Data Evaluation Report of Vegetative Buffer Study

PMRA Submission Number {.....} EPA MRID Number 46490302

Test material: Fipronil
IUPAC name: 5-amino-1-(2,6-dichloro-α,α,α-trifluoro-*p*-tolyl)-4-trifluoromethylsulfinylpyrazole-3-carbonitrile
CAS name: 5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-[(trifluoromethyl)sulfinyl]-1*H*-pyrazole-3-carbonitrile

Primary Reviewer: James Hetrick, Ph.D.
EPA
Signature: James G. Hetrick
Date: 4/30/08

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EPA
Signature: Thuy Nguyen
Date: 5/1/08

EPA PC Code: 129121

CITATION: Braun, D. C., J. J. Cappy, and J. W. White. 2004. Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season CHIPCO Choice Treated Turfgrass under Simulated Rainfall. Sponsored by Bayer Crop Science, RTP, NC. Performed by Stone Environmental, Montpelier, VT; White Environmental, Lexington, KY; Bayer CropSciences, RTP,NC ; and AgVise Laboratories, Northward, ND. MRID 46490302.

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EXECUTIVE SUMMARY:

The fipronil buffer effectiveness study (MRID 46490302) provides acceptable data on the impact of a 15 feet grass buffer for controlling runoff of fipronil (Chipco Topchoice®) and its degradation products (MB46136, MB46513, and MB 46950) from small plot runoff studies with cool season grass in Cedar Grove, NC. The study was submitted to fulfill a condition of registration regarding runoff concerns of fipronil residues from broadcast use of fipronil for control of fire ants. The registrant did not provide any concurrent biological monitoring of adjacent aquatic environments to assess the impact of fipronil and its degradation products on aquatic invertebrates.

Paired-runoff plots were constructed to assess the effectiveness of a 15 feet grass buffer in reducing edge-of- field fipronil residue runoff from 60 feet treated test plots in Cedar Grove, NC. Paired treatment plots consisted of a plot with the 15 feet untreated grass buffer at the top of plot (CST) to serve as a control site with no runoff buffer. The other plot (CSB) had the 15 feet untreated grass buffer at the bottom of the plot to serve as a runoff buffer. Chipco® Topchoice™ was applied at a rate of 87 lbs/A (~0.013 lbs ai/A) to each test plot. Rainfall was simulated at an intensity of 1 inch hr^{-1} for two runoff events. Time-paced and flow proportional samples of runoff water were collected at the edge-of-field. Fipronil and its degradation products (MB46136, MB46513, and MB 46950) were analyzed in the runoff samples. The total suspended sediment (TSS) was also measured in runoff samples.

In the CST (control) treatment, the maximum fipronil concentration during for runoff events ranged from 3.056 to 3.088 µg/L in time paced samples and 3.509 to 2.863 µg/L in flow proportional samples. In the CSB (buffer) treatment, the maximum fipronil concentration for two runoff events ranged from 0.975 to 1.451 µg/L in time paced samples and 1.007 to 1.208 µg/L in flow proportional samples.

Based on the average fipronil mass in runoff, the 15 foot grass buffer reduced runoff of fipronil from 62% to 75%.

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: The SETAC-Europe: Procedures for Assessing the Environmental Fate and Ecotoxicity of Pesticides (March 1995; pp. 1, 34) is not applicable.

COMPLIANCE: This study was conducted in compliance with USEPA FIFRA Good Laboratory Practices (40 CFR Part 160), which are consistent with the OECD Principles of GLP (p. 3). Signed and dated GLP, Data Confidentiality, Quality Assurance, and Certificate of Authenticity statements were provided (pp. 2-3, 5-6).

A. MATERIALS:

1. Site Description

The vegetative buffer study was conducted on a commercial sod farm in Cedar Grove, NC **(Figures 2, 3, and 4 pp 85-87)**. The site is characterized as a "moderately sloping field in area used for sod production". The vegetation on the site is predominately tall fescue with some Kentucky bluegrass. The soil series on the site is classified as an Helena sand loam (clayey, mixed, thermic Aquic Hapludalf) with a 6% slope. Soil characteristics of the site are shown in **Table 5 (page 54)** and **Table 7 (page 57).** The soil is classified a Hydrologic Group C soil with slow permeability, low available water holding capacity, and a high shrink-swell capacity. A ring infiltrometer was used to measure the soil infiltration rates prior to irrigation. The soil had infiltration rates ranging from 1.1 to 1.7 cm hr^{-1} **(Table 6, pp 55-56)**.

2. Site Preparation and Maintenance

The test site was planted in tall fescue with some Kentucky bluegrass in March 2001 **(Table 2, pp 51)**. Preparation of the test site required tilling (harrowing, plowing, tine cultivated, raked, and planed) for seed bed preparation. Prior to seeding, the site was treated with fertilizer (16-8-8 @ 500 lbs/A) and chicken manure @ 4 tons/A. The grass was mowed < 4.5 inches. Irrigation was applied at an average rate of 20 inches/year. On March 14th, 2002 the test plot was treated with Cool Power™ (@ 1 qt/A), Endurance® or Barricade® (@ 1 lb/A), and Banvel® (0.5 pints/A).

The test site was irrigated on May 8th prior to the set-up of the rainfall simulator. The turf was mowed to a height of 3.0 inches. The test site was mowed on May 5th, May 11th (3 days before the fipronil application), and May 22nd (8 days post fipronil application). The mowing was conducted using a mulching mower to eliminate removal of fipronil residues.

3. Rainfall Simulator

The rainfall simulator was designed according to Coody and Lawrence (1994). The water source for the rainfall simulator was an irrigation pond near the test plots. The water quality of the pond water is shown in **Tables 4 (pp 53)**. Collection jars were used to gauge rainfall volume and intensity. Rainfall intensity and volume ranged from 0.93 to 1.12 in/hr and 1.52 to 2.18 inches **(Table 10, pp 60)**. Time-dependent flow from the test plots are shown in **Tables 11 to 14 (pp 61 to 72).** Cumulative runoff ranged from 2136 to 2243 liters from the CST test plot (buffer at top of plot) and 1712 to 1800 liters from the CSB test plot (buffer at bottom of plot). Runoff yield, expressed as a percentage of simulated rainfall, was 47 to 55 % for the CST test plot and 38.2 to 51.3% for the CSB test plot **(Table 15, pp 73)**. The mean total suspended sediments (TSS) in the time paced runoff samples ranged from 22 mg/L (Event 1) and 23 mg/L (Event 2) for CST test plots and 77 mg/L (Event 1) and 40 mg/L (Event 2) to for CSB test plots **(Tables 16 and 17, pp 74 and 75).** In flow proportional runoff samples, the

mean TSS was 35 mg/L (Event 1) and 17 mg/L (Event 2) for CST test plots and 61 mg/L (Event 1) and 28 mg/L (Event 2) CSB test plots **(Table 18, pp 76)**.

4. Experimental Design

Two adjacent runoff test plots (12 ft X 75 ft) were oriented parallel to the slope using metal flashing to provide hydrologic separation. Each test plot had an untreated buffer section (12 ft x 15 ft) within the test plot **(Figures 5 and 6, pp 88-89)**. The CST treatment had the untreated buffer section at the top of the plot. The CSB treatment had the untreated buffer section at the bottom of the plot. On May 14 2002, the fipronil treated section in each plot (12 ft X 60 ft) was amended with 87 lbs/A of CHIPCO ® Topchoice™ (115 and 124 mg fipronil/treated section) using a drop seeder applicator **(Table 9, pp 59)**. After the fipronil application, each test plot was irrigated for 15 minutes (~0.25 inches of water) as recommended by the label.

On May 16, 2002 (2 days post application) and May 23, 2002 (9 days post application), the test plots were irrigated at rainfall intensity of 1.0 inch per hour. The rainfall simulations were terminated when a minimum of 10 runoff samples were collected, and a minimum of 0.5 inches (1,062 liters) of runoff had been produced from each test plot. The rainfall intensity was measured using 10 randomly placed catch cups.

At the downhill side boundary of the test plots, a metal flume and gutter system were installed to direct water into a sampling basin. Each metal flume was equipped with a flow meter. Additionally, each flume was equipped with a stilling well to allow accurate measurement of runoff depth. Runoff flow for the flume system was calculated using the flow equation $Q=1.55H^{2.58}$, where Q = flow rate in cubic feet per second and H = head in feet.

Two autosamplers for each test plot were used to collect time-dependent runoff samples for pesticide analysis. One autosampler was calibrated to collect runoff samples at regular time intervals (75 ml every 3 minutes) from a splash pan. Consecutive samples for three sampling times (3, 6, and 9 minutes) were composited from the initial runoff event, mid term runoff events, and the end of the runoff event. The other autosampler was calibrated to collect flow-proportional samples from a 55 gallon drum. One liter samples were collected for each 30 liters of runoff passing through the flume.

The site was instrumented with an electronic weather station. Weather data includes air temperature, soil temperature at 4 inches below-ground surface (BGS), rainfall, wind speed, and solar radiation. Weather data were recorded on 1 minute time intervals and then averaged for hourly and daily time periods **(Table 3, pp 52)**.

5. Analytical

Samples of runoff water were collected and stored for chemical analysis. In time- paced samples, the samples were collected and stored in Teflon capped 350 ml glass vessels. In the flow proportional samples, the runoff water in the stainless steel collection drum was mixed

and then sampled using agitated and submerged 250 ml HDPE bottles. Five replicate samples were taken for residue analysis. Samples were stored in field coolers prior to transfer to the Bayer CropScience for residue analysis. Water quality characterization and TSS analysis were performed by Agvise Laboratories.

Residues of fipronil in runoff water were analyzed using a LC/MS/MS method entitled "Insecticides, Fipronil: Method of Analysis for Possible Residues of Fipronil, MB46513, MB45950, and MB46136 in Water-Revision 2000-4" issued May 21, 2002. This method has method detection limit (MDL) of 0.004 µg/L and limit of quantification (LOQ) of 0.010 µg/L. (Reviewer Note: The method procedure requires filtration through 0.45 or 0.2 µM nylon filtration disk after an acetoanitrile extraction of unfiltered runoff water (Bayer Crop Study 02YV33113, page42). No storage stability study was conducted because samples were analyzed within a month of sampling **(Table 6, pp 169-171).**

Procedural method verification in HPCL water at concentrations of 0.01, 1, and 2 ug/L showed recoveries of 106± 20% for fipronil (n=12), 96± 11% for MB46513 (n=12), 93± 10% for MB45950 (n=12), and 92± 10% for MB46136 (n=12) **(Table 2 pp 165).** Method verification was conducted using irrigation water and HPLC water at the LOQ (0.010 µg/L) and 10X LOQ (0.100 µg/L). Residue recoveries ranged from 60% to 86% **(Table 1, pp 164)**. Field spikes at 0.10 and 2.00 ug/L were prepared by spiking irrigation water with fipronil residues in glass and HDPE containers. The field spike samples were stored in a cooler on blue ice and then stored in a refrigerator at 2-8°C. Recoveries of the field spikes were 94-98% for fipronil, 96%-105% for MB46513, 97 to 104% for MB45950, and 94-102% for MB46136 **(Table 5, page 168)**.

B. REPORTED RESULTS

1. Sediment Concentration and Transport – The maximum sediment concentration in runoff water was 151 mg/L in runoff Event 1 (Event 1) and 80 mg/L in runoff Event 2 (Event 2) were detected in the CSB treatment. **(Table 19, pp** 77). In the CST treatment, the maximum sediment concentration in runoff water was 33 mg/L in Event 1 and 48 mg/L in Event 2. The buffer effectiveness ranged from -147% (Event 1) to -34% (Event 2) for the Time-Paced Method, -41% (Event 1) to -31% (Event 2) for the Flow-Proportional Method, and -80% (Event 1) to -33% (Event 2) for the Method Average. The total suspended sediment accounted for 6.8 kg/ha (Event 1) and 4.7 kg/ha (Event 2) in the CST treatment. In the CSB treatments, the TSS accounted for 12.2 kg/ha (Event 1) and 6.2 kg/ha (Event 2). The registrant believes the estimated buffer effectiveness on reducing sediment loading is not accurate because of the low sediment concentrations from turf runoff plots.

2. Concentration of Fipronil and its Metabolites in Runoff-

In the time-paced samples for Event 1, the maximum fipronil concentration was 3.056 µg/L (mean=2.224 µg/L) 1 in the CST test plot and 0.975 µg/L (mean=0.507 µg/L) in the CSB test plot **(Table 20, pp 78)**. For Event 2, the maximum fipronil concentration was

3.088 µg/L (mean= 2.228 µg/L) for the CST test plot and 1.451 µg/L (mean=0.793 µg/L) for the CSB test plot (**Table 21, pp 79**). In the flow proportional samples for Event 1, the maximum fipronil concentration was 3.509 µg/L in the CST test plot and 1.007 µg/L in the CSB test plot (**Table 22, pp 80**). For Event 2, the maximum fipronil concentration was 2.863 µg/L for the CST test plot and 1.208 µg/L for the CSB test plot (**Table 22, pp 80**). Lower concentrations of total fipronil residues in runoff water were observed for Event 2. The registrant believe that lower total fipronil concentration in Event 2 illustrate the residues became less available for runoff.

Chemographs show that fipronil and total fipronil concentrations in runoff waters from the CST test plot were consistently higher than the CSB test plot (**Figures 12, 13, 14, and 15, pp 95-98**). The chemographs showed different patterns of fipronil residue concentrations in runoff waters. In the CST plots, fipronil concentrations increased immediately after the simulated rainfall (~ 3.00 µg/L @ 40 minutes post rainfall event) and then declined to a plateau concentrations (~ 1.8 to 2.4 µg/L @ 98 to 117 minutes post rainfall event). In contrast, the CSB plots showed fipronil concentrations gradually increasing to a plateau of ~ 0.8 to 1.7 µg/L @ 98 to 117 minutes post rainfall event.

The registrant believes these data show the effectiveness of the 15 feet buffer in reducing fipronil residue runoff.

