APPENDIX 4.1-12

Land Exchange Alternative
Drainage Report

CEQA DRAINAGE STUDY

OTAY RANCH VILLAGE 14 AND PLANNING AREA 16/19- LAND EXCHANGE ALTERNATIVE

County of San Diego, California

Preparation/Revision Date:
January 29, 2018

Prepared for:

Jackson- Pendo Development Company
2245 San Diego Avenue, Suite 223
San Diego, CA 92110

Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

Engineer of Work
Hunsaker & Associates San Diego, Inc.
9707 Waples Street
San Diego, CA 92121
Phone: (858)558-4500
Fax: (858)558-1414
Web: www.HunsakerSD.com

Alisa S. Vialpando, R.C.E. 47945 Date
Vice President

TABLE OF CONTENTS

LIST OF TABLES IN CHAPTER I

LIST OF FIGURES IN CHAPTER I

ADDITIONAL INFORMATION

CHAPTER 1 - EXECUTIVE SUMMARY

1.1 Introduction

OVERVIEW & BACKGROUND

This technical report provides a project level analysis of the Land Exchange Alternative (defined below) for inclusion in the Otay Ranch Village 14 and Planning Areas 16/19 Environmental Impact Report (EIR). The regional location is shown in Figure1.

The Land Exchange Alternative is located within Otay Ranch Village 14 and Planning Areas 16 and 19 in the Proctor Valley Parcel of Otay Ranch as shown on Figure 2. Village 14 and Planning Areas 16 and 19 are part of the larger Otay Ranch, an approximately 23,000-acre master-planned community in southern San Diego County designed as a series of villages and planning areas.

The Land Exchange Alternative proposes 1,530 homes within a development footprint that is limited to Proctor Valley Village 14. The majority of Planning Areas 16 and 19 would be converted to MSCP and Otay Ranch RMP Preserve and would not be developed.

The following describes the major components and characteristics of the Land Exchange Alternative.

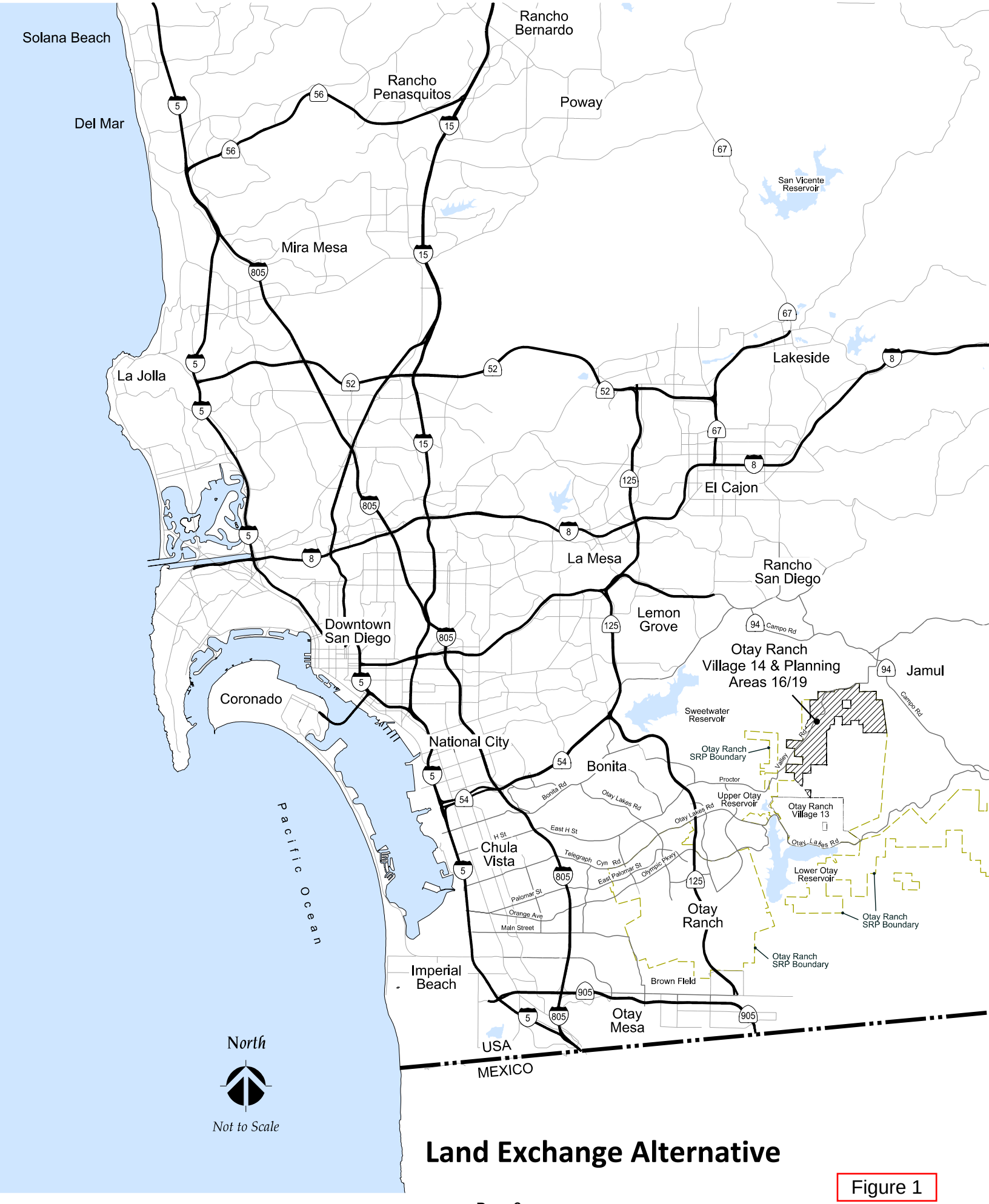
DEFINITIONS

"Land Exchange Area" Defined

As indicated above, the "Land Exchange Area" is located within Otay Ranch Village 14 and Planning Areas 16 and 19 as depicted in Figure 3. The total Land Exchange Area covers approximately 2,387 acres, of which the Applicant owns 1,294 acres, the State owns approximately 1,053 acres and 39.9 acres are Offsites. Within the Land Exchange Area, there are 1,003 acres in Village 14 and 1,345 acres in Planning Areas 16 and 19. Offsites include Proctor Valley Road and related utilities in the south and central portions of Village 14. The State's ownership is included in order to process a General Plan Amendment to remove existing approved Otay Ranch GDP/SRP and County General Plan development land uses and convert these acres to MSCP/Otay Ranch RMP Preserve.

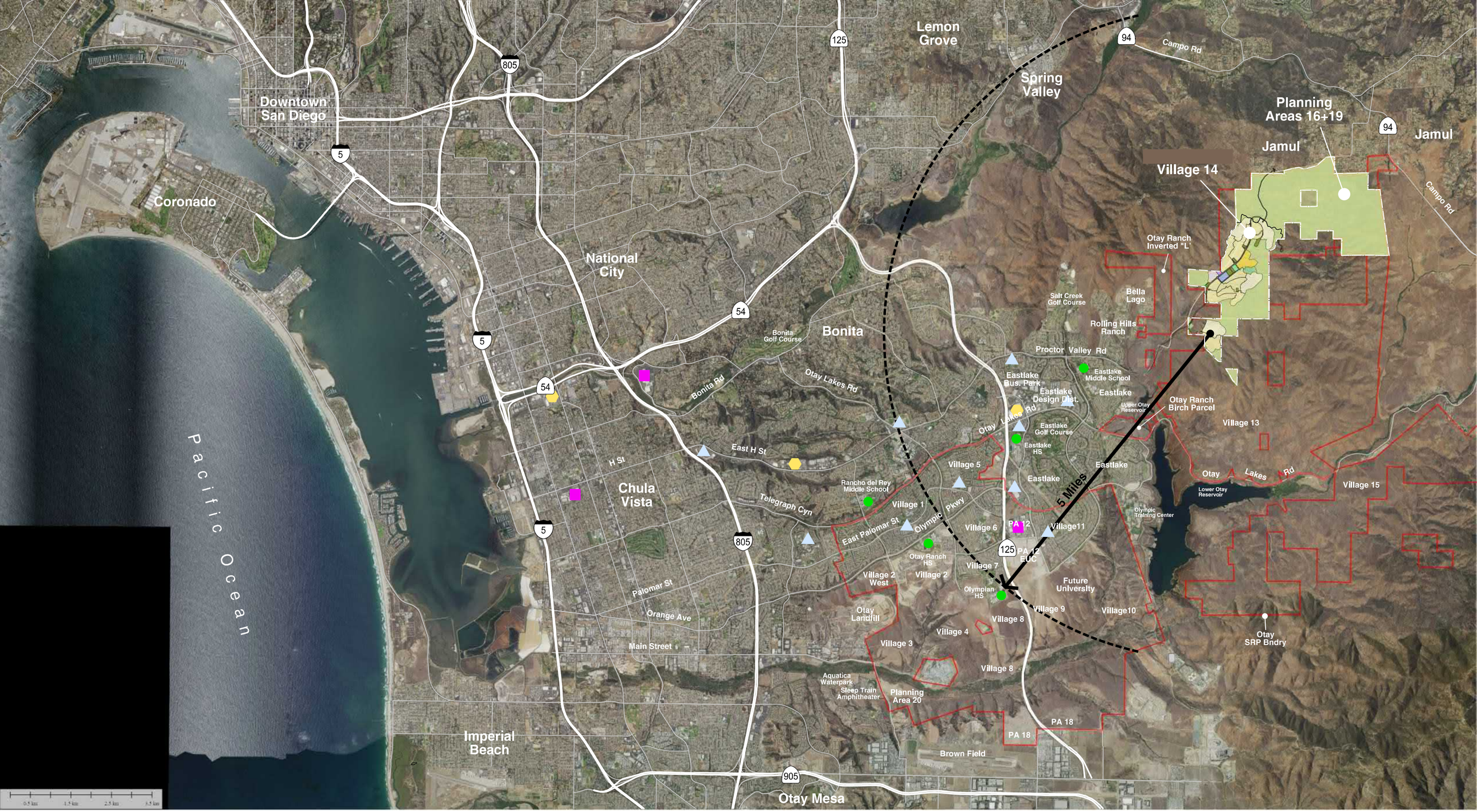
"Land Exchange Alternative" Defined

The Land Exchange Alternative limits development to Otay Ranch Village 14 and converts the majority of development approved by the Otay Ranch GDP/SRP in Planning Areas 16 and 19 to MSCP and Otay Ranch RMP Preserve. The Land Exchange Alternative assumes the completion of a land exchange agreement with the State of California and a simultaneous boundary adjustment to the MSCP and Otay Ranch RMP Preserve systems.



Land Exchange Alternative

Figure 1



North

0 1 2 MILES

Scale in miles

LEGEND

Retail
- Regional
- Big Box
- Local

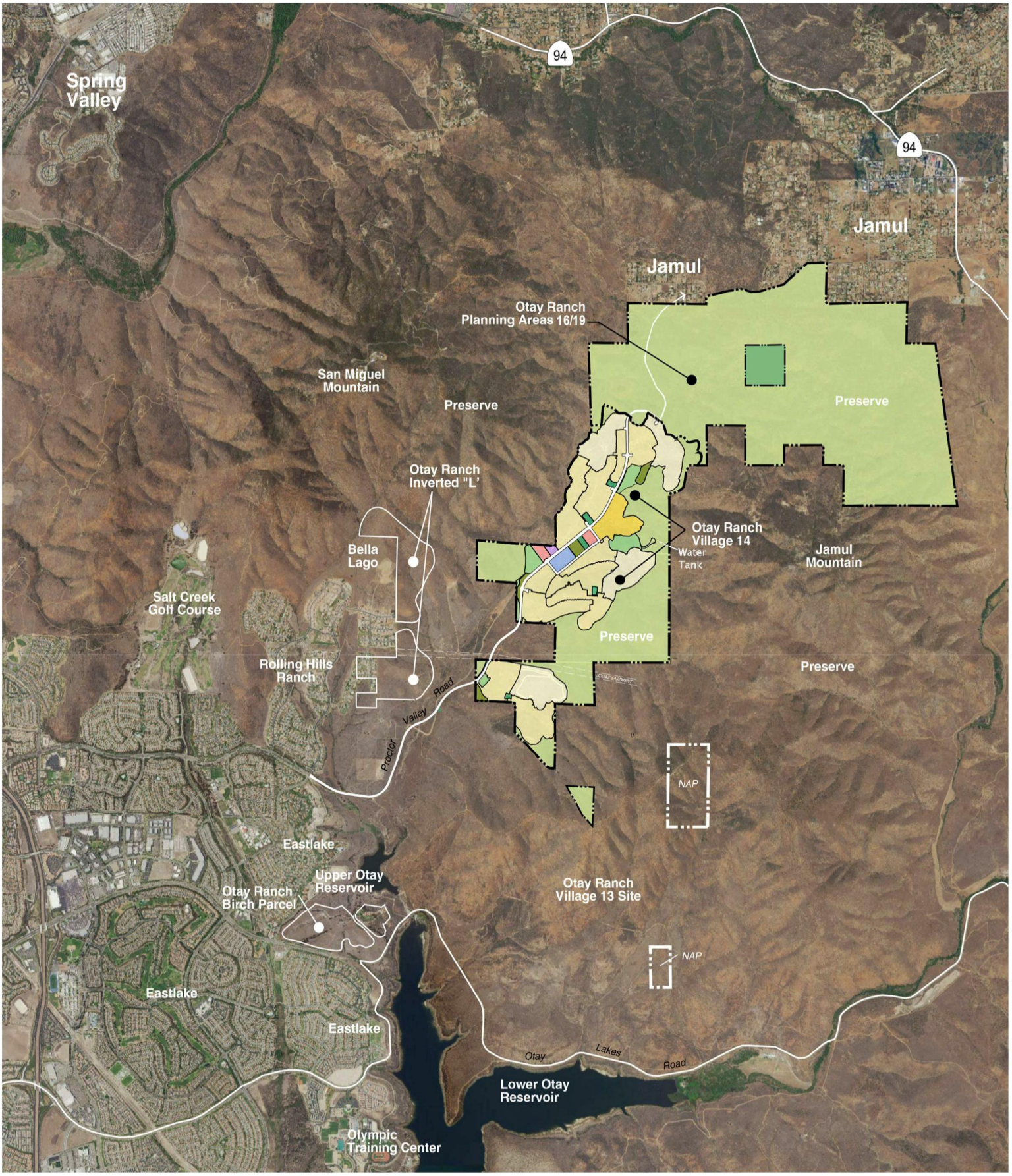
Secondary School (7-12)

Otay SPA Boundary

Source: NAIP Color Imagery for US (1m Resolution)
Aerial Flown: May 2014

Land Exchange Alternative

Figure 2



North

0 1200 2400

Scale in feet

Source: NAIP Color Imagery for US (1m Resolution
Aerial Flown: May 201

LAND EXCHANGE ALTERNATIVE

Figure 3

Specifically, the "Land Exchange Alternative" proposes to:

- Exchange 278 acres owned by the State in Village 14 for 278 acres owned by the Applicant in Planning Area 16.

- Amend MSCP and Otay Ranch RMP Preserve boundaries via a boundary adjustment where approximately 169.8 acres in Planning Areas 16/19 are converted to Otay Ranch RMP Preserve and 142.3 acres in Village 14 are converted to Otay Ranch RMP Preserve and 43.6 acres in Village 14 are converted to development footprint for an overall net increase in Otay Ranch RMP Preserve of 268.5 acres.

After implementation, the Land Exchange Alternative land plan is depicted in Figure 4. The Land Exchange Alternative contemplates a Specific Plan, General Plan Amendments, EIR, Rezone, Tentative Map, the Otay Ranch RMP Amendment, and County MSCP Subarea Plan South County Segment Boundary Adjustment.

