PRELIMINARY UTILITY STUDY

for

3820 CHILES ROAD

Davis, CA

October 6, 2017
Rev. October 25, 2017
Rev. May 22, 2018

Prepared By:

CUNNINGHAM ENGINEERING
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1. Introduction and Overview

The 3820 Chiles Road Apartments Project is a proposed *225-unit* multi-family residential development. The approximately 7.19-acre project is located at the southeast corner of Chiles Road and La Vida Way in south Davis.

The existing site consists of the Pacific Standard Life building which has been previously leased by UC Davis, but is currently vacant. The project proposes to demolish the existing building and site improvements, and to construct three and four-story apartment buildings and associated amenities. As part of the project, approximately 10' of the Chiles Road frontage will be dedicated to the City as right-of-way, and Chiles road will be widened and reconfigured to accommodate raised center medians and left turn and acceleration lanes.

The purpose of this preliminary study is to estimate utility demands of the proposed project, and to evaluate the capacity of water, sanitary sewer, and drainage facilities to serve the new development.

This study was based on a conceptual site plan prepared by LPAS Architects, dated *October 19*, 2017. *The project unit count was subsequently increased from 222 to 225 units and the mix of unit sizes was modified slightly.*

This report was revised on May 22, 2018 to use a population factor of 2.44 persons per rental unit. This was calculated by Raney Management using census data for apartment units City wide. This is a conservative factor for the proposed project given the unit mix and the anticipated demographic, i.e. less students who often share bedrooms. As shown in Appendix A, a factor of approximately 2.0 is more realistic.

2. Water System

Existing and Proposed Water Facilities
As shown on Attachment 1 - Utility Exhibit, there are existing 8" domestic water mains within La Vida Way and Chiles Road. The existing on-site water infrastructure will be demolished and replaced with new water improvements to serve the proposed project. An on-site fire water loop with hydrants will be constructed with two connection points to existing water mains in Chiles Rd and/or La Vida Way. A domestic water line connection, to serve indoor and irrigation demands, will be made to the 8" main in Chiles Road.

A City fire flow test was completed on Chiles Road on August 7, 2017 and resulted in a static pressure of 55 psi, a residual pressure of 46 psi at a flow of 1,655 gpm and a pressure of 20 psi at a flow of 3,560 gpm. See Attachment 2 – Fire Flow Test.

Water Demands
Based on an estimated count of *549 people (225 units @ 2.44 people per unit)* at 57 gallons per person per day, the anticipated inside use average day demand is approximately *31,293* gallons per

day (gpd) and a peak hour demand of approximately *39.1* gallons per minute (gpm). The estimated peak hour landscape irrigation application rate is 30.3 gpm. The total estimated combined project demands are an Average Day demand of *38,568* gpd and peak hour demand of *69.4* gpm. See Attachment 3 – Preliminary Water Demands

Fire Flow demand is based on building information provided by the project architect on September 26, 2017. The building construction will be Type V-A, with an estimated gross square footage of 275,150 sf. The calculated fire flow is 2,000 gpm (including a 75% reduction for fire sprinklers as allowed by the Fire Code, pending approval from the Fire Marshal). Fire Flow plus Maximum Day Demand is approximately *2,022* gpm.

As noted above, we believe these flows overstate anticipated conditions at full occupancy.

3. Sanitary Sewer System

Existing and Proposed Sanitary Sewer Facilities
As shown on the Attachment 1-Utility Exhibit, there are existing 6" and 8" sanitary sewer mains located adjacent to the site, within La Vida Way. Based on as-built information, there appears to be an existing 6" sanitary sewer service to the site, near the intersection of El Segundo Ave and La Vida Way, that may serve as the connection point for the project. The existing on-site sewer infrastructure will be demolished and replaced with a network of on-site private sewer lines that will flow by gravity from the proposed buildings to this point of connection.

Sanitary Sewer Demands
For preliminary purposes, it has been conservatively assumed that sewer flows will be equivalent to inside water use. Therefore, the average daily sewer generation rate is *31,293* gpd, or *0.031* million gallons per day (mgd). Including the City Standard peaking factor and inflow and infiltration rate, the peak wet weather flow (PWWF) is estimated to be *0.096* mgd. See Attachment 4 – Preliminary Sewer Demands.

Off-Site Sanitary Sewer Analysis
The offsite sanitary sewer calculations evaluate the existing City sanitary sewer system capacity from La Vida Way, adjacent to the project site, to the existing 15" sewer line in El Macero Dr. Study limits and shed areas used are shown on Attachment 5 – Offsite Sewer Exhibit.

The sewer calculations are based on approximate unit counts for the proposed project and land uses derived from City of Davis General Plan and land use maps. Based on the current preliminary architectural plan, the project will consist of *549 people*. The proposed project flow rates are based on a value of 57 gpd per capita as outlined in the Brown and Caldwell Water Supply Assessment prepared for the City of Davis, January 2015. This value reflects the flows generated by more efficient, low flow fixtures required by the current plumbing code.

The flowrates for existing residential land uses were based on information provided by Public Works in October 2016.

- The residential unit generation rate is 65 gpd per capita, derived from the influent measurements at the City wastewater treatment plant.
    - For single family residences, the unit generation rate is combined with a value of 2.71 capita per lot.
    - For existing multi-family land uses, the unit generation rate is combined with the values of 2.71 capita per lot at 15 dwelling units per acre.
- The retail/commercial flow rate is based on the City of Davis Sewer System Management Plan, August 2012, and City of Davis standards. The unit generation rate is 15 gpd per employee at 1 employee per 250 building square feet. The retail/commercial FAR is 0.25.

Though we believe the project demands overstate the anticipated conditions, as shown on Attachment 6 – Offsite Sewer Calculations, the existing City sewer system flowing to El Macero Dr. has the capacity to support the buildout of the General Plan with the inclusion of the proposed 3820 Chiles Rd. project *(d/D equal to 50%). The shed will be fully developed upon completion of this project, with little opportunity to add additional flows in the future.*

4. Storm Drain System

Existing and Proposed Storm Drainage Facilities
As shown on the Attachment 1 - Utility Exhibit, there is an existing 24" storm drain main adjacent to the site within the eastern portion of Chiles Road, and existing 15" and 24" storm drain mains within La Vida Way. The existing on-site storm drain infrastructure will be demolished and replaced with new improvements to serve the proposed project.

The project design seeks to limit the post-project 10-year peak discharge to estimated existing levels. In addition, current State Water Resources Control Board (SWRCB) requirements call for limiting the 2year/24-hour peak discharge to pre-project levels, in order to mitigate for potential hydromodification impacts. The proposed impervious area is 5.09 acres (70% impervious). *Existing percent impervious is 44% impervious.*

Proposed site detention storage will be within detention basins at the northeastern portion of the site, adjacent to Chiles Road, and the western portion of the site, adjacent to La Vida Way. It is recognized that the proposed site LID features/water quality BMPs (pervious pavement and stormwater planters) may contribute incidental storage (and potentially some peak flow attenuation) during storm events in excess of the stormwater quality storm. However, for the purposes of evaluating the 2-year or 10-year storms herein, any additional storage associated with upland BMPs has been conservatively assumed to be zero. Detained site runoff will flow at a metered rate to the city storm drain pipe system.

Hydrologic Analysis
The rainfall/runoff analysis and detention routing was conducted using an HEC-HMS model. Within HMS, the response of each sub-basin element was computed using a combination of the USBR (Sacramento region) unit hydrograph method and the initial/constant loss method.