3. Fipronil Mass Transport

The fipronil mass transport calculations for percent of applied fipronil show the 15 feet buffer lowers the average mass transport of fipronil by 75% for Event 1 and 62% for Event 2 (**Table 23, pp 81**). For total fipronil residues, the 15 feet buffer removed 76% for Event 1 and 63% for Event 2 (**Table 24, pp 82,**).

C. REVIEWER COMMENTS

1. A fixed small plot field study:buffer zone (4.0) ratio was used in the study. Available data suggest the effectiveness of the buffer zone is dependent on numerous factors including runoff flow rate and depth, soil type, antecedent moisture, source area size, rainfall intensity and quantity, etc. (USDA/NRCS, 2000[Ω]). Sediment filter strip design also is dependent on the rainfall amount and intensity. The Universal Soil Loss Equation rainfall-erosivity factor for the Southeastern United States ranges from 250 to 350 (EPA, 1985[ℓ]). Under these conditions, effective sediment trapping in filter strips is expected for source area:filter ratios of < 50 (USDA/NRCS, 2000). This information suggest effective sediment trapping would be expected for the proposed source area: buffer ratio of 4.0. More importantly, the use of a low field area to buffer area ratio may bias the assessment of buffer effectiveness.

[Ω] USDA. 2000.Conservation Buffers to Reduce Pesticide Losses. USDA/NRCS

[ℓ] EPA. 1985 Field Agricultural Runoff Monitoring (FARM) Manual. EPA/600/3-85/043. Athens, GA.

2. The registrant did not attempt to conduct separate analysis the fipronil residues on entrained sediments and dissolved in runoff water. This analysis would be useful in understanding the importance of fipronil sorption on entrained sediments.

3. Fipronil residue concentrations in this study are edge-of-field concentrations in runoff waters from a treated site. They do not account for any off-site attenuation or dilution due to site specific hydrology or topography. The reviewer notes the reported concentrations are expected to be most representative of first-order streams, where water quality characteristics are dominated by runoff.

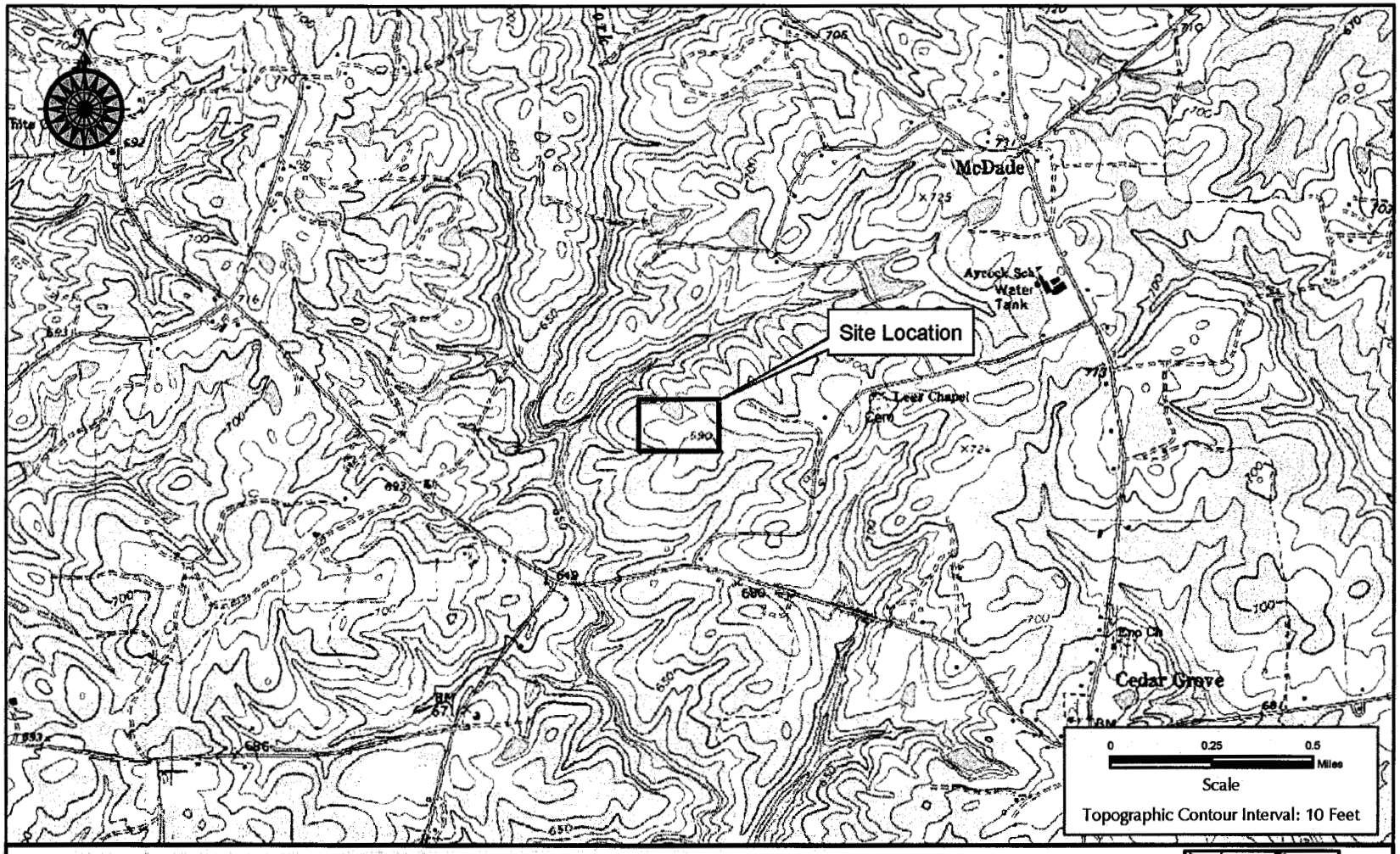

FIGURE 2: SITE LOCATION MAP (ORANGE COUNTY, NORTH CAROLINA)
Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco TopChoice™ Treated Turfgrasses Under Simulated Rainfall

Sources: Topographic Map from USGS 1:24,000 Scale Series, Cedar Grove quad

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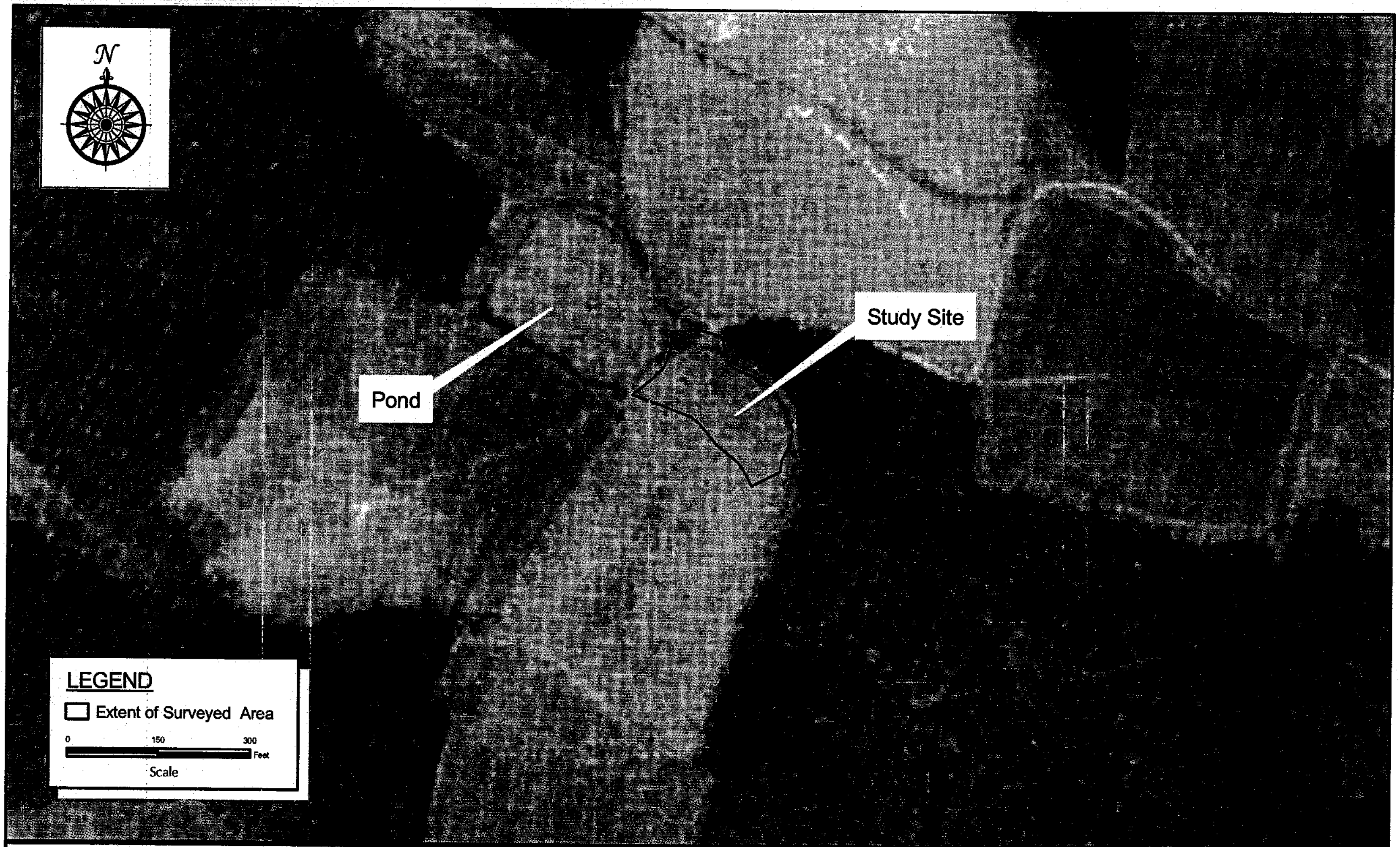

FIGURE 3: STUDY SITE ORTHOPHOTO (ORANGE COUNTY, NORTH CAROLINA)
Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco TopChoice™ Treated Turfgrasses Under Simulated Rainfall

Sources: Orthophoto from www.geocomm.com

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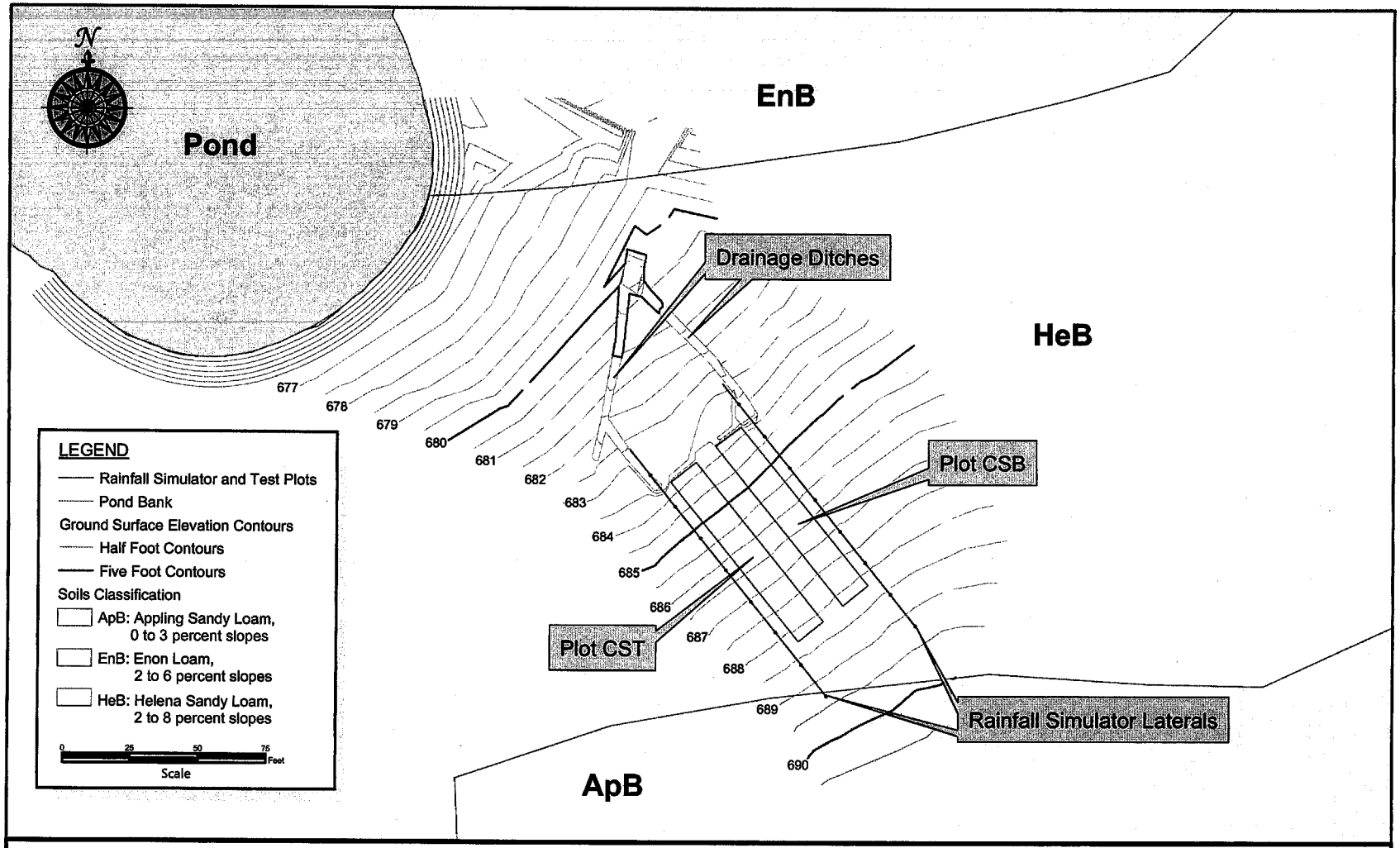

FIGURE 4: SITE TOPOGRAPHY AND SOIL CLASSIFICATION (ORANGE COUNTY, NORTH CAROLINA)
Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco TopChoice™ Treated Turfgrasses Under Simulated Rainfall

Sources: Soils Classification from Natural Resource Conservation Service SSURGO database (May 2000)
Topographic survey from ENT Land Surveys, Inc., Hillsborough, NC (May 2002)
Note: Pond boundary based on site survey.

