Community Development Department
Planning Division – Cupertino
APPROVED
Case # TM-2022-001
Application Number(s)

Approval Body: Director / Staff
Approval Date 06/03/22
Signature Jim Throop
Case Manager

CISTERN SIZING CALCULATIONS BY DRAINAGE AREAS:

Drainage Area 1 (DA-1) Volume Based Treatment Measures
using the URQM Approach

Step 1.		Drainage Area for BMP:	17.28	acres
Step 2.	a.	Impervious Area:	10.60	acres
	b.	Impervious ratio: (i)	61.4%	
Step 3.		Watershed runoff Coefficient Cw =	0.419	
		$(Cw = 0.858i^3-0.78i^2+0.774i+0.04)$		
Step 4.		Mean Annual Precipitation	16	inches
Step 5.		Closest Rain Gage	San Jose Airport	

Gage	MAP_{gage}	$(P_6)_{gage}$ (in)
San Jose Airport	13.9	0.512
Palo Alto	13.7	0.522
Morgan Hill	19.5	0.76

MAP_{gage} 13.9
$(P_6)_{gage}$ 0.512

Step 6. Mean Storm Event Precipitation Depth $(P_6)_{site}$
$(P_6)_{site} = (P_6)_{gage} X (MAP_{site})/(MAP_{gage})$ 0.589 inches

Step 7. "a" regression constant

a=	48 hour	1.963	48 hour
a=	24 hour	1.582	a= 1.963
a=	12 hour	1.312	

Step 8. Maximized Storage Area
$P_o = (a X Cw) X P_6$ 0.485 inches

Step 9. Volume of Runoff to be Treated
Design Volume = Po X A X 1ft/12in 0.699 acre-ft
30,439 cuft

Step 10. Size Cistern
Total Cistern Storage Volume
540,000 gal
72,187 cuft

Drainage Area 2 (DA-2) Volume Based Treatment Measures
using the URQM Approach

Step 1.		Drainage Area for BMP:	32.05	acres
Step 2.	a.	Impervious Area:	20.64	acres
	b.	Impervious ratio: (i)	64.4%	
Step 3.		Watershed runoff Coefficient Cw =	0.444	
		$(Cw = 0.858i^3-0.78i^2+0.774i+0.04)$		
Step 4.		Mean Annual Precipitation	16	inches
Step 5.		Closest Rain Gage	San Jose Airport	

Gage	MAP_{gage}	$(P_6)_{gage}$ (in)
San Jose Airport	13.9	0.512
Palo Alto	13.7	0.522
Morgan Hill	19.5	0.76

MAP_{gage} 13.9
$(P_6)_{gage}$ 0.512

Step 6. Mean Storm Event Precipitation Depth $(P_6)_{site}$
$(P_6)_{site} = (P_6)_{gage} X (MAP_{site})/(MAP_{gage})$ 0.589 inches

Step 7. "a" regression constant

a=	48 hour	1.963	48 hour
a=	24 hour	1.582	a= 1.963
a=	12 hour	1.312	

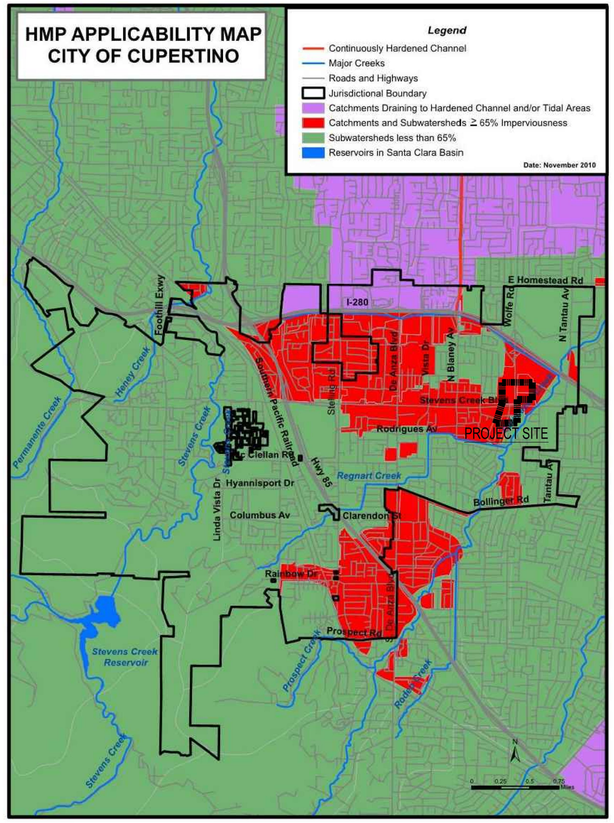
Step 8. Maximized Storage Area
$P_o = (a X Cw) X P_6$ 0.514 inches