The model results tabulated in Figures 1 and 2 below represent two site conditions: the existing (pre-project) and the proposed (post-project) condition. The peak discharge from the existing-condition sub-basin (named "EXIST" within the table) provides the target site discharge (both 2-year and 10-year) for the proposed model.

The proposed condition is modeled by two sub-basins and two detention basins. The eastern sub-basin represents the portion of the site which will drain to Chiles Road, and the western sub-basin represents the portion of the site which will drain to La Vida Way.

The proposed sub-basins - named "PROP-E" and "PROP-W" in the table below- have a combined peak discharge which is greater than existing due to the increase in impervious area in the developed site. In the developed condition, the site runoff will flow to one of two of the proposed detention basins ("POND-E" and "POND-W") with metered outflows set to limit the total outflow to be no greater than the existing discharge. The outflow structures will be raised to be above the bottom of the ponds such that storage volume will be available to provide the required bioretention for two of the water quality subsheds. The combined peak storage required is approximately 0.093 ac-ft, excluding storage required for water quality purposes. The total post-project discharge for the site is summed at the junction "TOTAL OUTFLOW". The results from the Figures below for both the 2-year and 10-year storms confirm that the overall peak discharge at "TOTAL OUTFLOW" is equal to or less than the existing condition.

Figure 1: 2-Year, 24-Hour Storm Results

Global Summary Results for Run "2yr24hr"

Project: 1579 3820 CHILES RD Simulation Run: 2yr24hr

Start of Run: 01Jan3000, 00:00 Basin Model: Basin 2
End of Run: 03Jan3000, 00:00 Meteorologic Model: 2yr-24hr
Compute Time:02Oct2017, 11:16:25 Control Specifications:Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
EXIST	0.011583	6.13515	01Jan3000, 12:09	0.92
PROP-E	0.007389	5.66635	01Jan3000, 12:05	1.35
PROP-W	0.003656	2.77825	01Jan3000, 12:05	1.27
POND-E	0.007389	4.05257	01Jan3000, 12:08	1.35
POND-W	0.003656	1.73698	01Jan3000, 12:09	1.27
TOTAL OUTFLOW	0.011045	5.76983	01Jan3000, 12:09	1.32

Figure 2: 10-Year, 24-Hour Storm Results

Global Summary Results for Run "10yr24hr"

Project: 1579 3820 CHILES RD Simulation Run: 10yr24hr

Start of Run: 01Jan3000, 00:00 Basin Model: Basin 2
End of Run: 03Jan3000, 00:00 Meteorologic Model: 10yr-24hr
Compute Time:02Oct2017, 11:16:09 Control Specifications:Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
EXIST	0.011583	11.22678	01Jan3000, 12:09	1.68
PROP-E	0.007389	9.83064	01Jan3000, 12:05	2.35
PROP-W	0.003656	4.83842	01Jan3000, 12:05	2.21
POND-E	0.007389	7.54531	01Jan3000, 12:08	2.35
POND-W	0.003656	3.45886	01Jan3000, 12:09	2.21
TOTAL OUTFLOW	0.011045	10.98129	01Jan3000, 12:08	2.30

5. Storm Water Quality

The proposed project will include integration of bioretention basins and pervious pavements to meet the storm water quality measures required by the State General Permit, dated February 5, 2013. Sizing of these measures will be performed using the volumetric sizing methodology outlined in Section 5 of the CASQA Stormwater Best Management Practice Handbook, New Development and Redevelopment (2003).

As shown on Attachment 7 – Storm Water Quality Exhibit, the site has been divided into nine individual subsheds. The runoff from each subshed will be managed in separate water quality treatment measures. Preliminary sizing calculations for each of these measures are included in Attachment 8 – Storm Water Quality Calculations.

Attachments

Attachment 1 - Utility Exhibit

Attachment 2 - Fire Flow Test

Attachment 3 - Preliminary Water Demands

Attachment 4 - Preliminary Sewer Demands

Attachment 5 - Off-Site Sewer Exhibit

Attachment 6 - Off-Site Sewer Calculations

Attachment 7 - Storm Water Quality Exhibit

Attachment 8 - Storm Water Quality Calculations

APPENDIX A

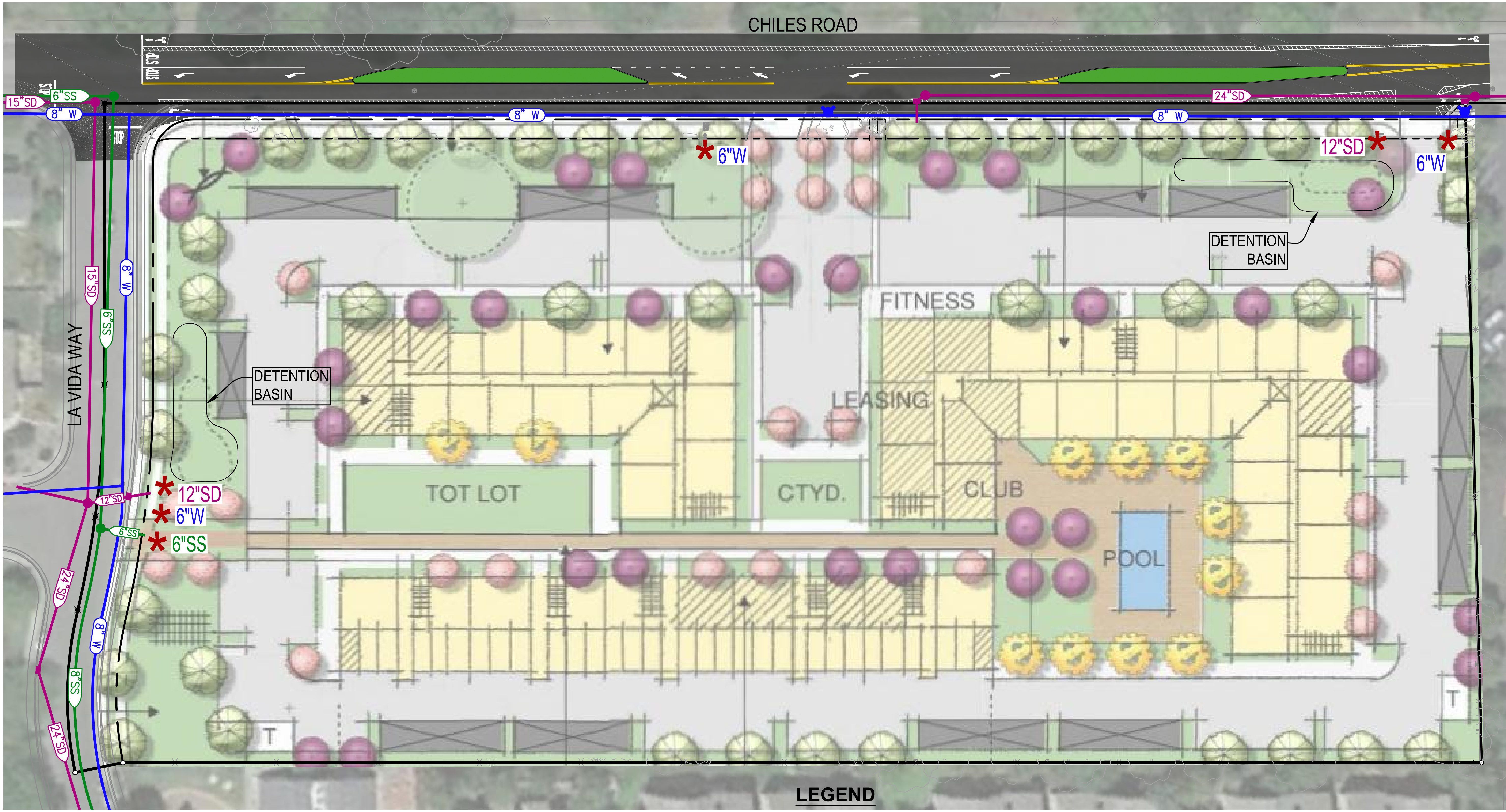
1– Preliminary Population Projection

2– Preliminary Water Demands

3– Preliminary Sewer Demands

4– Off-Site Sewer Calculations

ATTACHMENT 1



LEGEND

24"SD	EXISTING STORM DRAIN PIPE, DRAIN INLET, AND MANHOLE
8" W	EXISTING WATER PIPE AND FIRE HYDRANT
6"SS	EXISTING SANITARY SEWER PIPE AND MANHOLE
* 24"SD	POTENTIAL UTILITY POINT OF CONNECTION