"Village 14" Defined

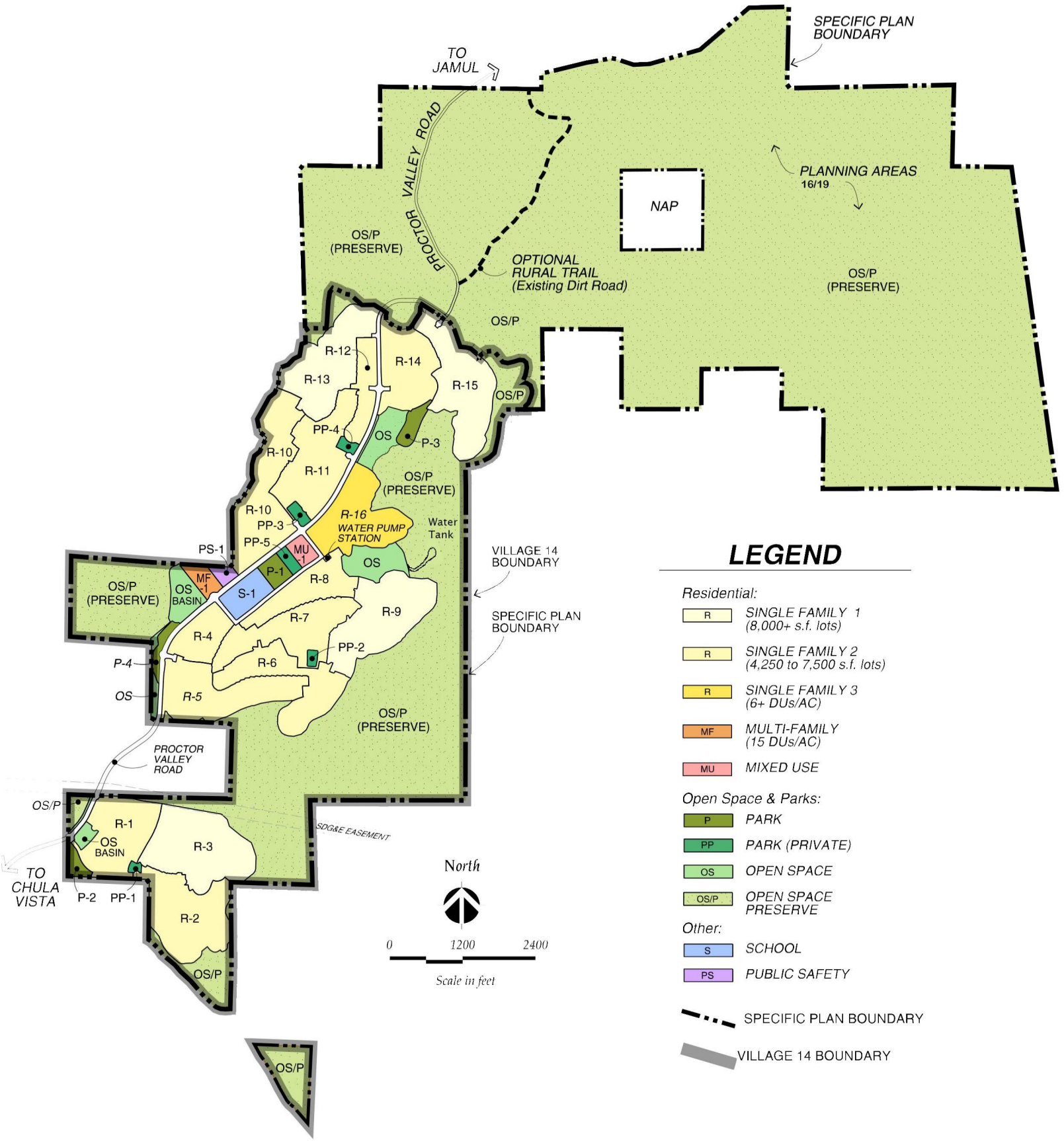
"Village 14" as referred to herein is a discrete subset of the Land Exchange Alternative and reflects that portion located exclusively within Village 14 as depicted in Figure 5. The majority of the technical reports focus on Village 14 as this is where the development is planned.

Proposed Specific Plan

Summary

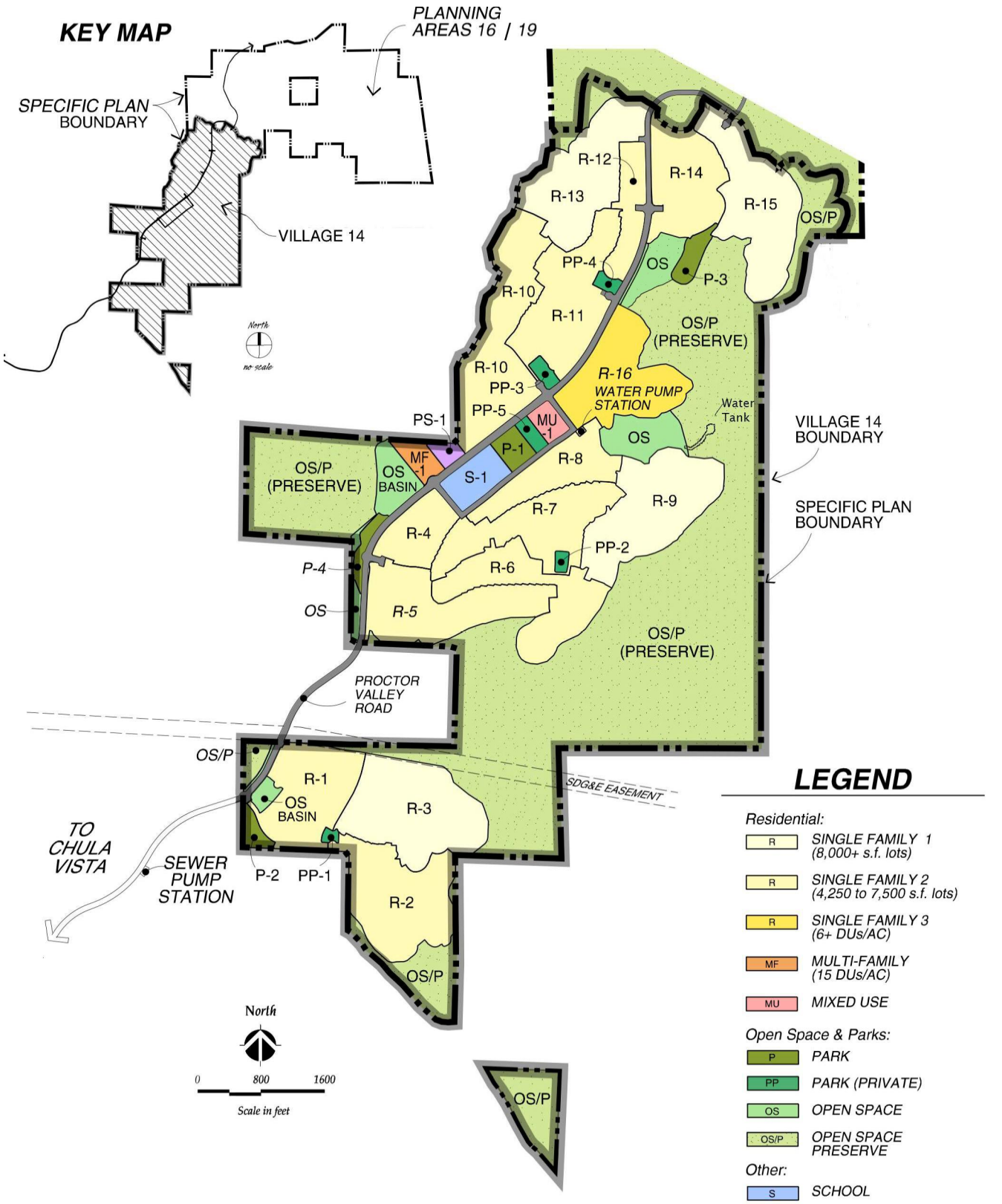
The adopted Otay Ranch GDP/SRP requires the preparation of a Site Utilization Plan that describes proposed land uses. Figures 4 and 5 depict the proposed Site Utilization Plan for the Land Exchange Alternative. Additionally, Table 1 quantifies the land uses.
The Land Exchange Alternative includes approximately 511 acres designated for 1,530 homes, 1,124 of which would be traditional single-family homes, 283 would be single family age-restricted and 123 would be multifamily homes as indicated on Table 1 below. 18 neighborhoods are planned with approximate densities ranging from 1.5 to 15.0 dwelling units per acre. The age-restricted neighborhoods would be gated, as would four of the single-family neighborhoods situated on the largest lots.

Village 14 in the Land Exchange Alternative is planned around a Village Core, centrally located in the heart of the village. Higher density residential uses will be adjacent to the Village Core with single family residential radiating out in decreasing densities. The Village Core is comprised of the Neighborhood Center which includes an 8-acre elementary school; a 4-acre Village Green (public park); a 3-acre Mixed Use Site with up to 15,000 square feet of commercial/retail uses and 54 multi-family homes; and a 2-acre Village Square Community Facility. The Village Core also includes a 2-acre public safety site for a fire station and sheriff's storefront facility and 69 multi-family townhomes located adjacent to the public safety site.



Land Exchange Alternative

Figure 4



Land Exchange Alternative

Figure 5

Table 1

Otay Ranch Land Exchange Alternative

Site Utilization Plan - Land Use Summary

January 25, 2018

Proctor Valley Village 14		Acres	Units	Density
Residential Uses				
Single Family Residential				
R-1	SF-2	28.9	112	3.9
R-2	SF-2	37.1	72	1.9
R-3	SF-1	41.7	67	1.6
R-4	SF-2	14.3	57	4.0
R-5	SF-2	33.9	109	3.2
R-6	SF-2	30.6	75	2.4
R-7	SF-2	32.1	91	2.8
R-8	SF-2	20.1	47	2.3
R-9	SF-1	41.5	74	1.8
R-10	Age Restricted SF-1	42.5	127	3.0
R-11	Age Restricted SF-1	34.4	156	4.5
R-12	SF-2	12.3	44	3.6
R-13	SF-1	36.4	66	1.8
R-14	SF-2	26.9	60	2.2
R-15	SF-1	38.5	59	1.5
R-16	SF-3	31.7	191	6.0
Single Family Subtotal		503.1	1,407	2.8
Multi-Family & Mixed Use				
MF-1		4.6	69	15.2
MU-1 *(2)*		3.5	54	15.5
MF & Mixed Use Subtotal		8.0	123	15.3
Residential Subtotal *(3)*		511.2	1,530	3.0
Non-Residential Uses				
Public Parks				
P-1	Village Green	3.9		
P-2	Overlook Park	4.2		
P-3	South Park	2.9		
P-4	Scenic Park	2.5		
Public Parks Subtotal		13.5		
Private Parks				
PP-1	South	0.8		
PP-2	Central	1.0		
PP-3	Senior Activity Center	1.8		
PP-4	North	1.4		
PP-5	Village Core	1.9		
Private Parks/Recreation Subtotal		6.9		
Public Uses				
Public Safety		2.3		
Elementary School		8.3		
Public Uses Subtotal		10.6		
Open Space & Preserve				
Internal Open Space *(4)*		33.4		
Preserve		403.9		
Open Space & Preserve Subtotal		437.3		
Circulation Subtotal *(5)*		23.1		
Non-Residential Uses Subtotal		491.4		
Proctor Valley Village 14 Subtotal		1,002.6	1,530	1.5
Planning Area 16/19 Preserve				
Circulation in Preserve *(6)*		16.4		
Preserve		276.3		
Exchange to State for preserve		278.0		
Existing State Ownership (portion)		774.1		
Planning Area 16/19 Preserve Subtotal		1,344.9		
Proctor Valley Village and Preserve Grand Total		2,347.3	1,530	0.7

NOTES

(1) Additional offsites excluded from the acreage above include:

Proctor Valley Road Offsite Central & South	40.2
Offsite Sewer to Salt Creek Interceptor	

(2) Mixed Use acreage includes 15,000 sf of commerical use

(3) Residential acreage includes 153.2 acres of fuel mod and internal open space slopes and 2.6 acres of private pocket parks.

(4) Open Space included 11.3 acres of basins and HOA open space lots not included in the residential acreage.

(5) Proctor Valley Road Onsite in Village 14 only

(6) Proctor Valley Road north in Planning Area 16 is in Preserve.

The Land Exchange Alternative is designed around an active lifestyle and wellness recreation theme and includes an extensive park and recreation system including four public parks totaling 13 acres as depicted on Figure 5. The remaining private recreation facilities include three private swim clubs, a senior activity center, the Village Square community facility and numerous pocket parks totaling approximately 9 acres. Approximately 4.6 miles of community pathway are proposed on the Proctor Valley Road. Approximately three miles of Park-to-Park Loop connect to the regional pathway.

After implementing the proposed land exchange agreement, MSCP and RMP Preserve boundary adjustments, and General Plan Amendments, the Land Exchange Alternative Area will include 1,749 acres of land designated MSCP and Otay Ranch RMP Preserve, consisting of 404 acres in Proctor Valley Village 14, and 1,345 acres in Planning Areas 16 and 19.

Circulation and Access

Under the Land Exchange Alternative, regional access to Village 14 would be provided by State Route 125 (SR-125), located approximately three miles to the west. Interstate 805 (I-805), approximately eight miles to the west, provides secondary north/south access. SR-54, located approximately six miles to the northwest, connects to SR-125 and I-805, and provides regional east/west access.

Proctor Valley Road would provide the main access to Village 14. Five roundabouts would identify the entrance into each residential area as well as provide traffic calming at key internal intersections. The internal circulation plan also includes a series of residential collectors and residential streets to provide access to the residential neighborhoods.

Proctor Valley Road is planned as a two-lane road and is designated as a scenic corridor. The Land Exchange Alternative includes an Otay Ranch GDP/SRP amendment to the classification of Proctor Valley Road from a 4 Lane Major to a 2 Lane Light Collector. The northern connection of Proctor Valley Village 14 to Jamul will be in the alignment of the existing partially-improved Proctor Valley Road and will be paved provide both public access and secondary emergency access to both communities.

The Lane Exchange Alternative Circulation Plan incorporates vehicular and non-vehicular modes of transportation to create an integrated system of roads, bike lanes, trails, pathways, and sidewalks.

Options

The Land Exchange Alternative includes three options for internal circulation: (1) the Proctor Valley Road North Option, (2) the Preserve Trails Option and (3) the Perimeter Trail Option. The Draft EIR Land Exchange Alternative assesses each of these options and their respective impacts. Each of the options summarized below. For detailed descriptions with exhibits, see the Specific Plan Section VIII. Internal Circulation Options.

Proctor Valley Road North Option: The Proctor Valley Road North Option applies to Proctor Valley Road Street Section 10 at the northerly edge of Village 14. Street Section 10 would be replaced with Street Section 10B to provide for two dedicated bike lanes (one on each side of the road) instead of the "sharrows" [1] proposed in the Land Exchange Alternative. Note that Street Section 10A provides a transition section at the northerly property boundary and does not change in the Option scenario. Generally, the Proctor Valley Road North Option would increase the right-of-way width from 40 feet to 48 feet.

Preserve Trails Option: The Preserve Trails Option consists of two segments of existing, disturbed trails. These segments would be located within the Otay Ranch RMP Preserve. The Preserve Trails Option includes segments "A" & "B" as identified in the Otay Ranch GDP/SRP, which are also identified as segments 52& 49 in the County of San Diego's Community Trails Master Plan (CTMP). Segment "A"/"52" is 4,450 lineal feet, generally located at the northern terminus of Village 14 and extending northeast through the onsite Otay Ranch RMP Preserve to the eastern edge of the Echo Valley loop (CTMP Trail 53). Segment "B"/"49" is approximately 3,100 lineal feet and is located between South and Central Village 14, along an existing, historic ranch road. This trail is located within onsite Otay Ranch RMP Preserve and bisects regional wildlife corridor R1. The Preserve Trails Option would retain these portions of trails in their existing conditions, which meet the CTMP primitive trail standard. No improvements to these Preserve Trails are contemplated.

Perimeter Trail Option: The Perimeter Trail Option is an approximately 4.5-mile perimeter trail located within the Development Footprint of Village 14. The Perimeter Trail Option is situated primarily within the Otay Ranch RMP 100-foot Preserve Edge. The Perimeter Trail Option is designed to CTMP primitive trail standards, and the trail tread varies from 2-6 feet. Due to topography, trail grades range from 2% to the maximum grade allowed of 30%. The Perimeter Trail Option requires the construction of approximately 5,200 lineal feet (1.0 mile) of 5 to-7-foot-high retaining walls due to steep topography and drainage constraints. The Perimeter Trail Option would be graded as part of overall project grading and does not encroach into the Otay Ranch RMP Preserve. The perimeter trail would be accessed at public parks and trailheads and would be maintained by the County of San Diego.

