finished floor elevations meet CLV Criteria.
6. Recommend drainage features to protect the project from storm runoff.

LOCATION AND DEVELOPMENT DESCRIPTION

Durango & Grand Montecito is located within Section 29, Township 19 South, Range 60 East, M.D.M., in Clark County, Nevada. The proposed project will consist of **117 single-family residential units** within **±8.8 acres** of **APN 125-29-512-015.** A copy of the *Assessor's Parcel Map* is included in **Appendix A**. Please refer to **Figure 1 – Vicinity Map** for the location of the project.

Currently, the site is undeveloped with sparse vegetation. The site is bordered by commercial development to the north and west, Durango Drive to the south, and Grand Montecito Parkway to the east. The existing site generally slopes from west to the east via natural washes toward Grand Montecito Parkway. The proposed interior streets will consist of 30-foot wide and 40-foot-wide private drive aisles with a normal crown section and superelevated streets, roll-type curb and gutter and a 5-foot sidewalk on one side. The entry off Grand Montecito Parkway will consist of a 43-foot-wide private drive aisle with a normal crown section, L-type curb and gutter, and 6-foot detached sidewalks on both sides. Drainage improvements will include roadway improvements, storm drain, drop inlets, swales, and valley gutters to convey offsite and onsite storm runoff through the site and into the existing storm drain in Grand Montecito Parkway.

VICINITY MAP

PREVIOUS DRAINAGE STUDIES

Previous hydrology studies that were utilized in the preparation of this report:

1. *Technical Drainage Study for Durango & Grand Montecito Multi-Family Residential. Approved August 18, 2022* (Montecito Study, DS5570)

    a. The *Montecito Study* establishes the existing conditions offsite and onsite surface flows. It appears in the HEC-HMS model for this study, McCarran rainfall was used inadvertently. The lag times and curve numbers for the offsite and onsite basins have been referenced and reanalyzed with the appropriate rainfall.

2. *Technical Drainage Study for Centennial Hills Commercial Park. Approved September 1, 2006.* (Commercial Study, DS3941)

    a. The *Commercial Study* established the flowrates impacting the project site from the west, south and east in the Ultimate Conditions. In the Ultimate Condition, a flow rate of **21/60 cfs**, 10-year and 100-year respectively, is present in Durango Drive south of the project. The Ultimate Condition flow rate in Grand Montecito Parkway adjacent to the site is **19/73 cfs**. The *Commercial Study* references the *Final Design Report for Durango Drive Improvements – Tropical Parkway to I-215* (December 2003). Recent construction of CCRFCD facilities Gowan North – El Capitan Branch make the *Commercial Study* Ultimate Condition flows relevant.

3. *Technical Drainage Study for Durango-Riley Park. Approved August 6, 2008.* (Park Study, DS4281)

    a. The *Park Study* constructed an earthen berm to protect the park. By constructing the berm, more flow was diverted to Durango Drive than what was presented in the Commercial Study. The flow rate in Durango Drive presented in the *Park Study* is **33/91 cfs**. This flow rate is used for this study.

4. *Improvement Plans for Durango Drive Improvements – Tropical Parkway to I-215. December 2003.* (Durango Plans, CLV 107V3704)

    a. The *Durango Plans* are included to show the design of the existing storm drain in Durango Drive and Grand Montecito Parkway adjacent to the site. The starting HGL for the WSPG model in this study was referenced from the Durango Plans.

Kimley-Horn has reviewed the reference studies listed and agrees with the information included therein. The information referenced is for determining the existing and proposed development patterns and quantities of flow adjacent to the proposed project site. Flows referenced are indicated throughout this report and are accepted by Kimley-Horn for this study. Pertinent reference material is included in **Appendix D**.

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

"*The Las Vegas Valley Flood Control Master Plan Update*", **Figure F-17**, dated December 2018, as prepared by the Clark County Regional Flood Control District (CCRFCD) illustrates the existing and proposed master planned facilities in the area (**See Appendix A**). As shown on the exhibit, the project site is **not** located adjacent to any existing or proposed regional master planned facilities.

FEMA FLOOD HAZARD DESIGNATION

The Special Flood Hazard Areas (SFHA) for both the unincorporated and the incorporated portions of Clark County, Nevada, are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps. This subject site is located on FEMA Flood Insurance Rate Map (FIRM) Community Panel No. **32003C 1745E**, revised September 27, 2002. As shown on the FEMA FIRM Exhibit (see **Appendix A**), the subject site is located within a FEMA-designated **Zone X**. Therefore, this project is not currently located in a FEMA-designated SFHA. Areas described as Zone X are areas determined to be outside the 0.2% annual chance floodplain.