0 30 60

SCALE: 1" =60'

DESIGNED BY: NC
DRAWN BY: NC
CHECKED BY: CWC

SCALE
1" = 60'

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3820 CHILES ROAD
UTILITY EXHIBIT

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SHEET
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DATE: 10/6/2017
JOB NO: 1579.02

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60

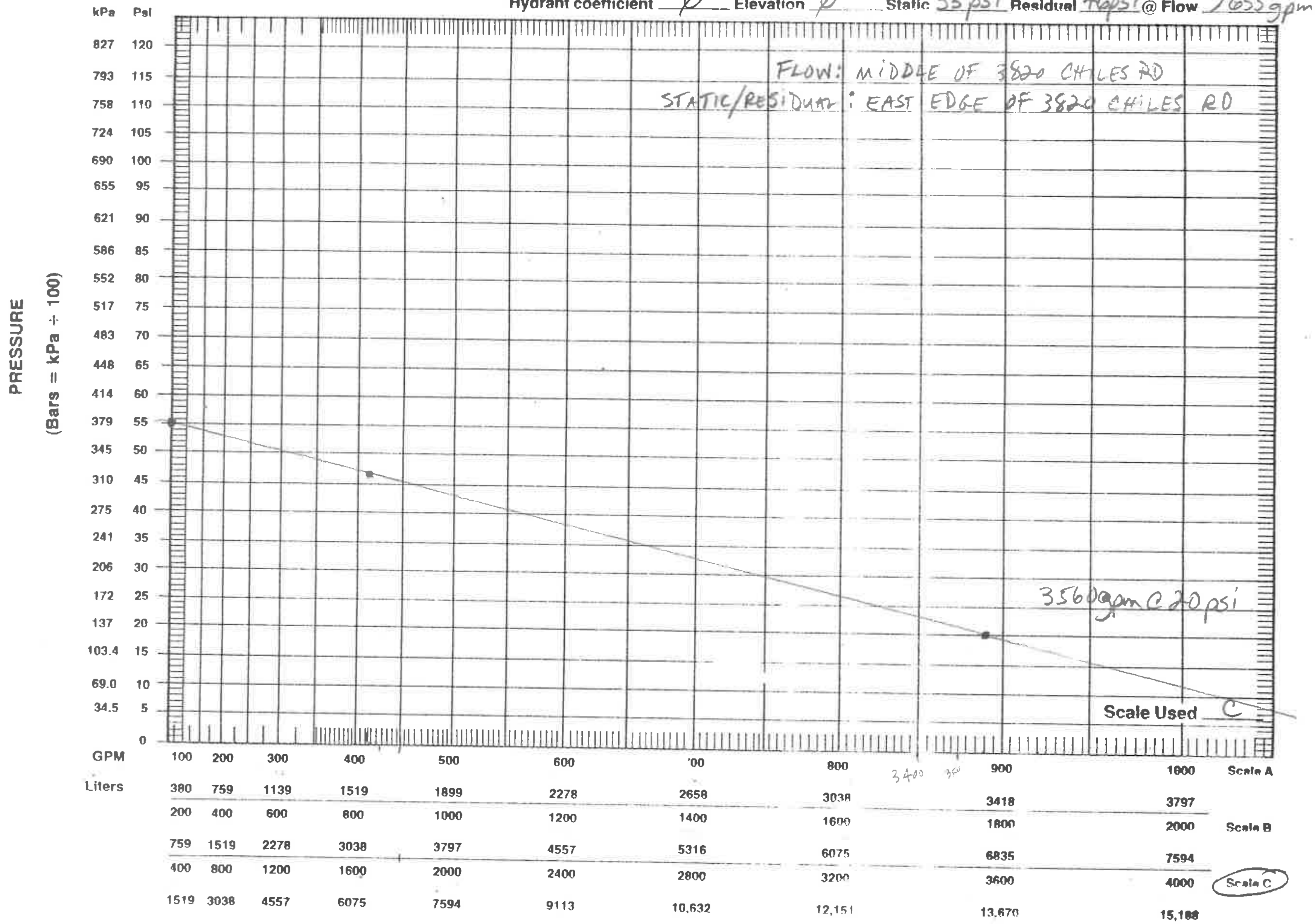
ATTACHMENT 2 - FIRE FLOW TEST

outlet size 4 1/2" ~~pitot~~ HOSEMONSTER reading 25psi

Water Flow Test Summary Sheet

Conducted by SANDHULDT/GEORGE Location 3820 CHILES RD Date 8-7-17

Hydrant coefficient Ø Elevation Ø Static 55psi Residual 46psi @ Flow 1655gpm



Attachment 3

3820 CHILES ROAD
Preliminary Water Demands

Prepared by Cunningham Engineering Corporation
10/6/2017, Rev 5/22/18

Domestic Water Demand (Indoor Use)

Unit Type	# of Units	# of Persons	Per Person ADD (gpd)	Total ADD (gpd)
Micro Studio	16	39	57	2,225
1 Bedroom	90	220	57	12,517
2 Bedroom	102	249	57	14,186
3 Bedroom	17	41	57	2,364
	225	549		**31,293**

Peaking Factors: Max Day/Average Day = 1.0
Peak Hour/Max Day = 1.8

	Avg day Demand (gpd)	Avg day Demand (gpm)	Max Day Demand (gpm)	Peak Hr Demand (gpm)	Annual Usage (mgy)
INSIDE USE TOTALS	**31,293**	**21.7**	**21.7**	**39.1**	**11.42**

Fire Flows

	Fire Flow (gpm)	Duration (hrs)
Type VA Construction, Greater than 191,401 SF	8,000	4

MAX DAY PLUS 25% OF LARGEST FIRE FLOW (gpm) = 2,022

Fire Flows per 2017 Fire Code-75% reduction for fire sprinklers

Irrigation - Peak Hour

Project Area (acres)	Percent Landscape (%)	Landscape Area (acres)	Peak day Application (in/day)	Peak day Application (gpd)	Irrigation Window (hrs/day)	Max Day Applic rate (gpm)	Assumed PH/PD=	**Peak Hr Applic rate (gpm)**
7.19	30%	2.1	0.1255	7,275	8	15.2	2.0	**30.3**