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TABLE 5
Soil Sample Characterization Data

Depth Interval (in. bgs)	Sample ID	Sand (%)	Silt (%)	Clay (%)	USDA Texture	Bulk Density	CEC (meq/100g)	OM (%)	pH[1]	Ca (ppm)	Mg (ppm)	K (ppm)	Na (ppm)	H (ppm)
0 - 4	33113-S-01-C-0-4	69	22	9	Sandy Loam	1.21	5.6	1.6	6.5	526	75	102	45	18
	33113-S-02-C-0-4	73	18	9	Sandy Loam	1.33	4.3	1.1	6.3	397	47	76	41	15
	33113-S-03-C-0-4	77	16	7	Loamy Sand	1.33	4.9	0.8	6.3	444	50	99	38	18
	33113-S-04-C-0-4	61	20	19	Sandy Loam	1.20	8.2	0.9	6.6	836	142	77	43	25
	Mean	70	19	11		1.27	5.8	1.1	6.4	551	79	89	42	19
	Standard Deviation	7	3	5		0.07	1.7	0.4	0.1	197	44	14	3	4
4 - 12	33113-S-01-C-4-12	67	24	9	Sandy Loam	1.35	5.8	1.0	7.0	571	91	58	56	18
	33113-S-02-C-4-12	59	20	21	Sandy Clay Loam	1.28	6.8	0.9	6.2	658	119	68	48	22
	33113-S-03-C-4-12	59	24	17	Sandy Loam	1.22	7.5	0.8	6.8	711	120	105	45	25
	33113-S-04-C-4-12	57	20	23	Sandy Clay Loam	1.19	9.3	0.7	6.9	1020	213	47	59	20
	Mean	61	22	18		1.26	7.4	0.9	6.7	740	136	70	52	21
	Standard Deviation	4	2	6		0.07	1.5	0.1	0.4	195	53	25	7	3

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Source: Agvise Laboratories Soil Characterization Report, 5/21/02

Note: 1. pH determined with a pH electrode in a 1:1 soil:water suspension (Agvise Laboratories SOP NUT.02.05)

Abbreviations: in. bgs = inches below ground surface; ppm = parts per million; CEC = cation exchange capacity; meq/100g = milliequivalents per 100 g; OM = organic matter

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Date/Initials: 09/03/02 MN; rev. 12/10/03 DCB

TABLE 7
Water Retention of Undisturbed Soil Cores at Five Pressure Heads

Sample Date	Sample ID	Percent Moisture				
		1/10 Bar	1/3 Bar	1 Bar	5 Bar	15 Bar
5/15/2002	33113-S-01-MR	12.40	10.00	7.81	6.08	6.04
	33113-S-02-MR	9.75	7.62	6.13	5.00	4.68
	33113-S-03-MR	9.90	8.30	7.18	6.40	5.07
	33113-S-04-MR	13.80	11.30	9.12	7.90	7.43
	Mean	11.46	9.31	7.56	6.35	5.81
	Standard Deviation	1.98	1.66	1.25	1.20	1.22

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Source: Agvise Laboratories Soil Characterization Report, 7/10/02, 7/19/02, 7/23/02

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Date/Initials: 09/03/02 MN; rev. 12/10/03 DCB

TABLE 6
Soil Infiltration Test Results

INFILTRATION TEST ID: 33113-IT-01

Time (hr:min)	Volume Added (mL)	Cumulative Volume (mL)	Cumulative Depth[1] (cm)	Cumulative Depth[2] (in.)	Elapsed Time (hr:min)
11:30	0	0	0.00	0.00	0:00
11:36	401	401	0.21	0.08	0:06
11:42	331	732	0.39	0.15	0:12
11:48	328	1060	0.57	0.22	0:18
11:54	250	1310	0.70	0.28	0:24
12:00	263	1573	0.84	0.33	0:30
12:06	155	1728	0.93	0.36	0:36
12:12	245	1973	1.06	0.42	0:42
12:18	165	2138	1.14	0.45	0:48
12:24	228	2366	1.27	0.50	0:54
12:30	170	2536	1.36	0.53	1:00
12:36	257	2793	1.50	0.59	1:06
12:42	172	2965	1.59	0.62	1:12
12:48	155	3120	1.67	0.66	1:18
12:54	190	3310	1.77	0.70	1:24
13:00	213	3523	1.89	0.74	1:30

Test Method:	Single Ring Infiltrometer
Ring Diameter (2):	1.63 ft, 1.57 ft
Ring Area ($in.^2$):	289.5
Ring Area (cm^2):	1867.9

INFILTRATION RATE RESULTS

Calculation Method	(cm/hr)	(in./hr)
Arithmetic Method[3]	1.3	0.50
Regression Method[4]	1.1	0.41

Source: SEI Field Data Sheets, 5/20/02

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Notes: 1. Cumulative Depth (cm) = Cumulative Volume (ml)/Ring Infiltrometer Area (cm^2)

2. Cumulative Depth (in.) = Cumulative Depth (cm)/2.54

3. Infiltration Rate = Cumulative Depth/Elapsed Time (min) x 60 (min/hr)

4. Infiltration Rate calculated as the slope of the best fit (sum of least squares) line through the cumulative depth (cm)/elapsed time (min) data, multiplied by 60 min/hr. Due to a slight shift in the rate at approximately 30 minutes, the regression line was fit through the data between elapsed time = 30 minutes and the termination of the test (R^2 = 0.9986). Using only these later data points in the analysis provides an estimate for the infiltration rate after the system has fully equilibrated and the soils are saturated.

Abbreviations: cm/hr = centimeters/hour; in./hr = inches/hour

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Date/Initials: 07/25/02 DCB; rev. 12/10/03 DCB

TABLE 6 (Continued)
Soil Infiltration Test Results

INFILTRATION TEST ID: 33113-IT-02

Time (hr:min)	Volume Added (mL)	Cumulative Volume (mL)	Cumulative Depth[1] (cm)	Cumulative Depth[2] (in.)	Elapsed Time (hr:min)
11:34	0	0	0.00	0.00	0:00
11:40	530	530	0.26	0.10	0:06
11:46	475	1005	0.50	0.20	0:12
11:52	400	1405	0.70	0.28	0:18
11:58	322	1727	0.86	0.34	0:24
12:04	380	2107	1.05	0.41	0:30
12:10	320	2427	1.21	0.48	0:36
12:16	520	2947	1.47	0.58	0:42
12:22	290	3237	1.61	0.63	0:48
12:28	300	3537	1.76	0.69	0:54
12:34	265	3802	1.89	0.74	1:00
12:40	380	4182	2.08	0.82	1:06
12:46	190	4372	2.17	0.86	1:12
12:52	235	4607	2.29	0.90	1:18
12:58	245	4852	2.41	0.95	1:24
13:04	235	5087	2.53	1.00	1:30

Test Method:	Single Ring Infiltrometer
Ring Diameter (2):	1.73 ft, 1.59 ft
Ring Area (in.^{2}):	311.6
Ring Area (cm^2):	2010.6

INFILTRATION RATE RESULTS

Calculation Method	(cm/hr)	(in./hr)
Arithmetic Method[3]	1.7	0.66
Regression Method[4]	1.3	0.53

Source: SEI Field Data Sheets, 5/20/02

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Notes: 1. Cumulative Depth (cm) = Cumulative Volume (ml)/Ring Infiltrometer Area (cm^2)

2. Cumulative Depth (in.) = Cumulative Depth (cm)/2.54

3. Infiltration Rate = Cumulative Depth/Elapsed Time (min) x 60 (min/hr)

4. Infiltration Rate calculated as the slope of the best fit (sum of least squares) line through the cumulative depth (cm)/elapsed time (min) data, multiplied by 60 min/hr. Due to a slight shift in the rate at approximately 42 minutes, the regression line was fit through the data between elapsed time = 42 minutes and the termination of the test (R^2 = 0.9953). Using only these later data points in the analysis provides an estimate for the infiltration rate after the system has fully equilibrated and the soils are saturated.

Abbreviations: cm/hr = centimeters/hour; in./hr = inches/hour

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Date/Initials: 07/25/02 DCB; *rev.* 12/10/03 DCB

TABLE 2
Agronomic History of Study Site

ctivity	Description
Planting and Harvest	The turf crop at the test site was planted in March 2001; it was approximately 14 months old at the start of the experiment. The previous crop was planted in March 2000 and harvested in November-December 2000. For several years, the field including the test site had been managed on a different schedule than the other sod fields on the farm, which are typically seeded in fall and harvested the following spring.
Turf Variety	A Rebel II blend had been used throughout the farm for 3-4 years at a rate of 200 lb/acre. The blend consists of: 30% Rebel II tall fescue, 30% Rebel 3D tall fescue, 30% Rebel 2000 tall fescue, and 10% Kentucky bluegrass.
Field Cultivation	To prepare the seed bed, the field is harrowed using a disc harrow, plowed with a 3-4 tine bottom plow, cultivated with a spring tine cultivator, raked with a rock rake and picker, and planed with a land plane. A Cultipack Seeder is used to plant the field. Plastic netting (Conwed Sod Net) is applied to the entire seeded area. Prior to harvest, a turf roller is used to smooth the sod. The turf roller has an 8 ft wide roller and weighs approximately 5,000 pounds. The test site sod was last rolled in February 2002. At harvest, sod is cut into small rolls 16 inches wide.
Irrigation	A 'lateral wheel line' or 'side roll' irrigation system is used. Irrigation is applied as needed to maintain turf quality. Irrigation rate averages approximately 20 inches/year, but the amount is highly variable.
Mowing	Grass is typically kept mowed below 4.5 inches. The mowing decks on the tractors are set at 3 inches.
Fertilizer Application	Prior to seeding, 16-8-8 fertilizer is applied at 500 lb/A and chicken litter is applied at 4 tons/A. Chelated iron and straight nitrogen are applied as needed on the standing crop.
Pesticide Application	All chemical applications occur in the spring. On March 14, 2002 the following products were applied: 1. Cool Power™ at 1 qt/acre for broadleaf weed control 2. Endurance® or Barricade® at 1 lb/acre for pre-emergent control of crabgrass 3. Banvel® at 1/2 pint/acre for broadleaf weed control This same application regime was used between 1999-2001, except no Barricade® was applied and 1 qt/acre MSMA was applied.

STONE ENVIRONMENTAL, INC.

Source: Interview with James Horner, farm manager, May 23, 2002; SEI field data sheets, May, 2002

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\SiteCharacterization.xls~AgHistory

Date/Initials: 09/05/022 MN; rev. 9/27/02 DCB; rev. 12/10/03 DCB

TABLE 4
Characterization of Simulator Source Water

Sample ID	Temperature (°C)	pH	Conductivity (mmhos/cm)	Sodium (ppm)	Calcium (ppm)	Magnesium (ppm)	Hardness[1] (ppm)	SAR	TDS (ppm)	Turbidity (NTU)	TSS (ppm)
Sampling Conducted Immediately Prior to Simulated Rainfall Runoff Event 1, May 16, 2002											
33113-SW-01-C[2]	na	na	na	na	na	na	na	na	na	na	5
33113-SW-02-C[2]	na	na	na	na	na	na	na	na	na	na	4
33113-SW-03-C[2]	na	na	na	na	na	na	na	na	na	na	4
Sample Mean											4
Field Measurement[3]	20.5	8.88	0.0983								
Sampling Conducted Immediately Prior to Simulated Rainfall Runoff Event 2, May 23, 2002											
33113-SW-04-C	na	8.6	0.17	6	7	4	36	0.41	40	1.80	na
33113-SW-05-C	na	7.5	0.13	6	7	4	35	0.42	24	2.08	na
33113-SW-06-C	na	7.6	0.12	6	7	4	35	0.42	32	2.02	na
Sample Mean		7.9	0.14	6	7	4	35	0.42	32	1.97	
Field Measurement[3]	18.6	9.17	0.0985								

STONE ENVIRONMENTAL, INC.

Source: SEI field data, 5/16/02 and 5/23/02; Agvise Laboratories Water Characterization Report, 6/6/02

Notes: 1. Hardness expressed as milligram equivalent $CaCO_3/L$

2. Samples intended for Series 3 Water Characterization analysis, but inadvertently analyzed for Total Suspended Solids, which consumed the samples

3. Field measurements recorded on 5/16/02 and 5/23/02 immediately prior to sample collection

Abbreviations: na = not analyzed; mmhos/cm = millimhos per centimeter; ppm = parts per million; ; SAR = Sodium Absorption Ratio; TDS = Total Dissolved Solids; NTU = nephelometric turbidity units; TSS = Total Suspended Solids

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\SiteCharacterization.xls~Simulator WaterChar

Date/Initials: 9/30/02 DCB; rev. 12/10/03 DCB; rev. 2/5/04 DCB

TABLE 10
Rainfall Simulator Performance

	Event 1 (May 16, 2002)		Event 2 (May 23, 2002)	
	Plot CSB	Plot CST	Plot CSB	Plot CST
Number of Collection Jars (n)	10	10	10	10
Mean Volume (mL)	184	213	261	265
Standard Deviation (mL)	26	31	30	24
Coefficient of Variation (percent)	14	14	12	9
Coefficient of Uniformity (CU) [1]	88	88	90	93
Simulator Start Time (hr:min:sec)	11:51:15	11:51:15	10:55:40	10:55:40
Simulator End Time (hr:min:sec)	13:29:07	13:29:07	12:52:30	12:52:30
Simulated Rainfall Duration (min)	97.87	97.87	116.83	116.83
Rainfall Delivery (cm) [2]	3.85	4.46	5.46	5.54
Rainfall Delivery (in.) [3]	1.52	1.76	2.15	2.18
Rainfall Intensity (in./hr) [4]	0.93	1.08	1.10	1.12
Total Simulated Rainfall Input (L) [5]	3,219	3,730	4,565	4,628
Percent of 1.0 in./hr Target [6]	93	108	110	112

Source: Stone Environmental field data sheets 5/16/02 and 5/23/02

STONE ENVIRONMENTAL, INC.