HYDROLOGIC METHODOLOGY

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

MODEL DESCRIPTION

The hydrologic model utilized in this study is the **HEC-1** Flood Hydrograph Package developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. **HEC-1** is a rainfall runoff event simulation model utilizing an interconnected system of hydrologic and hydraulic components to simulate the surface runoff response of a drainage area to precipitation. The calculations of this study were performed using the SCS Unit Hydrograph of the **HEC-1** Flood Hydrograph Model. The detailed explanation of the theory and background is presented in Section 4 of the SCS National Engineering Handbook and the **HEC-1** User Manual. Since the drainage area for the overall watershed is less than 8 square miles, and **SDN3** design storm was selected for the use in the HEC-1 computer model.

PRECIPITATION

According to Figure **513** of the Manual, the project is **not** located within the **McCarran Airport Rainfall Area**; therefore, point rainfall values for the 10-year and 100-year, six-hour storm event were adjusted per **Table 501** and calculated to be **1.67** and **3.00** inches, respectively (see **Appendix B**).

CURVE NUMBER

The soils information for the project watershed was referenced from the Soil Survey of Las Vegas Area, Nevada, Part of Clark County" prepared by the United States Department of Agriculture Natural Resources Conservation Services (USDA NRCS). A *Custom Soil Resource Report* for the project site is included in **Appendix B**. The report indicates that the project area consists of Soil Type 191 (Dalian, very cobbly fine sandy loam, 2 to 8 percent) which is classified as Hydrologic Soil Group "**A**". HSG "**A**" is characterized as having low runoff potential.

The land uses / Land covers for the project site consist of: "**Streets"** for the adjacent streets and "**Commercial, Retail, Casino, and High-Rise Condominiums**" for developed areas, as referenced from the *Montecito Study*. This land use matches the land use presented in this study.

For the given soil, CN values were determined from appropriate columns of **Curve Number Matrix** of the CCRFCD Master Plan Update (MPU), which can be found in the *Montecito Study* in **Appendix D**. Curve numbers ranging from **92** to **98** were determined for the proposed conditions subbasins. Existing conditions curve numbers and offsite subbasins were referenced from the *Montecito Study*, *Commercial Study*, and *Park Study* respectively, which can be found in **Appendix D**.

A copy of "*The Las Vegas Valley Flood Control Master Plan Update"*, Figure **W-2B**, dated December 2018, as prepared by CCRFCD is included in **Appendix A** to illustrate Regional's hydrologic subareas, land use and soils in the area.

DRAINAGE AREAS AND FLOW PATTERNS

The subbasins and flow patterns used for the hydrologic modeling were determined from elevations established for the project site in a master grading digital file. Aerial topography with 1-foot contour intervals and survey data has been used for subbasin delineations.

LAG TIME

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

$$T = 0.6T_c$$

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

HYDROLOGY

Existing conditions hydrology was referenced from the *Montecito Study*. Proposed conditions hydrology has been prepared to address the proposed improvements. Proposed condition subbasins have been included on **Figure PRO-1** and depict the drainage patterns used in the hydrologic analysis for the project. Copies of the figure is included in **Appendix A**. HEC-1 Models for Proposed conditions subbasins have been included in **Appendix B**. Tables summarizing the results of the HEC-1 Models have been included on **Figure PRO-1** in **Appendix A**.

EXISTING CONDITIONS

Existing conditions assume the site undeveloped, and all offsite tributary areas as developed. Additionally, existing conditions assume all adjacent streets are fully developed. Offsite flows from the property to the west are conveyed east through natural washes through the project site and discharged to Grand Montecito Parkway to the east which will eventually be intercepted by existing drop inlets in the roadway. See **Figure 6** in **Appendix D**.

The project-specific existing conditions hydrology consists of one (1) onsite subbasin that was referenced from the *Montecito Study* (***XON1**) and five (5) offsite basins (***DOF1, *DOF2, *DOF3, *DOF4,** and ***DOF5**). Additional offsite flow rates are referenced from the *Commercial Study* and the *Park Study* which analyzed flow rates in Durango Drive and Grand Montecito Parkway. Offsite flows are referenced from the *Montecito Study* and are assumed to be the same in the proposed condition. All offsite and onsite basins surface flow to Grand Montecito Parkway in the existing condition. Reference **Figure 6** and the referenced hydrologic calculations have been included in **Appendix D**.

