Appendix 7.1-A
Water Savings from UBAK2 Program

UBAK2 Program Water Savings

Active Water Savings			Savings (AFY)												
Activity Name	Customer Class	Number	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
HE Toilets (Com): Cust Rebates or Vouchers	Commercial	6	0.116	0.108	0.101	0.095	0.088	0.082	0.077	0.071	0.066	0.060	0.055	0.051	0.046
Clotheswasher (SF): Cust Reb or Voucher	Single Family	15	0.149	0.138	0.128	0.119	0.109	0.101	0.092	0.084	0.076	0.069	0.061	0.054	0.000
CW common (MF): Cust Reb or Voucher	Multi Family	1	0.044	0.041	0.038	0.035	0.032	0.029	0.027	0.024	0.000	0.000	0.000	0.000	0.000
CW in-unit (MF): Cust Reb or Voucher	Multi Family	4	0.029	0.027	0.025	0.023	0.021	0.019	0.018	0.016	0.015	0.013	0.012	0.010	0.000
CW coin-op: Cust Reb or Voucher	Commercial	1	0.055	0.051	0.047	0.043	0.040	0.037	0.033	0.030	0.000	0.000	0.000	0.000	0.000
Urinals (0.25 gpf): Cust Rebates or Vouchers	Commercial	2	0.057	0.055	0.053	0.051	0.049	0.047	0.045	0.043	0.041	0.040	0.038	0.036	0.035
High Efficiency Pop-Up Nozzle Web Voucher (SF)	Single Family	5,000	15.989	15.989	15.989	15.989	15.989	15.989	15.989	15.989	15.989	15.989	0.000	0.000	0.000
High Efficiency Pop-Up Nozzle Web Voucher (MF)	Multi Family	5,000	15.989	15.989	15.989	15.989	15.989	15.989	15.989	15.989	15.989	15.989	0.000	0.000	0.000
High Efficiency Pop-Up Nozzle Web Voucher (Com)	Commercial	8,000	25.582	25.582	25.582	25.582	25.582	25.582	25.582	25.582	25.582	25.582	0.000	0.000	0.000
Conserv Kit Dist (SF)	Single Family	70	0.945	0.814	0.698	0.597	0.507	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Conserv Kit Dist (MF)	Multi Family	6	0.081	0.070	0.060	0.051	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WBIC (SF)	Single Family	40	3.544	3.544	3.544	3.544	3.544	3.544	3.544	3.544	3.544	3.544	0.000	0.000	0.000
Large Landscape Water Use Reports	Irrigation	34	4.343	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lg Lndscp Surveys & Irrig Sys: Rebates	Irrigation	6	1.975	1.975	1.975	1.975	1.975	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
UHET: Cust Rebates or Vouchers	Single Family	4		0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089
UHET: Cust Rebates or Vouchers	Multi Family	30	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819
Total Active Water Savings		18,219.0	69.8	65.3	65.1	65.0	64.9	62.3	62.3	62.3	62.2	62.2	1.1	1.1	1.0

Active Water Savings															
Activity Name	Customer Class	Number	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	otal Lifetime
HE Toilets (Com): Cust Rebates or Vouchers	Commercial	6	0.042	0.037	0.033	0.029	0.026	0.022	0.019	0.015	0.012	0.009	0.006	0.003	1.3
Clotheswasher (SF): Cust Reb or Voucher	Single Family	15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.2
CW common (MF): Cust Reb or Voucher	Multi Family	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.3
CW in-unit (MF): Cust Reb or Voucher	Multi Family	4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.2
CW coin-op: Cust Reb or Voucher	Commercial	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.3
Urinals (0.25 gpf): Cust Rebates or Vouchers	Commercial	2	0.034	0.032	0.031	0.030	0.029	0.027	0.026	0.025	0.024	0.023	0.022	0.021	0.9
High Efficiency Pop-Up Nozzle Web Voucher (SF)	Single Family	5,000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	159.9
High Efficiency Pop-Up Nozzle Web Voucher (MF)	Multi Family	5,000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	159.9
High Efficiency Pop-Up Nozzle Web Voucher (Com)	Commercial	8,000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	255.8
Conserv Kit Dist (SF)	Single Family	70	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.6
Conserv Kit Dist (MF)	Multi Family	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.3
WBIC (SF)	Single Family	40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	35.4
Large Landscape Water Use Reports	Irrigation	34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.3
Lg Lndscp Surveys & Irrig Sys: Rebates	Irrigation	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	9.9
UHET: Cust Rebates or Vouchers	Single Family	4	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	2.2
UHET: Cust Rebates or Vouchers	Multi Family	30	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	0.819	20.5
Total Active Water Savings		18,219.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	656.0

Appendix 7.2-A
Water Savings from TCCWD1 and TCCWD2 Programs

TCCWD1 and TCCWD2 Water Savings Estimates

TCCWD1 Direct Install Program

		Number of Units (#/yr)	Useful Life (yrs)	Unit Savings (AF/Yr)	Annual Savings (AF)	Lifetime Savings AF
SF Pres. HET		80	25	0.030468	2	38
MF Pres. HET		20	25	0.052871	1	18
SF Low Flow Showerhead		1,200	8	0.006161	7	51
MF Low Flow Showerhead		300	8	0.005825	2	13
SF UHET / Stealth		770	25	0.089000	69	1,645
MF UHET / Stealth		130	25	0.089000	12	278
				Total Selected Savings:	**93**	**2,042**

The unit savings are taken directly from the MOU Compliance Policies *Flex Track Menu* approved by the CUWCC Board of

TCCWD2 Rebate Program

		Number of Units (#/yr)	Useful Life (yrs)	Unit Savings (AF/Yr)	Annual Savings (AF)	Lifetime Savings AF
SF Pres. HET		800	25	0.030468	24	585
MF Pres. HET		100	25	0.052871	5	127
CII HET		50	25	0.028996	1	21
				Total Selected Savings:	**31**	**733**