Irrigation - Water Use

Landscaped Area (sf):	**93,000**		
Hydrozone # 1 - Low Water Use			
Hydrozone Area (SF)	79,050	85%	
Peak Day Application Rate (in/day)	0.10		
ETO -Evapotranspiration in/yr	52.5		
PF - Plant Factor	0.3		
IE-Irrigation Efficiency factor	0.81		
Conversion factor to gal per sq ft	0.62		
EWU	**952,992**	**GAL/YR**	
Hydrozone # 2 - Medium Water Use			
Hydrozone Area (SF) - 10%	9,300	10%	
Peak Day Application Rate (in/day)	0.23		
ETO -Evapotranspiration in/yr	52.5		
PF - Plant Factor	0.5		
IE-Irrigation Efficiency factor	0.75		
Conversion factor to gal per sq ft	0.62		
EWU	**201,810**	**GAL/YR**	
Hydrozone # 3 - High Water Use			
Hydrozone Area (SF)	4,650	**5%**	
Peak Day Application Rate (in/day)	0.35		
ETO -Evapotranspiration in/yr	52.5		
PF - Plant Factor	0.9		
IE-Irrigation Efficiency factor	0.75		
Conversion factor to gal per sq ft	0.62		
EWU	**181,629**	**GAL/YR**	
Total	**1.34**	**MGY**	

NOTES:
1. Unit counts based on Conceptual Site Plan by LPAS, dated 10/19/2017
2. Unit demands are based the Draft Water Supply Assessment (Table 3-4) prepared for the City of Davis by Brown and Caldwell, January 2015.
3. Peaking Factor for Maximum Day inside use assumed to be 1.0. Expected to remain substantially consistent year round.
4. Peaking Factor for Peak Hour domestic water use is assumed to be 1.8 per City of Davis standards.
5. Population of 2.44 per unit reflects City wide average census data as calculated by Raney Management. See Appendix A.

Attachment 4

3820 CHILES ROAD
Preliminary Sewer Demands

Prepared by Cunningham Engineering Corporation
10/6/2017, Revised 5/22/2018

Proposed Sewer Demands

	Sewered Population (person)	Unit ADD (gpd)	Total ADD (gpd)	Total ADD (mgd)
Residential	549	57	31,293	0.031
			31,293	**0.031**

Total ADDF	**0.031**	mgd
PF=[7.67*(ADDF)^-0.093]	2.93	
PDWF=ADDF*PF	**0.092**	mgd

Infiltration and Inflow

Land Area (ac)	Unit I&I (gpd/ac)	Total I&I (gpd)	Total I&I (mgd)	
7.19	600	4,314	**0.004**	4%

PWWF = PDWF + I&I **0.096** **mgd**

Existing Sewer Demands

	Area (ac)	Unit ADD (gpd)	Total ADD (gpd)	Total ADD (mgd)
Office/Comm	7.4	915	6,769	0.007
			6,769	**0.007**

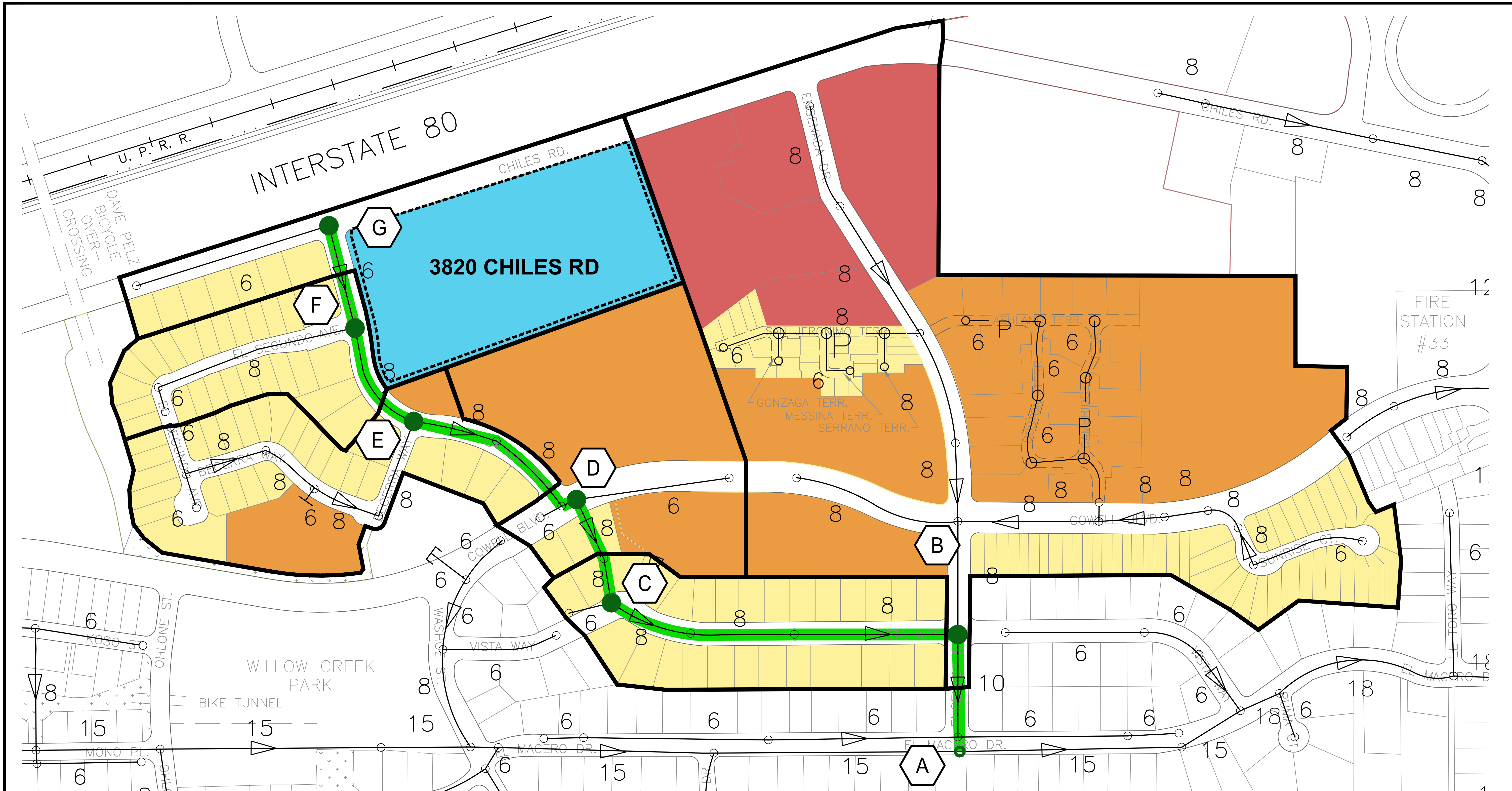
Total ADDF	**0.007**	mgd
PF=[7.67*(ADDF)^-0.093]	3.38	
PDWF=ADDF*PF	**0.023**	mgd

Infiltration and Inflow

Land Area (ac)	Unit I&I (gpd/ac)	Total I&I (gpd)	Total I&I (mgd)	
7.4	600	4,440	**0.004**	16%

PWWF = PDWF + I&I **0.027** **mgd**

NOTES:
1. Proposed Unit counts based on Conceptual Site Plan by LPAS, dated 9/25/2017
2. Existing Sewer Demands based on Commercial Office Land Use, 0.35 FAR, 1 employee per 250 sf, 15 gpd per employee
3. For preliminary planning purposes, it is assumed that inside water use is equivalent to sewer use. Unit demands are based the Draft Water Supply Assessment prepared for the City of Davis by Brown and Caldwell, January 2015.
4. Peaking factor equation per City of Davis standards
5. I&I unit flow rate per City of Davis standards
6. Population of 2.44 per unit reflects City wide average census data as calculated by Raney Management. See Appendix A.