PROPOSED CONDITIONS

The proposed conditions drainage patterns assume the offsite area as described in existing conditions with the proposed site and adjacent half streets as developed. The proposed onsite flow patterns are similar to existing conditions. See **Figure PRO** in **Appendix A**. The project-specific proposed conditions hydrology consists of one (1) onsite subbasin (**ON)** and the same reference basins as existing conditions. Onsite basin **ON** was prorated to determine flowrates impacting the proposed improvements. A unit flowrate (cfs/acre) for the onsite subbasin was calculated by dividing the total flowrate of the subbasin by the overall subbasin area. The total flowrate generated by areas shown on **Figure PRO** is approximated by multiplying the calculated unit flow rate (cfs/acre) by the delineated portion of the tributary area (acres). Prorate calculations for the onsite subbasin have been included on **Figure PRO**. **Table 1** summarizes the HEC-1 results for proposed conditions and **Table 2** summarizes the prorated proposed conditions flowrates. Hydrologic calculations have been included in **Appendix B**.

Table 1: Proposed Condition Flow Summary

BASIN ID / COMB. PT	BASIN AREA (ac)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
**CP-3	-	51	28
*DOF3	1.05	4	2
*DOF1	5.97	19	9
*DOF4	1.70	5	3
*DOF5	0.73	2	1
*CP1	-	81 (30)	44 (16)
GMP	0.75	3	2
CP3	-	84 (33)	44 (14)
*DOF2	4.25	13	6
ON	8.80	28	13
CP2	-	40	19

*Referenced/Revised from Montecito Study

**Referenced/Revised from Commercial Study

Table 2: Proposed Condition Prorated Flow Summary

Proposed Onsite					
SUBBASIN	Q_{100} (cfs)	Q_{10} (cfs)	AREA (ac)	Q_{100} (cfs/acre)	Q_{10} (cfs/acre)
ON	28	13	8.80	3.18	1.48
Proposed Onsite Prorated Basins					
SUBBASIN	Q_{100} (cfs)	Q_{10} (cfs)	AREA (ac)	Q_{100} (cfs/acre)	Q_{10} (cfs/acre)
ON1	1	0.5	0.26	3.18	1.48
ON2	2.5	1	0.82	3.18	1.48
ON3	1	0.5	0.30	3.18	1.48
ON4	0.5	<1	0.17	3.18	1.48
ON5	0.5	<1	0.15	3.18	1.48
ON6	1	0.5	0.26	3.18	1.48
ON7	1.5	1	0.51	3.18	1.48
ON8	2.5	1.5	0.76	3.18	1.48
ON9	<1	<1	0.14	3.18	1.48
ON10	0.5	<1	0.19	3.18	1.48
ON11	2	1	0.54	3.18	1.48
ON12	0.5	<1	0.18	3.18	1.48
ON13	2	1	0.66	3.18	1.48
ON14	1	0.5	0.27	3.18	1.48
ON15	1.5	1	0.46	3.18	1.48
ON16	1	0.5	0.29	3.18	1.48

SUBBASIN	Q_{100} (cfs)	Q_{10} (cfs)	AREA (ac)	Q_{100} (cfs/acre)	Q_{10} (cfs/acre)
ON17	1.5	1	0.53	3.18	1.48
ON18	1	<1	0.21	3.18	1.48
ON19	1.5	1	0.47	3.18	1.48
ON20	1	0.5	0.32	3.18	1.48
ON21	0.5	<1	0.17	3.18	1.48
ON22	1	0.5	0.29	3.18	1.48
ON23	0.5	<1	0.18	3.18	1.48
ON24	<1	<1	0.13	3.18	1.48
ON25	1	0.5	0.29	3.18	1.48
ON26	1	0.5	0.24	3.18	1.48
TOTAL	**28**	**13**	**8.80**	**NA**	**NA**

Offsite basin ***DOF2** is captured and conveyed through the site via storm drain and combine with most of onsite flow generated by onsite subbasin **ON** at **CP2** as storm drain flow. Flow generated by ****CP3** (*Commercial Study,* **28/51 cfs**) combines with flow referenced from the *Montecito Study* at ***CP1** as surface flow. Flow generated by **CP-7 (*Commercial Study,* **21/601 cfs**) combines with flow generated by **CP060** (*Park Study*, **12/31 cfs**) and prorate basin **ON18**.

