100-1/11

DOLPHIN GREEN PRE-DEVELOPMENT

100-YR STORM

System A

1. Node A01 → A02

C = 0.35
A = 0.034 ac
ΣCA = 0.012

L = 100'
S = 0.052
Lm = 100'

Ti = 8.7 min
I = 5 in/hr

$Q_{A02} = \Sigma CAI = (0.012)(5) = 0.06$ cfs

$Q_{A02} = 0.06$ cfs
$T_c = 8.7$ min

2. Node A02 → A03

C = 0.35
A = 0.062
CA = 0.02
ΣCA = 0.012 + 0.02 = 0.034

L = 175'
S = 0.01

$Q_{03} = 0.15$ cfs
$T_c = 10.2$ min

Assume $q_{ave} = 1.6$ cfs/ac, V = 2 ft/s

$Q_{ave} = 0.06 + (1.6\text{cfs/ac})(0.062)/2 = 0.11$ cfs

$T_t = \frac{L/V}{60} = \frac{175/2}{60} = 1.46$, $T_c = 8.7 + 1.46 = 10.2$ min

I = 4.5 in/hr

$Q_{03} = \Sigma CAI = (0.034)(4.5) = 0.15$ cfs

Check → $Q_{ave} = 0.06 + (.15 - .06)/2 = 0.11$ cfs ✓ok

100-2/11

3. Node A03 → A04

$C = 0.35$ $L = 76'$

$A = 0.128$ $S = 0.061$

$CA = 0.045$

$\Sigma CA = 0.034 + 0.045 = .079$

Assume $q_{ave} = 1.5$ cfs/ac , $V = 2$ ft/s

$Q_{ave} = 0.15\text{ cfs} + (1.5\text{ cfs/ac})(.128)/2 = 0.25\text{ cfs}$

$T_t = \frac{L/v}{60} = \frac{76/2}{60} = 0.63\text{ min}$, $T_c = 10.2 + .63 = 10.8\text{ min}$

$I = 4.4\text{ in/hr}$

$Q_{A04} = \Sigma CAI = (0.079)(4.4) = 0.35\text{ cfs}$

check

$Q_{ave} = 0.15 + (.35 - .15)/2 = 0.25\text{ cfs}$ ✓ok

$Q_A = 0.35$ cfs	
$T_c = 10.8$ min	100 yr storm volume
$I = 4.4$ in/hr	to SD on El Camino Real
$A = 0.22$ ac	

System B

1. Node B01 → B02

C = 0.35 L = 69' Ti = 10.9 min
A = 0.085 S = 0.022 I = 4.3 in/hr
ΣCA = 0.03 L_m = 85'

Q_{B02} = ΣCAI = (0.30)(4.3) = 1.3 cfs

Q_{B02} = 0.13 cfs
Tc = 10.9 min

2. Node B02 → B03

C = 0.35 L = 367'
A = 0.52 ac S = 0.061
CA = 0.18 n = 0.035
ΣCA = 0.03 + 0.18 = .21

Assume q_{ave} = 1.3 cfs/ac , V = 3 ft/s

Q_{ave} = 0.13 + (1.3)(.52)/2 = 0.47 cfs

$T_t = \frac{L/V}{60} = \frac{367/3}{60} = 2.0$ min Tc = 10.9 + 2 = 13 min
I = 3.9 in/hr

Q_{B03} = ΣCAI = (.21)(3.9) = 0.82 cfs

check → Q_{ave} = 0.13 + (0.82 − 0.13)/2 = 0.48 ≈ 0.47 cfs ✓

100-4/11

System B

Q_{B03} = 0.82 cfs
T_c = 13 min
I = 3.9 in/hr
A = 0.6 ac

100-5/11

System C

1. Node C01 – B03(c)

$C = 0.35$ $L = 180'$ $T_i = 9.5$ min

$A = 0.23$ ac $S = 0.044$ $I = 4.8$ in/hr

$\Sigma CA = 0.08$ $L_m = 100'$

$$Q_{B03(c)} = \Sigma CAI = (0.08)(4.8) = 0.38 \text{ cfs}$$

System C	
$Q_{B03(c)}$	= 0.38 cfs
T_c	= 9.5 min
I	= 4.8 in/hr
A	= 0.23 ac

100-6/11

System D

1. Node D01 → D02

$C = 0.90$ $L = 78'$ $T_i = 2.8$ min
$A = 0.11$ ac $S = 0.062$ $I = 7$ in/hr
$\Sigma CA = 0.1$ $L_m = 90'$