LEGEND

- SINGLE FAMILY
- MULTIPLE FAMILY
- RETAIL & COMMERCIAL
- NEW MULTIPLE FAMILY
- SHED BOUNDARY
- PROJECT BOUNDARY
- A SHED PIPE NODE
- 8 EXISTING SEWER PIPE AND SIZE

0 125 250
SCALE: 1" =250'

DESIGNED BY: NC
DRAWN BY: NC
CHECKED BY: CWC
SCALE
1" = 250'

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3820 CHILES ROAD
OFF-SITE SEWER EXHBIT

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SHEET 1 OF 1
DATE: 10/6/2017
JOB NO: 1579.02

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Attachment 6 - Offsite Sewer Calculations

Cunningham Engineering Corp.
2940 Spafford Street, Suite 200
Davis, CA 95616

Project: 3820 Chiles Road
Project No.: 1579.02
Location: Davis, CA

Date: 10/6/17, Rev 5/22/18
Calc By: NC
Checked By: CWC

Design Criteria:
Infiltration Rate (I+I)= 600 gal/acre/day
Mannings "n" = 0.013
Peaking factor (PF)= see table and note 6

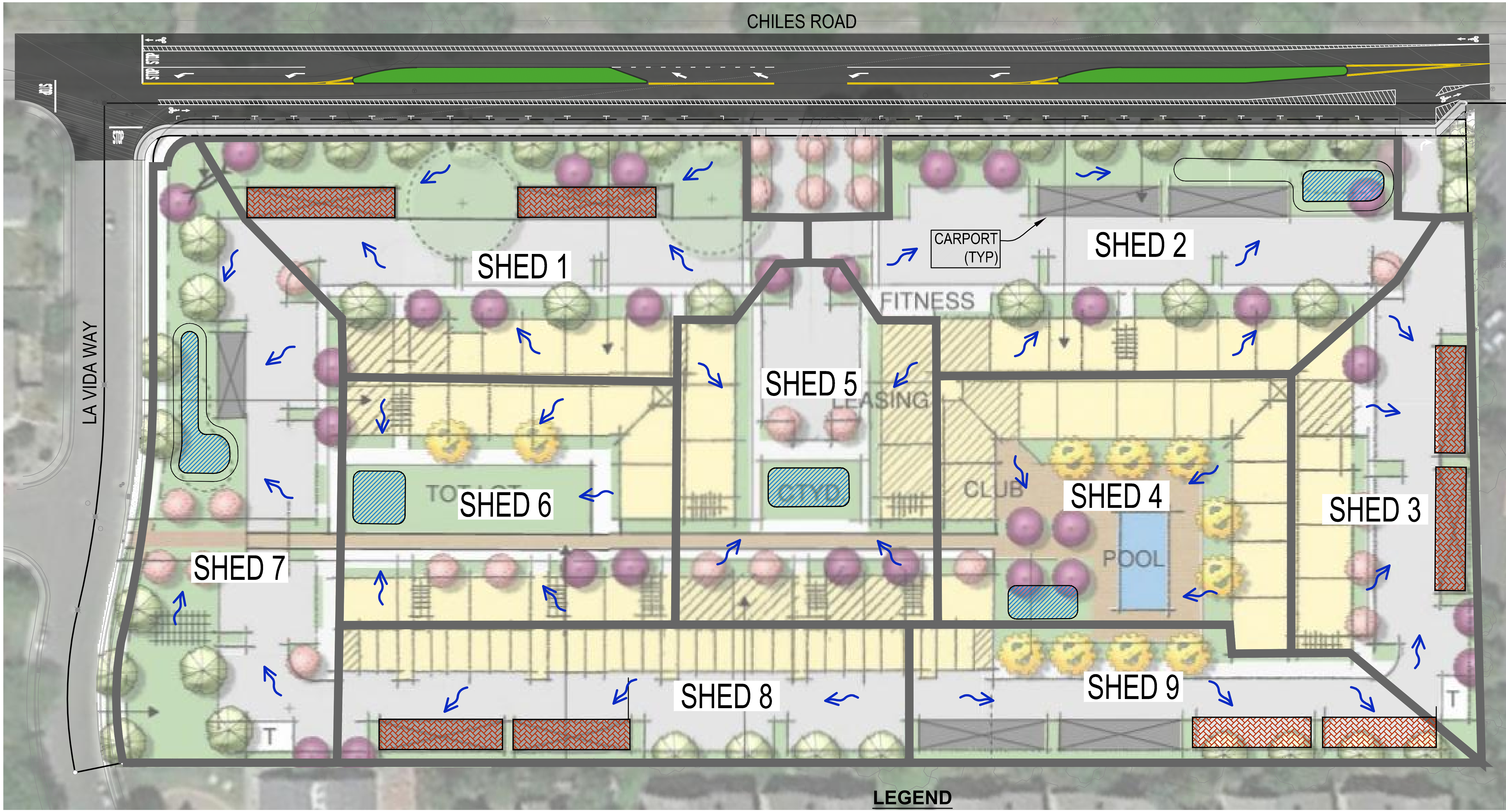
Reach			SINGLE FAMILY		MULTI-FAMILY			PROPOSED PROJECT		RETAIL / COMMERCIAL																	
From	To	Total Shed Area (AC)	# of Lots (EDU's)	ADF (gpd)	Area (ac)	# of EDU's	ADF (gpd)	# of persons	ADF (gpd)	Area (ac)	Building Area (sf)	ADF (gpd)	Incr ADF (mgd)	Cumm ADF (mgd)	PF	Incr I&I (mgd)	Cumm I&I (mgd)	Peak Cumm Flow (mgd)	Peak Cumm Flow, Qp(cfs)	Pipe Dia. (in)	Pipe Slope (ft/ft)	Total Capacity Qcap (cfs)	Available Capacity (Qcap-Qp) (cfs)	Qp/Qcap (%)	d (ft)	d/D (%)	V (ft/s)	Vel.@ Q-Full (ft/s)
G	F	10.9	7	1,233	0.00	0	0	549	31,293	0.0	0	0	0.0325	0.033	2.92	0.007	0.007	0.101	0.16	6	0.005	0.40	0.24	39.6%	0.22	43.0%	1.9	2.0
F	E	4.5	27	4,756	0.00	0	0	0	0	0.0	0	0	0.0048	0.037	2.88	0.003	0.009	0.117	0.18	8	0.0035	0.71	0.53	25.3%	0.23	34.0%	1.7	2.0
E	D	7.8	33	5,813	1.97	30	5,205	0	0	0.0	0	0	0.0110	0.048	2.81	0.005	0.014	0.150	0.23	8	0.0035	0.71	0.48	32.4%	0.26	39.0%	1.8	2.0
D	C	8.8	6	1,057	7.03	105	18,575	0	0	0.0	0	0	0.0196	0.068	2.73	0.005	0.019	0.204	0.32	8	0.0035	0.71	0.40	44.2%	0.31	46.0%	2.0	2.0
C	B	6.6	28	4,932	0.00	0	0	0	0	0.0	0	0	0.0049	0.073	2.71	0.004	0.023	0.220	0.34	8	0.0035	0.71	0.37	47.7%	0.32	48.0%	2.1	2.0
B	A	39.5	70	12,331	17.99	270	47,534	0	0	13.2	144,075	8,644	0.0685	0.141	2.55	0.024	0.047	0.407	0.63	10	0.0032	1.24	0.61	50.8%	0.42	50.0%	2.3	2.3
A																												
Totals		78.1	171		405			549		144,075			0.141		2.55	0.047		0.407	0.6									
ADF Totals (mgd)			0.030		0.071			0.031		0.009			0.141															
% of Total ADF			21%		50%			22%		6%			100%															

Notes:

1. Areas calculated and land use derived from City of Davis sewer, land use and zoning maps
2. Existing areas within City assumed built-out per General Plan
3. Node numbers and shed boundaries are shown on the 3820 CHILES RD OFF-SITE SEWER EXHIBIT
4. Design flow criteria:

Single-Family Residential	176	gpd/lot [65 gal/cap-day and 2.71 capita/lot, COD PW Dept]
Multi-Family Residential	176	gpd/lot [65 gal/cap-day and 2.71 capita/lot, COD PW Dept]
Multi-Family Residential density	15	DU/gross acre [COD stds]
New Multi-Family Residential	57	gpd/cap [Brown and Caldwell Water Supply Assessment, January 2015]
Retail/Commercial FAR	0.25	[COD stds]
Retail/Commercial	0.06	gpd/sf [15 gpd/employee with 1 empl per 250 sf (net), COD stds]

5. Infiltration and Inflow (I+I) Rate = 600 gal per acre per day [COD stds]
6. Peaking Factor (PF) = 7.67*ADF^-0.093 (COD stds)
7. Population of 2.44 per unit reflects City wide average census data as calculated by Raney Management. See Appendix A.