HYDRAULIC CALCULATIONS

STREETS

The resulting street flow data is based on the flows generated during proposed conditions. The resulting flow depths and velocities are presented in **Tables 3** and **4**. **Figure PRO** in **Appendix A** show the locations of the cross sections corresponding to the calculations included in **Tables 6**. Pertinent reference material has been included in **Appendix D**. The onsite normal depth sections and flow rates have been calculated from their respective tributary subbasins and are presented in **Table 7**. Private drive aisles (36') have been modeled as full street sections with a normal crown, roll-type curb and gutter, and a 5-foot sidewalk on one side. The hydraulic calculations can be found in **Appendix C**.

Table 3: Proposed Condition Hydraulic Street Sections

STREET SECTION	TRIBUTARY BASINS	SLOPE	Q_{100}	FLOW DEPTH	VELOCITY	D*V	Q_{10}	FLOW DEPTH	VELOCITY	D*V	DRY LANE
		%	(cfs)	(ft)	(ft/s)	ft^2/s	(cfs)	(ft)	(ft/s)	ft^2/s	
GMP	*CP1 + 1/2 GMP + ON12	0.70	118	1.04	4.86	5.05	40	0.77	3.33	2.56	-
**H-6	**CP7 + ***CP060 + ON18	1.50	92	0.78	5.69	4.44	33	0.53	4.58	2.43	-

*Referenced/Revised from Montecito Study
**Referenced/Revised from Commercial Study
***Referenced/Revised from Park Study

Table 4: Proposed Condition Hydraulic Onsite Sections

SECTION	TRIBUTARY BASINS	CHANNEL SLOPE	Q_{100}	FLOW DEPTH	VELOCITY	D*V
		%	(cfs)	(ft)	(ft/s)	ft^2/s
ON2	ON1 + ON2 + ON23	2.23	4.0	0.25	2.75	0.69
ON3N	ON1 + ON2 + ON3 + ON4 + ON7 + ON23	0.84	7.0	0.42	2.41	1.01
ON3S	ON5 + ON6 + ON8 + ON9 + ON10 + ON11 + ON16 + ON24 + ON26	0.84	7.5	0.43	2.43	1.04
ON6	ON6	1.03	1.00	0.23	1.74	0.40
ON8	ON5 + ON6 + ON8 + ON9 + ON10	1.89	4.5	0.27	2.64	0.71
ON10	ON10	0.60	0.5	0.21	1.22	0.26
ON12	ON12	4.48	0.5	0.12	2.89	0.35
ON13	ON13 + ON21 + ON22	1.89	3.5	0.25	2.50	0.63
ON14	ON13 + ON14 + ON21 + ON22 + DI5 BYPASS	0.50	5.4	0.42	1.86	0.78
ON17	ON17	1.58	1.5	0.20	1.96	0.39
ON19	ON15 + ON17 + ON19 + ON25	0.64	5.5	0.41	2.07	0.85
ON22	ON22	0.60	1.0	0.25	1.41	0.35

Based on the calculated flow characteristics, the Manual criteria for depth (D) and velocity times depth (V*D) during the 100-year storm event will be met.

The Manual criteria for a major roadway requires a 12-foot-wide dry lane in addition to a dry center turn lane in each direction for streets with a ROW greater than 80 feet during a 10-year storm event. The street hydraulic sections show that dry-lane criteria will be met with the development of this site.

STORM DRAIN FACILITIES AND PROTECTION

The proposed flood control facilities for the site includes swales, storm drain, and drop inlets. Facility names for the onsite and offsite facilities in the calculations correspond with the tributary prorated subbasin and the facility location. All existing and proposed flood control facilities have been shown on

the **Figure WSPG**, included in **Appendix A,** and the plans included in **Appendix E**. All proposed facilities have been sized to convey the proposed conditions flowrates. Proposed storm drain systems and drop inlets have been sized to collect and convey the 100-year flows to the existing storm drain facility in Grand Montecito. The proposed 30-inch storm drain will connect to an existing drop inlet that has an existing 36-inch outlet pipe.