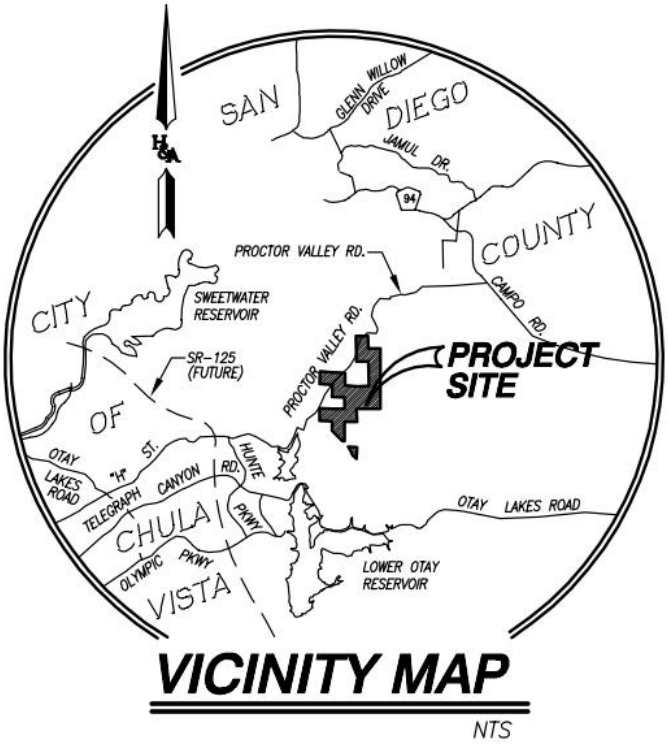
Hunsaker & Associates has evaluated these options and they are not material to the information presented in this technical report.

Drainage Opening Discussion

All runoff from the project site currently discharges to the Upper Otay Reservoir via Proctor Valley. Development of the site will not cause any diversion to or from the Upper Otay Reservoir watershed. The Upper Otay Reservoir serves as a recreational area as well as a dam with an overflow into the downstream Lower Otay Reservoir. Water from the Lower Otay Reservoir (and, thus, from the entire catchment of the reservoir) rarely discharges to the Otay River downstream of Savage Dam. Water from the Otay Reservoir is conveyed in a pipeline to the Otay Water Treatment Plant, treated to drinking water standards, and distributed as potable water to homes and businesses in the City of San Diego and neighboring communities. The only time any water is released from Otay Reservoir to the Otay

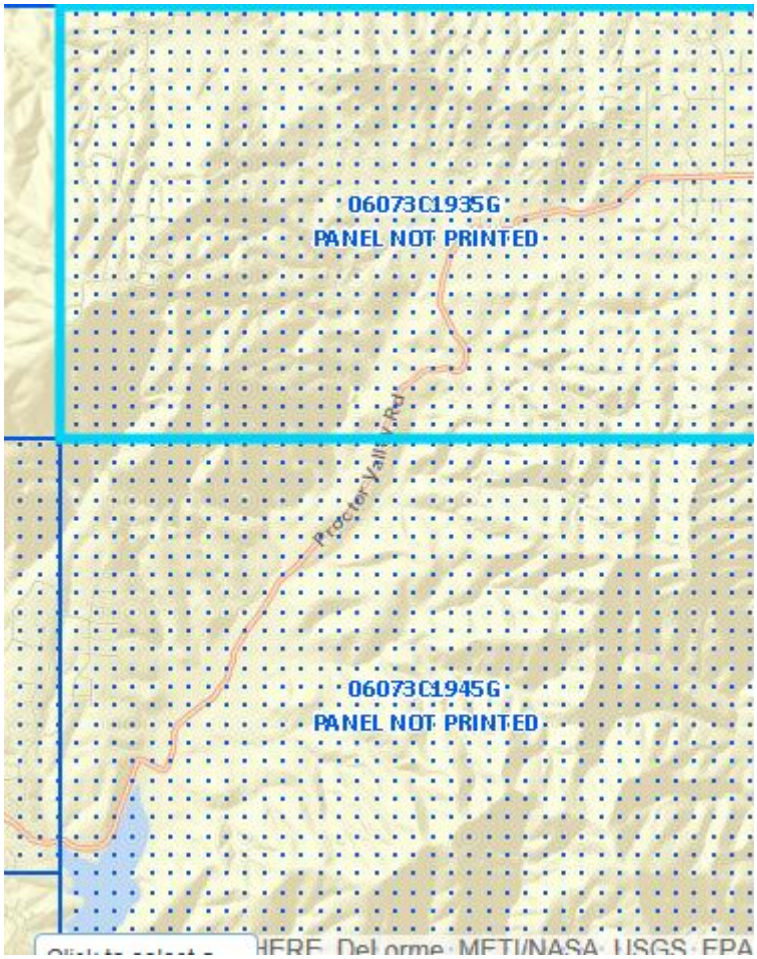
River downstream is when the reservoir fills up and overflows, which has happened only seven times since 1917. The City of San Diego has stated that they will impound the maximum amount of water possible.

REGIONAL LOCATION MAP



This Drainage Study for Otay Ranch Village 14 And Planning Area 16/19- Land Exchange Alternative has been prepared to assess the onsite peak flow runoff rates from the proposed Land Exchange Alternative site as well as any associated offsite runoff which will be conveyed through the project site. Additionally, this report analyzes the proposed major storm drain facilities needed to route these flows downstream without adversely impacting the downstream natural drainageways. The impact of development along and within Proctor Valley Road north and south of the proposed Land Exchange Alternative development was also included with the hydrologic analysis of this study.

No previous hydrologic analyses are known to exist for the site. According to the FEMA Flood Map Service Center, no flood map has been printed and no historic or pending actions appear to have occurred for this area. Since the site lays outside any FEMA floodplain boundaries no Letters of Map Revision will be required.



All methodology used in this report are consistent with standards set forth by the San Diego County Hydrology Manual (SDCHM). Hydrological calculations were conducted using the Rational Method for the onsite and smaller offsite areas which were relevant in determining expected flows being conveyed through the site and which were less than 1.0 square mile in size. The larger-area hydrologic calculations (greater than 1.0 sq miles) were analyzed using HEC-HMS software. Per County of San Diego methodology, which is detailed in Chapter 2, all hydrologic results correspond to the 100-year design storm. The AES-2015 computer software was used to model the runoff response per the Modified Rational Method. Methodology used for the computation of design rainfall events, runoff coefficients, and rainfall intensity values are consistent with criteria set forth in the most current SDCHM. A more detailed explanation of methodology and model development used for this analysis is listed in Chapter 2 of this report. Refer to Chapters 3 ,4, and 5 for all hydrologic results. For City of San Diego review, Chapter 4.1.4 contains hydrologic analysis of Proctor Valley Road south of the Land Exchange Alternative site.

Treatment of storm water runoff has been addressed in a separate report, titled "*PDP SWQMP for Otay Ranch Village 14 and Planning Areas 16/19- Land Exchange Alternative*" by Hunsaker & Associates dated January 2018.

1.2 Summary of Pre-Developed Conditions

The existing project location contains no development. On-site topography is characterized by steep hills, incised canyon and vegetation consisting mainly of brush. No development exists in off-site areas which drain through the Proctor Valley Village 14 project site. Proctor Valley Road traverses the proposed Land Exchange Alternative site connecting the community of Jamul to the City of Chula Vista. The road is partially paved through its length with minimal drainage structures. In general, the road follows the existing contours and shows evidence of runoff overtopping and sheet flowing particularly at the locations of the major existing drainage paths. Proctor Valley Road and Proctor Valley generally parallel each other. The drainage areas tributary to Proctor Valley are as shown on Exhibit 3.1 in Chapter 3. Canyon runoff east and west of Proctor Valley confluence at Proctor Valley and flow in a southwesterly direction to discharge into the Upper Otay Reservoir.

Chapter 3 includes the HEC-HMS analysis relative to the areas impacted by the Proposed Project including the improvements to Proctor Valley Road. The table below summarizes the flows calculated at various points along Proctor Valley. Please refer to Exhibit 3.1 for reference.

TABLE 2 - Summary of Existing Flows along Proctor Valley

Junction Name	Existing Drainage Area to Junction (acres)	100-year Existing Peak Flow (cfs)
J001	953.77	1,528
J003	2,775.71	4,928
J004	4,001.52	7,076
J005	5,372.63	9,660
J007	6,111.18	10,955
J008	6,223.71	10,991
J009	6,880.65	12,036

As shown in Table 2 above, the existing watershed to be affected by the Land Exchange Alternative is about 10.75 square miles and includes the southern portion of the City of Jamul. With minimal drainage facilities along the length of Proctor Valley Road, road drainage overtopping, sheet flows, and sediment accumulation is evident along the road length.

1.3 Summary of Developed Conditions

Development of the 1,002.6 acre Otay Ranch Village 14 and Planning Area 16/19-Land Exchange Alternative project will include the construction of residential dwelling units, multiple park sites, roads, and public-use facilities such as a school site and firehouse. Roughly 426 acres of the 1,002.6-acre study area will be

reserved for open space and Preserve uses. Refer to Figure 5 above for the sites land use plan.

As mentioned above, the Proctor Valley and Proctor Valley Road (PVR) generally parallel each other with the road located along the east side of Proctor Valley through most of its length. The Land Exchange Alternative and its associated improvements to Proctor Valley Road will not significantly alter the existing Proctor Valley Road alignment. Development of this project will essentially straddle Proctor Valley Road on its eastern and western sides. In general, development elevations east of PVR increase as the distance from PVR increases until the open space and preserve areas are reached. These open space and preserve areas continue to climb in elevation up to the watershed ridgeline. For the developed areas west of PVR, the western boundary of the developed areas defines the onsite ridgeline for drainage towards PVR.

The location of the site along PVR is such that it intersects the offsite preserve area's natural drainage path towards Proctor Valley. Therefore, a storm drain will be required to collect and convey this offsite runoff through the Land Exchange Alternative site. The proposed onsite storm drain system will collect development runoff and discharge into a proposed BMP basin intended for water quality and hydromodification treatment. Routing the offsite preserve area flows through the proposed basins would significantly increase the basin size. Therefore, dual storm drain configurations are proposed throughout the site wherever feasible to avoid comingling of onsite and offsite flows.

All runoff from the Land Exchange Alternative site will drain to the Upper Otay Reservoir. The runoff from the 85th percentile storm, as defined by the SDCHM, and drier weather runoff from developed areas of the site will be routed to water quality basins. The riser outlet structure for each basin will be designed to address water quality and hydromodification for its respective watershed and drainage management area (DMA). The performance of the Water Quality Basins is described in depth in the "*PDP SWQMP for Otay Ranch Village 14 and Planning 16/19- Land Exchange Alternative*" by Hunsaker & Associates dated January 2018. Peak flows from each basin will outlet via its respective riser top and discharge into Proctor Valley. Energy dissipation will be required at each discharge location to reduce flow velocities below erosive levels.

Development of the Land Exchange Alternative site will not cause any diversion to or from the Lower Otay Reservoir watershed. Hydrologic analysis of the site was carried out in two ways dependent on the scope and size of area being analyzed. For example, HEC-HMS analysis was prepared to determine Q100 flowrates generated on a larger scale with tributary areas over 1.0 square mile while Rational Method was used for peak flow determination for the onsite areas. The HEC-HMS study helped determine the expected flowrates at the proposed major crossing locations along Proctor Valley Road which will need to convey large flows and require special design consideration at this design phase. Chapter 5 includes the unit hydrograph hydrologic model and map for proposed conditions. Table 3 below summarizes the 100-year developed condition peak flows to each of the discharge locations along Proctor Valley.

TABLE 3 - Summary of Proposed Flows along Proctor Valley

Junction Name	Proposed Drainage Area to Junction (acres)	100-year Proposed Peak Flow (cfs)
J001	953.79	1,528
J003	2,764.00	4,977
J004	4068.10	6,925
J005	5,328.12	9,922
J007	6109.83	11,222
J008	6,190.58	11,219
J009	6,880.65	12,372

The Rational Method hydrologic calculations were prepared for the smaller (less than 1.0 square mile) onsite developed areas and for the offsite preserve areas along the Proposed Project's eastern slopes. Four separate hydrologic models were completed as a means of providing a clearer presentation for such a large project. All the models are included in Chapter 4 and divided as follows:

1. Drainage Area Tributary to North WQ Basin
2. Drainage Area Tributary to South WQ Basin
3. Eastern Slopes Drainage Area bypassing WQ Basin
4. Drainage Areas Along Proctor Valley Road (south of Proctor Valley Village 14)

The hydrology maps associated with the Rational Method models above are included at the end of Chapter 4. The maps identify the flow information at the discharge points downstream of each proposed water quality basin.

1.4 Analysis and Results

1.4.1 Hydrology

Table 4 summarizes the overall effect of on-site development in the discharge of the 100-year peak flow event to the Upper Otay Reservoir. As expected, the total Post-Development area equals the total Pre-Development area since there are not any diversions from the area upstream of the Upper Otay Reservoir.

TABLE 4 - Summary of Pre vs. Post-Developed Condition Flows to Upper Otay Reservoir as impacted by Proctor Valley Village 14

Condition	Tributary Area (acres)	100-Year Peak Flow (cfs)
Pre-Developed	6,880.65	12,036
Post-Developed	6,880.65	12,372
DIFFERENCE	**0**	**+336**

The Upper Otay Reservoir discharges into the Lower Otay Reservoir which is used as a water source and rarely discharges to the Otay River downstream of the Savage Dam. Water from the reservoir is conveyed in a pipeline to the Otay Water Treatment Plant, treated to drinking standards, and distributed as potable water to homes and businesses in the City of San Diego and neighboring communities. The City of San Diego has stated that they will impound the maximum amount of water as possible and oppose any reductions in the volume of runoff into the Lower Otay Reservoir. The City of San Diego has additionally specified that the quality of storm water runoff discharging into the reservoir is acceptable and the Source Protection Guidelines for New Development used to address water quality matters. The BMP measures proposed for development of the Proposed Project site will consist of biofiltration facilities which will treat development flows prior to discharging into Proctor Valley or Jamul Creek and will address pollutant concerns in accordance with San Diego County BMP Design Manual. Since the capacity of the Upper Otay Reservoir is more than sufficient to convey the proposed peak flow increases and all proposed upstream storm drain will be sized to convey the projected 100-year peak flow, no detention basins are required as part of the Proposed Project. The City of San Diego provided input on and reviewed this report and the SWQMP. Based on this coordinated effort, the assumptions and results presented herein are in conformance with the City of San Diego requirements for drainage above the Otay Lakes Reservoirs.

1.4.2 Additional Culvert Considerations

Table 5 provides a summary of the proposed major conveyance storm drain facilities.

TABLE 5 - Summary of Proposed 100-year peak flows and Conveyance

Crossing ID #	Discharge Location	100- Year Developed Peak Flow (cfs)	(Est.) Proposed Stormwater Conveyance Size
J006	Along PVR between North and South WQ Basins	2,675 cfs	12’ x 20’ arch culvert
J008	Along PVR south of (residential portions of) Village 14	11.334 cfs	Three (3) – 12’ x 34’ arch culverts
PVR1	South of North WQ Basin	1,055 cfs	96” RCP
PVR2	South of South WQ Basin	600 cfs	3- 4’ x 7’ RCBC
PVR3	Southern end of PVR	1,426 cfs	3- 6’x 6’ RCBC

Table 5 estimates that the onsite storm drain system will consist of pipe with diameters ranging between 18” to 96”. The two major crossings above along Proctor Valley Road will include one 12’ x 20’ arch culvert, and three 12’ x 34’ arch culvert crossings. These major crossings will also serve as wildlife crossings. The preliminary sizing of these two wildlife crossings are based on conversations with environmental consultants and coordinated with reputable nationwide pipe and culvert suppliers.

All headwall locations will be designed with a minimum of 1 ft of freeboard for the 100-year peak flow.