	Average Annual Savings (AF)	Lifetime Savings AF
TCCWD1	80.6	2042.1
TCCWD2	28.8	733.4
Total	109.4	2775.4

Active Water Savings		**Savings (AFY)-->**																										
Activity Name	**Lifetime of Device**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**Total Lifetime**
TCCWD1-Direct Install																												
SF Pres. HET	25	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.9	1.7	1.6	1.5	1.3	1.2	1.1	0.9	0.8	0.7	0.5	0.4	0.3	0.1	0.0	**38.4**
MF Pres. HET	25	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9	0.9	0.8	0.7	0.7	0.6	0.5	0.5	0.4	0.3	0.3	0.2	0.1	0.1	0.0	**17.6**
SF Low Flow Showerhead	8	7.4	7.4	7.4	7.4	7.4	5.6	4.2	2.8	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**51.0**
MF Low Flow Showerhead	8	1.7	1.7	1.7	1.7	1.7	1.6	1.2	0.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**12.7**
SF UHET / Stealth	25	34.3	34.3	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	**1644.7**
MF UHET / Stealth	25	5.8	5.8	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	**277.7**
	TCCWD1 Subtotal-->	**52.7**	**52.7**	**92.7**	**92.7**	**92.7**	**90.8**	**89.0**	**87.2**	**85.4**	**83.6**	**82.9**	**82.7**	**82.5**	**82.3**	**82.1**	**81.9**	**81.7**	**81.5**	**81.3**	**81.1**	**80.9**	**80.7**	**80.5**	**80.3**	**80.1**	**2,042**
TCCWD2 -Rebate																												
SF Pres. HET	25	12.2	12.2	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	**585.0**
MF Pres. HET	25	2.6	2.6	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	**126.9**
CII HET	25	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.9	0.9	0.8	0.7	0.7	0.6	0.5	0.5	0.4	0.3	0.3	0.2	0.1	0.1	0.0	**21.5**
	TCCWD2 Subtotal-->	**16.3**	**16.3**	**31.1**	**31.1**	**31.1**	**31.1**	**31.1**	**31.1**	**31.1**	**31.1**	**30.6**	**30.5**	**30.5**	**30.4**	**30.3**	**30.3**	**30.2**	**30.1**	**30.1**	**30.0**	**29.9**	**29.9**	**29.8**	**29.7**	**29.7**	**733.4**
Total Active Water Savings		**69.0**	**69.0**	**123.8**	**123.8**	**123.8**	**121.9**	**120.1**	**118.3**	**116.5**	**114.7**	**113.5**	**113.2**	**113.0**	**112.7**	**112.4**	**112.2**	**111.9**	**111.6**	**111.4**	**111.1**	**110.8**	**110.6**	**110.3**	**110.0**	**109.8**	**2775.4**

Appendix 7.5-A
2010 Rain for Rent Invoice

INVOICE

Flood

RAIN FOR RENT

BAKERSFIELD
P O BOX 2248
BAKERSFIELD, CA 93303
661-399-1724

INVOICE

BILL TO: CITY OF ARVIN
200 CAMPUS DRIVE
PO 540
ARVIN CA 93203

INVOICE #: 031027540
Control #: R0271116
INVOICE DATE: 01/13/2011
PRINTED DATE: 01/13/2011
CONTRACT#: 031003525-001
DIVISION: 031

SHIP TO: CITY OF ARVIN
CUSTOMER WILL CALLED
ARVIN CA 93203

CUSTOMER: 310968
TEL: 661-854-3134
TERMS: NET 30
SALESMAN: 32941
PAGE: 1

IN & OUT RENTAL

IT HAS BEEN A PLEASURE SERVING YOU!
WE APPRECIATE YOUR BUSINESS AND THE CONFIDENCE YOU HAVE PLACED IN US. AGAIN, THANK YOU.

RECEIVED
JAN 19 11
FINANCE DEPARTMENT

PRODUCT #	DESCRIPTION	DATE OUT	BILLED THRU	STATUS	QTY	UNIT PRICE		DIS	AMOUNT
601243	PUMP-TRASH DV100 3015D TRLR	DEC 21,2010	JAN 11,2011	RTD:	1	1600.00	EA	*	1600.00
	METER OUT/IN: 0/384	METER USED: 0	INCLUDED:	0	OT:	0			
726303	ADAPT 4 FLGXGRV STL	DEC 21,2010	JAN 11,2011	RTD:	2	4.00	EA	*	8.00
	MRC HOSE 3" X 20' SUCTION 722422	DEC 21,2010	JAN 11,2011	RTD:	1	85.00	EA	*	85.00
	MRC HOSE 3" X 10' SUCTION 722443	DEC 21,2010	JAN 11,2011	RTD:	1	42.50	EA	*	42.50
	MRC HOSE 4" CL LAY FLT YELLOW	DEC 21,2010	JAN 11,2011	RTD:	1	212.50	EA	*	212.50
	MRC ADAPT 4" VIC X MCL	DEC 21,2010	JAN 11,2011	RTD:	1	4.00	EA	*	4.00
	MRC REDUCER 4X3 STL 727945	DEC 21,2010	JAN 11,2011	RTD:	1	4.00	EA	*	4.00
720763	CPLR-IND-GRV 3 HW STL 77	DEC 21,2010	JAN 11,2011	RTD:	5	2.10	EA	*	10.50
720764	CPLR-IND-GRV 4 HW STL 77	DEC 21,2010	JAN 11,2011	RTD:	1	2.10	EA	*	2.10
	MRC HITCH	DEC 21,2010	JAN 11,2011	RTD:	1	.00	EA	*	.00
	AIR QUALITY FEE				1	85.00			85.00
	ENVIRO. RECOVERY FEE				1	11.25		*	11.25

TOT RENTALS: 1968.60 TOT SALES: .00 TOT SERVICES: 96.25

SUBTOTAL: 2064.85
CA TAX 163.34
TOTAL: 2228.19

200-020-5008

CUSTOMER, (RENTEE or BUYER as context requires), shall be deemed to accept all terms, conditions and provisions hereof upon execution of this agreement; ordering; or delivery of equipment to customer, whichever comes first.