Notes: Diameter of collection jar opening = 7.8 cm; Radius = 3.9 cm

1. CU = 100 (1-D/M), where D = $(1/n)\Sigma|Xi-M|$, and M= $(1/n)\Sigma Xi$
2. Rainfall Delivery (cm) = Mean Volume (mL)/pi(3.9 cm)^2
3. Rainfall Delivery (in.) = Rainfall Delivery (cm)/(2.54 cm/in.)
4. Rainfall Intensity (in./hr) = Rainfall Delivery (in.)*(60 min/hr)/Event Duration (min)
5. Total Input = Delivery (in.)/12)*(plot length--75 ft)(plot width--12 ft)*(7.48052 gal/ft^3)(3.785 L/gal)
6. Percent of Target = Rainfall Intensity (in./hr)/(1.0 in./hr)*100, where 1.0 in./hr is the target rainfall input

Path: O:\Proj-02\1281-F-FipRO\Report_36528\Tables\Simulator Performance.xls

int: 9/9/02 MN; rev. 12/10/03 DCB

TABLE 11
Runoff Flow from Plot CST (Top Buffer) on Event 1, May 16, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
12:06	15	0	0 017	0 031	1 86	1 33	0 00	
12:07	16	1	0 019	0 036	2 16	1 55	2 16	
12:08	17	2	0 022	0 050	3 00	2 15	5 16	
12:09	18	3	0 024	0 064	3 84	2 76	9 00	
12:10	19	4	0 025	0 071	4 26	3 06	13 26	
12:11	20	5	0 028	0 089	5 34	3 83	18 60	
12:12	21	6	0 029	0 099	5 94	4 26	24 54	24 54
12:13	22	7	0 030	0 109	6 54	4 69	31 08	
12:14	23	8	0 031	0 120	7 20	5 17	38 28	
12:15	24	9	0 032	0 128	7 68	5 51	45 96	
12:16	25	10	0 034	0 149	8 94	6 42	54 90	
12:17	26	11	0 034	0 157	9 42	6 76	64 32	
12:18	27	12	0 036	0 170	10 20	7 32	74 52	
12:19	28	13	0 037	0 193	11 58	8 31	86 10	
12:20	29	14	0 039	0 215	12 90	9 26	99 00	
12:21	30	15	0 040	0 231	13 86	9 95	112 86	88 32
12:22	31	16	0 042	0 266	15 96	11 45	128 82	
12:23	32	17	0 043	0 278	16 68	11 97	145 50	
12:24	33	18	0 043	0 288	17 28	12 40	162 78	
12:25	34	19	0 045	0 315	18 90	13 56	181 68	
12:26	35	20	0 045	0 320	19 20	13 78	200 88	
12:27	36	21	0 046	0 337	20 22	14 51	221 10	
12:28	37	22	0 047	0 349	20 94	15 03	242 04	
12:29	38	23	0 047	0 353	21 18	15 20	263 22	
12:30	39	24	0 047	0 362	21 72	15 59	284 94	172 08
12:31	40	25	0 047	0 362	21 72	15 59	306 66	
12:32	41	26	0 047	0 358	21 48	15 41	328 14	
12:33	42	27	0 048	0 370	22 20	15 93	350 34	
12:34	43	28	0 048	0 381	22 86	16 40	373 20	
12:35	44	29	0 049	0 397	23 82	17 09	397 02	
12:36	45	30	0 049	0 393	23 58	16 92	420 60	
12:37	46	31	0 050	0 412	24 72	17 74	445 32	
12:38	47	32	0 050	0 421	25 26	18 13	470 58	
12:39	48	33	0 051	0 432	25 92	18 60	496 50	211 56
12:40	49	34	0 051	0 432	25 92	18 60	522 42	
12:41	50	35	0 051	0 427	25 62	18 38	548 04	
12:42	51	36	0 051	0 432	25 92	18 60	573 96	
12:43	52	37	0 051	0 432	25 92	18 60	599 88	
12:44	53	38	0 051	0 436	26 16	18 77	626 04	
12:45	54	39	0 051	0 445	26 70	19 16	652 74	
12:46	55	40	0 052	0 452	27 12	19 46	679 86	
12:47	56	41	0 052	0 470	28 20	20 24	708 06	
12:48	57	42	0 052	0 461	27 66	19 85	735 72	239 22
12:49	58	43	0 052	0 470	28 20	20 24	763 92	
12:50	59	44	0 053	0 482	28 92	20 75	792 84	
12:51	60	45	0 052	0 466	27 96	20 06	820 80	
12:52	61	46	0 053	0 477	28 62	20 54	849 42	
12:53	62	47	0 053	0 477	28 62	20 54	878 04	
12:54	63	48	0 052	0 466	27 96	20 06	906 00	
12:55	64	49	0 053	0 482	28 92	20 75	934 92	

TABLE 11 (Continued)
Runoff Flow from Plot CST (Top Buffer) on Event 1, May 16, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
12:56	65	50	0 052	0 470	28 20	20 24	963 12	
12:57	66	51	0 053	0 477	28 62	20 54	991 74	256 02
12:58	67	52	0 052	0 466	27 96	20 06	1019 70	
12:59	68	53	0 052	0 470	28 20	20 24	1047 90	
13:00	69	54	0 053	0 477	28 62	20 54	1076 52	
13:01	70	55	0 052	0 466	27 96	20 06	1104 48	
13:02	71	56	0 053	0 482	28 92	20 75	1133 40	
13:03	72	57	0 053	0 482	28 92	20 75	1162 32	
13:04	73	58	0 053	0 482	28 92	20 75	1191 24	
13:05	74	59	0 053	0 482	28 92	20 75	1220 16	
13:06	75	60	0 053	0 482	28 92	20 75	1249 08	257 34
13:07	76	61	0 053	0 487	29 22	20 97	1278 30	
13:08	77	62	0 053	0 477	28 62	20 54	1306 92	
13:09	78	63	0 053	0 482	28 92	20 75	1335 84	
13:10	79	64	0 054	0 504	30 24	21 70	1366 08	
13:11	80	65	0 054	0 508	30 48	21 87	1396 56	
13:12	81	66	0 054	0 496	29 76	21 36	1426 32	
13:13	82	67	0 054	0 496	29 76	21 36	1456 08	
13:14	83	68	0 054	0 508	30 48	21 87	1486 56	
13:15	84	69	0 054	0 513	30 78	22 09	1517 34	268 26
13:16	85	70	0 054	0 504	30 24	21 70	1547 58	
13:17	86	71	0 055	0 528	31 68	22 73	1579 26	
13:18	87	72	0 054	0 513	30 78	22 09	1610 04	
13:19	88	73	0 055	0 523	31 38	22 52	1641 42	
13:20	89	74	0 054	0 518	31 08	22 30	1672 50	
13:21	90	75	0 055	0 523	31 38	22 52	1703 88	
13:22	91	76	0 054	0 518	31 08	22 30	1734 96	
13:23	92	77	0 055	0 523	31 38	22 52	1766 34	
13:24	93	78	0 055	0 541	32 46	23 29	1798 80	281 46
13:25	94	79	0 055	0 536	32 16	23 08	1830 96	
13:26	95	80	0 055	0 523	31 38	22 52	1862 34	
13:27	96	81	0 055	0 528	31 68	22 73	1894 02	
13:28	97	82	0 054	0 518	31 08	22 30	1925 10	
13:29	98	83	0 052	0 450	27 00	19 38	1952 10	
13:30	99	84	0 049	0 393	23 58	16 92	1975 68	
13:31	100	85	0 046	0 337	20 22	14 51	1995 90	
13:32	101	86	0 044	0 297	17 82	12 79	2013 72	
13:33	102	87	0 041	0 252	15 12	10 85	2028 84	230 04
13:34	103	88	0 039	0 215	12 90	9 26	2041 74	
13:35	104	89	0 037	0 190	11 40	8 18	2053 14	
13:36	105	90	0 035	0 168	10 08	7 23	2063 22	34 38
13:37	106	91	0 033	0 137	8 22	5 90	2071 44	
13:38	107	92	0 031	0 123	7 38	5 30	2078 82	
13:39	108	93	0 030	0 107	6 42	4 61	2085 24	
13:40	109	94	0 029	0 097	5 82	4 18	2091 06	
13:41	110	95	0 026	0 079	4 74	3 40	2095 80	
13:42	111	96	0 025	0 070	4 20	3 01	2100 00	
13:43	112	97	0 024	0 064	3 84	2 76	2103 84	
13:44	113	98	0 023	0 058	3 48	2 50	2107 32	
13:45	114	99	0 022	0 050	3 00	2 15	2110 32	

TABLE 11 (Continued)
Runoff Flow from Plot CST (Top Buffer) on Event 1, May 16, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
13:46	115	100	0 021	0 046	2 76	1 98	2113 08	
13:47	116	101	0 020	0 042	2 52	1 81	2115 60	
13:48	117	102	0 019	0 039	2 34	1 68	2117 94	
13:49	118	103	0 019	0 037	2 22	1 59	2120 16	
13:50	119	104	0 018	0 033	1 98	1 42	2122 14	
13:51	120	105	0 017	0 030	1 80	1 29	2123 94	
13:52	121	106	0 016	0 029	1 74	1 25	2125 68	
13:53	122	107	0 015	0 027	1 62	1 16	2127 30	
13:54	123	108	0 015	0 026	1 56	1 12	2128 86	
13:55	124	109	0 014	0 025	1 50	1 08	2130 36	
13:56	125	110	0 013	0 023	1 38	0 99	2131 74	
13:57	126	111	0 013	0 023	1 38	0 99	2133 12	
13:58	127	112	0 012	0 022	1 32	0 95	2134 44	
13:59	128	113	0 012	0 022	1 32	0 95	2135 76	
14:00	129	114	0 011	0 020	1 20	0 86	2136 96	
14:01	130	115	0 011	0 000	0 00	0 00	2136 96	
14:02	131	116	0 010	0 000	0 00	0 00	2136 96	
14:03	132	117	0 010	0 000	0 00	0 00	2136 96	
14:04	133	118	0 010	0 000	0 00	0 00	2136 96	
14:05	134	119	0 009	0 000	0 00	0 00	2136 96	
14:06	135	120	0 009	0 000	0 00	0 00	2136 96	
14:07	136	121	0 009	0 000	0 00	0 00	2136 96	
14:08	137	122	0 008	0 000	0 00	0 00	2136 96	
14:09	138	123	0 008	0 000	0 00	0 00	2136 96	
14:10	139	124	0 007	0 000	0 00	0 00	2136 96	
14:11	140	125	0 007	0 000	0 00	0 00	2136 96	

Source: Automated flow data collection with ISCO 3230 flowmeter

STONE ENVIRONMENTAL, INC.

Notes: 1. Clock time recorded in flow meter memory during runoff event

2. Elapsed Time since start of simulated rainfall event

3. Elapsed Time since first observation of runoff from plot

4. Flume Depth (m) recorded in flow meter memory during runoff event

5. Flow Rate (L/sec) calculated using Isco's Flowlink ver. 3.22 software

6. Flow Rate (L/min) calculated as: Flow Rate (L/sec) x 60 sec/min

7. Flow Rate (mm/hr) calculated as: (Flow Rate (L/min) x 60 min/hr x 1000 ml/L x cm^3/ml x 10 mm/cm) /(900 ft^2 x (30.48 cm/ft)^2)

8. Cumulative Runoff Flow (L) = previous minutes cumulative flow (L) + current flow rate (L/min). The flow total was reset to zero at the start of the first minute of runoff

9. Sample Interval runoff flow (L) =current cumulative flow (L) - cumulative flow of previous sample (L)

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_RunoffData.xls~CST_E1

int: 9/30/02 MN; rev. 12/10/03 DCB

TABLE 12
Runoff Flow from Plot CSB (Bottom Buffer) on Event 1, May 16, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
12:11	20	0	0 015	0 026	1 56	1.12	0.00	
12:12	21	1	0 015	0 026	1 56	1.12	1.56	
12:13	22	2	0 016	0 028	1 68	1.21	3.24	
12:14	23	3	0 016	0 029	1 74	1.25	4.98	
12:15	24	4	0 017	0 032	1 92	1.38	6.90	
12:16	25	5	0 018	0 033	1 98	1.42	8.88	
12:17	26	6	0 019	0 036	2 16	1.55	11.04	11 04
12:18	27	7	0 019	0 039	2 34	1.68	13.38	
12:19	28	8	0 019	0 038	2 28	1.64	15.66	
12:20	29	9	0 020	0 043	2 58	1.85	18.24	
12:21	30	10	0 021	0 045	2 70	1.94	20.94	
12:22	31	11	0 022	0 051	3 06	2.20	24.00	
12:23	32	12	0 022	0 053	3 18	2.28	27.18	
12:24	33	13	0 024	0 063	3 78	2.71	30.96	
12:25	34	14	0 026	0 079	4 74	3.40	35.70	
12:26	35	15	0 033	0 139	8 34	5.98	44.04	33 00
12:27	36	16	0 040	0 231	13 86	9.95	57.90	
12:28	37	17	0 042	0 266	15 96	11.45	73.86	
12:29	38	18	0 044	0 297	17 82	12.79	91.68	
12:30	39	19	0 044	0 304	18 24	13.09	109.92	
12:31	40	20	0 045	0 307	18 42	13.22	128.34	
12:32	41	21	0 044	0 304	18 24	13.09	146.58	
12:33	42	22	0 046	0 341	20 46	14.68	167.04	
12:34	43	23	0 045	0 307	18 42	13.22	185.46	
12:35	44	24	0 046	0 331	19 86	14.25	205.32	161 28
12:36	45	25	0 046	0 328	19 68	14.12	225.00	
12:37	46	26	0 045	0 324	19 44	13.95	244.44	
12:38	47	27	0 046	0 328	19 68	14.12	264.12	
12:39	48	28	0 046	0 341	20 46	14.68	284.58	
12:40	49	29	0 046	0 341	20 46	14.68	305.04	
12:41	50	30	0 047	0 345	20 70	14.85	325.74	
12:42	51	31	0 047	0 349	20 94	15.03	346.68	
12:43	52	32	0 047	0 349	20 94	15.03	367.62	
12:44	53	33	0 047	0 356	21 36	15.33	388.98	183 66
12:45	54	34	0 047	0 356	21 36	15.33	410.34	
12:46	55	35	0 047	0 362	21 72	15.59	432.06	
12:47	56	36	0 047	0 362	21 72	15.59	453.78	
12:48	57	37	0 047	0 362	21 72	15.59	475.50	
12:49	58	38	0 048	0 366	21 96	15.76	497.46	
12:50	59	39	0 049	0 397	23 82	17.09	521.28	
12:51	60	40	0 049	0 397	23 82	17.09	545.10	
12:52	61	41	0 050	0 412	24 72	17.74	569.82	
12:53	62	42	0 050	0 408	24 48	17.57	594.30	205 32
12:54	63	43	0 050	0 412	24 72	17.74	619.02	
12:55	64	44	0 050	0 408	24 48	17.57	643.50	
12:56	65	45	0 049	0 404	24 24	17.39	667.74	
12:57	66	46	0 051	0 427	25 62	18.38	693.36	
12:58	67	47	0 049	0 397	23 82	17.09	717.18	