Step 9. Volume of Runoff to be Treated
Design Volume = Po X A X 1ft/12in 1.372 acre-ft
59,779 cuft

Step 10. Size Cistern
Total Cistern Storage Volume
767,000 gal
102,533 cuft

NOTE:

FOR THE PURPOSE OF THIS STORMWATER MANAGEMENT PLAN, THE SITE HAS BEEN LOOKED AT AS TWO DRAINAGE AREAS. RAINWATER CISTERNS WILL BE DESIGNED IN MORE DEPTH AND COORDINATED WITH THE PLUMBING ENGINEER TO WORK WITH CONSTRUCTION PHASING, THE SITE SPANNING PUBLIC RIGHT OF WAY AND IRRIGATION AND TOILET DEMANDS. THESE CISTERNS WILL BE SIZED INDIVIDUALLY BASED THEIR RESPECTIVE DRAINAGE AREAS.



HYDROMODIFICATION MAP

N.T.S.

NOTE:

PROJECT IS EXEMPT FROM HYDROMODIFICATION BECAUSE IT IS LOCATED IN A WATERSHED THAT IS GREATER THAN 65% IMPERVIOUS.

PRE AND POST DEVELOPMENT STORM DRAINAGE RUNOFF ANALYSIS:

CALCULATION OF WEIGHTED "C", C_W

The following equation is used to compute the weighted "c":

$$C_w = \frac{C_iA_i + C_pA_p + C_tA_t}{A_T}$$

C_w = Weighted runoff coefficient for drainage area A
C_i = Impervious Area Runoff Coefficient (c varies, see below)
C_p = Pervious Area Runoff Coefficient (c varies, see below)

A_i = Impervious Drainage Area (acres)
A_p = Pervious Drainage Area (acres)
A_T = Total Drainage Area (acres)

Site Pre-Development Weighted "C"

Pervious Area =	0.87 ac	c = 0.30
Impervious Area =	49.95 ac	c = 0.90
Total Area =	50.82 ac	

$C_{w(pre)}$ = 0.89

Site Post-Development Weighted "C"

Landscape Area =	15.20 ac	c = 0.30
Impervious Area =	34.14 ac	c = 0.90
Total Area =	49.33 ac	

$C_{w(post)}$ = 0.72

CALCULATION OF RAINFALL INTENSITY, i

i = Intensity (in/hr) based on NOAA's PDS-based precipitation frequency estimates for Cupertino

TC = Time of Concentration (minutes), assumed to be 10 minutes

Calculation of 10-Year Rainfall Intensity
TC_{pre} = 10.00 minutes TC_{post} = 10.00 minutes
$i_{10year(pre)}$ **1.76 in/hr** $i_{10year(post)}$ **1.76 in/hr**

Calculation of 25-Year Rainfall Intensity
TC_{pre} = 10.00 minutes TC_{post} = 10.00 minutes
$i_{10year(pre)}$ **2.14 in/hr** $i_{10year(post)}$ **2.14 in/hr**

Calculation of 100-Year Rainfall Intensity
TC_{pre} = 10.00 minutes TC_{post} = 10.00 minutes
$i_{100year(pre)}$ **2.74 in/hr** $i_{100year(post}$ **2.74 in/hr**

CALCULATION OF 10-YEAR PEAK FLOW AND WATER QUALITY FLOW, Q

Use the Rational Equation for Peak Flow Calcuation:
$Q = C_w * i * A_t$

Q = Peak Flow (cfs) for drainage area "A"
Cw = Weighted runoff coefficient for drainage area A
i = Intensity (in/hr) based on NOAA's PDS-based precipitation frequency estimates for Cupertino
A_T = Total Drainage Area (acres)