SIGNATURE TITLE DATE

THIS IS AN AGREEMENT, READ BOTH SIDES BEFORE SIGNING.

CUSTOMER / ORIGINAL

Appendix 7.5-B
Arvin Precipitation and Precipitation Frequency Atlas

Appendix 7-B - Sycamore Road Flood Reduction Project

University of California
UCCE Plumas-Sierra

Arvin-Edison, Arvin - Daily Totals for December

Uhwxug#wr#P rqwko|#Wrwdov ¡#Uhwxug#wr#Z hdwkhu

	2013		2012		2011		2010		2009	
Day	High/Low Temps	Rain Total	High/Low Temps	Rain Total	High/Low Temps	Rain Total	High/Low Temps	Rain Total	High/Low Temps	Rain Total
1	N/A	N/A	72/50	0.04	M	M	57/33	0	61/34	0
2	N/A	N/A	71/55	0.04	63/35	0	63/34	0	62/34	0
3	N/A	N/A	59/49	0.16	57/30	0	59/40	0	60/34	0
4	N/A	N/A	64/41	0	57/29	0	63/47	0	62/33	0
5	N/A	N/A	69/43	0	62/30	0	70/43	0.08	M	M
6	N/A	N/A	61/53	0.04	61/27	0	66/42	0	56/38	0
7	N/A	N/A	57/52	0.28	59/28	0	64/37	0	54/37	0.52
8	N/A	N/A	60/43	0	58/27	0	65/38	0	45/32	0
9	N/A	N/A	57/45	0	61/29	0	70/41	0	47/28	0
10	N/A	N/A	61/38	0.04	62/32	0	64/46	0	54/32	0.44
11	N/A	N/A	64/38	0	55/29	0	68/48	0	60/44	0.04
12	N/A	N/A	64/39	0.28	49/32	0.08	60/46	0	69/44	0.04
13	N/A	N/A	49/43	0.32	M	M	62/44	0	60/48	0.08
14	N/A	N/A	51/39	0	57/33	0	59/41	0.12	59/42	0
15	N/A	N/A	52/36	0	54/33	0	51/48	0.24	54/37	0
16	N/A	N/A	60/37	0	53/32	0	51/42	0	65/38	0
17	N/A	N/A	66/48	0.04	53/31	0	58/44	0.24	48/38	0
18	N/A	N/A	54/38	0.48	63/36	0	58/50	1.8	49/47	0
19	N/A	N/A	51/32	0	47/29	0	59/55	1.08	58/41	0
20	N/A	N/A	60/29	0	59/30	0	54/48	0.92	57/39	0
21	N/A	N/A	59/31	0	57/30	0	62/46	0	61/41	0
22	N/A	N/A	60/32	0	56/32	0	62/51	0.4	52/40	0.16
23	N/A	N/A	58/41	0	57/27	0	57/43	0	52/31	0
24	N/A	N/A	54/41	0.28	57/27	0	62/40	0	54/29	0
25	N/A	N/A	47/38	0	63/27	0	70/44	0.12	56/29	0
26	N/A	N/A	54/44	0.16	58/27	0	57/46	0.2	60/33	0

Appendix 7-B - Sycamore Road Flood Reduction Project

27	N/A	N/A	49/43	0.08	54/31	0	57/41	0.04	58/36	0
28	N/A	N/A	53/33	0	60/28	0	54/42	0	52/39	0
29	N/A	N/A	51/37	0.04	60/33	0	56/42	0.2	50/38	0
30	N/A	N/A	47/38	0.16	61/32	0	47/34	0.12	51/40	0.4
31	N/A	N/A	51/34	0	M	M	51/29	0.16	59/38	0
Totals:	**/**	**0**	**57/40**	**2.44**	**57/-69**	**0.08**	**59/42**	**5.72**	**56/3**	**1.68**

Rainfall measured in inches. Temperatures in Farenheit.
*** M - Weather station is Missing Data.**