TABLE 12 (Continued)
Runoff Flow from Plot CSB (Bottom Buffer) on Event 1, May 16, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
12:59	68	48	0 050	0 408	24 48	17.57	741.66	
13:00	69	49	0 050	0 408	24 48	17.57	766.14	
13:01	70	50	0 050	0 421	25 26	18.13	791.40	
13:02	71	51	0 050	0 421	25 26	18.13	816.66	222 36
13:03	72	52	0 050	0 412	24 72	17.74	841.38	
13:04	73	53	0 050	0 421	25 26	18.13	866.64	
13:05	74	54	0 051	0 436	26 16	18.77	892.80	
13:06	75	55	0 051	0 436	26 16	18.77	918.96	
13:07	76	56	0 051	0 436	26 16	18.77	945.12	
13:08	77	57	0 051	0 436	26 16	18.77	971.28	
13:09	78	58	0 051	0 441	26 46	18.99	997.74	
13:10	79	59	0 051	0 436	26 16	18.77	1023.90	
13:11	80	60	0 051	0 436	26 16	18.77	1050.06	233 40
13:12	81	61	0 051	0 441	26 46	18.99	1076.52	
13:13	82	62	0 052	0 452	27 12	19.46	1103.64	
13:14	83	63	0 052	0 452	27 12	19.46	1130.76	
13:15	84	64	0 052	0 450	27 00	19.38	1157.76	
13:16	85	65	0 052	0 461	27 66	19.85	1185.42	
13:17	86	66	0 052	0 450	27 00	19.38	1212.42	
13:18	87	67	0 052	0 456	27 36	19.63	1239.78	
13:19	88	68	0 052	0 456	27 36	19.63	1267.14	
13:20	89	69	0 052	0 470	28 20	20.24	1295.34	245 28
13:21	90	70	0 052	0 466	27 96	20.06	1323.30	
13:22	91	71	0 052	0 466	27 96	20.06	1351.26	
13:23	92	72	0 053	0 487	29 22	20.97	1380.48	
13:24	93	73	0 053	0 475	28 50	20.45	1408.98	
13:25	94	74	0 052	0 466	27 96	20.06	1436.94	
13:26	95	75	0 053	0 475	28 50	20.45	1465.44	
13:27	96	76	0 053	0 482	28 92	20.75	1494.36	
13:28	97	77	0 050	0 412	24 72	17.74	1519.08	
13:29	98	78	0 047	0 358	21 48	15.41	1540.56	245 22
13:30	99	79	0 045	0 317	19 02	13.65	1559.58	
13:31	100	80	0 044	0 295	17 70	12.70	1577.28	
13:32	101	81	0 041	0 245	14 70	10.55	1591.98	
13:33	102	82	0 039	0 221	13 26	9.52	1605.24	
13:34	103	83	0 038	0 197	11 82	8.48	1617.06	
13:35	104	84	0 035	0 168	10 08	7.23	1627.14	
13:36	105	85	0 034	0 147	8 82	6.33	1635.96	
13:37	106	86	0 032	0 128	7 68	5.51	1643.64	
13:38	107	87	0 031	0 115	6 90	4.95	1650.54	109 98
13:39	108	88	0 029	0 100	6 00	4.31	1656.54	
13:40	109	89	0 028	0 091	5 46	3.92	1662.00	
13:41	110	90	0 026	0 080	4 80	3.44	1666.80	
13:42	111	91	0 025	0 071	4 26	3.06	1671.06	
13:43	112	92	0 025	0 069	4 14	2.97	1675.20	
13:44	113	93	0 023	0 058	3 48	2.50	1678.68	
13:45	114	94	0 023	0 054	3 24	2.33	1681.92	
13:46	115	95	0 022	0 053	3 18	2.28	1685.10	

TABLE 12 (Continued)
Runoff Flow from Plot CSB (Bottom Buffer) on Event 1, May 16, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
13:47	116	96	0 021	0 046	2 76	1.98	1687.86	
13:48	117	97	0 021	0 046	2 76	1.98	1690.62	
13:49	118	98	0 020	0 041	2 46	1.77	1693.08	
13:50	119	99	0 017	0 032	1 92	1.38	1695.00	
13:51	120	100	0 017	0 030	1 80	1.29	1696.80	
13:52	121	101	0 016	0 029	1 74	1.25	1698.54	
13:53	122	102	0 015	0 027	1 62	1.16	1700.16	
13:54	123	103	0 015	0 026	1 56	1.12	1701.72	
13:55	124	104	0 014	0 025	1 50	1.08	1703.22	
13:56	125	105	0 014	0 024	1 44	1.03	1704.66	
13:57	126	106	0 013	0 023	1 38	0.99	1706.04	
13:58	127	107	0 012	0 023	1 38	0.99	1707.42	
13:59	128	108	0 012	0 022	1 32	0.95	1708.74	
14:00	129	109	0 012	0 022	1 32	0.95	1710.06	
14:01	130	110	0 011	0 022	1 32	0.95	1711.38	
14:02	131	111	0 011	0 022	1 32	0.95	1712.70	
14:03	132	112	0 010	0 000	0 00	0.00	1712.70	
14:04	133	113	0 010	0 000	0 00	0.00	1712.70	
14:05	134	114	0 009	0 000	0 00	0.00	1712.70	
14:06	135	115	0 008	0 000	0 00	0.00	1712.70	
14:07	136	116	0 008	0 000	0 00	0.00	1712.70	
14:08	137	117	0 007	0 000	0 00	0.00	1712.70	
14:09	138	118	0 007	0 000	0 00	0.00	1712.70	
14:10	139	119	0 007	0 000	0 00	0.00	1712.70	
14:11	140	120	0 007	0 000	0 00	0.00	1712.70	

Source: Automated flow data collection with ISCO 3230 flowmeter STONE ENVIRONMENTAL, INC.

Notes: 1. Clock time recorded in flow meter memory during runoff event

2. Elapsed Time since start of simulated rainfall event

3. Elapsed Time since first observation of runoff from plot

4. Flume Depth (m) recorded in flow meter memory during runoff event

5. Flow Rate (L/sec) calculated using Isco's Flowlink ver. 3.22 software

6. Flow Rate (L/min) calculated as: Flow Rate (L/sec) x 60 sec/min

7. Flow Rate (mm/hr) calculated as: (Flow Rate (L/min) x 60 min/hr x 1000 ml/L x cm^3/ml x 10 mm/cm) /(900 ft^2 x (30.48 cm/ft)^2)

8. Cumulative Runoff Flow (L) = previous minutes cumulative flow (L) + current flow rate (L/min). The flow total was reset to zero at the start of the first minute of runoff

9. Sample Interval runoff flow (L) =current cumulative flow (L) - cumulative flow of previous sample (L)

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_RunoffData.xls~CSB_E1

int: 9/30/002 MN; rev. 12/10/03 DCB

TABLE 13
Runoff Flow from Plot CST (Top Buffer) on Event 2, May 23, 2002

Time[1] (24 hour)	Elapsed Time: Simulated Rainfall[2] (minutes)	Elapsed Time: Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Runoff Flow: Rate[5] (L/sec)	Runoff Flow: Rate[6] (L/min)	Runoff Flow: Rate[7] (mm/hr)	Runoff Flow: Cumulative[8] (L)	Runoff Flow: Sample Interval[9] (L)
11:20	25	0	0 013	0 023	1 38	0.99	0.00	
11:21	26	1	0 015	0 026	1 56	1.12	1.56	
11:22	27	2	0 017	0 032	1 92	1.38	3.48	
11:23	28	3	0 020	0 040	2 40	1.72	5.88	
11:24	29	4	0 020	0 043	2 58	1.85	8.46	
11:25	30	5	0 022	0 051	3 06	2.20	11.52	
11:26	31	6	0 024	0 061	3 66	2.63	15.18	15 18
11:27	32	7	0 025	0 068	4 08	2.93	19.26	
11:28	33	8	0 025	0 066	3 96	2.84	23.22	
11:29	34	9	0 025	0 071	4 26	3.06	27.48	
11:30	35	10	0 027	0 086	5 16	3.70	32.64	
11:31	36	11	0 028	0 096	5 76	4.13	38.40	
11:32	37	12	0 028	0 096	5 76	4.13	44.16	
11:33	38	13	0 029	0 098	5 88	4.22	50.04	
11:34	39	14	0 030	0 113	6 78	4.87	56.82	
11:35	40	15	0 031	0 123	7 38	5.30	64.20	49 02
11:36	41	16	0 033	0 137	8 22	5.90	72.42	
11:37	42	17	0 034	0 157	9 42	6.76	81.84	
11:38	43	18	0 036	0 182	10 92	7.84	92.76	
11:39	44	19	0 038	0 202	12 12	8.70	104.88	
11:40	45	20	0 039	0 215	12 90	9.26	117.78	
11:41	46	21	0 041	0 245	14 70	10.55	132.48	
11:42	47	22	0 042	0 260	15 60	11.19	148.08	
11:43	48	23	0 042	0 266	15 96	11.45	164.04	
11:44	49	24	0 043	0 285	17 10	12.27	181.14	116 94
11:45	50	25	0 044	0 300	18 00	12.92	199.14	
11:46	51	26	0 044	0 304	18 24	13.09	217.38	
11:47	52	27	0 045	0 317	19 02	13.65	236.40	
11:48	53	28	0 046	0 337	20 22	14.51	256.62	
11:49	54	29	0 046	0 335	20 10	14.42	276.72	
11:50	55	30	0 047	0 349	20 94	15.03	297.66	
11:51	56	31	0 047	0 353	21 18	15.20	318.84	
11:52	57	32	0 047	0 358	21 48	15.41	340.32	
11:53	58	33	0 048	0 366	21 96	15.76	362.28	181 14
11:54	59	34	0 048	0 379	22 74	16.32	385.02	
11:55	60	35	0 048	0 381	22 86	16.40	407.88	
11:56	61	36	0 049	0 401	24 06	17.27	431.94	
11:57	62	37	0 049	0 401	24 06	17.27	456.00	
11:58	63	38	0 049	0 404	24 24	17.39	480.24	
11:59	64	39	0 050	0 408	24 48	17.57	504.72	
12:00	65	40	0 049	0 397	23 82	17.09	528.54	
12:01	66	41	0 049	0 404	24 24	17.39	552.78	
12:02	67	42	0 050	0 416	24 96	17.91	577.74	215 46
12:03	68	43	0 050	0 425	25 50	18.30	603.24	
12:04	69	44	0 050	0 416	24 96	17.91	628.20	
12:05	70	45	0 050	0 416	24 96	17.91	653.16	
12:06	71	46	0 051	0 432	25 92	18.60	679.08	
12:07	72	47	0 050	0 425	25 50	18.30	704.58	

TABLE 13 (Continued)
Runoff Flow from Plot CST (Top Buffer) on Event 2, May 23, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
12:08	73	48	0 051	0 436	26 16	18.77	730.74	
12:09	74	49	0 052	0 450	27 00	19.38	757.74	
12:10	75	50	0 052	0 450	27 00	19.38	784.74	
12:11	76	51	0 052	0 452	27 12	19.46	811.86	234 12
12:12	77	52	0 052	0 452	27 12	19.46	838.98	
12:13	78	53	0 052	0 452	27 12	19.46	866.10	
12:14	79	54	0 051	0 445	26 70	19.16	892.80	
12:15	80	55	0 052	0 461	27 66	19.85	920.46	
12:16	81	56	0 052	0 466	27 96	20.06	948.42	
12:17	82	57	0 053	0 477	28 62	20.54	977.04	
12:18	83	58	0 052	0 470	28 20	20.24	1005.24	
12:19	84	59	0 053	0 487	29 22	20.97	1034.46	
12:20	85	60	0 053	0 492	29 52	21.18	1063.98	252 12
12:21	86	61	0 054	0 496	29 76	21.36	1093.74	
12:22	87	62	0 054	0 496	29 76	21.36	1123.50	
12:23	88	63	0 054	0 496	29 76	21.36	1153.26	
12:24	89	64	0 053	0 487	29 22	20.97	1182.48	
12:25	90	65	0 053	0 482	28 92	20.75	1211.40	
12:26	91	66	0 053	0 487	29 22	20.97	1240.62	
12:27	92	67	0 053	0 487	29 22	20.97	1269.84	
12:28	93	68	0 054	0 508	30 48	21.87	1300.32	
12:29	94	69	0 054	0 513	30 78	22.09	1331.10	267 12
12:30	95	70	0 054	0 504	30 24	21.70	1361.34	
12:31	96	71	0 054	0 504	30 24	21.70	1391.58	
12:32	97	72	0 054	0 504	30 24	21.70	1421.82	
12:33	98	73	0 054	0 496	29 76	21.36	1451.58	
12:34	99	74	0 053	0 487	29 22	20.97	1480.80	
12:35	100	75	0 054	0 501	30 06	21.57	1510.86	
12:36	101	76	0 054	0 508	30 48	21.87	1541.34	
12:37	102	77	0 054	0 518	31 08	22.30	1572.42	
12:38	103	78	0 055	0 528	31 68	22.73	1604.10	273 00
12:39	104	79	0 055	0 531	31 86	22.86	1635.96	
12:40	105	80	0 055	0 541	32 46	23.29	1668.42	
12:41	106	81	0 055	0 536	32 16	23.08	1700.58	
12:42	107	82	0 055	0 536	32 16	23.08	1732.74	
12:43	108	83	0 055	0 536	32 16	23.08	1764.90	
12:44	109	84	0 056	0 546	32 76	23.51	1797.66	
12:45	110	85	0 056	0 551	33 06	23.72	1830.72	
12:46	111	86	0 056	0 556	33 36	23.94	1864.08	
12:47	112	87	0 056	0 556	33 36	23.94	1897.44	293 34
12:48	113	88	0 056	0 551	33 06	23.72	1930.50	
12:49	114	89	0 056	0 551	33 06	23.72	1963.56	
12:50	115	90	0 056	0 546	32 76	23.51	1996.32	
12:51	116	91	0 055	0 536	32 16	23.08	2028.48	
12:52	117	92	0 053	0 487	29 22	20.97	2057.70	
12:53	118	93	0 050	0 408	24 48	17.57	2082.18	
12:54	119	94	0 047	0 353	21 18	15.20	2103.36	
12:55	120	95	0 045	0 307	18 42	13.22	2121.78	