LEGEND

PERVIOUS PAVEMENT

PROPOSED DRAINAGE PATTERN

BIORETENTION PLANTER

NOTE: TYPES, NUMBER, SIZES, AND LOCATIONS OF STORM WATER QUALITY MEASURES ARE PRELMINARY AND SUBJECT TO CHANGE.

0 30 60

SCALE: 1" =60'

DESIGNED BY:

DRAWN BY: NC

CHECKED BY: CWC

SCALE

1" = 60'

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3820 CHILES ROAD

STORM WATER QUALITY EXHIBIT

DAVIS CALIFORNIA

SHEET 1 OF 1

DATE: 10/25/2017

JOB NO: 1579.02

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SHED 1- PERVIOUS PAVEMENT

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[(b)]	Weighted % Imperviousness[(c,d)]
Roof/Asphalt/concrete	22,675	100	0.537	54
Porous pavement [(e)]	3,525	25	0.084	2
Lawn/turf	16,000	0	0.379	0
Total Contributing Area[(a)]	42,200	–	–	56

a. Total contributing area = sum of unit areas
b. Weighting factor = unit area / total tributary area
c. Weighted imperviousness = weighting factor x percent imperviousness
d. Design imperviousness = sum of weighted imperviousness

Pervious Pavement Calculations

Shed Area	42,200	sf
C	0.38	
Shed Area to be Treated	15,962	sf
85th percentile - 24 hr storm	0.65	in
Voids	30%	

.

V (cf)	Design Surface Area (sf)	Required Media Depth (in)	Provided Media Depth (in)
865	3,525	9.8	10.0

Notes:
Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.
V=Required Capture Volume (cf) - based on 85th percentile-24 hr storm (0.65 inches)

I_{WQ} =Design Imperviousness

C = runoff coefficient=$0.858\,(I_{WQ})^3 - 0.78\,(I_{WQ})^2 + 0.774\,(I_{WQ}) + 0.04$

SHED 2 - BIORETENTION PLANTER

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	30,800	100	0.677	68
Decomposed Granite	0	40	0.000	0
Lawn/turf	14,700	0	0.323	0
Total Contributing Area[a]	45,500	–	–	68

a. Total contributing area = sum of unit areas
b. Weighting factor = unit area / total tributary area
c. Weighted imperviousness = weighting factor x percent imperviousness
d. Design imperviousness = sum of weighted imperviousness

Bioretention Calculations

Shed Area	1.04	ac
C	**0.47**	
desired capture (for 48 hr storm)	80%	

Vu (in) [From graph on page 333 of CASQA BMP Handbook, 48-hr drawdown]	Required Volume (cf)	Design Volume (cf)
0.35	1,327	1,330

Notes:
Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.
V=Required Capture Volume (cf)
Vu=Unit Basin Storage Volume (in) (from graph on page 333 of CASQA BMP Handbook)
I_{WQ} =Design Imperviousness
C = runoff coefficient=$0.858 (I_{WQ})^3 - 0.78 (I_{WQ})^2 + 0.774 (I_{WQ}) + 0.04$

SHED 3- PERVIOUS PAVEMENT

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	20,925	100	0.755	76
Porous pavement [e]	3,075	25	0.111	3
Lawn/turf	3,700	0	0.134	0
Total Contributing Area[a]	27,700	–	–	78

a. Total contributing area = sum of unit areas
b. Weighting factor = unit area / total tributary area
c. Weighted imperviousness = weighting factor x percent imperviousness
d. Design imperviousness = sum of weighted imperviousness

Pervious Pavement Calculations

Shed Area	27,700	sf
C	**0.58**	
Shed Area to be Treated	16,063	sf
85th percentile - 24 hr storm	0.65	in
Voids	30%	

.

V (cf)	Design Surface Area (sf)	Required Media Depth (in)	Provided Media Depth (in)
870	3,075	11.3	12.0

Notes:

Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.

V=Required Capture Volume (cf) - based on 85th percentile-24 hr storm (0.65 inches)

I_{WQ} =Design Imperviousness

C = runoff coefficient=0.858 $(I_{WQ})^3$ - 0.78 $(I_{WQ})^2$ + 0.774 (I_{WQ}) + 0.04

SHED 4 - BIORETENTION PLANTER

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	27,400	100	0.806	81
Decomposed Granite	0	40	0.000	0
Lawn/turf	6,600	0	0.194	0
Total Contributing Area[a]	34,000	–	–	81

a. Total contributing area = sum of unit areas
b. Weighting factor = unit area / total tributary area
c. Weighted imperviousness = weighting factor x percent imperviousness
d. Design imperviousness = sum of weighted imperviousness

<u>Bioretention Calculations</u>

Shed Area	0.78	ac
C	**0.61**	
desired capture (for 48 hr storm)	80%	

Vu (in) [From graph on page 333 of CASQA BMP Handbook, 48-hr drawdown]	Required Volume (cf)	Design Volume (cf)
0.4	1,133	1,200

Notes:
Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.
V=Required Capture Volume (cf)
Vu=Unit Basin Storage Volume (in) (from graph on page 333 of CASQA BMP Handbook)
I_{WQ} =Design Imperviousness
C = runoff coefficient=$0.858 (I_{WQ})^3 - 0.78 (I_{WQ})^2 + 0.774 (I_{WQ}) + 0.04$

SHED 5 - BIORETENTION PLANTER

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	24,900	100	0.773	77
Decomposed Granite	0	40	0.000	0
Lawn/turf	7,300	0	0.227	0
Total Contributing Area[a]	32,200	–	–	77

a. Total contributing area = sum of unit areas

b. Weighting factor = unit area / total tributary area

c. Weighted imperviousness = weighting factor x percent imperviousness

d. Design imperviousness = sum of weighted imperviousness

Bioretention Calculations

Shed Area	0.74	ac
C	**0.57**	
desired capture (for 48 hr storm)	80%	

Vu (in) [From graph on page 333 of CASQA BMP Handbook, 48-hr drawdown]	Required Volume (cf)	Design Volume (cf)
0.4	1,073	1,100

Notes:

Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.