Agriculture and Natural Resources, University of California

Webmaster Email: alrasband@ucdavis.edu

NOAA Atlas 14, Volume 6, Version 2
Location name: Arvin, California, US*
Coordinates: 35.1947, -118.8362
Elevation: 419ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.068 (0.055-0.084)	0.087 (0.070-0.108)	0.115 (0.093-0.144)	0.141 (0.113-0.177)	0.179 (0.139-0.233)	0.212 (0.162-0.281)	0.249 (0.185-0.337)	0.289 (0.210-0.403)	0.352 (0.245-0.508)	0.406 (0.275-0.607)
10-min	0.097 (0.079-0.121)	0.125 (0.101-0.155)	0.165 (0.134-0.207)	0.202 (0.162-0.254)	0.257 (0.200-0.334)	0.304 (0.232-0.403)	0.356 (0.266-0.483)	0.415 (0.301-0.577)	0.504 (0.352-0.729)	0.582 (0.394-0.870)
15-min	0.117 (0.095-0.146)	0.151 (0.122-0.188)	0.200 (0.162-0.250)	0.244 (0.196-0.307)	0.311 (0.242-0.404)	0.368 (0.280-0.487)	0.431 (0.321-0.584)	0.502 (0.364-0.698)	0.609 (0.425-0.881)	0.704 (0.476-1.05)
30-min	0.161 (0.131-0.201)	0.207 (0.168-0.258)	0.275 (0.222-0.344)	0.335 (0.269-0.423)	0.427 (0.332-0.555)	0.505 (0.385-0.670)	0.593 (0.442-0.803)	0.690 (0.501-0.960)	0.838 (0.585-1.21)	0.968 (0.655-1.45)
60-min	0.226 (0.183-0.281)	0.291 (0.235-0.362)	0.386 (0.312-0.482)	0.470 (0.377-0.592)	0.599 (0.466-0.778)	0.709 (0.540-0.939)	0.831 (0.619-1.13)	0.967 (0.702-1.35)	1.18 (0.820-1.70)	1.36 (0.918-2.03)
2-hr	0.329 (0.267-0.410)	0.417 (0.338-0.520)	0.543 (0.439-0.679)	0.653 (0.523-0.822)	0.815 (0.634-1.06)	0.950 (0.725-1.26)	1.10 (0.817-1.49)	1.26 (0.912-1.75)	1.49 (1.04-2.15)	1.68 (1.14-2.51)
3-hr	0.399 (0.323-0.497)	0.503 (0.408-0.628)	0.651 (0.526-0.813)	0.779 (0.625-0.981)	0.966 (0.751-1.26)	1.12 (0.854-1.48)	1.29 (0.958-1.74)	1.46 (1.06-2.04)	1.72 (1.20-2.48)	1.92 (1.30-2.87)
6-hr	0.519 (0.421-0.647)	0.657 (0.532-0.819)	0.847 (0.684-1.06)	1.01 (0.809-1.27)	1.24 (0.965-1.61)	1.43 (1.09-1.89)	1.62 (1.21-2.20)	1.83 (1.33-2.55)	2.12 (1.48-3.06)	2.34 (1.58-3.50)
12-hr	0.628 (0.509-0.782)	0.817 (0.662-1.02)	1.08 (0.870-1.35)	1.29 (1.04-1.63)	1.59 (1.24-2.07)	1.83 (1.39-2.42)	2.07 (1.54-2.80)	2.32 (1.68-3.23)	2.66 (1.85-3.84)	2.91 (1.97-4.35)
24-hr	0.783 (0.702-0.891)	1.06 (0.946-1.21)	1.42 (1.27-1.63)	1.72 (1.52-1.99)	2.13 (1.82-2.55)	2.45 (2.05-3.00)	2.78 (2.25-3.49)	3.11 (2.45-4.03)	3.56 (2.68-4.83)	3.90 (2.83-5.49)
2-day	0.909 (0.815-1.03)	1.25 (1.12-1.42)	1.70 (1.52-1.95)	2.08 (1.84-2.40)	2.59 (2.21-3.09)	2.98 (2.48-3.65)	3.38 (2.75-4.25)	3.80 (2.99-4.92)	4.36 (3.28-5.91)	4.78 (3.47-6.73)
3-day	0.975 (0.874-1.11)	1.35 (1.21-1.53)	1.86 (1.66-2.13)	2.28 (2.02-2.63)	2.86 (2.44-3.42)	3.30 (2.75-4.04)	3.76 (3.05-4.72)	4.23 (3.33-5.48)	4.88 (3.67-6.61)	5.38 (3.90-7.57)
4-day	1.03 (0.924-1.17)	1.43 (1.28-1.63)	2.00 (1.78-2.28)	2.46 (2.17-2.83)	3.09 (2.63-3.69)	3.57 (2.98-4.37)	4.08 (3.31-5.13)	4.60 (3.62-5.96)	5.32 (4.00-7.20)	5.86 (4.25-8.25)
7-day	1.15 (1.03-1.31)	1.62 (1.45-1.85)	2.27 (2.03-2.60)	2.82 (2.49-3.25)	3.57 (3.05-4.27)	4.15 (3.46-5.08)	4.74 (3.85-5.95)	5.34 (4.20-6.92)	6.15 (4.63-8.33)	6.76 (4.90-9.50)
10-day	1.23 (1.10-1.40)	1.74 (1.56-1.98)	2.46 (2.20-2.82)	3.07 (2.71-3.54)	3.92 (3.34-4.69)	4.57 (3.81-5.59)	5.23 (4.25-6.58)	5.91 (4.65-7.65)	6.83 (5.14-9.25)	7.50 (5.44-10.6)
20-day	1.48 (1.32-1.68)	2.14 (1.92-2.44)	3.10 (2.77-3.55)	3.92 (3.47-4.52)	5.10 (4.35-6.11)	6.04 (5.04-7.39)	7.01 (5.69-8.80)	8.00 (6.30-10.4)	9.32 (7.01-12.6)	10.3 (7.48-14.5)
30-day	1.72 (1.54-1.95)	2.50 (2.24-2.85)	3.66 (3.27-4.19)	4.68 (4.14-5.40)	6.17 (5.26-7.38)	7.36 (6.14-9.01)	8.58 (6.97-10.8)	9.85 (7.75-12.8)	11.5 (8.70-15.7)	12.8 (9.29-18.0)
45-day	2.05 (1.84-2.33)	2.99 (2.68-3.41)	4.41 (3.94-5.04)	5.67 (5.02-6.54)	7.56 (6.44-9.04)	9.10 (7.58-11.1)	10.7 (8.67-13.4)	12.3 (9.71-16.0)	14.6 (11.0-19.7)	16.2 (11.8-22.8)
60-day	2.35 (2.10-2.67)	3.42 (3.06-3.90)	5.06 (4.52-5.79)	6.53 (5.78-7.54)	8.73 (7.44-10.4)	10.5 (8.79-12.9)	12.5 (10.1-15.7)	14.4 (11.3-18.7)	17.1 (12.9-23.1)	19.1 (13.8-26.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