10-Year Pre-Development Rainfall Peak Flow
C_w = 0.89
i = 1.8 in/hr
A_T = 49.13 acres
$Q_{pre-10year}$ = 0.89 * 1.8 * 49.13 **76.93 cfs**

10-Year Post-Development Rainfall Peak Flow
C_w = 0.72
i = 1.8 in/hr
A_T = 49.13 acres
$Q_{post-10yea}$ = 0.72 * 1.8 * 49.13 **61.84 cfs**

CALCULATION OF 25-YEAR PEAK FLOW AND WATER QUALITY FLOW, Q

Use the Rational Equation for Peak Flow Calcuation:
$Q = C_w * i * A_t$

Q = Peak Flow (cfs) for drainage area "A"
Cw = Weighted runoff coefficient for drainage area A
i = Intensity (in/hr) based on NOAA's PDS-based precipitation frequency estimates for Cupertino
A_T = Total Drainage Area (acres)

25-Year Pre-Development Rainfall Peak Flow
C_w = 0.89
i = 2.1 in/hr
A_T = 49.13 acres
$Q_{pre-10year}$ = 0.89 * 2.1 * 49.13 **93.54 cfs**

25-Year Post-Development Rainfall Peak Flow
C_w = 0.72
i = 2.1 in/hr
A_T = 49.13 acres
$Q_{post-10yea}$ = 0.72 * 2.1 * 49.13 **75.19 cfs**

CALCULATION OF 100-YEAR PEAK FLOW AND WATER QUALITY FLOW, Q

Use the Rational Equation for Peak Flow Calcuation:
$Q = C_w * i * A_t$

Q = Peak Flow (cfs) for drainage area "A"
Cw = Weighted runoff coefficient for drainage area A
i = Intensity (in/hr) based on NOAA's PDS-based precipitation frequency estimates for Cupertino
A_T = Total Drainage Area (acres)

100-Year Pre-Development Rainfall Peak Flow
C_w = 0.89
i = 2.7 in/hr
A_T = 49.13 acres
$Q_{pre-10year}$ = 0.89 * 2.7 * 49.13 **119.77 cfs**

100-Year Post-Development Rainfall Peak Flow
C_w = 0.72
i = 2.7 in/hr
A_T = 49.13 acres
$Q_{post-10yea}$ = 0.72 * 2.7 * 49.13 **96.28 cfs**

SANDIS CIVIL ENGINEERS SURVEYORS PLANNERS
1700 S. Winchester Blvd, Suite 200, Campbell, CA 95008 I P. 408.636.0900 I F. 408.636.0999 I www.sandis.net
SILICON VALLEY TRI-VALLEY CENTRAL VALLEY SACRAMENTO EAST BAY/SF

DATE: 03/23/2022
SCALE: NTS
DRAWN BY: SP
APPROVED BY: ND
DRAWING NO.: 215028

DATE MARCH 23, 2022
CHAD J. BROWNING
R.C.E. NO. 68315, EXPIRES 9-30-19

REGISTERED PROFESSIONAL ENGINEER CHAD J. BROWNING No. C68315 Exp. 9/30/23 CIVIL STATE OF CALIFORNIA

No.	REVISION/ISSUE	DATE	BY
REV-0	SB-35 DEVELOPMENT APPLICATION	03/27/2018	ND
REV-1	SB-35 APPLICATION REVISIONS	08/06/2018	ND
REV-2	SB-35 APPLICATION CONFORM SET	09/15/2018	ND
REV-3	SB-35 MODIFICATION DOCUMENTS	03/23/2022	ND

STORMWATER TREATMENT CALCULATIONS

TENTATIVE SUBDIVISION MAP
VALLCO TOWN CENTER
CUPERTINO CALIFORNIA

SHEET **TM8.1** OF 73 SHEETS

File: S:\215028\(4) ENGINEERING\(2) PLAN SETS\(3) SHEET SET\TENTATIVE MAP\TM-8 STORMWATER TREATMENT PLAN.dwg Date:Mar 09, 2022 - 12:01pm, Isolis