V=Required Capture Volume (cf)

Vu=Unit Basin Storage Volume (in) (from graph on page 333 of CASQA BMP Handbook)

I_{WQ} =Design Imperviousness

C = runoff coefficient=$0.858 (I_{WQ})^3 - 0.78 (I_{WQ})^2 + 0.774 (I_{WQ}) + 0.04$

SHED 6 - BIORETENTION PLANTER

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	20,400	100	0.658	66
Decomposed Granite	0	40	0.000	0
Lawn/turf	10,600	0	0.342	0
Total Contributing Area[a]	31,000	–	–	66

a. Total contributing area = sum of unit areas
b. Weighting factor = unit area / total tributary area
c. Weighted imperviousness = weighting factor x percent imperviousness
d. Design imperviousness = sum of weighted imperviousness

Bioretention Calculations

Shed Area	0.71	ac
C	**0.46**	
desired capture (for 48 hr storm)	80%	

Vu (in) [From graph on page 333 of CASQA BMP Handbook, 48-hr drawdown]	Required Volume (cf)	Design Volume (cf)
0.35	904	1,000

Notes:
Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.
V=Required Capture Volume (cf)
Vu=Unit Basin Storage Volume (in) (from graph on page 333 of CASQA BMP Handbook)
I_{WQ} =Design Imperviousness
C = runoff coefficient=$0.858 (I_{WQ})^3 - 0.78 (I_{WQ})^2 + 0.774 (I_{WQ}) + 0.04$

SHED 7 - BIORETENTION PLANTER

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	22,100	100	0.536	54
Decomposed Granite	0	40	0.000	0
Lawn/turf	19,100	0	0.464	0
Total Contributing Area[a]	41,200	–	–	54

a. Total contributing area = sum of unit areas

b. Weighting factor = unit area / total tributary area

c. Weighted imperviousness = weighting factor x percent imperviousness

d. Design imperviousness = sum of weighted imperviousness

Bioretention Calculations

Shed Area	0.95	ac
C	0.36	
desired capture (for 48 hr storm)	80%	

Vu (in) [From graph on page 333 of CASQA BMP Handbook, 48-hr drawdown]	Required Volume (cf)	Design Volume (cf)
0.3	1,030	1,100

Notes:

Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.

V=Required Capture Volume (cf)

Vu=Unit Basin Storage Volume (in) (from graph on page 333 of CASQA BMP Handbook)

I_{WQ} =Design Imperviousness

C = runoff coefficient=$0.858 (I_{WQ})^3 - 0.78 (I_{WQ})^2 + 0.774 (I_{WQ}) + 0.04$

SHED 8- PERVIOUS PAVEMENT

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	23,000	100	0.774	77
Porous pavement [e]	3,300	25	0.111	3
Lawn/turf	3,400	0	0.114	0
Total Contributing Area[a]	29,700	–	–	80

a. Total contributing area = sum of unit areas

b. Weighting factor = unit area / total tributary area

c. Weighted imperviousness = weighting factor x percent imperviousness

d. Design imperviousness = sum of weighted imperviousness

Pervious Pavement Calculations

Shed Area	29,700	sf
C	**0.60**	
Shed Area to be Treated	17,876	sf
85th percentile - 24 hr storm	0.65	in
Voids	30%	

.

V (cf)	Design Surface Area (sf)	Required Media Depth (in)	Provided Media Depth (in)
968	3,300	11.7	12.0

Notes:

Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.

V=Required Capture Volume (cf) - based on 85th percentile-24 hr storm (0.65 inches)

I_{WQ} =Design Imperviousness

C = runoff coefficient=0.858 $(I_{WQ})^3$ - 0.78 $(I_{WQ})^2$ + 0.774 (I_{WQ}) + 0.04

SHED 9- PERVIOUS PAVEMENT

Calculation Table for Determination of Design Imperviousness (I_{WQ})

Site Element	Unit Area (ft^2)	Percent Imperviousness	Weighting Factor[b]	Weighted % Imperviousness[c,d]
Roof/Asphalt/concrete	15,600	100	0.639	64
Porous pavement [e]	2,400	25	0.098	2
Lawn/turf	6,400	0	0.262	0
Total Contributing Area[a]	24,400	–	–	66

a. Total contributing area = sum of unit areas
b. Weighting factor = unit area / total tributary area
c. Weighted imperviousness = weighting factor x percent imperviousness
d. Design imperviousness = sum of weighted imperviousness

Pervious Pavement Calculations

Shed Area	24,400	sf
C	**0.46**	
Shed Area to be Treated	11,252	sf
85th percentile - 24 hr storm	0.65	in
Voids	30%	

.

V (cf)	Design Surface Area (sf)	Required Media Depth (in)	Provided Media Depth (in)
610	2,400	10.2	12.0

Notes:
Calculations based on section 5.5 of the California Stormwater BMP Handbook, dated January 2003 per section E.12.e(ii),c.1.b of the State General Permit, dated February 5, 2013.
V=Required Capture Volume (cf) - based on 85th percentile-24 hr storm (0.65 inches)

I_{WQ} =Design Imperviousness

C = runoff coefficient=$0.858 (I_{WQ})^3 - 0.78 (I_{WQ})^2 + 0.774 (I_{WQ}) + 0.04$

APPENDIX A - 1

3820 CHILES ROAD
Preliminary Population Projection

Prepared by Cunningham Engineering Corporation
5/22/2018

Number of Persons	% Persons Studio	One Bdrm	Two Bdrm	Three Bdrm		Studio # Units	Studio # Persons	One Bedroom # Units	One Bedroom # Persons	Two Bedroom # Units	Two Bedroom # Persons	Three Bedroom # Units	Three Bedroom # Persons
1	100%	66%	-	-		16	16.0	59	59.4	-	-	-	-
2	-	33%	60%	-		-	-	30	59.4	61	122.4	-	-
3	-	-	30%	50%		-	-	-	-	31	91.8	9	25.5
4	-	-	10%	30%		-	-	-	-	10	40.8	5	20.4
5	-	-	-	10%		-	-	-	-	-	-	2	8.5
6	-	-	-	10%		-	-	-	-	-	-	2	10.2
					Sub-Total Units:	16	-	90	-	102	-	17	-
					Sub-Total Persons:	-	16	-	119	-	255	-	65

Total Units:	225
Total Persons:	454
Persons/Unit:	2.02

Appendix A - 2

3820 CHILES ROAD
Preliminary Water Demands

Prepared by Cunningham Engineering Corporation
10/6/2017, Rev 5/22/18

Domestic Water Demand (Indoor Use)

Unit Type	# of Units	# of Persons	Per Person ADD (gpd)	Total ADD (gpd)
Micro Studio	16	16	57	912
1 Bedroom	90	119	57	6,772
2 Bedroom	102	255	57	14,535
3 Bedroom	17	65	57	3,682
	225	454		**25,878**

Peaking Factors: Max Day/Average Day = 1.0
Peak Hour/Max Day = 1.8

	Avg day Demand (gpd)	Avg day Demand (gpm)	Max Day Demand (gpm)	Peak Hr Demand (gpm)	Annual Usage (mgy)
INSIDE USE TOTALS	**25,878**	**18.0**	**18.0**	**32.3**	**9.45**

Fire Flows

	Fire Flow (gpm)	Duration (hrs)
Type VA Construction, Greater than 191,401 SF	8,000	4

MAX DAY PLUS 25% OF LARGEST FIRE FLOW (gpm) = 2,018

Fire Flows per 2017 Fire Code-75% reduction for fire sprinklers

Irrigation - Peak Hour

Project Area (acres)	Percent Landscape (%)	Landscape Area (acres)	Peak day Application (in/day)	Peak day Application (gpd)	Irrigation Window (hrs/day)	Max Day Applic rate (gpm)	Assumed PH/PD=	**Peak Hr Applic rate (gpm)**
7.19	30%	2.1	0.1255	7,275	8	15.2	2.0	**30.3**