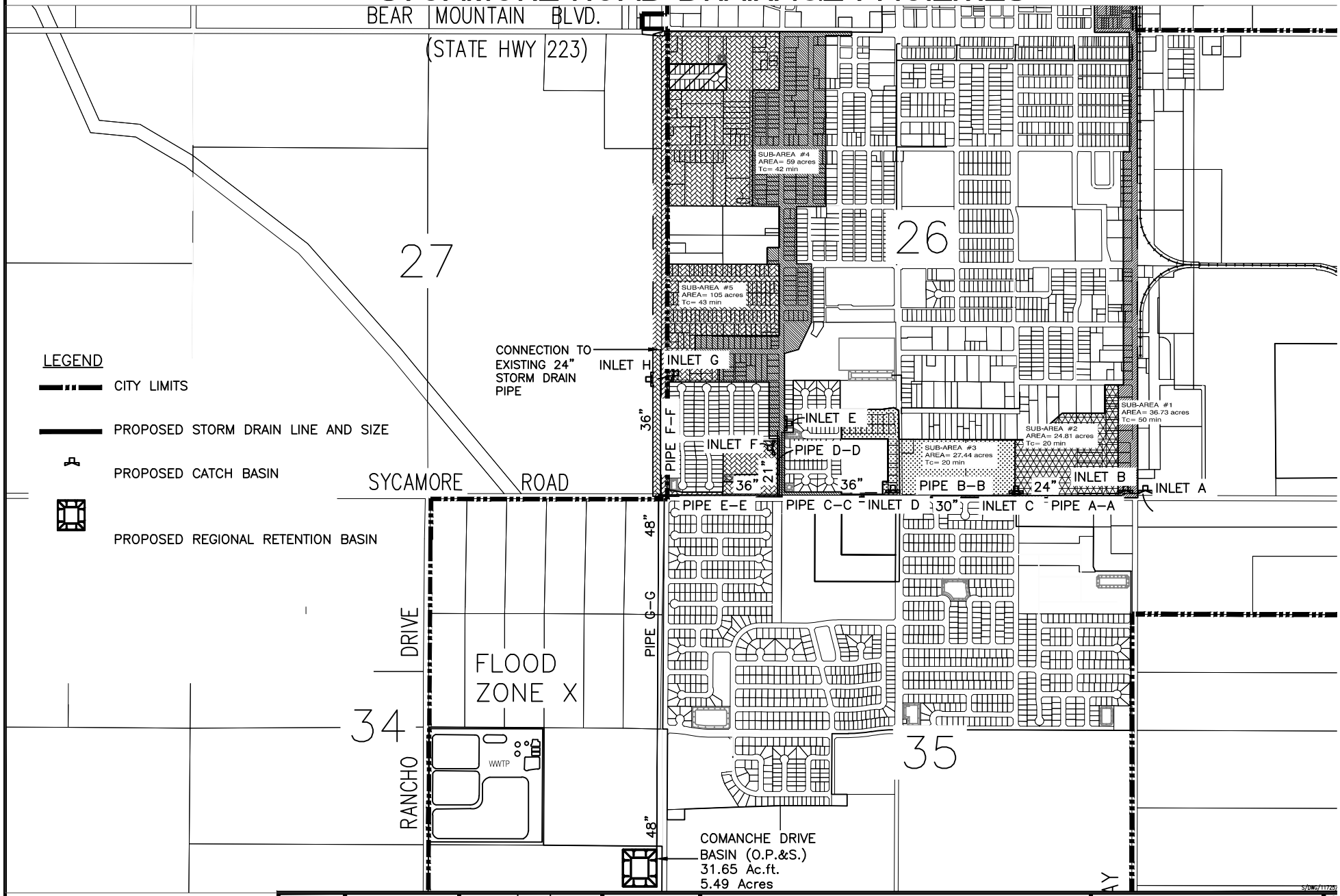
Please refer to NOAA Atlas 14 document for more information.

Back to Top

Appendix 7.5-C
Helt Engineering Storm Drain System Analysis

EXHIBIT "B"

SYCAMORE ROAD DRAINAGE FACILITIES



JOB NO.	DATE: 3-1-2013	REVISIONS	CK'D BY	DATE CK'D
11725	SCALE: AS-NOTED			
	DRAWN BY: SCC			
	CK'D BY:			
	DATE CK'D:			

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CITY OF ARVIN
SYCAMORE ROAD DRAINAGE FACILITIES
INLET & PIPE SCHEMATIC

Preliminary Sycamore Drainage System

Time of Concentration & Peak Flow

Prepared by: SCC
Date prepared: 3-11-2013

HEI Project # 13703

TIME OF CONCENTRATION - SUBBASIN 1

	Zone	% Imperv.	Subarea Flow Length	Channel Flow Length	Change in Elevation	Initial Time of Concentra	Runoff Coefficient	Area	10-yr Intensity	10-yr Runoff	Average Peak Flow	Slope	Streetflow Velocity	Travel Time (min)	Total Time of Concentrati	Recalculated 10-yr intensity	Recalculated Total Flow
			L	L'	ΔH	Tc'	C	A	i	Q	Q	S	V	T_t	Tc'	i	Q
Subarea 1	A	15	806	-	2.5	32	0.13	2.23	0.35	0.10					32.00	0.35	0.10
											0.49	0.0037	2.60	4.13			
Subarea 2	R2	50	812	645	4.2	16.8	0.45	9.09	0.26	1.06					36.13	0.36	1.59
											2.24	0.0077	2.37	6.69			
Subarea 3	C2 + R2	78	848	951	4.8	13.7	0.71	7.83	0.23	1.30					42.82	0.39	3.91
											4.02	0.0045	2.10	7.94			
Subarea 4	R1	40	1000	1000	4.5	19.6	0.37	2.03	0.27	0.20					50.76	0.43	4.59
											4.76	0.0042	2.14	7.79			
Subarea 5	R1	40	1000	1000	4.2	19	0.37	3.38	0.27	0.34					58.55	0.46	5.55
											5.71	0.0030	1.76	9.47			
Subarea 6	R1	40	1000	1000	3	15.4	0.37	3.67	0.25	0.33					68.02	0.50	6.59
											6.97	0.0030	1.75	9.52			
Subarea 7	M2	90	1000	1000	2.9	15.3	0.81	3.83	0.25	0.76					77.54	0.52	8.60
											9.15	0.0045	2.15	7.75			
Subarea 8	M2	90	1000	1000	4.45	14	0.81	5.73	0.24	1.09					85.29	0.55	11.53