$Q_{D02} = \Sigma CAI = (0.1)(7) = .7$ cfs

$Q_{D02} = 0.7$ cfs
$T_c = 2.8$ min

2. Node D02 → D03

$C = 0.35$ $L = 141'$
$A = 0.197$ ac $S = 0.05$
$CA = 0.07$
$\Sigma CA = 0.1 + 0.07 = .17$

Assume $q_{ave} = 2.5$ cfs/ac $V = 3$ ft/s

$Q_{ave} = 0.7 + 2.5(.197)/2 = 0.95$ cfs

$T_t = \frac{L/V}{60} = \frac{141/3}{60} = 0.94$ min $T_c = 2.8 + 0.94 = 3.7$ min
$I = 7$ in/hr

$Q_{D03} = \Sigma CAI = (0.17)(7) = 1.2$ cfs

Check =

$Q_{ave} = 0.7 + (1.2 - .7)/2 = 0.95$ cfs $= 0.95$ ✓ ok

System D

$Q_{D03} = 1.2$ cfs
$T_c = 3.7$ min
$I = 7$ in/hr
$A = 0.30$ ac

100-8/11

System E

1. Node E01 → B03

$C = 0.82$ $L = 135'$ $T_i = 2.8 \text{ min}$
$A = .08 \text{ ac}$ $S = 0.067$ $I = 7 \text{ in/hr}$
$\Sigma CA = 0.071$ $L_m = 90'$

$Q_{B03(E)} = \Sigma CAI = (0.071)(7) = 0.50 \text{ cfs}$
$T_c = 2.8 \text{ min}$

2. Junction of systems B, C, & E @ B03

System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ΣCA
B = z	0.82	13	3.9	0.6	0.21
C = y	0.38	9.5	4.8	0.23	0.08
E = x	0.50	2.8	7	0.086	0.071

$T_x < T_y < T_z \rightarrow T_{cE} < T_{cC} < T_{cB}$

$$Q_{Tx} = Q_x + \frac{T_x}{T_y} Q_y + \frac{T_x}{T_z} Q_z$$

$$= 0.5 + \frac{2.8}{9.5}(0.38) + \frac{2.8}{13}(0.82)$$

$$= 0.79 \text{ cfs}$$

100–9/11

$$Q_{Ty} = Q_y + \frac{I_y}{I_x} Q_x + \frac{I_y}{I_z} Q_z$$

$$= 0.38 + \frac{4.8}{7}(0.5) + \frac{9.5}{13}(0.82)$$

$$= 1.3 \text{ cfs}$$

$$Q_{Tz} = Q_z + \frac{I_z}{I_x} Q_x + \frac{I_z}{I_y} Q_y$$

$$= 0.82 + \frac{3.9}{7}(0.5) + \frac{3.9}{4.8}(0.38)$$

$$= 1.4 \text{ cfs} \leftarrow \text{Largest } Q$$

$Q_{B03} = 1.4$ cfs
$T_c = 13$ min
$I = 3.9$ in/hr
$A = 0.92$ ac
$\Sigma CA = 0.36$

100-10/11

3. Junction B03 → E02

$C = 0.2$
$A = 0.16\ ac$
$CA = 0.13$
$\Sigma CA = 0.36 + 0.13 = 0.49$

$L = 238'$
$S = 0.033$
$n = 0.013$

Assume $q_{ave} = 2.2\ cfs/ac$, $V = 2.5\ ft/s$

$Q_{ave} = 1.4 + (2.2)(.16)/2 = 1.58\ cfs$

$T_t = \frac{L/v}{60} = \frac{238/2.5}{60} = 1.58\ min$, $T_c = 15\ min$
$I = 3.6\ in/hr$