1.4.3 Open Channel Floodway Analysis

Unit hydrograph flow rates (Q100) were used for the determine the expected water surface elevations along Proctor Valley and its tributaries. The values calculated within the HEC HMS analysis were inserted into the HEC RAS model which was set up to simulate the proposed condition flood patterns associated with the project. Chapter 6 contains the results of the analysis. The CD located at the end of the that chapter contains the HEC RAS data files. The results from the HEC RAS study were transferred to the hydrology exhibits as shown on the maps at the end of Chapter 4. These preliminary exhibits and calculations demonstrate that the pads within the proposed development are not located within the 100-year floodway. Further detailed analysis will be required during the final engineering phase to confirm the results included within this study and to address any issues relative to road crossing locations and associated slope stabilization and erosion measures necessary along the floodway path.

1.5 Hydromodification Considerations

For Hydromodification analysis refer to *“‘HMP Flow Control Facility Design for Otay Ranch Village 14 and Planning Areas 16/19- Land Exchange Alternative”,* Hunsaker & Associates, San Diego, January 2018.

1.6 Conclusions and Recommendations

- Based on the unit hydrograph hydrologic calculations, the Land Exchange Alternative site will increase the Post-Development 100-year peak flow by about 336 cfs from 12,036 cfs to12,372 cfs. However, Post-Development storm drain facilities can accommodate the proposed peak flow increases.

- While development of the Land Exchange Alternative site would increase design flow rates as compared to Pre-Development conditions, the increases will be mitigated by the construction or improvements to Proctor Valley Road. These improvements include storm drains, culverts, and arch crossings that will also serve as wildlife crossings. These crossings have been designed to safely convey the developed condition 100-year peak flow. Flooding concerns downstream of Proctor Valley Road are mitigated by the large storage volume provided by the Otay Reservoir.

- Post-Development discharges into Proctor Valley will require energy dissipation at discharge locations to reduce velocities below erosive limits. Some measures include installation of concrete energy dissipating headwalls, rip rap, and rip rap impact basins.

- The proposed water quality and hydromodification measures are expected to reduce the overall potential for erosion as a consequence of the Land Exchange Alternative site despite the increase in peak flow. A detailed explanation is presented in the "*HMP Flow Control Facility Design for Otay Ranch Village 14 and Planning Area 16/19- Land Exchange Alternative*". It is expected that the proposed project will help to reduce the sediment deposition in Upper Otay Reservoir as long as the proper erosion and sediment control measures are taken during construction.

- The proposed project will be designed to comply with all water quality standards and waste discharge requirements. Storm water treatment design is further discussed in the "*PDP SWQMP for Otay Ranch Village 14 and Planning 16/19- Land Exchange Alternative*".

- Development of the Proposed Project site will not degrade potential beneficial uses of downstream water bodies as designated by the Regional Water Quality Control Board, including water bodies listed on the Clean Water Section 303d list.

- Minor alterations to the existing drainage pattern, required as part of the Proposed Project, will be mitigated to prevent substantial erosion or siltation onsite and offsite. Energy dissipater systems will also be designed at all proposed culvert outfalls.

- Development of the Proposed Project site will not encroach on any 100-year flood hazard areas as defined by FEMA. As such, no CLOMR is required.

- Prior to recordation of a final map, 100-year flood lines will be established for any lot encumbered by a drainage channel conveying a watershed area in excess of 100 acres. Any such floodplain boundary shall be clearly delineated on the non-title information sheet of the final map.

- On-site and off-site drainage easements shall be provided to the satisfaction of the Director of Public Works.

- A flowage easement shall be granted to the San Diego County Flood Control District if any lots are subject to inundation by the 100-year flood from a drainage area in excess of one square mile.

- A copy of this study along with the *PDP SWQMP for Otay Ranch Village 14 and Planning 16/19- Land Exchange Alternative* and the *HMP Flow Control Facility Design for Otay Ranch Village* 14 and *Planning Area 16/19- Land Exchange Alternative* will be submitted to the City of San Diego for review.

1.7 References

PDP SWQMP for Otay Ranch Village 14 and Planning Areas 16/19- Land Exchange Alternative, Hunsaker & Associates, San Diego, January 2018.

HMP Flow Control Facility Design for Otay Ranch Village 14 and Planning Areas 16/19- Land Exchange Alternative, Hunsaker & Associates, San Diego, January 2018.

Model Standard Urban Storm Water Mitigation Plan for San Diego County, Port of San Diego, and Cities in San Diego County; February 14, 2002.

Order No. R9-2007-0001, NPDES No. CAS0108758 – Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, San Diego Unified Port District and the San Diego County Regional Airport Authority", California Regional Water Quality Control Board – San Diego Region; January 24, 2007.

San Diego County Hydrology Manual; County of San Diego Department of Public Works Flood Control Division, June 2003.

Julien, P., Simons, D. "Sediment Transport Capacity of Overland Flow". May-June 1985, Vol. 28(3). American Society of Agricultural Engineers 0001-2351 / 85 / 2803-0755

Brown and Caldwell, *"Final Hydromodification Management Plan"*, March 2011. Prepared for County of San Diego

Federal Emergency Management Agency, "Flood Insurance Study; San Diego County, California and Incorporated Areas", Revised September 29, 2006.

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.1 – Design Rainfall Determination

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.1 – 100-Year, 6-Hour Rainfall Isopluvial Map

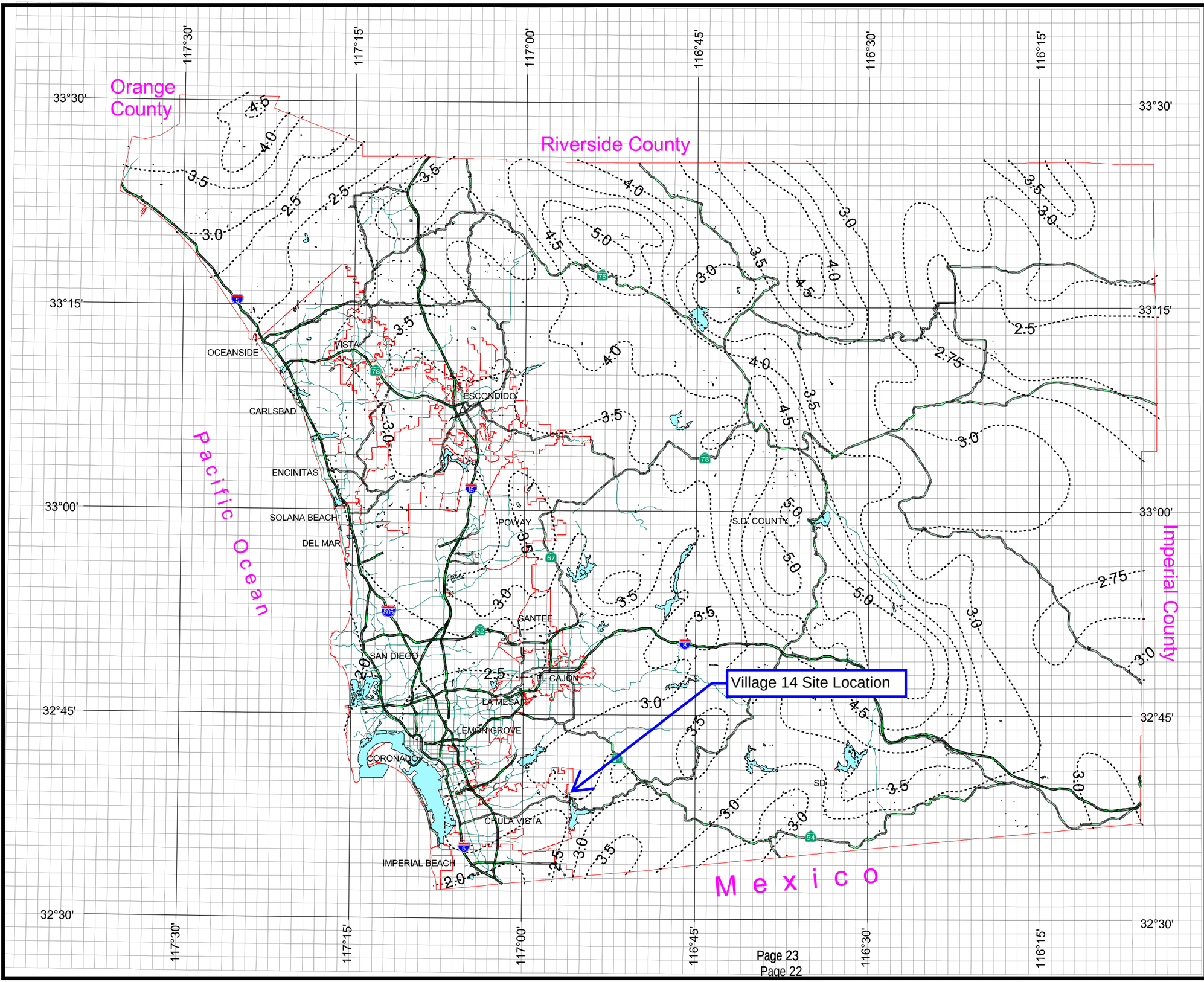
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P6 = 3.1 inches



DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.1 – 100-Year, 24-Hour Rainfall Isopluvial Map

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

P24 = 6.0 inches

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

Village 14 Site Location

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
CHULA VISTA
IMPERIAL BEACH
SD

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.2 – Runoff Coefficient Determination

Page 27
Page 26

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

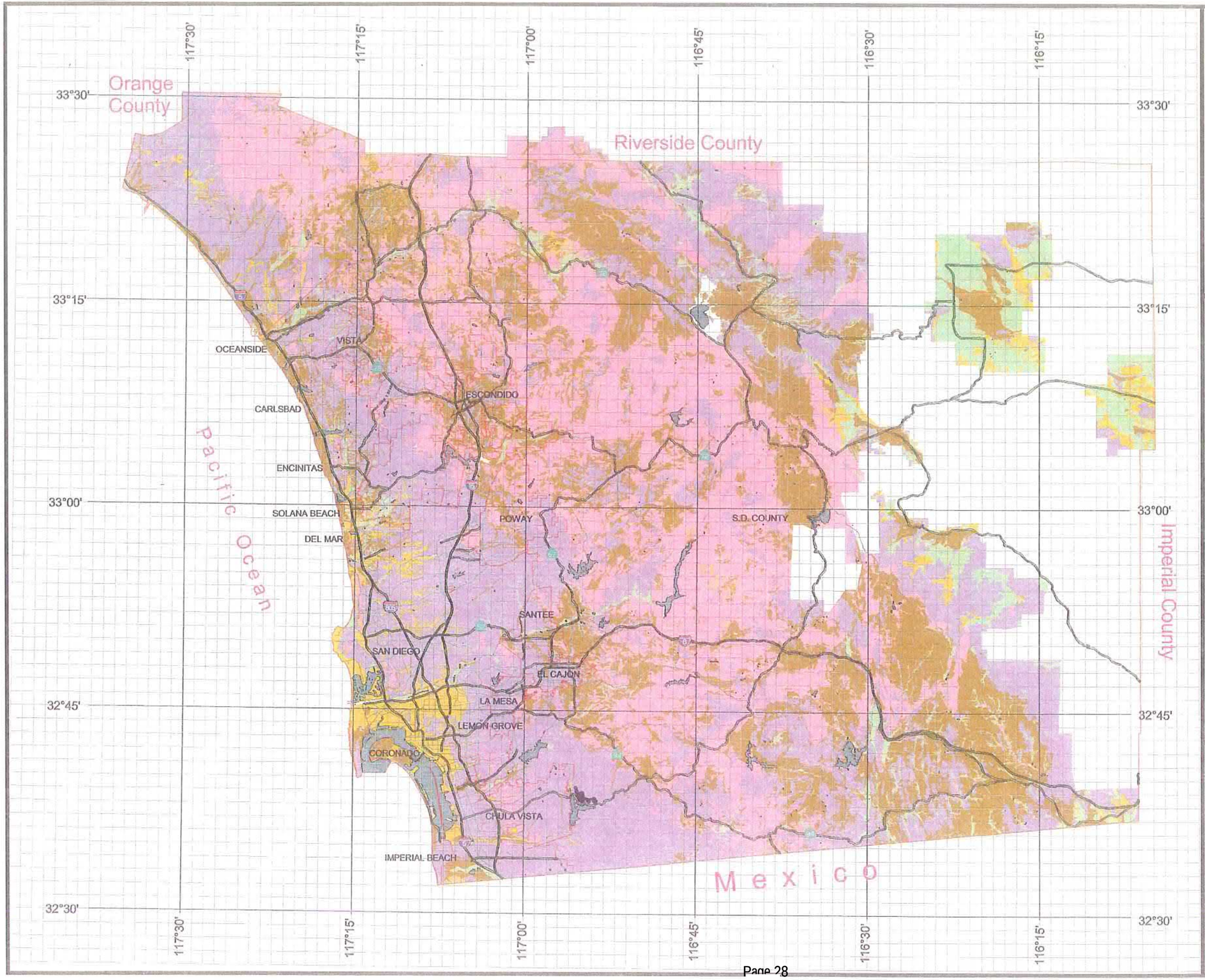
← FOR PROCTOR VALLEY ROAD PORTION

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

RUNOFF COEFFICIENTS USED BASED ON CALCULATED DU/A.

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

Hydrologic Soil Group—San Diego County Area, California
(VILLAGE 14 HYDROLOGIC SOIL GROUPS)

VILLAGE 14
LAND EXCHANGE
EIR ALTERNATIVE

Map Scale: 1:19,000 if printed on D portrait (22" x 34") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

Natural Resources Conservation Service

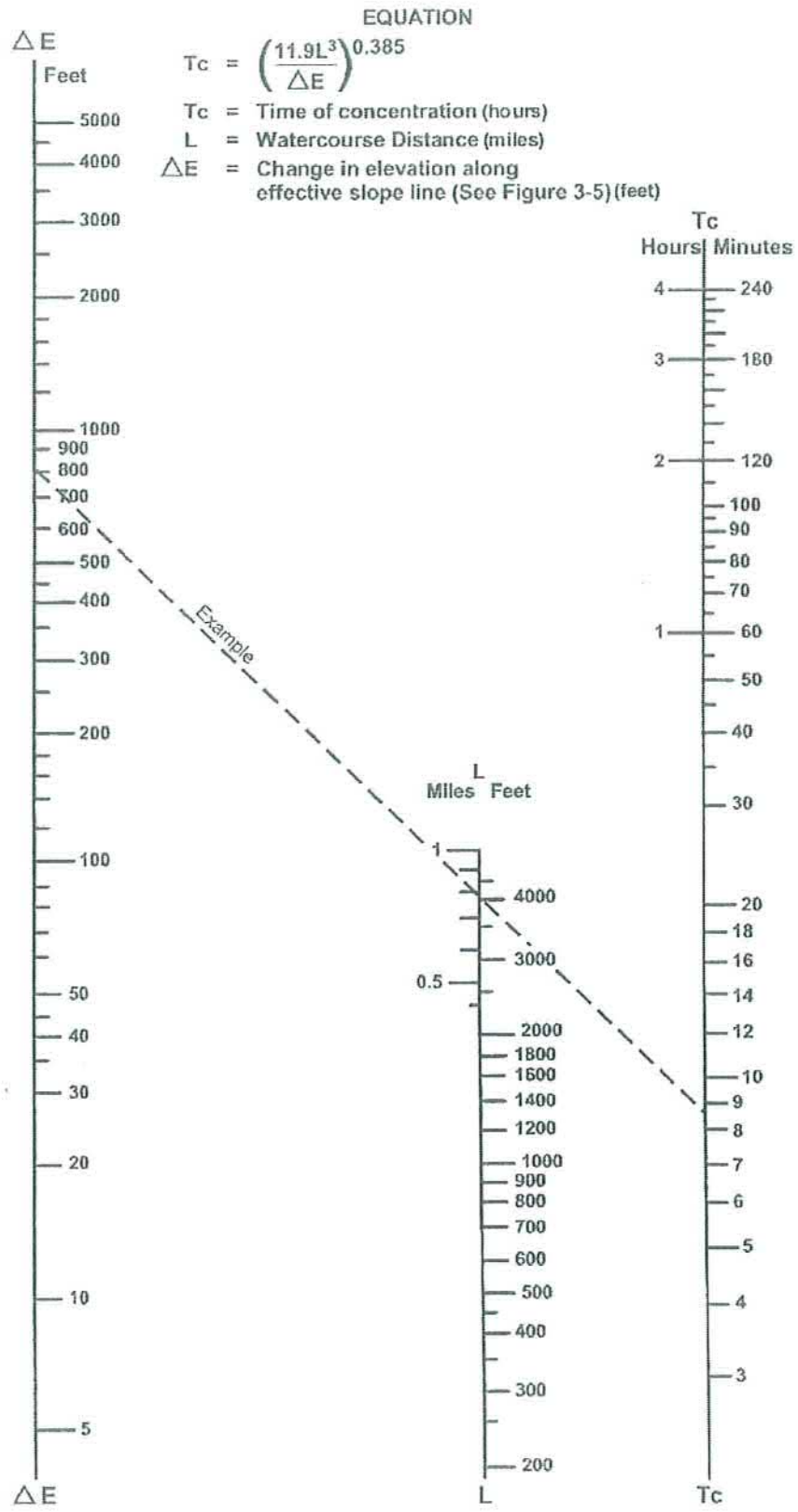
Web Soil Survey
National Cooperative Soil Survey