Irrigation - Water Use

Landscaped Area (sf):	**93,000**		
Hydrozone # 1 - Low Water Use			
Hydrozone Area (SF)	79,050	85%	
Peak Day Application Rate (in/day)	0.10		
ETO -Evapotranspiration in/yr	52.5		
PF - Plant Factor	0.3		
IE-Irrigation Efficiency factor	0.81		
Conversion factor to gal per sq ft	0.62		
EWU	**952,992**	**GAL/YR**	
Hydrozone # 2 - Medium Water Use			
Hydrozone Area (SF) - 10%	9,300	10%	
Peak Day Application Rate (in/day)	0.23		
ETO -Evapotranspiration in/yr	52.5		
PF - Plant Factor	0.5		
IE-Irrigation Efficiency factor	0.75		
Conversion factor to gal per sq ft	0.62		
EWU	**201,810**	**GAL/YR**	
Hydrozone # 3 - High Water Use			
Hydrozone Area (SF)	4,650	**5%**	
Peak Day Application Rate (in/day)	0.35		
ETO -Evapotranspiration in/yr	52.5		
PF - Plant Factor	0.9		
IE-Irrigation Efficiency factor	0.75		
Conversion factor to gal per sq ft	0.62		
EWU	**181,629**	**GAL/YR**	
Total	**1.34**	**MGY**	

NOTES:
1. Unit counts based on Conceptual Site Plan by LPAS, dated 10/19/2017
2. Unit demands are based the Draft Water Supply Assessment (Table 3-4) prepared for the City of Davis by Brown and Caldwell, January 2015.
3. Peaking Factor for Maximum Day inside use assumed to be 1.0. Expected to remain substantially consistent year round.
4. Peaking Factor for Peak Hour domestic water use is assumed to be 1.8 per City of Davis standards.

Appendix A - 3

3820 CHILES ROAD
Preliminary Sewer Demands

Prepared by Cunningham Engineering Corporation
10/6/2017, Revised 5/22/2018

Proposed Sewer Demands

	Sewered Population (person)	Unit ADD (gpd)	Total ADD (gpd)	Total ADD (mgd)
Residential	454	57	25,878	0.026
			25,878	**0.026**

Total ADDF	**0.026**	mgd
PF=[7.67*(ADDF)^-0.093]	2.98	
PDWF=ADDF*PF	**0.077**	mgd

Infiltration and Inflow

Land Area (ac)	Unit I&I (gpd/ac)	Total I&I (gpd)	Total I&I (mgd)	
7.19	600	4,314	**0.004**	5%

PWWF = PDWF + I&I **0.081** **mgd**

Existing Sewer Demands

	Area (ac)	Unit ADD (gpd)	Total ADD (gpd)	Total ADD (mgd)
Office/Comm	7.4	915	6,769	0.007
			6,769	**0.007**

Total ADDF	**0.007**	mgd
PF=[7.67*(ADDF)^-0.093]	3.38	
PDWF=ADDF*PF	**0.023**	mgd

Infiltration and Inflow

Land Area (ac)	Unit I&I (gpd/ac)	Total I&I (gpd)	Total I&I (mgd)	
7.4	600	4,440	**0.004**	16%

PWWF = PDWF + I&I **0.027** **mgd**

NOTES:
1. Proposed Unit counts based on Conceptual Site Plan by LPAS, dated 10/19/2017
2. Existing Sewer Demands based on Commercial Office Land Use, 0.35 FAR, 1 employee per 250 sf, 15 gpd per employee
3. For preliminary planning purposes, it is assumed that inside water use is equivalent to sewer use. Unit demands are based the Draft Water Supply Assessment prepared for the City of Davis by Brown and Caldwell, January 2015.
4. Peaking factor equation per City of Davis standards
5. I&I unit flow rate per City of Davis standards

Appendix A - 4

Cunningham Engineering Corp.
2940 Spafford Street, Suite 200
Davis, CA 95616

Project: 3820 Chiles Road
Project No.: 1579.02
Location: Davis, CA

Date: 10/6/17, Rev 5/22/18
Calc By: NC
Checked By: CWC

Design Criteria:
Infiltration Rate (I+I)= 600 gal/acre/day
Mannings "n" = 0.013
Peaking factor (PF)= see table and note 6

Reach			SINGLE FAMILY		MULTI-FAMILY			PROPOSED PROJECT		RETAIL / COMMERCIAL																	
From	To	Total Shed Area (AC)	# of Lots (EDU's)	ADF (gpd)	Area (ac)	# of EDU's	ADF (gpd)	# of beds	ADF (gpd)	Area (ac)	Building Area (sf)	ADF (gpd)	Incr ADF (mgd)	Cumm ADF (mgd)	PF	Incr I&I (mgd)	Cumm I&I (mgd)	Peak Cumm Flow (mgd)	Peak Cumm Flow, Qp(cfs)	Pipe Dia. (in)	Pipe Slope (ft/ft)	Total Capacity Qcap (cfs)	Available Capacity (Qcap-Qp) (cfs)	Qp/Qcap (%)	d (ft)	d/D (%)	V (ft/s)	Vel.@ Q-Full (ft/s)
G	F	10.9	7	1,233	0.00	0	0	454	25,878	0.0	0	0	0.0271	0.027	2.97	0.007	0.007	0.087	0.13	6	0.005	0.40	0.26	33.9%	0.20	40.0%	1.8	2.0
F	E	4.5	27	4,756	0.00	0	0	0	0	0.0	0	0	0.0048	0.032	2.92	0.003	0.009	0.102	0.16	8	0.0035	0.71	0.56	22.2%	0.21	31.0%	1.7	2.0
E	D	7.8	33	5,813	1.97	30	5,205	0	0	0.0	0	0	0.0110	0.043	2.84	0.005	0.014	0.136	0.21	8	0.0035	0.71	0.50	29.4%	0.25	37.0%	1.8	2.0
D	C	8.8	6	1,057	7.03	105	18,575	0	0	0.0	0	0	0.0196	0.063	2.75	0.005	0.019	0.191	0.30	8	0.0035	0.71	0.42	41.3%	0.29	44.0%	2.1	2.0
C	B	6.6	28	4,932	0.00	0	0	0	0	0.0	0	0	0.0049	0.067	2.73	0.004	0.023	0.207	0.32	8	0.0035	0.71	0.39	44.8%	0.31	46.0%	2.0	2.0
B	A	39.5	70	12,331	17.99	270	47,534	0	0	13.2	144,075	8,644	0.0685	0.136	2.55	0.024	0.047	0.394	0.61	10	0.0032	1.24	0.63	49.2%	0.41	49.0%	2.4	2.3
A																												
	Totals	78.1	171		405			454		144,075			0.136		2.55	0.047		0.394	0.6									
	ADF Totals (mgd)		0.030		0.071			0.026		0.009			0.136															
	% of Total ADF		22%		52%			19%		6%			100%															

Notes:

1. Areas calculated and land use derived from City of Davis sewer, land use and zoning maps
2. Existing areas within City assumed built-out per General Plan
3. Node numbers and shed boundaries are shown on the 3820 CHILES RD OFF-SITE SEWER EXHIBIT
4. Design flow criteria:

Single-Family Residential	176	gpd/lot [65 gal/cap-day and 2.71 capita/lot, COD PW Dept]
Multi-Family Residential	176	gpd/lot [65 gal/cap-day and 2.71 capita/lot, COD PW Dept]
Multi-Family Residential density	15	DU/gross acre [COD stds]
New Multi-Family Residential	57	gpd/cap [Brown and Caldwell Water Supply Assessment, January 2015]
Retail/Commercial FAR	0.25	[COD stds]
Retail/Commercial	0.06	gpd/sf [15 gpd/employee with 1 empl per 250 sf (net), COD stds]

5. Infiltration and Inflow (I+I) Rate = 600 gal per acre per day [COD stds]
6. Peaking Factor (PF) = 7.67*ADF^-0.093 (COD stds)