$Q_{E02} = \Sigma CAI = (0.49)(3.6) = 1.76\ cfs$

Check:

$Q_{ave} = 1.4 + (1.76 - 1.4)/2 = 1.58\ cfs$ ✓ok

$Q_{E02} = 1.76\ cfs$
$T_c = 15\ min$
$I = 3.6\ in/hr$
$A = 1.08\ ac$
$\Sigma CA = 0.49$

100 - 11/11

4. Junction of System D&E @ E02

System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ΣCA
D = y	1.2	3.7	7	0.3	0.17
E = z	1.76	15	3.6	1.08	0.44

$0 < T_{cy} < T_{cz} \rightarrow T_{cD} < T_{cE}$

$$Q_{Ty} = Q_y + \frac{T_y}{T_z} Q_z = 1.2 + \frac{3.7}{15}(1.76) = 1.63 \text{ cfs}$$

$$Q_{Tz} = Q_z + \frac{I_z}{I_y} Q_y = 1.76 + \frac{3.6}{7}(1.2) = \underline{2.38 \text{ cfs}}$$

Into SD inlet on Via Las Rosas:

Q_{100} = 2.38 cfs
T_c = 15 min
I = 3.6 in/hr
A = 1.38 ac

100-8/11

System E

1. Node E01 → B03

$C = 0.82$ $L = 135'$ $T_i = 2.8\,min$
$A = .08\,ac$ $S = 0.067$ $I = 7\,in/hr$
$\Sigma CA = 0.071$ $L_m = 90'$

$Q_{B03(E)} = \Sigma CAI = (0.071)(7) = 0.50\,cfs$
$T_C = 2.8\,min$

2. Junction of systems B, C, & E @ B03

System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ΣCA
B = z	0.82	13	3.9	0.6	0.21
C = y	0.38	9.5	4.8	0.23	0.08
E = x	0.50	2.8	7	0.086	0.071

$T_x < T_y < T_z \rightarrow T_{CE} < T_{CC} < T_{CB}$

$$Q_{Tx} = Q_x + \frac{T_x}{T_y} Q_y + \frac{T_x}{T_z} Q_z$$

$$= 0.5 + \frac{2.8}{9.5}(0.38) + \frac{2.8}{13}(0.82)$$

$$= 0.79\,cfs$$

DOLPHIN GREEN CAR WASH

POST DEVELOPMENT 2-YEAR STORM

System A

1. Node A01 → A02

Same as pre development condition

Q_{A02} = 0.03 cfs	A = 0.034 ac
Tc = 8.7 min	ΣCA = 0.012
I = 2.4 in/hr	

2. Node A02 → A03

Same as Pre development Condition

Q_{A03} = 0.075 cfs	A_z = 0.062
Tc = 10.16 min	ΣCA = 0.034
I = 2.2 in/hr	

3. Node A03 → A04 (outlet 1)

$C_{A03-A04} = 0.35$
$A_{A03-A04} = 0.017$ ac

$CA = (0.35)(0.017) = .006$

$\Sigma CA = 0.034 + .006 = 0.04$

L = 40'
S = 0.066 V ditch

Assume Q_{Ave} A03 → A04, $q_{ave} = 0.5$ cfs/ac

$$Q_{Ave} = Q_{A03} + \frac{q_{ave}(A03 \rightarrow A04)}{2}$$

$$= 0.075 + \frac{(.5 \text{ cfs/ac})(0.017 \text{ ac})}{2}$$

$$= .079 \text{ cfs}$$

Assume $V = 2$ ft/s

$$T_t = \frac{L/V}{60} = \frac{40/2}{60} = 0.33 \text{ min}, \quad T_c = 10.2 + 0.33 = 10.5 \text{ min}$$

$$I = 2.2 \text{ in/hr}$$

$$Q_{A04} = \Sigma CAI = (0.04)(2.2) = \underline{\underline{0.09 \text{ cfs}}}$$