1/7/2015
Page 1 of 6

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.3 – Peak Intensity Determination



SOURCE: California Division of Highways (1941) and Kirpich (1940)

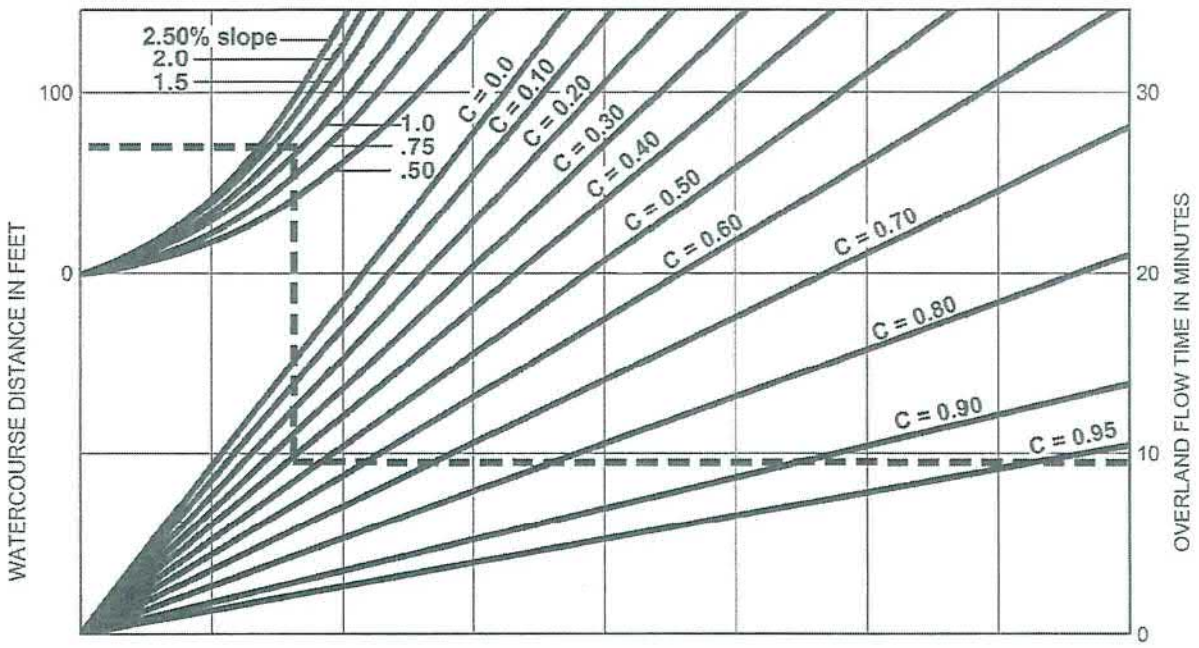
FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.3 – Urban Watershed Overland Time of flow Nomograph



EXAMPLE:
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

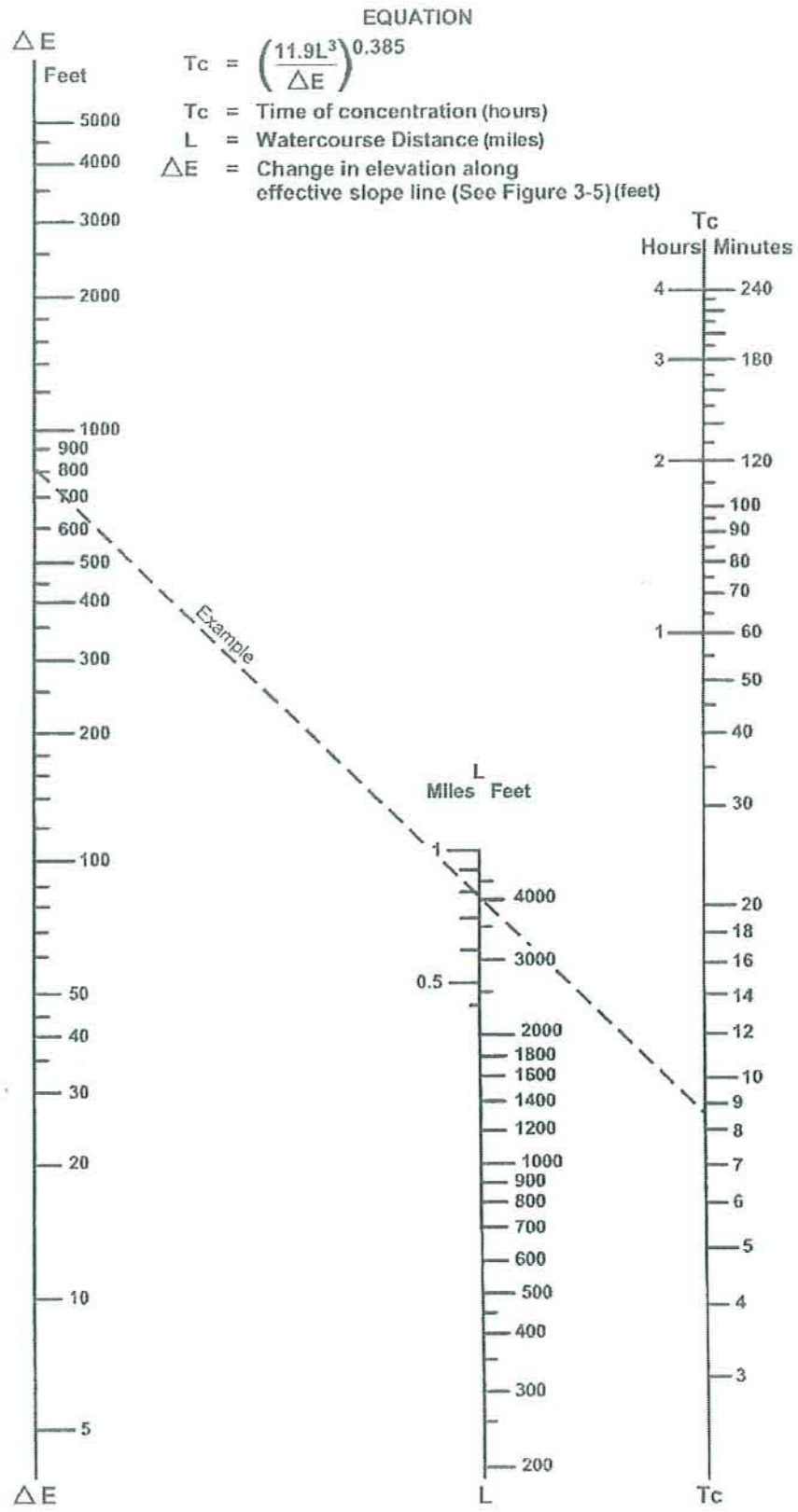
FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.3 – Natural Watershed Overland Time of flow Nomograph



SOURCE: California Division of Highways (1941) and Kirpich (1940)

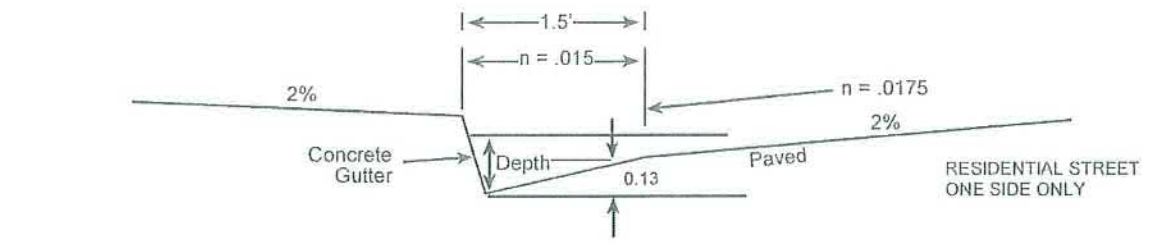
FIGURE 3-4

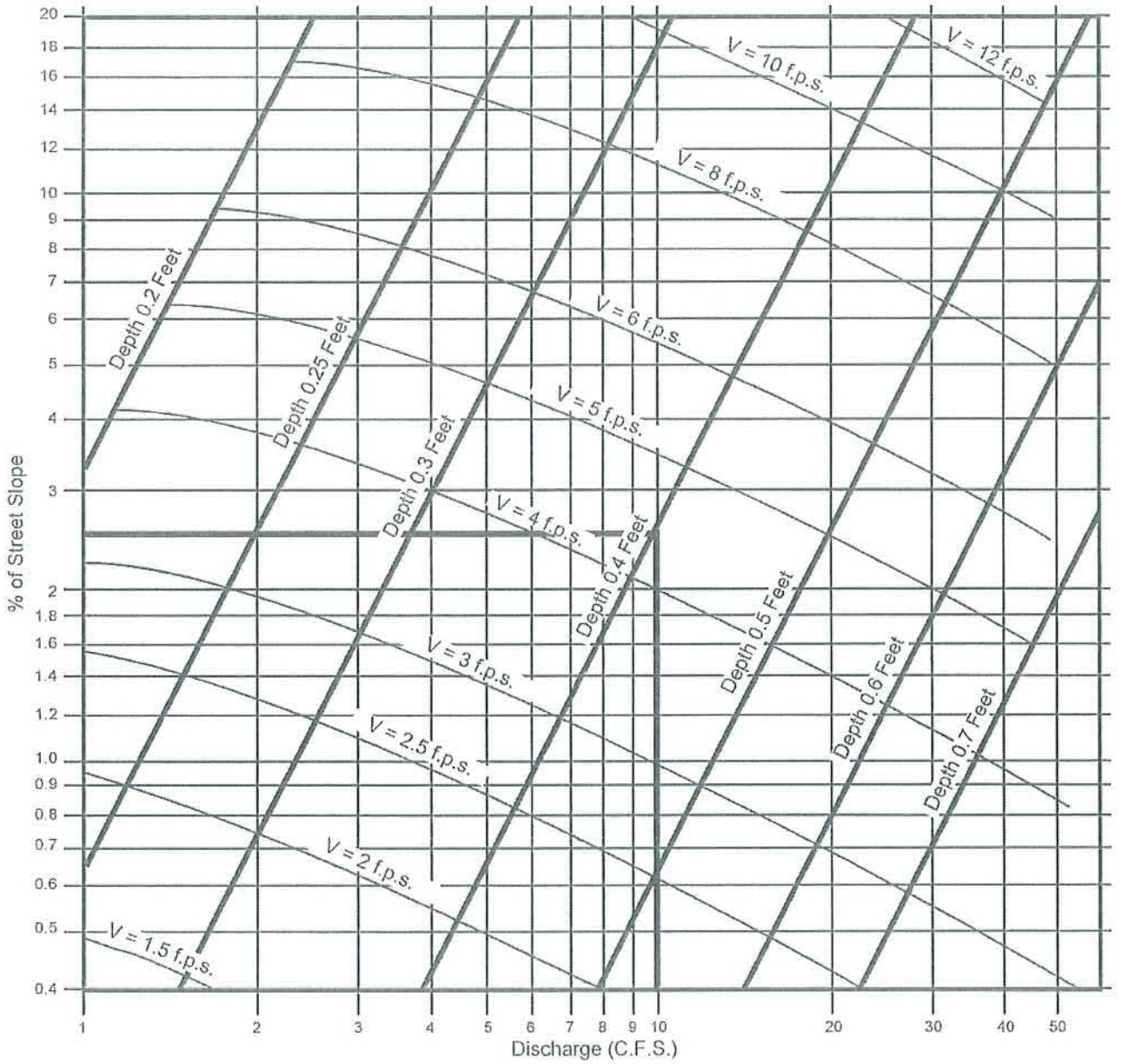
Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.3 – Gutter and Roadway Discharge (Velocity Chart)





EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

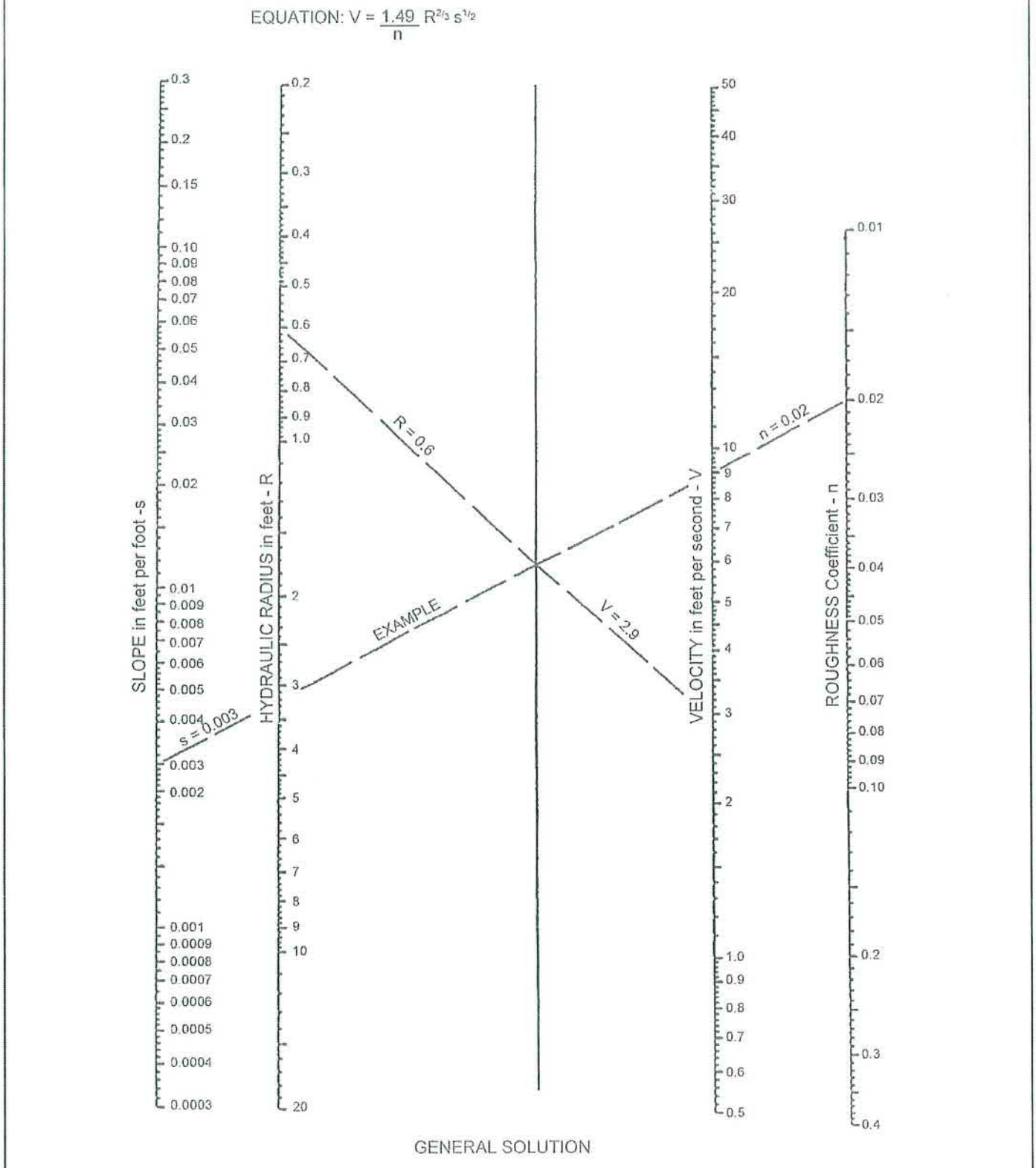
FIGURE 3-6

Gutter and Roadway Discharge - Velocity Chart

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.3 – Manning's Equation Nomograph