TOTAL TIME OF CONCENTRATION FOR SUBBASIN 1 = 85.29 min
SUBBASIN 1 PEAK FLOW = 11.53 cfs

TIME OF CONCENTRATION - SUBBASIN 2

	Zone	% Imperv.	Subarea Flow Length	Channel Flow Length	Change in Elevation	Initial Time of Concentra	Runoff Coefficient	Area	10-yr Intensity	10-yr Runoff	Average Peak Flow	Slope	Streetflow Velocity	Travel Time (min)	Total Time of Concentrati	Recalculated 10-yr intensity	Recalculated Total Flow
			L	L'	ΔH	Tc'	C	A	i	Q	Q	S	V	T_t	Tc'	i	Q
Subarea 1	A1	15	802	-	3	21.5	0.13	4.61	0.28	0.17					21.50	0.28	0.17
											0.87	0.0042	1.50	7.23			
Subarea 2	M2	90	818	651	3	13.5	0.81	7.38	0.23	1.40					28.73	0.33	2.16
											2.98	0.0020	1.45	7.86			
Subarea 3	A1+R4	54	1000	684	3.7	18.2	0.49	12.71	0.26	1.64					36.60	0.37	4.68

TOTAL TIME OF CONCENTRATION FOR SUBBASIN 2 = 36.6 min
SUBBASIN 2 PEAK FLOW = 4.68 cfs

TIME OF CONCENTRATION - SUBBASIN 3

	Zone	% Imperv.	Subarea Flow Length	Channel Flow Length	Change in Elevation	Initial Time of Concentra	Runoff Coefficient	Area	10-yr Intensity	10-yr Runoff	Average Peak Flow	Slope	Streetflow Velocity	Travel Time (min)	Total Time of Concentrati	Recalculated 10-yr intensity	Recalculated Total Flow
			L	L'	ΔH	Tc'	C	A	i	Q	Q	S	V	T_t	Tc'	i	Q
Subarea 1	R1	40	744	-	1.2	21.2	0.37	5.1	0.30	0.56					21.20	0.28	0.53
											2.32	0.0036	1.66	5.82			
Subarea 2	R4 + R1	72	1000	580	4	16	0.64	22.17	0.25	3.58					27.02	0.32	5.11

TOTAL TIME OF CONCENTRATION FOR SUBBASIN 2 = 27 min
SUBBASIN 2 PEAK FLOW = 5.11 cfs

TIME OF CONCENTRATION - SUBBASIN 4

	Zone	% Imperv.	Subarea Flow Length	Channel Flow Length	Change in Elevation	Initial Time of Concentra	Runoff Coefficient	Area	10-yr Intensity	10-yr Runoff	Average Peak Flow	Slope	Streetflow Velocity	Travel Time (min)	Total Time of Concentrati	Recalculated 10-yr intensity	Recalculated Total Flow
			L	L'	ΔH	Tc'	C	A	i	Q	Q	S	V	T_t	Tc'	i	Q
Subarea 1	C2+R4+R1	49	784	-	2.6	18	0.44	8.46	0.26	0.98					18.00	0.26	0.98
											1.92	0.0049	1.89	8.82			
Subarea 2	R1	40	1000	1000	4.5	19.8	0.37	18.57	0.27	1.88					26.82	0.32	3.41
											3.92	0.0054	2.23	7.30			
Subarea 3	R1	40	1000	977	4.8	19.3	0.37	10.26	0.27	1.03					34.12	0.35	5.10
											5.49	0.0053	2.49	6.69			
Subarea 4	R1	40	1000	1000	4.5	19.5	0.37	7.8	0.27	0.78					40.81	0.38	6.65
											7.15	0.0068	2.55	2.13			
Subarea 5	R1	40	1000	326	4.8	19.3	0.37	10.13	0.27	1.01					42.94	0.39	8.29
											8.49	0.0045	2.17	5.72			
Subarea 6	R1	40	745	745	3.2	17.3	0.37	4.13	0.26	0.39					48.67	0.42	9.47

TOTAL TIME OF CONCENTRATION FOR SUBBASIN 4 = **48.67** min

SUBBASIN 4 PEAK FLOW = **9.47 cfs**

TIME OF CONCENTRATION - SUBBASIN 5

	Zone	% Imperv.	Subarea Flow Length	Channel Flow Length	Change in Elevation	Initial Time of Concentra	Runoff Coefficient	Area	10-yr Intensity	10-yr Runoff	Average Peak Flow	Slope	Streetflow Velocity	Travel Time (min)	Total Time of Concentrati	Recalculated 10-yr intensity	Recalculated Total Flow
			L	L'	ΔH	Tc'	C	A	i	Q	Q	S	V	T_t	Tc'	i	Q
Subarea 1	C2 + R4	85	1000	-	2.2	16.5	0.76	9.88	0.25	1.90					16.50	0.25	1.90
											2.35	0.0042	1.89	8.82			
Subarea 2	R3	60	1000	1000	4.2	17.2	0.54	6.52	0.26	0.91					25.32	0.31	3.47
											4.02	0.0020	1.45	4.14			
Subarea 3	R1	40	946	360	3.4	19.8	0.37	10.9	0.27	1.10					29.46	0.33	5.97
											6.33	0.0023	1.52	10.96			
Subarea 4	R1	40	1000	1000	2.3	22.1	0.37	6.71	0.29	0.71					40.42	0.38	9.83
											10.35	0.0032	1.90	8.77			
Subarea 5	R1	40	1000	1000	3.2	20.7	0.37	10.05	0.28	1.04					49.19	0.42	13.97
											14.73	0.0065	2.72	3.71			
Subarea 6	R1	40	736	605	3.9	17.2	0.37	16.03	0.26	1.53					52.90	0.45	18.57

Subareas 7-10 are not part of the longest flow path of the Subbasin. As tributary sub-areas, they contribute flow but are not part of the Total time of concentration calculation.