There are two (2) mainline systems proposed in the study (**MAIN** & **MAIN2**) along with two (2) Lateral storm drain systems (**MAIN_LAT1** & **MAIN2_LAT1**). System **MAIN** collects offsite flows from the west of the site (basin *DOF2) and onsite flows and connects to the existing drop inlet in Grand Montecito Parkway. System **MAIN2** collects the remaining onsite flows and connects into the **MAIN** system at the main entry (Montecito Bay Avenue). The starting HGL for the MAIN system was referenced from the Durango Plans. The remaining starting HGLs were taken from the corresponding models. WSPG models for the proposed mainlines and laterals have been included in **Appendix C**.

DROP INLETS

Proposed drop inlet calculations include a 50 percent clogging factor and are included in **Appendix C.** The proposed storm drain systems are designed to intercept and convey all onsite nuisance and storm flows up to a 100-year storm event. Drop inlet summaries have been included on **Figure PRO** and summarized in **Table 5**.

Table 5: Proposed Conditions Onsite Drop Inlet Summary

DROP INLET ID	TRIBUTARY AREA	SLOPE	FLOW DEPTH	Q_{100}	Q_{INT}	Q_{BYP}	DI TYPE
		(%)	(ft)	(cfs)	(cfs)	(cfs)	
DI#3	ON1 + ON2 + ON3 + ON4 + ON5 + ON6 + ON7 + ON8 + ON9 + ON10 + ON11 + ON16 + ON23 + ON24 + ON26	SUMP	0.38	15.5	15.5	0.0	15' TYPE DM2
DI#4	ON13 + ON14 + ON21 + ON22 + DI#5 BYPASS	0.50	0.42	5.9	5.9	0.0	7.5' TYPE DM2
DI#5	ON15 + ON17 + ON19 + ON25	0.64	0.40	5.5	4.6	0.9	7.5' TYPE DM2
DI#6	*DOF2 + ON20	SUMP	0.50	14.0	14.0	0.0	10' TYPE DM2

PROPOSED DRAINAGE SWALES

Proposed onsite swales have been provided to direct flows away from onsite structures and ultimately into existing and proposed storm drain facilities. Facility names for the proposed swales in the calculations correspond with the tributary subbasin/Cross Section Identifier. Information for the swales have been included on **Figure PRO** and summarized in **Table 6**. Normal depth calculations have been included in **Appendix C**.

Table 6: Drainage Swale Calculations

SWALE SECTION	TRIBUTARY BASIN	CHANNEL SLOPE	Q_{100}	FLOW DEPTH	VELOCITY	D*V	TYPE	SIDE SLOPES		Req'd d_{50}
		%	(cfs)	(ft)	(ft/s)	ft^2/s				
SW-ON1	ON1	1.50	1.0	0.38	2.32	0.88	V	3:1	3:1	N/A
SW-ON2	ON1	0.50	1.0	0.47	1.01	0.47	V	3:1	3:1	N/A
SW-ON3	ON4	0.57	0.5	0.35	1.36	0.48	V	3:1	3:1	N/A
SW-ON4	ON4	0.57	0.5	0.35	1.36	0.48	V	3:1	3:1	N/A
SW-ON5	ON5	1.50	0.5	0.29	1.95	0.57	V	3:1	3:1	N/A
SW-ON7	ON7	1.21	1.5	0.46	2.37	1.09	V	3:1	3:1	N/A
SW-ON9	ON9	0.50	0.5	0.36	1.29	0.46	V	3:1	3:1	N/A
SW-ON10	ON10	2.11	0.5	0.27	2.22	0.60	V	3:1	3:1	N/A
SW-ON11	ON11	0.58	2.0	0.59	1.93	1.14	V	3:1	3:1	N/A
SW-ON15	ON15	0.99	1.5	0.48	2.20	1.06	V	3:1	3:1	N/A
SW-ON16	ON16	0.52	1.0	0.46	1.56	0.72	V	3:1	3:1	N/A
SW-ON19	ON25	0.67	1.0	0.44	1.71	0.75	V	3:1	3:1	N/A
SW-ON21	ON21	0.79	0.5	0.33	1.53	0.50	V	3:1	3:1	N/A
SW-ON22	ON21	0.79	0.5	0.33	1.53	0.50	V	3:1	3:1	N/A
SW-ON23A	ON23	0.97	0.5	0.32	1.66	0.53	V	3:1	3:1	N/A
SW-ON23B	ON23	1.85	0.5	0.28	2.11	0.59	V	3:1	3:1	N/A
SW-ON24	ON24	0.51	0.5	0.36	1.30	0.47	V	3:1	3:1	N/A
SW-ON25	ON25	0.67	1.0	0.44	1.71	0.75	V	3:1	3:1	N/A