SOURCE: USDOT, FHWA, HDS-3 (1961)

FIGURE 3-7

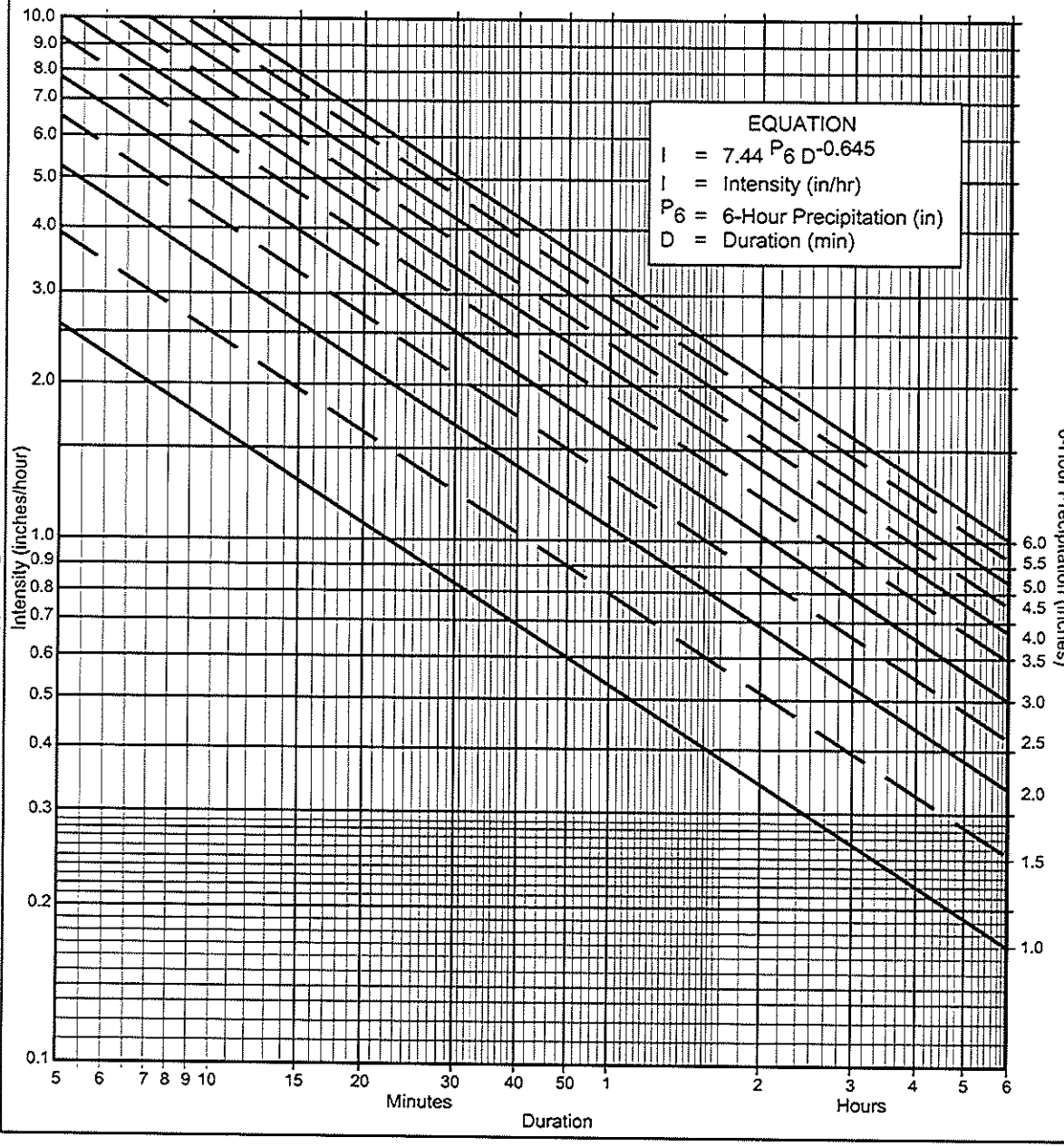
Manning's Equation Nomograph

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION (ULTIMATE CONDITIONS)

2.4 – Intensity Duration Design Chart (from San Diego County Hydrology Manual)

VILLAGE 14



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.1 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 51.67 %(2)

(c) Adjusted P_6(2) = N/A in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE
3-1

CHAPTER 2 - METHODOLOGY

2.5 – Rational Method Hydrologic Analysis

2.5 Rational Method Hydrologic Analysis

Computer Software Package – AES-2015

Design Storm - 100-year return intervals

Land Use – Single Family/Multi Family development, Schools, Parks & Open Space.

Soil Type – Hydrologic soil group D was assumed for all areas for proposed condition. Group D soils have very slow infiltration rates when thoroughly wetted. Consisting chiefly of clay soils with a high swelling potential, soils with a high permanent water table, soils with clay pan or clay layer at or near the surface, and shallow soils over nearly impervious materials, Group D soils have a very slow rate of water transmission.

Runoff Coefficient – In accordance with the San Diego County Hydrology Manual (SDCHM) Standards, the C coefficient for natural and undeveloped areas is 0.35; the C coefficient for developed areas is a weighted factor of 0.35 (landscape in soil D) and 0.9 (impervious areas) as a function of the fraction of impervious areas (a_i expressed as a decimal value between 0 and 1) according to:

$C = 0.35(1-a_i) + 0.9a_i$

Rainfall Intensity - Initial time of concentration values were determined using the County of San Diego's overland flow nomograph for urban areas. Downstream T_c values are determined by adding the initial sub-basin time of concentration and the downstream routing time. Per SDCHM standards, intensity values were determined from the County of San Diego's Intensity-Duration equation.

Method of Analysis – The Rational Method is the most widely used hydrologic model for estimating peak runoff rates. Applied to small urban and semi-urban areas with drainage areas less than 0.5 square miles, the Rational Method relates storm rainfall intensity, a runoff coefficient, and drainage area to peak runoff rate. This relationship is expressed by the equation:

$Q = CIA$

where:

Q = The peak runoff rate in cubic feet per second at the point of analysis.

C = A runoff coefficient representing the area - averaged ratio of runoff to rainfall intensity.

I = The time-averaged rainfall intensity in inches per hour corresponding to the time of concentration.

A = The drainage basin area in acres.

To perform a node-link study, the total watershed area is divided into subareas which discharge at designated nodes.

The procedure for the subarea summation model is as follows:

(1) Subdivide the watershed into an initial subarea (generally 1 lot in developed conditions or an area with a maximum overland flow length does not exceed values displayed in Table 3.2 of the SDCHM) and subsequent subareas, which are generally less than 10 acres in size. Assign upstream and downstream node numbers to each subarea.

(2) Estimate an initial T_c by using the appropriate nomograph or overland flow velocity estimation.

(3) Using the initial T_c, determine the corresponding values of I. Then Q = C I A.

(4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to the particular channel or conduit linking the two nodes. Then, repeat the calculation for Q based on the revised intensity (which is a function of the revised time of concentration)

The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipe flow, or various channel flows. The AES-2015 computer subarea menu is as follows:

SUBAREA HYDROLOGIC PROCESS

1. Confluence analysis at node.
2. Initial subarea analysis (including time of concentration calculation).
3. Pipe flow travel time (computer estimated).
4. Pipe flow travel time (user specified).
5. Trapezoidal channel travel time.
6. Street flow analysis through subarea.
7. User - specified information at node.
8. Addition of subarea runoff to main line.
9. V-gutter flow through area.
10. Copy main stream data to memory bank
11. Confluence main stream data with a memory bank
12. Clear a memory bank

At the confluence point of two or more basins, the following procedure is used to combine peak flow rates to account for differences in the basin's times of concentration. This adjustment is based on the assumption that each basin's hydrographs are triangular in shape.

(1). If the collection streams have the same times of concentration, then the Q values are directly summed,

$Q_p = Q_a + Q_b$; $T_p = T_a = T_b$

(2). If the collection streams have different times of concentration, the smaller of the tributary Q values may be adjusted as follows:

(i). The most frequent case is where the collection stream with the longer time of concentration has the larger Q. The smaller Q

value is adjusted by the ratio of rainfall intensities. $Q_p = Q_a + Q_b\ (I_a/I_b)$; $T_p = T_a$

(ii). In some cases, the collection stream with the shorter time of concentration has the larger Q. Then the smaller Q is adjusted by a ratio of the T values.

$Q_p = Q_b + Q_a\ (T_b/T_a)$; $T_p = T_b$

For more than 3 peaks that have a confluence in a discharge area (for example, 23 peaks discharging at the same time in the Otay Reservoir) a similar logic but more complex approach is used:

If "N" peaks are at confluence, and "N" different times of concentration are analyzed, "N" confluence calculations are made at each of the "N" time of concentration values.

Peak flows are arranged from smaller to larger in terms of time of concentration and not in terms of value. For a time of concentration Tc_i belonging to a peak Q_i the peaks whose time of concentration is smaller than Tc_i are adjusted by intensity and the peaks whose time of concentration is larger than Tc_i are adjusted by a ratio of the Tc_i values. The total peak flow with the time of concentration Tc_i (denoted as Q_{TTci}) will be:

$$Q_{TTci} = Q_1 \cdot (I_i/I_1) + Q_2 \cdot (I_i/I_2) + \ldots + Q_i + Q_{i+1}\ (Tc_i/Tc_{i+1}) + \ldots + Q_N \cdot (Tc_i/Tc_N)$$

The confluence peak is chosen as the larger between Q_{TTc1}, Q_{TTc2}, …. , Q_{TTci}, Q_{TTci+1}, …. , Q_{TTcN-1}, Q_{TTcN}

CHAPTER 2 - METHODOLOGY

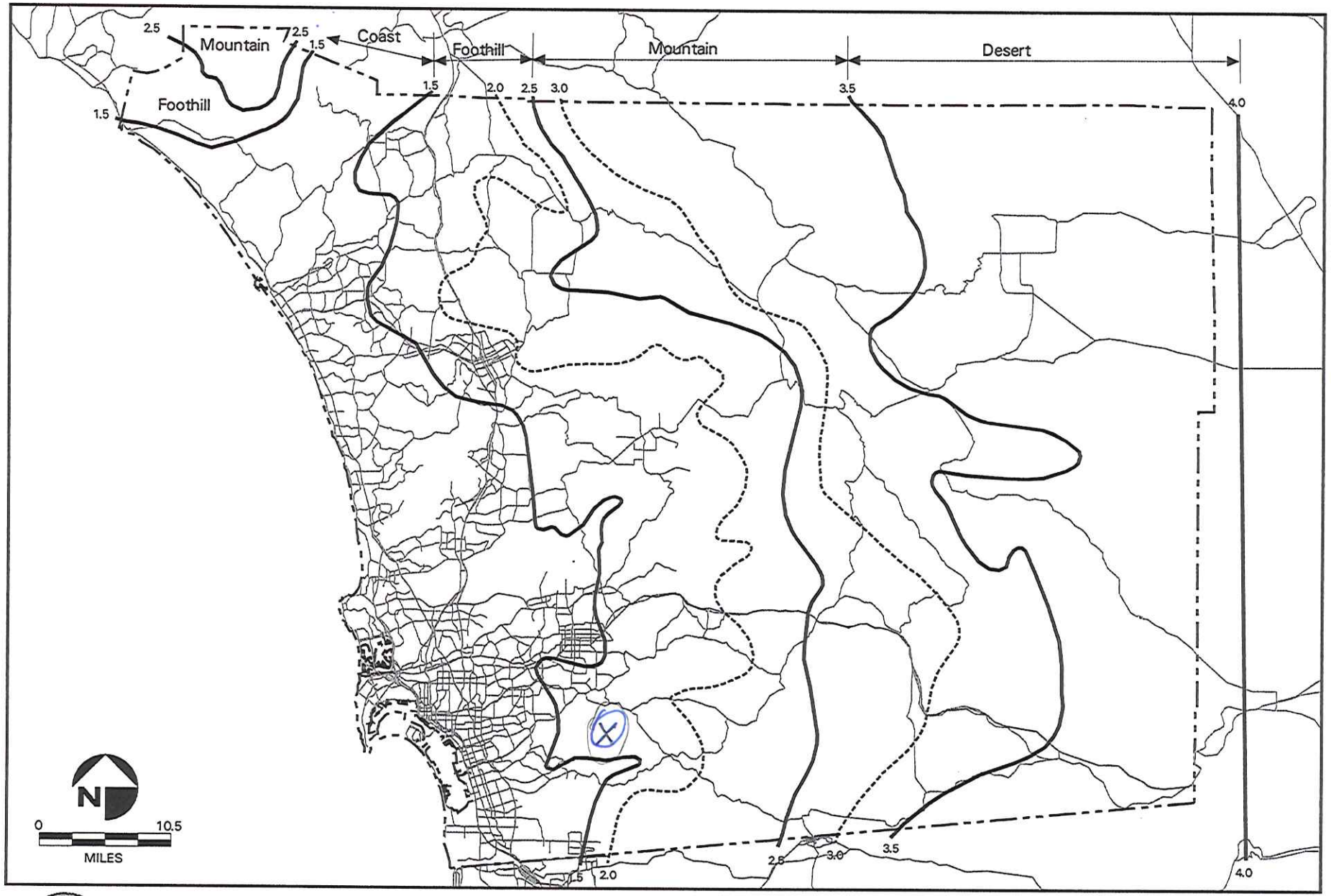
2.6 – NRCS Unit Hydrograph Hydrologic Analysis

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ClD2	Cieneba coarse sandy loam, 5 to 15 percent slopes, erod ed	D	4.6	0.0%
ClE2	Cieneba coarse sandy loam, 15 to 30 percent slopes, ero ded	D	25.9	0.3%
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes , eroded	D	12.5	0.1%
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	D	454.1	4.4%
DaC	Diablo clay, 2 to 9 percent slopes	D	196.6	1.9%
DaD	Diablo clay, 9 to 15 percent slopes	D	216.6	2.1%
DaE	Diablo clay, 15 to 30 percent slopes	D	326.3	3.2%
DoE	Diablo-Olivenhain complex, 9 to 30 percent slopes	D	137.8	1.3%
EsC	Escondido very fine sandy loam, 5 to 9 percent slopes	C	24.1	0.2%
EsD2	Escondido very fine sandy loam, 9 to 15 percent slopes, eroded	C	56.6	0.5%
FaC2	Fallbrook sandy loam, 5 to 9 percent slopes, eroded	C	55.0	0.5%
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded	C	139.0	1.3%
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded	C	52.1	0.5%
FvE	Fallbrook-Vista sandy loams, 15 to 30 percent slopes	C	6.7	0.1%
FwF	Friant fine sandy loam, 30 to 50 percent slopes	D	215.6	2.1%

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FxE	Friant rocky fine sandy loam, 9 to 30 percent slopes	D	878.1	8.5%
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes	D	2,296.1	22.2%
LpD2	Las Posas fine sandy loam, 9 to 15 percent slopes, erod ed	C	28.8	0.3%
LpE2	Las Posas fine sandy loam, 15 to 30 percent slopes, ero ded	C	16.0	0.2%
LrE	Las Posas stony fine sandy loam, 9 to 30 percent slopes	C	11.4	0.1%
LsE	Linne clay loam, 9 to 30 percent slopes	C	77.6	0.8%
OhC	Olivenhain cobbly loam, 2 to 9 percent slopes	D	393.7	3.8%
OhE	Olivenhain cobbly loam, 9 to 30 percent slopes	D	855.7	8.3%
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	61.5	0.6%
PeC2	Placentia sandy loam, 5 to 9 percent slopes, eroded	D	134.5	1.3%
PeD2	Placentia sandy loam, 9 to 15 percent slopes, eroded	D	10.5	0.1%
PfC	Placentia sandy loam, thick surface, 2 to 9 percent slo pes	D	19.0	0.2%
RaB	Ramona sandy loam, 2 to 5 percent slopes	C	8.5	0.1%
RaC2	Ramona sandy loam, 5 to 9 percent slopes, eroded	C	62.9	0.6%
Rm	Riverwash	D	31.8	0.3%
SnG	San Miguel-Exchequer rocky silt loams, 9 to 70 percent slopes	D	2,987.2	28.9%
VaB	Visalia sandy loam, 2 to 5 percent slopes	A	67.6	0.7%
VaC	Visalia sandy loam, 5 to 9 percent slopes	A	60.3	0.6%
VbB	Visalia gravelly sandy loam, 2 to 5 percent slopes	A	27.8	0.3%