Check ✓

$$Q_{ave} = 0.075 + (.09 - .075)/2 = 0.08 = .08 \checkmark$$

<u>Outlet 1 at Storm Drain on El Camino Real:</u>

$Q_A = 0.09$ cfs	$\Sigma CA = 0.04$
$T_{CA} = 10.5$ min	$A = 0.11$ ac
$I_A = 2.2$ in/hr	
Area $A = 0.11$ ac	

System B

1. Node B01 → B03 (Gen. Comm)

$C = 0.82$ $L = 330'$ $T_i = 2.9$ min
$A = 0.41$ ac $S = 0.06$ $I = 3.5$ in/hr
$\Sigma CA = 0.34$ $L_m = 90'$ Ignore T_t of 240'

$$Q_{B01 \to B03} = \Sigma CA\, I = (0.3\ \ )(3.5) = 1.19 \text{ cfs}$$

$$Q_{B01 \to B03} = 1.19 \text{ cfs}$$
$$T_c = 2.9 \text{ min}$$

2. Node B02 → B03 (Gen. Comm.)

$C = 0.82$ $L = 216'$ $T_i = 3.2$ min
$A = 0.19$ ac $S = 0.037$ $I = 3.5$ in/hr
$\Sigma CA = 0.16$ $L_m = 90'$

$$Q_{B02 \to B03} = \Sigma CA\, I = (0.16)(3.5) = 0.56 \text{ cfs}$$

$$Q_{B02 \to B03} = 0.56 \text{ cfs}$$
$$T_c = 3.2 \text{ min}$$

POST 2-4/9

3. Junction of System B at B03

	System	Q(cfs)	Tc(min)	I in/hr	A(ac)	ΣCA
Y	B01 → B03	1.19	2.9	3.5	0.41	0.34
Z	B02 → B03	0.56	3.2	3.5	0.19	0.16

$0 < T_{cy} < T_{cz} \rightarrow T_{B01 \rightarrow B03} < T_{B02 \rightarrow B03}$

$$Q_{Ty} = Q_Y + \frac{T_Y}{T_Z} Q_Z = 1.19 + \frac{2.9}{3.2}(0.56) = 1.70 \text{ cfs}$$

$$Q_{TZ} = Q_Z + \frac{I_Z}{I_Y} Q_Y = 0.56 + \frac{3.5}{3.5}(1.19) = \underline{1.75} \text{ cfs}$$

System B Total at B03 (driveway trench drain)

$Q_{B03} = 1.75$ cfs

$T_c = 3.2$ min

$I = 3.5$ in/hr

$A = 0.60$ ac

System C

1. Node C01 → C02 (natural, landscape)

$C = 0.35$ $\quad L = 116'$ $\quad T_c = 12.5$ min
$A = 0.03$ ac $\quad S = 0.013$ $\quad I = 1.9$ in/hr
$\Sigma CA = 0.011$ $\quad L_m = 70'$

$$Q_{C01 \to C02} = \Sigma CA\,I = (0.011)(1.9) = 0.02 \text{ cfs}$$

$Q_{C02} = 0.02$ cfs
$T_c = 12.5$ min

2. Node C03 → C04 (Street flow)

$C = 0.85$ $\quad L = 162'$
$A = 0.13$ ac $\quad S = .046$
$CA = 0.11$ $\quad n = 0.013$

$\Sigma CA = 0.011 + 0.11 = 0.12$

Assume $q_{ave} = 1.5$ cfs/ac, $V = 2$ ft/s

$$Q_{ave} = 0.02 + (1.5)(0.13)/2 = 0.12 \text{ cfs}$$

$$T_t = \frac{L/V}{60} = \frac{162/2}{60} = 1.35 \text{ min}$$

$T_c = 12.5 + 1.35 = 13.9$ min
$I = 1.8$ in/hr

$$Q_{C03 \to C04} = \Sigma CA\,I = (0.12)(1.8) = 0.22 \text{ cfs}$$ ✓

check ↓
$$Q_{ave} = 0.02 + (.22 - .02)/2 = 0.12 \text{ cfs} \; \checkmark \text{ ok}$$