Times of Concentration for the tributary sub-areas = Time of Concentration of the next adjacent subarea along the longest flow path

Total 10-yr Runoff of tributary sub-areas below are added to the Recalculated Total Flow of the adjacent subbasin above, as part of total time of concentration calculation

	Zone	% Imperv.	Subarea Flow Length	Change in Elevation	Time of Concentration	Runoff Coefficient	Area	10-yr Intensity	Subbasin Outlet
			L	ΔH	Tc'	C	A	i	
Subarea 7	R1	40	742	2.2	18.6	0.37	7.7	0.27	3
Subarea 8	R1 + R3	50	1000	3.1	19.5	0.45	11.72	0.27	4
Subarea 9	R1	40	1000	1.5	24.5	0.37	9.94	0.30	5
Subarea 10	R1	40	923	1.5	23.2	0.37	6.31	0.29	6
Subarea 11	A1	15	905	3.5	22.2	0.13	9.37	0.29	6

TOTAL TIME OF CONCENTRATION FOR SUBBASIN 5 = **52.9** min

SUBBASIN 5 PEAK FLOW = **18.6 cfs**

Methods and Assumptions:

- Zone Designation obtained from Arvin Zone Base Map, dated 5/25/2012
- Subarea Flow Length estimated from Arvin Road Base Map (4/02/2008)
- Channel Flow Length estimated from Arvin Road Base Map (4/02/2008)
- Delta H estimated from USGS quad map for overland flow and from Arvin Master Drainage Map street slopes (1986) for streetflow
- Initial Time of Concentration, Tc', obtained from Figure D-1 of KC Hydrology Manual
  **note: Initial Time of Concentration, Tc', based on Subarea Flow Length L, while Travel Time Tt based on Channel Flow Length, L'
- Runoff coefficient Values, for "A" type soil, obtained from Runoff Coefficient Chart, Hydrology Manual
- Area estimated from Arvin Road Base Map, dated 4/02/2008
- Precipitation Depth: Interpolated from NOAA Precipitation frequency table.
  (NOAA Precipitation frequency table based on frequency analysis of partial duration series (PDS) [Attached])
  Latitude = 35d11'42"
- 10-yr Runoff Q from equation Q = CiA
- Average Peak Flow, Q averaged from sub-area peak flows of upstream & downstream concentration points
  Q_{ave} = average($Q_{recalculated}$, $Q_{recalculated}$+$Q_{10\text{-}yr}$)
- Sub-area slopes estimated from Arvin Master Drainage Map (1986)
- Streetflow Velocity from Figure D-2b & D-2c, Kern County Hydrology Manual
- Travel Time T_t = channel flow length, L' / streetflow velocity, V
- Total Time of Concentration Tc' = Upstream Total Time of Concentration + Sub-area travel time T_t
- Recalculated 10-yr intensity based on Total time of concentration
- Recalculated Total Flow, Q = Σ(CiA)
- For initial sub-areas, had to runoff as sheetflow, negating the accumulation of flow in gutters.

Preliminary Sycamore Drainage System

Pipeline Flow Calculations

Prepared by: SCC
Date prepared: 3-12-2013

HEI Project #: 13703

PIPELINES

Element ID	Inlet / Junction Connections	Pipe Diameter or Height D	Length	Inlet Invert Elevation	Outlet Invert Elevation	Slope s	Manning's Roughness n	Design Flow Capacity Q	Upstream Subbasins	PEAK FLOW 10-yr Q	PEAK FLOW 100-yr Q
		(inches)	(ft)	(ft)	(ft)	(%)		(cfs)		(cfs)	(cfs)
A-A	B <-> C	30	1275	409.01	406.46	0.2000	0.0130	18.34	1	11.53	19.88
B-B	C <-> D	30	1427	406.46	403.61	0.2000	0.0130	18.34	1, 2	16.21	28.15
C-C	D <-> J03	36	1303	403.11	400.50	0.2000	0.0130	29.83	1-3	21.32	38.58
D-D	F <-> J03	24	536	402.57	401.50	0.2000	0.0130	10.12	4	9.47	16.73
E-E	J03 <-> J05	42	1345	400.00	397.31	0.2000	0.0130	45.12	1-4	30.79	55.31
F-F	H <-> J05	36	1353	400.52	397.81	0.2000	0.0130	29.83	5	18.60	32.86
G-G	J05 <-> SUMP	48	3971	396.81	388.87	0.2000	0.0130	64.24	1-5	49.39	88.17

Methods and Assumptions

- Design flow based on Manning's Equation:

$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

- Lengths based on Preliminary Sycamore Drainage Plan
- Sump outlet invert elevation based on Preliminary Sump Calculations
  410.69 (GS elev @ Comanche & Sycamore) - 3980.56' x .004 (length to sump x slope of Comanche Road, from Quad map) - 6' (Sump height, from sump volume calculation sheet) + .10 (Sump Outlet to Pipe G-G AP elevation difference) = 388.87
- Pipe invert elevations calculated from sump outlet invert elevation, pipe lengths, and slope of .2%, matching crown elevations.
  Invert elevations subject to change pending utility crossing elevations.
- mannings roughness = .013 (concrete pipe)
- Ignoring routing time of pipelines