TABLE 13 (Continued)
Runoff Flow from Plot CST (Top Buffer) on Event 2, May 23, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
12:56	121	96	0 042	0 266	15 96	11.45	2137.74	240 30
12:57	122	97	0 040	0 231	13 86	9.95	2151.60	
12:58	123	98	0 038	0 202	12 12	8.70	2163.72	
12:59	124	99	0 036	0 175	10 50	7.53	2174.22	36 48
13:00	125	100	0 034	0 157	9 42	6.76	2183 64	
13:01	126	101	0 032	0 134	8 04	5.77	2191 68	
13:02	127	102	0 031	0 118	7 08	5.08	2198 76	
13:03	128	103	0 029	0 103	6 18	4.43	2204 94	
13:04	129	104	0 028	0 091	5 46	3.92	2210 40	
13:05	130	105	0 027	0 084	5 04	3.62	2215 44	
13:06	131	106	0 026	0 073	4 38	3.14	2219 82	
13:07	132	107	0 025	0 069	4 14	2.97	2223 96	
13:08	133	108	0 023	0 057	3 42	2.45	2227 38	
13:09	134	109	0 022	0 050	3 00	2.15	2230 38	
13:10	135	110	0 021	0 046	2 76	1.98	2233 14	
13:11	136	111	0 020	0 042	2 52	1.81	2235 66	
13:12	137	112	0 019	0 038	2 28	1.64	2237 94	
13:13	138	113	0 018	0 035	2 10	1.51	2240 04	
13:14	139	114	0 017	0 032	1 92	1.38	2241 96	
13:15	140	115	0 017	0 030	1 80	1.29	2243 76	

Source: Automated flow data collection with ISCO 3230 flowmeter STONE ENVIRONMENTAL, INC.

Notes: 1. Clock time recorded in flow meter memory during runoff event

2. Elapsed Time since start of simulated rainfall event

3. Elapsed Time since first observation of runoff from plot

4. Flume Depth (m) recorded in flow meter memory during runoff event

5. Flow Rate (L/sec) calculated using Isco's Flowlink ver. 3.22 software

6. Flow Rate (L/min) calculated as: Flow Rate (L/sec) x 60 sec/min

7. Flow Rate (mm/hr) calculated as: (Flow Rate (L/min) x 60 min/hr x 1000 ml/L x cm^3/ml x 10 mm/cm) /(900 ft^2 x (30.48 cm/ft)^2;

8. Cumulative Runoff Flow (L) = previous minutes cumulative flow (L) + current flow rate (L/min). The flow total was reset to zero at the start of the first minute of runoff

9. Sample Interval runoff flow (L) =current cumulative flow (L) - cumulative flow of previous sample (L)

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_RunoffData.xls~CST_E2

int: 9/30/02 MN; rev. 12/10/03 DCB

TABLE 14
Runoff Flow from Plot CSB (Bottom Buffer) on Event 2, May 23, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
11:25	30	0	0 007	0 000	0 00	0.00	0.00	
11:26	31	1	0 006	0 000	0 00	0.00	0.00	
11:27	32	2	0 006	0 000	0 00	0.00	0.00	
11:28	33	3	0 007	0 000	0 00	0.00	0.00	
11:29	34	4	0 008	0 000	0 00	0.00	0.00	
11:30	35	5	0 010	0 000	0 00	0.00	0.00	
11:31	36	6	0 012	0 022	1 32	0.95	1.32	1 32
11:32	37	7	0 013	0 024	1 44	1.03	2.76	
11:33	38	8	0 014	0 025	1 50	1.08	4.26	
11:34	39	9	0 015	0 026	1 56	1.12	5.82	
11:35	40	10	0 016	0 029	1 74	1.25	7.56	
11:36	41	11	0 018	0 033	1 98	1.42	9.54	
11:37	42	12	0 018	0 035	2 10	1.51	11.64	
11:38	43	13	0 018	0 033	1 98	1.42	13.62	
11:39	44	14	0 017	0 031	1 86	1.33	15.48	
11:40	45	15	0 018	0 033	1 98	1.42	17.46	16 14
11:41	46	16	0 018	0 033	1 98	1.42	19.44	
11:42	47	17	0 018	0 035	2 10	1.51	21.54	
11:43	48	18	0 020	0 040	2 40	1.72	23.94	
11:44	49	19	0 028	0 094	5 64	4.05	29.58	
11:45	50	20	0 033	0 137	8 22	5.90	37.80	
11:46	51	21	0 035	0 162	9 72	6.98	47.52	
11:47	52	22	0 037	0 194	11 64	8.35	59.16	
11:48	53	23	0 039	0 221	13 26	9.52	72.42	
11:49	54	24	0 040	0 228	13 68	9.82	86.10	68 64
11:50	55	25	0 041	0 240	14 40	10.33	100.50	
11:51	56	26	0 041	0 242	14 52	10.42	115.02	
11:52	57	27	0 041	0 242	14 52	10.42	129.54	
11:53	58	28	0 041	0 248	14 88	10.68	144.42	
11:54	59	29	0 043	0 278	16 68	11.97	161.10	
11:55	60	30	0 044	0 292	17 52	12.57	178.62	
11:56	61	31	0 044	0 297	17 82	12.79	196.44	
11:57	62	32	0 044	0 304	18 24	13.09	214.68	
11:58	63	33	0 045	0 311	18 66	13.39	233.34	147 24
11:59	64	34	0 045	0 317	19 02	13.65	252.36	
12:00	65	35	0 045	0 320	19 20	13.78	271.56	
12:01	66	36	0 045	0 320	19 20	13.78	290.76	
12:02	67	37	0 046	0 328	19 68	14.12	310.44	
12:03	68	38	0 046	0 341	20 46	14.68	330.90	
12:04	69	39	0 046	0 337	20 22	14.51	351.12	
12:05	70	40	0 047	0 349	20 94	15.03	372.06	
12:06	71	41	0 047	0 353	21 18	15.20	393.24	
12:07	72	42	0 047	0 353	21 18	15.20	414.42	181 08
12:08	73	43	0 047	0 358	21 48	15.41	435.90	
12:09	74	44	0 049	0 389	23 34	16.75	459.24	
12:10	75	45	0 049	0 389	23 34	16.75	482.58	
12:11	76	46	0 049	0 389	23 34	16.75	505.92	
12:12	77	47	0 049	0 401	24 06	17.27	529.98	

TABLE 14 (Continued)
Runoff Flow from Plot CSB (Bottom Buffer) on Event 2, May 23, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
12:13	78	48	0 049	0 389	23 34	16.75	553.32	
12:14	79	49	0 049	0 401	24 06	17.27	577.38	
12:15	80	50	0 049	0 393	23 58	16.92	600.96	
12:16	81	51	0 050	0 416	24 96	17.91	625.92	211 50
12:17	82	52	0 049	0 404	24 24	17.39	650.16	
12:18	83	53	0 050	0 412	24 72	17.74	674.88	
12:19	84	54	0 051	0 427	25 62	18.38	700.50	
12:20	85	55	0 050	0 421	25 26	18.13	725.76	
12:21	86	56	0 051	0 432	25 92	18.60	751.68	
12:22	87	57	0 050	0 416	24 96	17.91	776.64	
12:23	88	58	0 050	0 421	25 26	18.13	801.90	
12:24	89	59	0 051	0 436	26 16	18.77	828.06	
12:25	90	60	0 051	0 445	26 70	19.16	854.76	228 84
12:26	91	61	0 052	0 452	27 12	19.46	881.88	
12:27	92	62	0 052	0 466	27 96	20.06	909.84	
12:28	93	63	0 053	0 477	28 62	20.54	938.46	
12:29	94	64	0 052	0 461	27 66	19.85	966.12	
12:30	95	65	0 052	0 452	27 12	19.46	993.24	
12:31	96	66	0 052	0 466	27 96	20.06	1021.20	
12:32	97	67	0 052	0 470	28 20	20.24	1049.40	
12:33	98	68	0 052	0 466	27 96	20.06	1077.36	
12:34	99	69	0 052	0 470	28 20	20.24	1105.56	250 80
12:35	100	70	0 053	0 477	28 62	20.54	1134.18	
12:36	101	71	0 053	0 482	28 92	20.75	1163.10	
12:37	102	72	0 053	0 487	29 22	20.97	1192.32	
12:38	103	73	0 053	0 492	29 52	21.18	1221.84	
12:39	104	74	0 053	0 487	29 22	20.97	1251.06	
12:40	105	75	0 054	0 496	29 76	21.36	1280.82	
12:41	106	76	0 053	0 482	28 92	20.75	1309.74	
12:42	107	77	0 053	0 482	28 92	20.75	1338.66	
12:43	108	78	0 053	0 487	29 22	20.97	1367.88	262 32
12:44	109	79	0 054	0 496	29 76	21.36	1397.64	
12:45	110	80	0 054	0 496	29 76	21.36	1427.40	
12:46	111	81	0 054	0 496	29 76	21.36	1457.16	
12:47	112	82	0 054	0 496	29 76	21.36	1486.92	
12:48	113	83	0 054	0 504	30 24	21.70	1517.16	
12:49	114	84	0 053	0 487	29 22	20.97	1546.38	
12:50	115	85	0 054	0 496	29 76	21.36	1576.14	
12:51	116	86	0 051	0 445	26 70	19.16	1602.84	
12:52	117	87	0 049	0 389	23 34	16.75	1626.18	258 30
12:53	118	88	0 047	0 345	20 70	14.85	1646.88	
12:54	119	89	0 044	0 292	17 52	12.57	1664.40	
12:55	120	90	0 042	0 263	15 78	11.32	1680.18	
12:56	121	91	0 040	0 231	13 86	9.95	1694.04	
12:57	122	92	0 038	0 202	12 12	8.70	1706.16	
12:58	123	93	0 036	0 182	10 92	7.84	1717.08	
12:59	124	94	0 035	0 162	9 72	6.98	1726.80	
13:00	125	95	0 034	0 149	8 94	6.42	1735.74	

TABLE 14 (Continued)
Runoff Flow from Plot CSB (Bottom Buffer) on Event 2, May 23, 2002

	Elapsed Time			Runoff Flow				
Time[1] (24 hour)	Simulated Rainfall[2] (minutes)	Runoff Duration[3] (minutes)	Flume Depth[4] (m)	Rate[5] (L/sec)	Rate[6] (L/min)	Rate[7] (mm/hr)	Cumulative[8] (L)	Sample Interval[9] (L)
13:01	126	96	0 032	0 130	7 80	5.60	1743.54	117 36
13:02	127	97	0 031	0 123	7 38	5.30	1750 92	
13:03	128	98	0 030	0 107	6 42	4.61	1757 34	
13:04	129	99	0 029	0 097	5 82	4.18	1763 16	
13:05	130	100	0 027	0 088	5 28	3.79	1768 44	
13:06	131	101	0 027	0 081	4 86	3.49	1773 30	
13:07	132	102	0 026	0 075	4 50	3.23	1777 80	
13:08	133	103	0 025	0 069	4 14	2.97	1781 94	
13:09	134	104	0 023	0 057	3 42	2.45	1785 36	
13:10	135	105	0 022	0 051	3 06	2.20	1788 42	
13:11	136	106	0 021	0 046	2 76	1.98	1791 18	
13:12	137	107	0 020	0 043	2 58	1.85	1793 76	
13:13	138	108	0 020	0 041	2 46	1.77	1796 22	
13:14	139	109	0 019	0 038	2 28	1.64	1798 50	
13:15	140	110	0 019	0 036	2 16	1.55	1800 66	

Source: Automated flow data collection with ISCO 3230 flowmeter

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Notes: 1. Clock time recorded in flow meter memory during runoff event

2. Elapsed Time since start of simulated rainfall event

3. Elapsed Time since first observation of runoff from plot

4. Flume Depth (m) recorded in flow meter memory during runoff event

5. Flow Rate (L/sec) calculated using Isco's Flowlink ver. 3.22 software

6. Flow Rate (L/min) calculated as: Flow Rate (L/sec) x 60 sec/min

7. Flow Rate (mm/hr) calculated as: (Flow Rate (L/min) x 60 min/hr x 1000 ml/L x cm^3/ml x 10 mm/cm) /(900 ft^2 x (30.48 cm/ft)^2)

8. Cumulative Runoff Flow (L) = previous minutes cumulative flow (L) + current flow rate (L/min). The flow total was reset to zero at the start of the first minute of runoff