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	B	88.6	0.9%
VvD	Vista rocky coarse sandy loam, 5 to 15 percent slopes	B	20.4	0.2%
VvE	Vista rocky coarse sandy loam, 15 to 30 percent slopes	B	51.3	0.5%
W	Water		134.4	1.3%
WmB	Wyman loam, 2 to 5 percent slopes	C	28.1	0.3%
WmC	Wyman loam, 5 to 9 percent slopes	C	76.8	0.7%
Totals for Area of Interest			**10,351.9**	**100.0%**



County of San Diego Hydrology Manual

Precipitation Zone Numbers (PZN)

FIGURE

C-1

PZN = 1.7

Village 14

Village 14

Table 4-10

RUNOFF CURVE NUMBERS FOR PZN CONDITIONS 1.0, 2.0, AND 3.0

CN For:			CN For:		
PZN Condition = 1.0	PZN Condition = 2.0 2.7	PZN Condition = 3.0	PZN Condition = 1.0	PZN Condition = 2.0 2.7	PZN Condition = 3.0
100	100	100	40	60	78
97	99	100	39	59	77
94	98	99	38	58	76
91	97	99	37	57	75
89	96	99	37	56	75
87	95	98	34	55	73
85	94	98	34	54	73
83	93	98	33	53	72
81	92	97	32	52	71
80	91	97	31	51	70
78	90	96	31	50	70
76	89	96	30	49	69
75	88	95	29	48	68
73	87 93	95	28	47	67
72	86	94	27	46	66
70	85 91	94	26	45	65
68	84 92	93	25	44	64
67	83	93	25	43	63
66	82	92	24	42	62
64	81	92	23	41	61
63	80	91	22	40	60
62	79	91	21	39	59
60	78	90	21	38	58
59	77	89	20	37	57
58	76	89	19	36	56
57	75	88	18	35	55
55	74	88	18	34	54
54	73	87	17	33	53
53	72	86	16	32	52
52	71	86	16	31	51
51	70 81	85	15	30	50
50	69	84			
48	68	84	12	25	43
47	67	83	9	20	37
46	66	82	6	15	30
45	65	82	4	10	22
44	64	81	2	5	13
43	63	80	0	0	0
42	62	79			
41	61	78			

Village 14

The adjustment for PZN Condition may be made to the composite CN for the watershed. It is not necessary to make the PZN Condition adjustment to each of the CNs for the different combinations of ground cover and soil group within the watershed before calculating the composite CN.

Table 4-6

PZN ADJUSTMENT FACTORS FOR FLOW COMPUTATIONS (San Diego County)

Storm Frequency	Coast (PZN = 1.0)	Foothills (PZN = 2.0)	Mountains (PZN = 3.0)	Desert (PZN = 4.0)
Less than 35-year return period	1.5	2.5	2.0	1.5
Greater than or equal to 35-year return period	2.0	3.0	3.0	2.0

Notes: PZN is the precipitation zone number (see Map, Appendix C). The PZN adjustment factor represents the PZN Condition that the CN for the watershed should be adjusted to.

4.1.3 Rainfall-Runoff Relationship

A relationship between accumulated rainfall and accumulated runoff was derived by NRCS from experimental plots for numerous soils and vegetative cover conditions. The following NRCS runoff equation is used to estimate direct runoff from 24-hour or 6-hour storm rainfall. The equation is:

$$Q_a = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{(Eq. 4-1)}$$

where: Q_a = accumulated direct runoff (in)

P = accumulated rainfall (potential maximum runoff) (in)

I_a = initial abstraction including surface storage, interception, evaporation, and infiltration prior to runoff (in)

S = potential maximum soil retention (in)

Table 4-2
RUNOFF CURVE NUMBERS[1] FOR PZN CONDITION = 2.0

Cover Description	Cover Treatment or Practice[2]	Hydrologic Condition[3]	Average Percent Impervious Area[4]	Curve Numbers for Hydrologic Soil Groups: A	B	C	D
Developing urban areas and newly graded areas (pervious areas only, no vegetation)				77	86	91	94
Impervious areas: Paved parking lots, roofs, and driveways (excluding right-of-way)				98	98	98	98
Residential districts by average lot size:[4]							
1/8 acre or less (town houses)			65%	77	85	90	92
1/4 acre			38%	61	75	83	87
1/3 acre			30%	57	72	81	86
1/2 acre			25%	54	70	80	85
1 acre			20%	51	68	79	84
2 acres			12%	46	65	77	82
Streets and roads	Paved; curbs and storm drains (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
	Hard surface (including right-of-way)			74	84	90	92
	Dirt (including right-of-way)			72	82	87	89
Urban districts[4]	Commercial and business		85%	89	92	94	95
	Industrial		72%	81	88	91	93
Western desert urban areas:							
Natural desert landscaping (pervious areas only)[5]				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

Page 53
Page 52

Village 14

Table 4-2 (Continued)
RUNOFF CURVE NUMBERS[1] FOR PZN CONDITION = 2.0

Cover Description	Cover Treatment or Practice[2]	Hydrologic Condition[3]	Average Percent Impervious Area[4]	Curve Numbers for Hydrologic Soil Groups: A	B	C	D
Close-seeded legumes or rotated pasture	Straight row	Poor		66	77	85	89
		Good		58	72	81	85
	Contoured	Poor		64	75	83	85
		Good		55	69	78	83
	Contoured and terraced	Poor		63	73	80	83
		Good		51	67	76	80
Cultivated land	Without conservation treatment			72	81	88	91
	With conservation treatment			62	71	78	81
Fallow	Bare soil			77	86	91	94
	Crop residue cover	Poor		76	85	90	92
		Good		74	83	88	90
Farmsteads (buildings, lanes, driveways, and surrounding lots)				59	74	82	86
Irrigated pasture		Poor		58	74	83	87
		Fair		44	65	77	82
		Good		33	58	72	79
Orchards (deciduous)			(see glossary description)				
Orchards (evergreen)		Poor		57	73	82	86
		Fair		44	65	77	82
		Good		33	58	72	79
Row crops	Straight row	Poor		72	81	88	91
		Good		67	78	85	89
	Contoured	Poor		70	79	84	88
		Good		65	75	82	86

Page 54
Page 53

Table 4-2 (Continued)
RUNOFF CURVE NUMBERS[1] FOR PZN CONDITION = 2.0

Cover Description	Cover Treatment or Practice[2]	Hydrologic Condition[3]	Average Percent Impervious Area[4]	Curve Numbers for Hydrologic Soil Groups: A	B	C	D
Small grain	Straight row	Poor		65	76	84	88
		Good		63	75	83	87
	Contoured	Poor		63	74	82	85
		Good		61	73	81	84
Vineyards[6]	Disked			76	85	90	92
	Annual grass or legume cover	Poor		65	78	85	89
		Fair		50	69	79	84
		Good		38	61	74	80
Annual grass (Dryland pasture)		Poor		67	78	86	89
		Fair		50	69	79	84
		Good		38	61	74	80
Barren				78	86	91	93
Meadow		Poor		63	77	85	88
		Fair		51	70	80	84
		Good		30	58	72	78
Open space (lawns, parks, golf courses, cemeteries, etc.)[7]	Grass cover <50%	Poor		68	79	86	89
	Grass cover 50% to 75%	Fair		49	69	79	84
	Grass cover >75%	Good		39	61	74	80
Pasture or range land		Poor		68	79	86	89
		Fair		49	69	79	84
		Good		39	61	74	80
Perennial grass		Poor		67	79	86	89
		Fair		50	69	79	84
		Good		38	61	74	80

Table 4-2 (Continued)
RUNOFF CURVE NUMBERS[1] FOR PZN CONDITION = 2.0

Cover Description	Cover Treatment or Practice[2]	Hydrologic Condition[3]	Average Percent Impervious Area[4]	Curve Numbers for Hydrologic Soil Groups: A	B	C	D
Turf[8]		Poor		58	74	83	87
		Fair		44	65	77	82
		Good		33	58	72	79
Water surfaces (during floods)				97	98	99	99
Broadleaf chaparral		Poor		53	70	80	85
		Fair		40	63	75	81
		Good		31	57	71	78
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
Herbaceous–mixture of grass, weeds, and low-growing brush, with brush the minor element		Poor	[9]	80	87	93	
		Fair	[9]	71	81	89	
		Good	[9]	62	74	85	←
Narrowleaf chaparral		Poor		71	82	88	91
		Fair		55	72	81	86
Oak-aspen–mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush		Poor	[9]	66	74	79	
		Fair	[9]	48	57	63	
		Good	[9]	30	41	48	
Open brush		Poor		62	76	84	88
		Fair		46	66	77	83
		Good		41	63	75	81

Page 56
Page 55

Table 4-2 (Continued)
RUNOFF CURVE NUMBERS[1] FOR PZN CONDITION = 2.0

Cover Description	Cover Treatment or Practice[2]	Hydrologic Condition[3]	Average Percent Impervious Area[4]	Curve Numbers for Hydrologic Soil Groups: A	B	C	D
Pinyon-juniper–pinyon, juniper, or both; grass understory		Poor	[9]		75	85	89
		Fair	[9]		58	73	80
		Good	[9]		41	61	71
Sagebrush with grass understory		Poor	[9]		67	80	85
		Fair	[9]		51	63	70
		Good	[9]		35	47	55
Wood or forest land		Thin stand, poor cover		45	66	77	83
		Good cover		25	55	70	77
Woods (woodland)		Poor		45	66	77	83
		Fair		36	60	73	79
		Good		28	55	70	77
Woodland-grass combination		Poor		57	73	82	86
		Fair		44	65	77	82
		Good		33	58	72	79

1 Average runoff condition, and $I_a = 0.2S$.
2 Hydrologic practices described as "straight row" and "contoured" are defined in the glossary.
3 For definition of hydrologic condition, see Tables 4-3, 4-4, and 4-5.
4 The average percent impervious area shown was used to develop the composite CNs. 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. If the impervious area is not directly connected, the NRCS method has an adjustment to reduce the effect.
5 Composite CNs for natural desert landscaping should be computed based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.
6 See glossary.
7 CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.
8 Includes lawns, cemeteries, golf courses and parks with ground cover of mowed and irrigated perennial grass.
9 CNs for Group A have not been developed.

Table 4-3

CLASSIFICATION OF NATIVE PASTURE OR RANGE

Vegetative Condition	Hydrologic Condition
Heavily grazed. Has no mulch or has plant cover on less than 50% of the area.	Poor
Not heavily grazed. Has plant cover on 50% to 75% of the area.	Fair
Lightly grazed. Has plant cover on more than 75% of the area.	Good

Table 4-4

AIR-DRY WEIGHT CLASSIFICATION OF NATIVE PASTURE OR RANGE

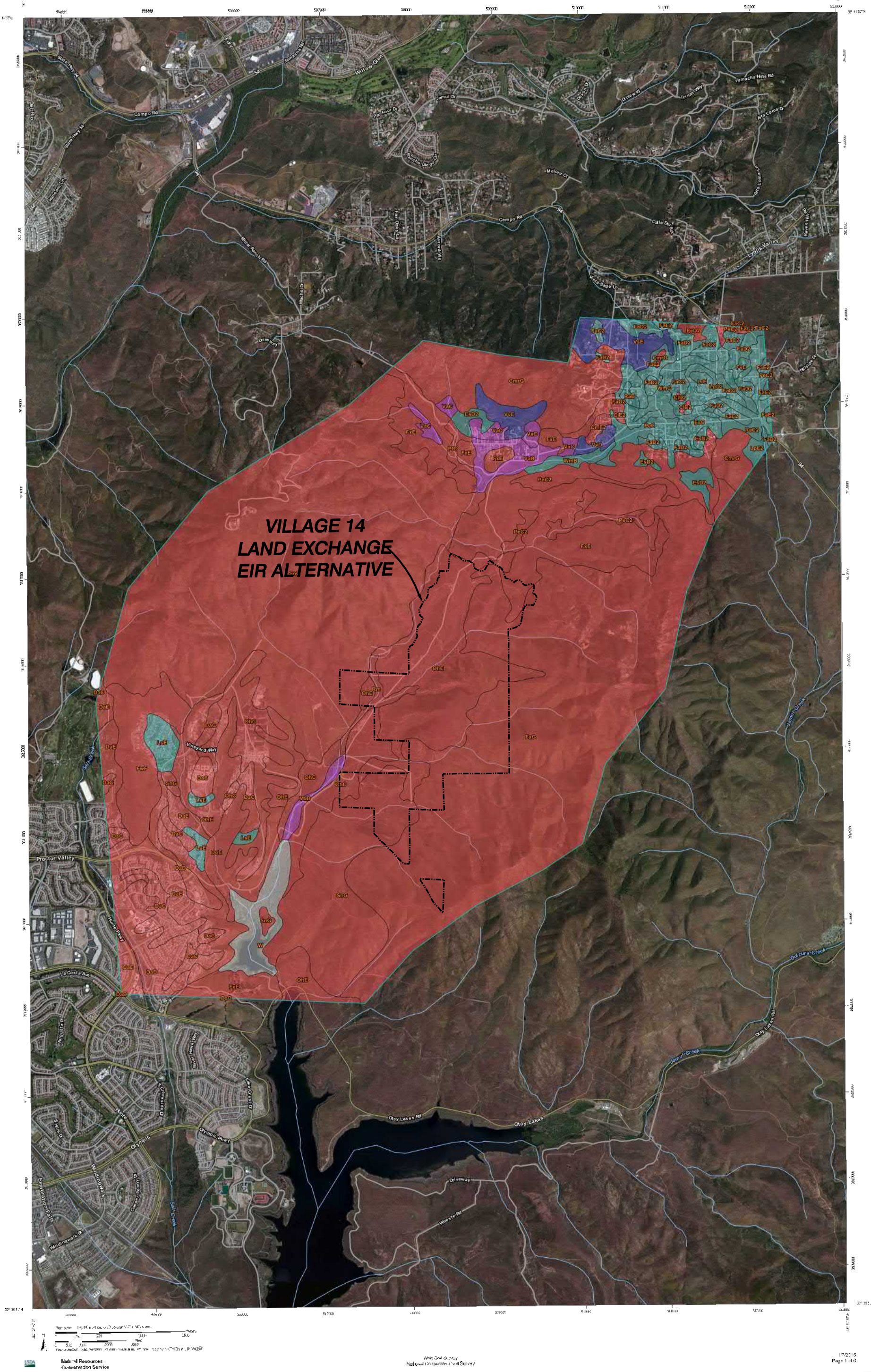
	Plant and litter air-dry weight (tons per acre):		
Cover density	Less than 0.5	0.5 to 1.5	More than 1.5
Less than 50%	Poor	Poor+	Fair
50% to 75%	Poor+	Fair	Fair+
More than 75%	Fair	Fair+	Good

Table 4-5

CLASSIFICATION OF WOODS

Vegetative Condition	Hydrologic Condition
Heavily grazed or regularly burned. Litter, small trees, and brush are destroyed.	Poor
Grazed but not burned. There may be some litter but these woods are not protected.	Fair
Protected from grazing. Litter and shrubs cover the soil.	Good

Hydrologic Soil Group—San Diego County Area, California
(Mt. Atse 14 HYDROLOGIC SOIL GROUPS)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 8, Sep 17, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 2, 2010—May 6, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
ClD2	Cieneba coarse sandy loam, 5 to 15 percent slopes, erod ed	D	4.6	0.0%
ClE2	Cieneba coarse sandy loam, 15 to 30 percent slopes, ero ded	D	25.9	0.3%
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes , eroded	D	12.5	0.1%
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	D	454.1	4.4%
DaC	Diablo clay, 2 to 9 percent slopes	D	196.6	1.9%
DaD	Diablo clay, 9 to 15 percent slopes	D	216.6	2.1%
DaE	Diablo clay, 15 to 30 percent slopes	D	326.3	3.2%
DoE	Diablo-Olivenhain complex, 9 to 30 percent slopes	D	137.8	1.3%
EsC	Escondido very fine sandy loam, 5 to 9 percent slopes	C	24.1	0.2%
EsD2	Escondido very fine sandy loam, 9 to 15 percent slopes, eroded	C	56.6	0.5%
FaC2	Fallbrook sandy loam, 5 to 9 percent slopes, eroded	C	55.0	0.5%
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded	C	139.0	1.3%
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded	C	52.1	0.5%
FvE	Fallbrook-Vista sandy loams, 15 to 30 percent slopes	C	6.7	0.1%
FwF	Friant fine sandy loam, 30 to 50 percent slopes	D	215.6	2.1%