Preliminary Sycamore Drainage System

Subbasin Area Calculations

Prepared by: SCC
Date prepared: 3-12-2013

HEI Project #: 13703

SUBBASINS										
Subbasin ID	**Area**	**Flow Path**	**Average Slope**	**Time of Concentration**	**Percent Impervious Area**	**10-yr Rainfall Intensity**	**100-yr Rainfall Intensity**	**Runoff Coefficient**	**10-yr Runoff Flow**	**100-yr Runoff Flow**
	A (acres)	L (feet)	S	Tc (min)	%	i (inch/hr)	i (inch/hr)	C	Q (cfs)	Q (cfs)
Subbasin-01	36.73	5945	0.0040	85.2900	65	0.55	0.94	0.57	11.53	19.88
Subbasin-02	24.811	1615	0.0037	36.6	45	0.37	0.65	0.52	4.68	8.27
Subbasin-03	27.44	1535	0.0037	27	75	0.28	0.56	0.68	5.11	10.43
Subbasin-04	59	4705.1	0.0045	48.67	50	0.42	0.74	0.38	9.47	16.73
Subbasin-05	105	4560	0.0040	52.9	55	0.44	0.78	0.40	18.60	32.86

Methods and Assumptions:

- Precipitation Depth: Interpolated from NOAA Precipitation frequency table.
  (NOAA Precipitation frequency table based on frequency analysis of partial duration series (PDS) [Attached])
  Latitude = 35d11'42" Longitude = 118d49'28"
- Method used: the Alternative Rational Method from the KC Hydrology Manual
- Time of Concentration: Based on Kirpich's equation:
  Tc = (0.0078 * ((L^0.77) * (S^-0.385)))
- Evaluated the subbasin areas as meeting the assumptions of the Alternative Rational Method with "C" Factor Curves:
  - No off-site undeveloped watershed contributory to the sites
  - Developments were homogenous with regards to soil type
  - Watersheds were less than 640 acres
  - Watersheds were non-homogenous with regards to development; however, the watersheds were sufficiently small, with most of the flow traveling along streets, as to assume homogenous watersheds. Percent impervious calculated as an average over the entire watershed.
- % Impervious area based on Impervious Area Table, KC Hydrology Manual
- Ground elevations based on USGS contour maps/Google Earth/previous projects along Sycamore
- Subbasin areas obtained from Sycamore Road Drainage Schematic Maps
- Flow path lengths estimated from Arvin Base Map

Updated 3/1/2013

CITY OF ARVIN
SYCAMORE DRAINAGE FACILITIES REGIONAL BASIN

Drainage Area # **1** Area (acres) 277 Acres

Area O	102.52
Area P	71.72
Area S	102.76

Year Storm	1-hr Rainfall (in)	24-hr Rainfall (in)
2		1.060
10		1.730
100		2.810

Source NOAA Point Precipitation Frequency Estimates - Lat 35.2091, Long -118.848

Land Use = Various

Impervious Cover = 56% Fig. C-3 Kern Co. Hydrology Manual

yr. Runoff Volume = $0.12(D_{10})(a_i)(\text{Area})$ Kern Co. Development Standards

yr. Runoff Volume = $0.12(D_{100})(a_i)(\text{Area})$

D_{10} = 10 yr 24-hr depth of rainfall (in)

D_{100} = 100 yr 24-hr depth of rainfall (in)

a_i = Average percent of impervious area

Area = Drainage area of total development

10 yr. Runoff Volume = 32.433 acre-ft

100 yr. Runoff Volume = 52.680 acre-ft

Retention Basin Design

Bottom Dimensions Bottom Surface Area = 313600.00 ft^2

Length (ft) = 560

Width (ft) = 560

Height (ft) = 5

Side Slope = 3

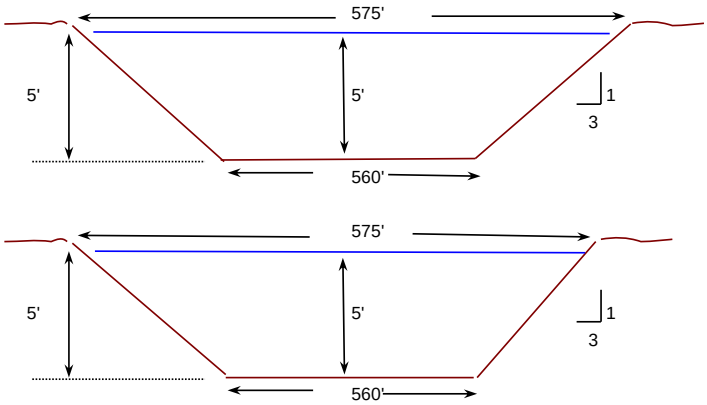
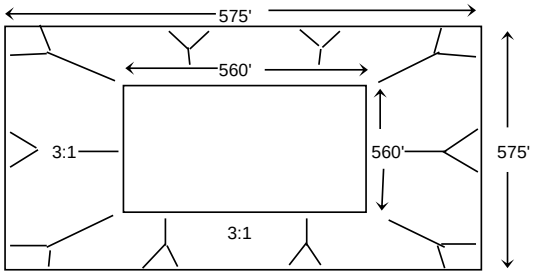
Top Dimensions Top Surface Area = 330625.00 ft^2

Length (ft) = 575

Width (ft) = 575

A1/2ws

Length (ft) = 567.5 Area = 322056.25 ft^2

Width (ft) = 567.5

Volume = 36.97 acre-ft = 1,610,375 ft^3