9. Sample Interval runoff flow (L) =current cumulative flow (L) - cumulative flow of previous sample (L)

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_RunoffData.xls~CSB_E2

int: 9/30/02 MN; rev. 12/10/03 DCB

TABLE 15
Rainfall Input and Runoff Yield

Simulated Rainfall Event	Plot	Buffer Position	Rainfall Intensity (in./hr)	Total Simulated Rainfall Input (in.)	Total Simulated Rainfall Input (L)	Total Runoff Volume (L)	Runoff Yield[1] (%)
Event 1, May 16, 2002							
	CST	Top	1.08	1.76	3,730	2,063	55.3
	CSB	Bottom	0.93	1.52	3,219	1,651	51.3
	Percent difference between top buffer and bottom buffer plots[2]			14%	14%	20%	7%
Event 2, May 23, 2002							
	CST	Top	1.12	2.18	4,628	2,174	47.0
	CSB	Bottom	1.10	2.15	4,565	1,744	38.2
	Percent difference between top buffer and bottom buffer plots[2]			1%	1%	20%	19%

Sources: SEI field data sheets and ISCO 3230 flowmeter data, 5/16/02 and 5/23/02

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Notes: 1. Runoff yield (%) calculated as: 100 x total runoff volume (L)/total simulated rainfall input (L)

2. Percent difference calculated as: 100 x (Plot CST Value - Plot CSB Value)/Plot CST Value

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_Runoff Data~RunoffYield

int: 10/21/02 DCB; rev. 12/10/03 DCB

TABLE 16
Total Suspended Solids in Time-Paced Runoff Samples, Event 1

Plot ID	Sample ID	Runoff Duration[1] (minutes)	Interval Flow[2] (L)	TSS[3] (ppm)
CST (Top Buffer)				
	33113-CST-TP-01-S	6	24 54	24
	33113-CST-TP-02-S	15	88 32	33
	33113-CST-TP-03-S	24	172 08	28
	33113-CST-TP-04-S	33	211 56	24
	33113-CST-TP-05-S	42	239 22	22
	33113-CST-TP-06-S	51	256 02	26
	33113-CST-TP-07-S	60	257 34	13
	33113-CST-TP-08-S	69	268 26	14
	33113-CST-TP-09-S	78	281 46	12
	33113-CST-TP-10-S	87	230 04	25
	33113-CST-TP-11-S	90	34 38	18
	max			33
	mean			22
CSB (Bottom Buffer)				
	33113-CSB-TP-01-S	6	11 04	127
	33113-CSB-TP-02-S	15	33 00	151
	33113-CSB-TP-03-S	24	161 28	69
	33113-CSB-TP-04-S	33	183 66	68
	33113-CSB-TP-05-S	42	205 32	61
	33113-CSB-TP-06-S	51	222 36	59
	33113-CSB-TP-07-S	60	233 40	57
	33113-CSB-TP-08-S	69	245 28	62
	33113-CSB-TP-09-S	78	245 22	54
	33113-CSB-TP-10-S	87	109 98	61
	max			151
	mean			77

Source: Agvise Laboratories Analytical Reports, 6/6/02 STONE ENVIRONMENTAL,

Notes: 1. Elapsed time since first observation of runoff from plot

2. Interval runoff flow (L) =current cumulative flow (L) - cumulative flow (L) of previous sample

3. TSS = Total Suspended Solids (parts per million)

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_Runoff Data~TP TSS_E1

int: 9/10/02 MN; rev. 12/10/03 DCB; rev. 2/5/04 DCB

TABLE 17
Total Suspended Solids in Time-Paced Runoff Samples, Event 2

Plot ID	Sample ID	Runoff Duration[1] (minutes)	Interval Flow[2] (L)	TSS[3] (ppm)
CST (Top Buffer)				
	33113-CST-TP-12-S	6	15 18	48
	33113-CST-TP-13-S	15	49 02	28
	33113-CST-TP-14-S	24	116 94	25
	33113-CST-TP-15-S	33	181 14	21
	33113-CST-TP-16-S	42	215 46	19
	33113-CST-TP-17-S	51	234 12	21
	33113-CST-TP-18-S	60	252 12	18
	33113-CST-TP-19-S	69	267 12	19
	33113-CST-TP-20-S	78	273 00	15
	33113-CST-TP-21-S	87	293 34	17
	33113-CST-TP-22-S	96	240 30	19
	max			48
	mean			23
CSB (Bottom Buffer)				
	33113-CSB-TP-11-S	6	1 32	80
	33113-CSB-TP-12-S	15	16 14	64
	33113-CSB-TP-13-S	24	68 64	41
	33113-CSB-TP-14-S	33	147 24	40
	33113-CSB-TP-15-S	42	181 08	33
	33113-CSB-TP-16-S	51	211 50	36
	33113-CSB-TP-17-S	60	228 84	31
	33113-CSB-TP-18-S	69	250 80	29
	33113-CSB-TP-19-S	78	262 32	29
	33113-CSB-TP-20-S	87	258 30	23
	33113-CSB-TP-21-S	96	117 36	32
	max			80
	mean			40

Source: Agvise Laboratories Analytical Reports, 6/20/02 STONE ENVIRONMENTAL,

Notes: 1. Elapsed time since first observation of runoff from plot

2. Interval runoff flow (L) =current cumulative flow (L) - cumulative flow (L) of previous sample

3. TSS = Total Suspended Solids (parts per million)

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_Runoff Data~TP TSS_E2

int: 9/10/02 MN; rev. 12/10/03 DCB; rev. 2/5/04 DCB

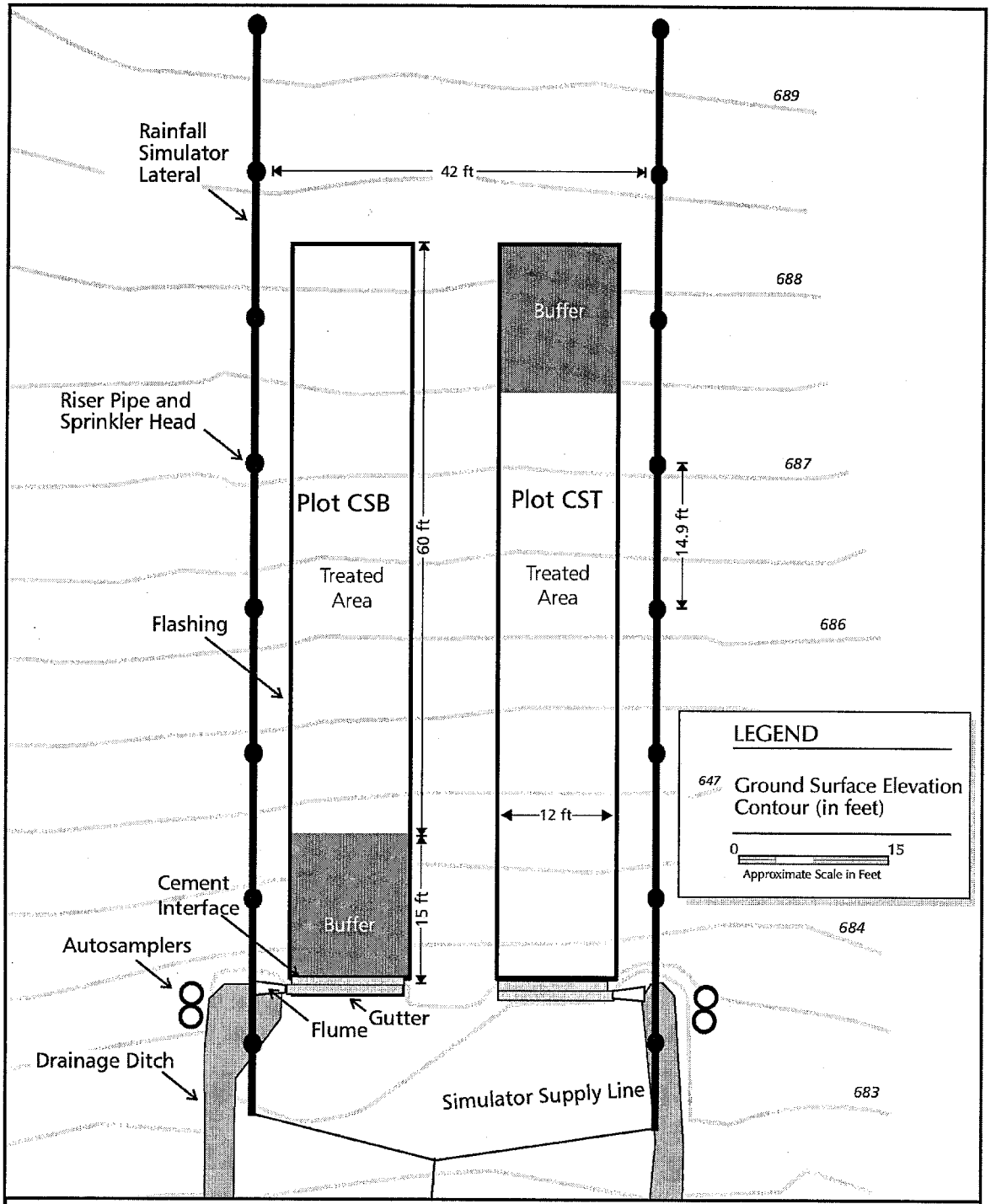

FIGURE 5: STUDY SITE PLAN
Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco Topchoice™ Treated Turfgrasses Under Simulated Rainfall
Cedar Grove, North Carolina

Source: SEI Field Notes
o:\proj-02\1281-F-FIPRO\33113\figures\33113siteplan.cdr
int: 09-12-02 jms

STONE ENVIRONMENTAL INC

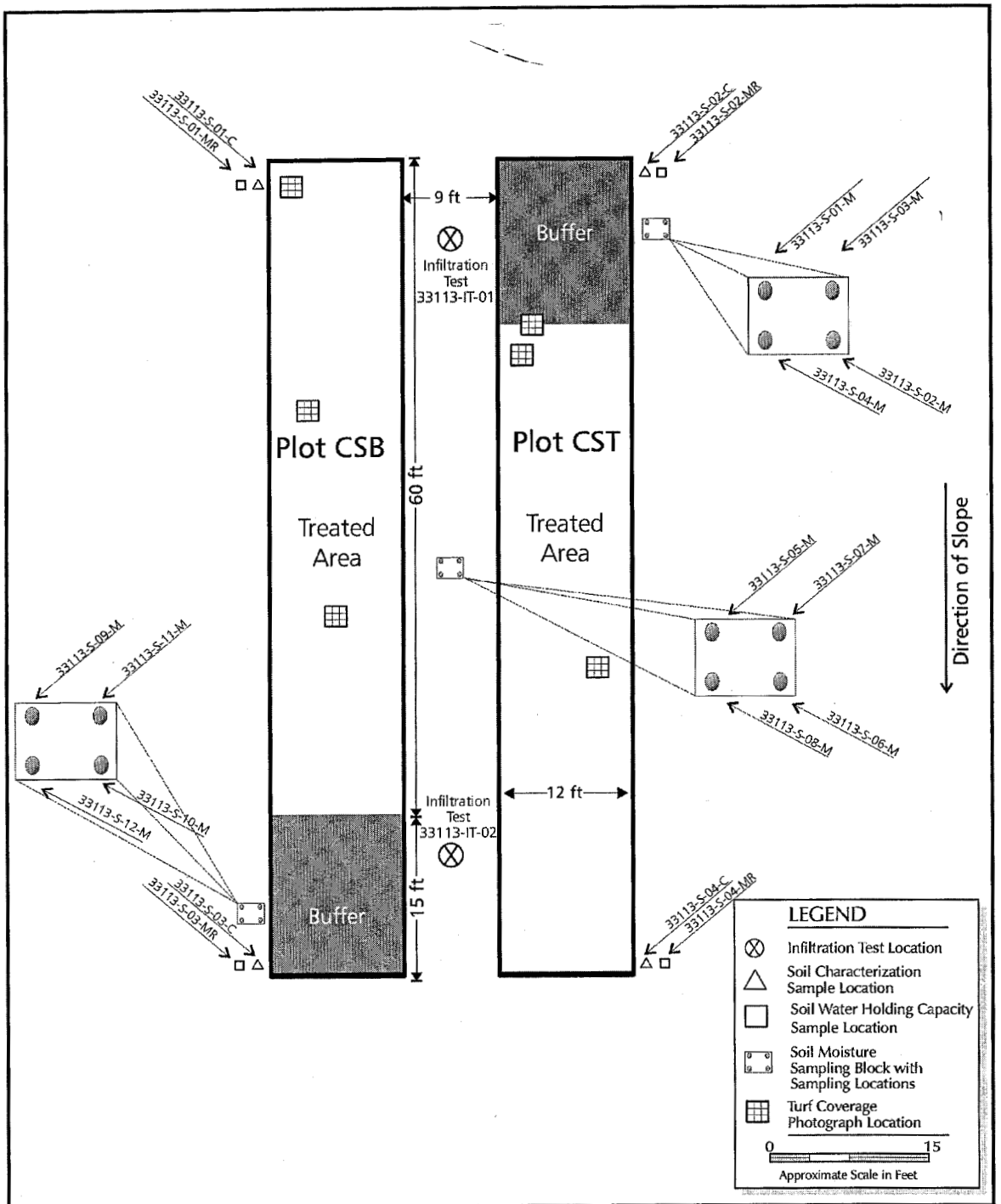

FIGURE 6: SITE CHARACTERIZATION PLAN
Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco Topchoice™ Treated Turfgrasses Under Simulated Rainfall
Cedar Grove, North Carolina

Source: SEI Field Notes
o:\proj-02\1281-F-FIPRO\33113\Figures\33113sitecharplan.cdr
int: 09-11-02 jms

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TABLE 9
Test Substance Application Details

		Plot CSB	Plot CST
Test Substance Lot:		C1275002	C1275002
Applicator Type:		drop spreader[1]	drop spreader[1]
Spreader Setting:		4.5	4.5
Ambient Temperature (°C):		NR	NR
Wind Speed (mph):		< 2 - 5	5
Wind Direction:		northwest	northwest
Application Date:		May 14, 2002	May 14, 2002
Application Start Time:		13:15	13:52
Application End Time:		NR	13:55
Application Pass Times (sec.):			
	Pass Number		
	1	12.39	11.25
	2	11.21	10.68
	3	11.23	11.23
	4	11.37	10.64
	5	10.89	10.58
	6	10.80	10.89
	average:	11.32	10.88
Test Substance Start Weight (g):		2270.5	2270.2
Test Substance End Weight (g):		1492.5	1431.1
Test Substance Applied[2] (g):		778.0	839.1
Active Ingredient Applied[3] (mg):		115	124
Target Application Rate[4] (g a.i./ha):		13.9	13.9
Target Application Rate[5] (oz. a.i./acre):		0.199	0.199
Actual Application Rate[6] (g a.i./ha):		17.2	18.6
Actual Application Rate[7] (oz. a.i./acre):		0.246	0.265
Percent of Target Application Rate (%):		123	133

STONE ENVIRONMENTAL, INC.