FINISHED FLOOR ELEVATION

The Clark County Regional Flood Control District requirement for the finish floor elevation (FF) is that it must be 18 inches above the centerline grade of the adjacent street or be elevated to twice the depth of flow up to 18 inches above the water surface elevation (WSE). Additional criteria require the finished floor elevation to be 6 inches above adjacent on-site flowline high point. The proposed finished floor elevations have been elevated to or above at least twice the depth of flow in the adjacent drive aisles. Finished floor elevation tables have been included in **Appendix C.**

Lots 42, 43, 54, 64, and **93** do not meet the above-mentioned criteria based on elevations of the adjacent side streets, or these lots, the adjacent side street has a top-of-curb elevation at or above the finished floor elevation. A solid grouted wall to a minimum of twice the depth of flow above the adjacent flow line elevation will provide the required freeboard protection for these lots. Please refer to the grading plans included in **Appendix D**.

CONCLUSIONS AND RECOMMENDATIONS

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

1. This project is in compliance with the applicable drainage laws recognized by the State of Nevada.

2. This project is in compliance with the CCRFCD's "*Master Plan Update*" and will **not** conflict with any Master Planned Facilities.

3. This project is in compliance with the CCRFCD's "*Hydrologic Criteria and Drainage Design Manual*", with the exceptions noted in the study.

4. This project lies within FEMA-designated **Flood Zone X**. Therefore, the project is not currently located in a FEMA-designated Special Flood Hazard Area.

5. The drainage facilities for this project have been designed to control and convey the onsite runoff from the 100-year storm safely through the site to match existing drainage patterns. In addition, they have been designed based upon generally accepted engineering practices and in accordance with local requirements.

6. Homes to be constructed with this project will have adequate freeboard or solid grouted wall protection from flows conveyed in the adjacent streets.

7. Runoff generated from, or conveyed by, the project will not adversely impact any downstream properties or facilities.

REFERENCES

1. Clark County Regional Flood Control District, "*Hydrologic Criteria and Drainage Design Manual*," August 1999, Revise September 2013.

2. Clark County Regional Flood Control District, "*2018 Las Vegas Valley Flood Control Master Plan Update*," November 2018.

3. U. S. Department of Agriculture Soil Conservation Service, *Soil Survey of Las Vegas Valley Area, Nevada, Part of Clark County*, September 2019, Version 14.

4. U.S. Army Corps of Engineers. HEC-1 Flood Hydrograph Package. Revised June 1998.

5. *Technical Drainage Study for Durango and Grand Montecito Multi-Family Residential, Prepared by Taney Engineering, August 2022.*

6. *Technical Drainage Study for Centennial Hills Commercial Park,* Prepared by Stantec, September 2006.

7. Technical Drainage Study for Durango-Riley Park, Prepared by Kimley-Horn and Associates, August 2008.

8. Improvement Plans for Durango Drive Improvements – Tropical Parkway to I-215, Prepared by VTN, December 2003.

Kimley»Horn

LIST OF APPENDICES

Appendix A – Documents & Figures

- Figure PRO Proposed Condition Basin Map
- Figure WSPG WSPG Exhibit
- Assessor's Parcel Map
- FIRM Exhibit
- Figure F-19 Flood Control Facilities
- Figure W Hydrologic Subareas, Land Use & Soils
- NOFA, 24-0075:MOD1, VAR1, SUP1, SDR1, TMP1

Appendix B – Hydrologic Parameters & HEC-1 Analyses

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

Appendix C – Hydraulic Calculations

- FlowMaster Hydraulic Sections – Streets
- FlowMaster Hydraulic Sections – Onsite
- FlowMaster Hydraulic Sections – Swale
- Drop Inlet Calculations
- WSPG Models

Appendix D – Reference Materials

- Technical Drainage Study, Durango & Grand Montecito Multi-Family Residential; Prepared by Taney Engineering. August 2022 (DS5570)
- Technical Drainage Study, Centennial Hills Commercial Park; Prepared by Stantec. September 2006 (DS3941).
- Technical Drainage Study for Durango-Riley Park; Prepared by Kimley-Horn and Associates. August 2008 (DS4281).
- Improvement Plans for Durango Drive Improvements – Tropical Parkway to I-215; Prepared by VTN. December 2003 (CLV 107V3704)

Appendix F – Improvement Plans