$Q_{C03 \to C04} = 0.22$, $T_c = 13.9$ min

POST 2 - 6/9

3. Node C05 → C04 (Nat., Landscape)

$C = 0.35$ $L = 150'$ $T_c = 6.9$ min
$A = 0.048$ ac $S = 0.082$ $I = 2.6$ in/hr
$\Sigma CA = 0.0168$ $L_m = 100'$

$$Q_{C05 \rightarrow C04} = \Sigma CA\, I = (0.0168)(2.6) = 0.04 \text{ cfs}$$

$Q_{C05 \rightarrow C04} = 0.04$ cfs

$T_c = 6.9$ min

4. Junction @ C04 from C03 & C05

	System	Q(cfs)	Tc (min)	I in/hr	A(ac)	ΣCA
Z	C03→C04	0.22	13.9	1.8	.03+ 0.13	0.12
Y	C05→C04	0.04	6.9	2.6	0.048	0.02
						.14

$0 < T_{cY} < T_{cZ} \rightarrow 0 < 6.9 < 13.9$

$$Q_{TY} = Q_Y + \frac{T_Y}{T_Z} Q_Z = 0.04 + \frac{6.9}{13.9}(0.22) = 0.15 \text{ cfs}$$

$$Q_{TZ} = Q_Z + \frac{I_Z}{I_Y} Q_Y = 0.22 + \frac{1.8}{2.6}(0.04) = \underline{0.23} \text{ cfs}$$

Junction C04 = $Q_{C04} = 0.23$ cfs
$T_c = 13.9$ min
$I = 1.8$ in/hr
$A_{total} = 0.21$ ac

POST 2-7/9

5. Node C04 → C06 (Street flow)

$C = 0.82$ $L = 190'$
$A = 0.17$ ac $S = 0.041$
$CA = 0.14$ $n = 0.013$
$\Sigma CA = 0.14 + .14 = 0.28$

Assume $q_{ave} = 1.5$ cfs/ac , $V = 2.5$ ft/s

$Q_{ave} = 0.23 + (1.5)(0.17)/2 = 0.36$ cfs

$T = \frac{L/V}{60} = \frac{190/2.5}{60} = 1.27$ min $T_c = 13.9 + 1.27 = 15.2$ min

$I = 1.7$ in/hr

$Q_{C04 \to C06} = \Sigma CAI = (0.28)(1.7) = \underline{\underline{0.48 \text{ cfs}}}$

check

$Q_{ave} = 0.23 + (.48 - .23)/2 = 0.36$ cfs ✓

$Q_{C06} = 0.48$ cfs
$T_c = 15.2$ min
$I = 1.7$ in/hr
$\Sigma CA = 0.28$ ac

System D

1. Node D01 → D02 (natural)

$C = 0.35$ $L = 290'$ $Tc = 8.7 min$
$A = 0.48 ac$ $S = 0.037$
$\Sigma CA = 0.168$ $Lm = 100'$ $I = 2.4 in/hr$

$$Q_{D01 \to D02} = \Sigma CAI = (0.168)(2.4) = 0.40 \text{ cfs}$$

$Q_{D02} = 0.40$ cfs
$Tc = 8.7$ min
$I = 2.4$ in/hr
$\Sigma CA = 0.168$ ac

2. Outlet 2 — Via Rosa
(Junction of C06 & D02 @ Storm Drain)

	System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ΣCA
Z	C	0.48	15.2	1.7	0.38	0.28
Y	D	0.40	8.7	2.4	0.48	0.17

$0 < T_{cy} < T_{cz} \rightarrow 0 < 8.7 < 15.2$

$$Q_{TY} = Q_y + \frac{T_Y}{T_Z} Q_Z = 0.40 + \frac{8.7}{15.2}(0.48) = 0.67 \text{ cfs}$$

$$Q_{TZ} = Q_Z + \frac{I_Z}{I_Y} Q_Y = 0.48 + \frac{1.7}{2.4}(0.40) = \underline{\underline{0.76}} \text{ cfs}$$

Outlet 2 at Storm Drain on Via Rosa:

$Q_{outlet\ 2} = 0.76$ cfs	2-year
$T_c = 15.2$ min	Post Development
$I = 1.7$ in/hr	
$A = 0.86$ ac	