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
FxE	Friant rocky fine sandy loam, 9 to 30 percent slopes	D	878.1	8.5%
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes	D	2,296.1	22.2%
LpD2	Las Posas fine sandy loam, 9 to 15 percent slopes, erod ed	C	28.8	0.3%
LpE2	Las Posas fine sandy loam, 15 to 30 percent slopes, ero ded	C	16.0	0.2%
LrE	Las Posas stony fine sandy loam, 9 to 30 percent slopes	C	11.4	0.1%
LsE	Linne clay loam, 9 to 30 percent slopes	C	77.6	0.8%
OhC	Olivenhain cobbly loam, 2 to 9 percent slopes	D	393.7	3.8%
OhE	Olivenhain cobbly loam, 9 to 30 percent slopes	D	855.7	8.3%
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	61.5	0.6%
PeC2	Placentia sandy loam, 5 to 9 percent slopes, eroded	D	134.5	1.3%
PeD2	Placentia sandy loam, 9 to 15 percent slopes, eroded	D	10.5	0.1%
PfC	Placentia sandy loam, thick surface, 2 to 9 percent slo pes	D	19.0	0.2%
RaB	Ramona sandy loam, 2 to 5 percent slopes	C	8.5	0.1%
RaC2	Ramona sandy loam, 5 to 9 percent slopes, eroded	C	62.9	0.6%
Rm	Riverwash	D	31.8	0.3%
SnG	San Miguel-Exchequer rocky silt loams, 9 to 70 percent slopes	D	2,987.2	28.9%
VaB	Visalia sandy loam, 2 to 5 percent slopes	A	67.6	0.7%
VaC	Visalia sandy loam, 5 to 9 percent slopes	A	60.3	0.6%
VbB	Visalia gravelly sandy loam, 2 to 5 percent slopes	A	27.8	0.3%

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	B	88.6	0.9%
VvD	Vista rocky coarse sandy loam, 5 to 15 percent slopes	B	20.4	0.2%
VvE	Vista rocky coarse sandy loam, 15 to 30 percent slopes	B	51.3	0.5%
W	Water		134.4	1.3%
WmB	Wyman loam, 2 to 5 percent slopes	C	28.1	0.3%
WmC	Wyman loam, 5 to 9 percent slopes	C	76.8	0.7%
Totals for Area of Interest			**10,351.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

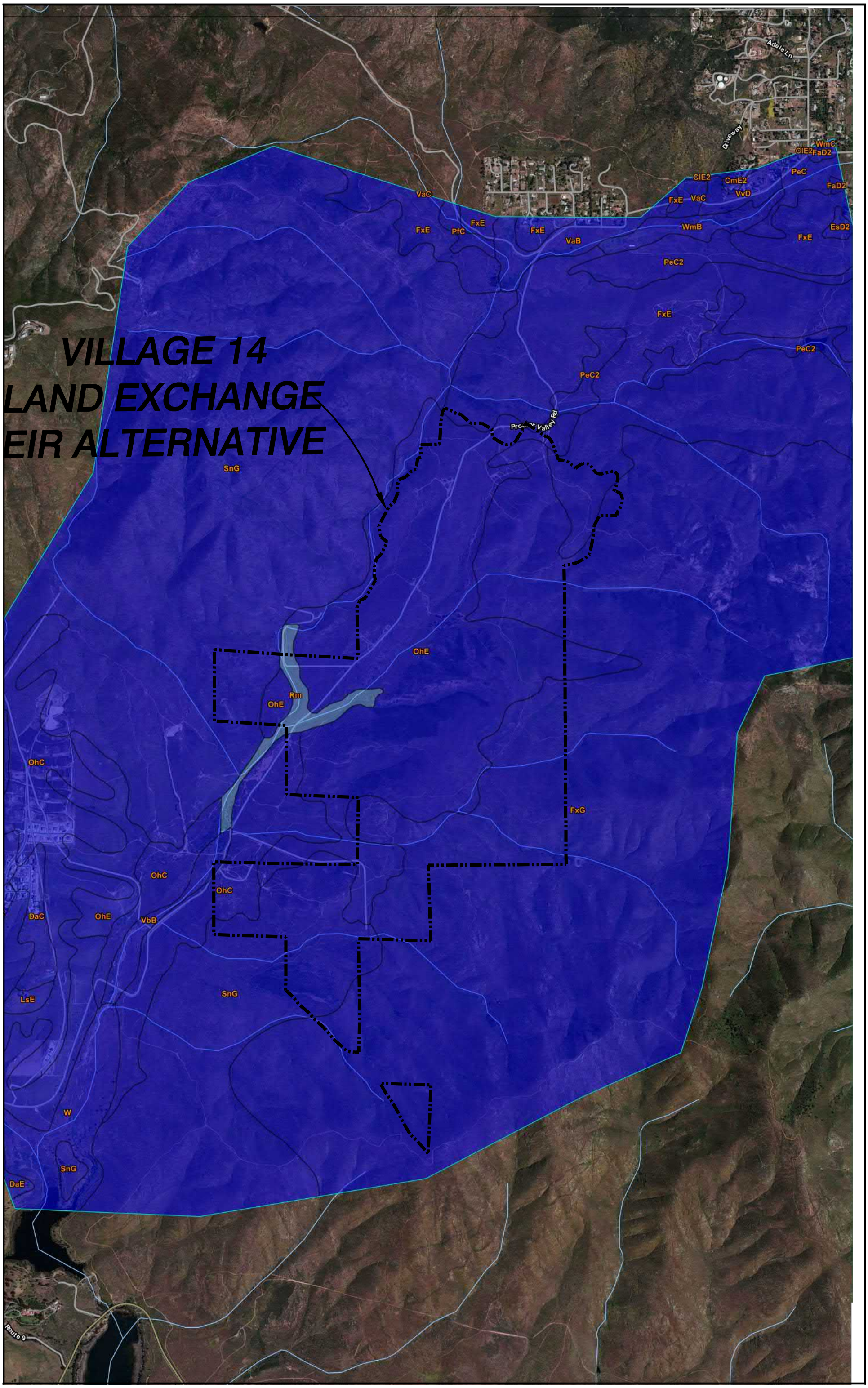
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher


VILLAGE 14
LAND EXCHANGE
EIR ALTERNATIVE
Adele Ln
Driveway
Prospect Valley Rd
Route 9
VaC
FxE
PfC
VaB
CIE2
CmE2
VvD
WmC
FaD2
PeC
EsD2
WmB
PeC2
SnG
OhE
Rm
OhC
FxG
DaC
VbB
LsE
W
DaE

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Soil Rating Lines
- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Soil Rating Points
- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 8, Sep 17, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2010—Jan 4, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to Water Table

Depth to Water Table— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
DoE	Diablo-Olivenhain complex, 9 to 30 percent slopes	>200	24.1	0.6%
FxE	Friant rocky fine sandy loam, 9 to 30 percent slopes	>200	100.8	2.4%
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes	>200	1,601.2	38.0%
OhC	Olivenhain cobbly loam, 2 to 9 percent slopes	>200	211.1	5.0%
OhE	Olivenhain cobbly loam, 9 to 30 percent slopes	>200	634.9	15.1%
PeC2	Placentia sandy loam, 5 to 9 percent slopes, eroded	>200	2.7	0.1%
PfC	Placentia sandy loam, thick surface, 2 to 9 percent slo pes	>200	4.3	0.1%
Rm	Riverwash	168	31.8	0.8%
SnG	San Miguel-Exchequer rocky silt loams, 9 to 70 percent slopes	>200	1,556.9	37.0%
VbB	Visalia gravelly sandy loam, 2 to 5 percent slopes	>200	27.8	0.7%
W	Water	>200	17.8	0.4%
Totals for Area of Interest			**4,213.2**	**100.0%**

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

2.6 NRCS Unit Hydrograph Hydrologic Analysis

The NRCS Unit Hydrograph is necessary for hydrologic analyses of watershed areas approximately one square mile and greater in size. The HEC-HMS Version 3.5 program was used to produce hydrographs using the Natural Resources Conservation Service (NRCS) Unit Hydrograph method for this study. HEC-HMS, developed by the United States Army Corps of Engineers' Hydrologic Engineering Center, simulates the surface runoff response of a watershed to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components.

The NRCS Unit Hydrograph calculations and input parameters follow the guidelines in Section 4 of the 2003 San Diego County Hydrology Manual (SDCHM). The input that was required to produce the hydrographs included rainfall depth, rainfall distribution, drainage basin area, precipitation loss data, and data to determine overland and channel routing information. Output from the model is presented in the form of hydrographs, which are curves relating runoff flowrates to elapsed time from the beginning of rainfall. Thus, the distribution of the entire runoff response is available for analysis.

Rainfall Distribution, Duration & Volume

Runoff for this analysis was generated using the County of San Diego's Nested Storm Hyetograph. The amount of rainfall to be distributed was obtained from the County of San Diego's rainfall isopluvial charts, which are located at the end of this section. This analysis models the 100-year return frequency rainfall event.

Rainfall Loss Criteria

To account for rainfall losses such as infiltration, interception and depression storage, the NRCS Curve Number method was selected. The NRCS method calculates the runoff volume and initial loss based on an empirical curve number, which is determined based on a basin's soil type and land use. Soils in this analysis were based on soil groups taken from the NRCS soil website. In most cases throughout this project, soil type D was found, which is characterized as soils with very low infiltration rates and high runoff potential (typically clay soils).

Based on the 2003 County of San Diego Hydrology Manual, the project site is determined to be located in PZN of 1.7. According to Table 4-6 of the SDCHM, an adjusted PZN of 2.7 was used for 100-year analysis. The following curve numbers were selected corresponding to 'weighted' soil types.

PZN = 2.0	Adjusted PZN = 2.7
87	93
85	91
84	90
70	81

To determine the curve number for a basin containing more than one of the preceding land uses, a composite curve number (weighted average) was calculated using a linear interpolation of the values in Table 4-10 from the SDCHM.

Basin Lag Time

Basin lag times were calculated for both existing and developed conditions based on relationships developed by the United States Army Corps of Engineers. The Corps lag time is defined as the elapsed time (in hours) from the beginning of unit effective rainfall to the instant that runoff hydrograph for a basin reaches 50 percent of the ultimate discharge volume. Per equation 4-17 from the County's Hydrology Manual, the lag time for a basin is calculated using the following empirical relationship.

$$\text{Lag Time (hours)} = 24 * n * [(L * L_c)/ ((S)^{1/2})]^{m}$$

n = basin factor
m = constant (0.38)
L = length of longest watercourse in miles
L_c = length along longest watercourse measured upstream to point opposite center of area (miles)
S = overall slope of longest watercourse (feet per mile)

The basin n factor is the visually estimated mean of the Mannings n values for all the channels within an area. Basin n factors are chosen according to the following criteria.

n = 0.100 The drainage area has extensive vegetation and streams that contain a large amount of brush, grass or other vegetation that slows flow velocity

n = 0.050 Drainage area is rugged, with sharp ridges and steep canyons through which watercourses meander around sharp bends, large boulders, and debris obstruction. The ground cover, excluding small areas of rock outcrops, includes considerable underbrush. No drainage improvements exist in the area.

n = 0.030 Drainage area is generally rolling, with rounded edges and moderate side slopes. Watercourses meander in fairly straight, unimproved channels with some boulders and debris. No drainage improvements exist in the area.

n = 0.015 Drainage area has fairly uniform, gentle slopes with most watercourses either improved or along paved streets. Ground cover consists of grass with appreciable areas developed to the extent that a large percentage of the area is impervious.

2.6 NRCS Unit Hydrograph Hydrologic Analysis

The NRCS Unit Hydrograph is necessary for hydrologic analyses of watershed areas approximately one square mile and greater in size. The HEC-HMS Version 3.5 program was used to produce hydrographs using the Natural Resources Conservation Service (NRCS) Unit Hydrograph method for this study. HEC-HMS, developed by the United States Army Corps of Engineers' Hydrologic Engineering Center, simulates the surface runoff response of a watershed to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components.

The NRCS Unit Hydrograph calculations and input parameters follow the guidelines in Section 4 of the 2003 San Diego County Hydrology Manual (SDCHM). The input that was required to produce the hydrographs included rainfall depth, rainfall distribution, drainage basin area, precipitation loss data, and data to determine overland and channel routing information. Output from the model is presented in the form of hydrographs, which are curves relating runoff flowrates to elapsed time from the beginning of rainfall. Thus, the distribution of the entire runoff response is available for analysis.

Rainfall Distribution, Duration & Volume

Runoff for this analysis was generated using the County of San Diego's Nested Storm Hyetograph. The amount of rainfall to be distributed was obtained from the County of San Diego's rainfall isopluvial charts, which are located at the end of this section. This analysis models the 100-year return frequency rainfall event.

Rainfall Loss Criteria

To account for rainfall losses such as infiltration, interception and depression storage, the NRCS Curve Number method was selected. The NRCS method calculates the runoff volume and initial loss based on an empirical curve number, which is determined based on a basin's soil type and land use. Soils in this analysis were based on soil groups taken from the NRCS soil website. In most cases throughout this project, soil type D was found, which is characterized as soils with very low infiltration rates and high runoff potential (typically clay soils).

Based on the 2003 County of San Diego Hydrology Manual, the project site is determined to be located in PZN of 1.7. According to Table 4-6 of the SDCHM, an adjusted PZN of 2.7 was used for 100-year analysis. The following curve numbers were selected corresponding to 'weighted' soil types.

PZN = 2.0	Adjusted PZN = 2.7
87	93
85	91
84	90
70	81

To determine the curve number for a basin containing more than one of the preceding land uses, a composite curve number (weighted average) was calculated using a linear interpolation of the values in Table 4-10 from the SDCHM.

Basin Lag Time

Basin lag times were calculated for both existing and developed conditions based on relationships developed by the United States Army Corps of Engineers. The Corps lag time is defined as the elapsed time (in hours) from the beginning of unit effective rainfall to the instant that runoff hydrograph for a basin reaches 50 percent of the ultimate discharge volume. Per equation 4-17 from the County's Hydrology Manual, the lag time for a basin is calculated using the following empirical relationship.

$$\text{Lag Time (hours)} = 24 * n * [(L * L_c)/ ((S)^{1/2})]^{m}$$

n = basin factor
m = constant (0.38)
L = length of longest watercourse in miles
L_c = length along longest watercourse measured upstream to point opposite center of area (miles)
S = overall slope of longest watercourse (feet per mile)

The basin n factor is the visually estimated mean of the Mannings n values for all the channels within an area. Basin n factors are chosen according to the following criteria.

n = 0.100 The drainage area has extensive vegetation and streams that contain a large amount of brush, grass or other vegetation that slows flow velocity

n = 0.050 Drainage area is rugged, with sharp ridges and steep canyons through which watercourses meander around sharp bends, large boulders, and debris obstruction. The ground cover, excluding small areas of rock outcrops, includes considerable underbrush. No drainage improvements exist in the area.

n = 0.030 Drainage area is generally rolling, with rounded edges and moderate side slopes. Watercourses meander in fairly straight, unimproved channels with some boulders and debris. No drainage improvements exist in the area.

n = 0.015 Drainage area has fairly uniform, gentle slopes with most watercourses either improved or along paved streets. Ground cover consists of grass with appreciable areas developed to the extent that a large percentage of the area is impervious.

CHAPTER 2 - METHODOLOGY

2.7 – Open Channel Inundation Calculations

2.7 HEC RAS river analysis

Using 100-year peak flows from HEC-HMS output, a HEC-RAS model was prepared to calculate the water surface elevation, velocities and top width along Proctor Valley and its tributaries in accordance with San Diego County standards.

Input parameters included a channel roughness coefficient, slopes, bottom width, and discharge. Manning's formula was used as the friction method within the software, which then calculated the normal depth of flow for the channel.