Source: SEI field data sheets, 5/14/02; Bayer CropScience Certificate of Analysis #202FKT31, 5/10/02

Notes: 1. Application made using a Scotts AccuGreen drop spreader

2. Calculated as: Test Substance Start Weight (g) - Test Substance End Weight (g)

3. Calculated as: Test Substance Applied (g) x (% a.i./100) x 1000mg/g; % a.i. (0.0148%) from Certifcate of Analysis #202FKT31

4. Calculated as: 87 lb/A Product x (% a.i./100) x (453.5924 g/lb) x (2.201 A/ha); % a.i. (0.0143%) per product label

5. Calculated as: 87 lb/A Product x (% a.i./100) x (16 oz./lb); % a.i. (0.0143%) per product label

6. Calculated as: (a.i. Applied (mg)/720 ft2 treated area) x (0.001 g/mg) x 43,560 ft2/A x 2.201 A/ha

7. Calculated as: (a.i. Applied (mg)/720 ft2 treated area) x (0.001 g/mg) x 43,560 ft2/A x (16 oz./453.5924 g)

Abbreviations: a.i. = active ingredient; NR = not recorded

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\SiteCharacterization.xls~Application

Date/Initials: 09/09/02 MN; rev. 12/10/03 DCB; rev. 12/22/03 DCB

TABLE 3

Daily Site Climatological Data

Date	Days After Application	Precipitation (inches)	Air Temperature (°C) Min	Max	Mean	Mean Soil Temperature Under Turf[1] (°C)	Mean Soil Temperature at 4 in. bgs[2] (°C)	Mean Relative Humidity (%)	Mean Wind Speed (mph)	Mean Wind Direction[3] (°N)	Maximum Solar Radiation[4] (MJ/m²/min)
5/13/2002	-1	0.69	14.3	28.8	23.7	23.1	22.2	68.3	9.9	237	0.0667
5/14/2002	0	0.00	8.9	19.0	13.9	17.1	19.2	57.1	5.7	311	0.0828
5/15/2002	1	0.00	6.7	22.6	14.8	17.9	18.5	58.8	2.6	309	0.0617
5/16/2002	2	0.00	8.6	26.3	18.6	19.0	19.2	60.6	5.0	224	0.0643
5/17/2002	3	0.00	16.9	28.2	22.8	21.2	20.6	59.4	7.1	215	0.0668
5/18/2002	4	0.21	8.8	23.4	16.9	19.1	20.6	72.8	8.7	311	0.0733
5/19/2002	5	0.00	5.4	15.7	10.2	16.2	17.4	62.7	3.8	15	0.0827
5/20/2002	6	0.00	3.6	17.1	11.1	16.6	17.1	59.4	2.6	16	0.0747
5/21/2002	7	0.04	6.6	13.5	10.2	15.9	17.0	81.9	1.6	17	0.0641
5/22/2002	8	0.00	4.8	18.3	11.1	15.9	16.4	61.5	2.9	25	0.0616
5/23/2002	9	0.00	2.8	23.8	13.6	17.6	17.4	60.9	1.2	284	0.0620

Source: SEI on-site weather station

Notes:
1. Probe positioned in soil directly below thatch layer
2. Probe positioned at four inches below ground surface (in. bgs)
3. Wind direction measured in degrees from magnetic north
4. A malfunction caused an unknown number of erroneous readings (zero values) in the 1-minute interval solar radiation data. The maximum values reported here are believed to be reliable.

Abbreviations: mph = miles per hour; MJ/m² =megajoules per square meter

Path: O:\Proj-02\1281-F-FIPRO\Report_33113\tables\pdf\dailyweather.pdf

Date: 8/8/2002 BH; 9/3/02 DCB; 12/2/03 BP; 12/10/03 DCB

Table 6. Critical Dates for Runoff Water Samples Analyzed for Fipronil-Related Residues

Sample Identification[a]	Collection Date	Date Received	Sample Work-up Dates		Storage Interval (Days) [b]
			Extraction Date	Analysis Date	
CSB-QP-01-R	5/16/2002	5/16/2002	6/14/2002	6/14/2002	29
CSB-QP-02-R	5/16/2002	5/16/2002	6/14/2002	6/14/2002	29
CSB-QP-03-R	5/16/2002	5/16/2002	6/14/2002	6/14/2002	29
CSB-QP-04-R	5/16/2002	5/16/2002	6/14/2002	6/14/2002	29
CSB-QP-05-R	5/16/2002	5/16/2002	6/14/2002	6/14/2002	29
CSB-QP-06-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CSB-QP-07-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CSB-QP-08-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CSB-QP-09-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CSB-QP-10-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CSB-TP-01-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-02-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-03-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-04-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-05-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-06-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-07-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-08-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-09-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-10-R	5/16/2002	5/16/2002	6/13/2002	6/14/2002	28
CSB-TP-11-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-12-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-13-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-14-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-15-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-16-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-17-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-18-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-19-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-20-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CSB-TP-21-R	5/23/2002	5/23/2002	6/20/2002	6/20/2002	28
CST-QP-01-R	5/16/2002	5/16/2002	6/14/2002	6/18/2002	29
CST-QP-02-R	5/16/2002	5/16/2002	6/14/2002	6/18/2002	29
CST-QP-03-R	5/16/2002	5/16/2002	6/14/2002	6/18/2002	29
CST-QP-04-R	5/16/2002	5/16/2002	6/14/2002	6/18/2002	29
CST-QP-05-R	5/16/2002	5/16/2002	6/14/2002	6/18/2002	29
CST-QP-06-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CST-QP-07-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CST-QP-08-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CST-QP-09-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CST-QP-10-R	5/23/2002	5/23/2002	6/21/2002	6/21/2002	29
CST-TP-01-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-02-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-03-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21

(continued; footnotes to follow)

Table 6. Critical Dates for Runoff Water Samples Analyzed for Fipronil-Related Residues (continued)

Sample Identification[a]	Collection Date	Date Received	Sample Work-up Dates		Storage Interval (Days) [b]
			Extraction Date	Analysis Date	
CST-TP-04-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-05-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-06-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-07-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-08-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-09-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-10-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-11-R	5/16/2002	5/16/2002	6/6/2002	6/11/2002	21
CST-TP-12-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-13-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-14-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-15-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-16-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-17-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-18-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-19-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-20-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-21-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-22-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25
CST-TP-23-R	5/23/2002	5/23/2002	6/17/2002	6/17/2002	25

a The following sample codes were used to identify the treated samples:
CSB = Cool Season Turf, Bottom Buffer Plot. CST = Cool Season Turf, Top Buffer Plot.
QP = Flow Proportional Runoff. TP = Time Paced Runoff.

b Storage interval is the number of days between the sample collection and extraction dates.

Table 2. Procedural Recoveries of Fipronil and Its Metabolites from Fortified Control HPLC Grade Water

Sample Identification	Analytical Set No.	Spike Level (ppb)	% Recovery			
			Fipronil	MB46513	MB45950	MB46136
HPLC Water Spike 10 ppt-6-3-02	Set #2	0.010	159	85	82	87
HPLC Water Spike 10 ppt-6-17-02	Set #5	0.010	121	107	103	112
HPLC Water Spike 10 ppt-6-20-02	Set #7	0.010	105	96	99	92
HPLC Water Spike 10 ppt-6-21-02	Set #8	0.010	110	101	104	88
HPLC Water Spike 100 ppt-6-13-02	Set #3	0.100	86	85	81	85
HPLC Water Spike 100 ppt-6-14-02	Set #4	0.100	108	106	102	104
HPLC Water Spike 100 ppt-6-17-02	Set #5	0.100	105	112	105	103
HPLC Water Spike 200 ppt-6-3-03	Set #2	0.200	92	74	78	76
HPLC Water Spike 1000 ppt-6-20-02	Set #7	1.000	101	102	97	95
HPLC Water Spike 1000 ppt-6-21-02	Set #8	1.000	87	95	91	90
HPLC Water Spike 2.0 ppb-6-13-03	Set #3	2.000	87	88	81	80
HPLC Water Spike 2.0 ppb-6-14-03	Set #4	2.000	105	99	99	97
Average ± S.D.			106 ± 20 (n=12)	96 ± 11 (n=12)	93 ± 10 (n=12)	92 ± 10 (n=12)

Table 3. Summary of Residue Results for Untreated Control Runoff Water Samples Analyzed for Fipronil -Related Residues

Analytical Set No.	Sample ID. 33113- [a]	Residues (ppb) [b]			
		Fipronil	MB46513	MB45950	MB46136
Set #2	SW-01-R	ND	ND	ND	ND
Set #2	UTC Pretreated Water	ND	ND	ND	ND
Set #3	IS-01-R	ND	ND	ND	ND
Set #3	SW-02-R	ND	ND	ND	ND
Set #4	IS-01-R	ND	ND	ND	ND
Set #4	SW-03-R	ND	ND	ND	ND
Set #5	IS-02-R	ND	ND	ND	ND
Set #5	SW-04-R	ND	ND	ND	ND
Set #7	IS-01-R	ND	ND	ND	ND
Set #7	SW-05-R	ND	ND	ND	ND
Set #8	IS-01-R	ND	ND	ND	ND
Set #8	SW-06-R	ND	ND	ND	ND

a The following sample codes were used identify the control samples:
IS = Irrigation Source Water. These samples were collected from the irrigation source water prior to the start of the study.
SW = Simulator Water. These samples were collected from the rain simulator and were transported from the field along with the field samples.

b MDL = 0.004 ppb; LOQ = 0.010 ppb; ND = none detected.

Table 1. Water Method Verification Results

Analyte	Sample Identification	Fortification Level (ppb)	Measured Residue Level (ppb)	% Recovery
Fortified Irrigation Source Water				
Fipronil	UTC- Pretreated Water-1	---	ND	na
	UTC- Pretreated Water-2	---	ND	na
	UTC Pretreated Water-10 ppt-1	0.010	0.007	70
	UTC Pretreated Water-10 ppt-2	0.010	0.007	68
	UTC Pretreated Water-100 ppt-1	0.100	0.060	60
	UTC Pretreated Water-100 ppt-2	0.100	0.063	63
MB46513	UTC- Pretreated Water-1	---	ND	na
	UTC- Pretreated Water-2	---	ND	na
	UTC Pretreated Water-10 ppt-1	0.010	0.008	81
	UTC Pretreated Water-10 ppt-2	0.010	0.007	66
	UTC Pretreated Water-100 ppt-1	0.100	0.074	74
	UTC Pretreated Water-100 ppt-2	0.100	0.074	74
MB45950	UTC- Pretreated Water-1	---	ND	na
	UTC- Pretreated Water-2	---	ND	na
	UTC Pretreated Water-10 ppt-1	0.010	0.007	74
	UTC Pretreated Water-10 ppt-2	0.010	0.008	77
	UTC Pretreated Water-100 ppt-1	0.100	0.075	75
	UTC Pretreated Water-100 ppt-2	0.100	0.076	76
MB46136	UTC- Pretreated Water-1	---	ND	na
	UTC- Pretreated Water-2	---	ND	na
	UTC Pretreated Water-10 ppt-1	0.010	0.009	86
	UTC Pretreated Water-10 ppt-2	0.010	0.008	78
	UTC Pretreated Water-100 ppt-1	0.100	0.077	77
	UTC Pretreated Water-100 ppt-2	0.100	0.080	80

--- = control sample
ND = none detected
NA= not applicable

Table 5. Summary of Results for Water Field Recovery Samples

Sample ID. 33113- [a]	Spiking Level (ppb)	Fipronil		MB46513		MB45950		MB46136	
		Residues (ppb) [b]	% Rec.	Residues (ppb) [b]	% Rec.	Residues (ppb) [b]	% Rec.	Residues (ppb) [b]	% Rec.
Field Recovery Samples [c]									
CS-SP-P-01	0.100	0.097	97	0.099	99	0.103	103	0.101	101
CS-SP-P-02	0.100	0.098	98	0.103	103	0.101	101	0.102	102
CS-SP-P-03	0.100	0.095	95	0.100	100	0.100	100	0.100	100
CS-SP-P-04	2.000	1.934	97	2.091	105	2.061	103	2.018	101
CS-SP-P-05	2.000	1.951	98	2.009	101	1.994	100	2.008	100
CS-SP-P-06	2.000	1.956	98	2.093	105	2.074	104	2.035	102
CS-SP-G-01	0.100	0.095	95	0.098	98	0.101	101	0.095	95
CS-SP-G-02	0.100	0.090	90	0.098	98	0.098	98	0.094	94
CS-SP-G-03	0.100	0.096	96	0.097	97	0.101	101	0.095	95
CS-SP-G-04	2.000	1.893	95	1.964	98	2.011	101	1.987	99
CS-SP-G-05	2.000	1.887	94	1.966	98	2.006	100	1.962	98
CS-SP-G-06	2.000	1.887	94	1.917	96	1.946	97	1.942	97
Untreated Controls									
CS-UTC-P-01	---	ND	---	ND	---	ND	---	ND	---
CS-UTC-P-02	---	ND	---	ND	---	ND	---	ND	---
CS-UTC-G-01	---	ND	---	ND	---	ND	---	ND	---
CS-UTC-G-02	---	ND	---	ND	---	ND	---	ND	---
Procedural Recoveries									
HPLC Water Spike 100 ppt-6-18-02	0.100	0.107	107	0.111	111	0.106	106	0.107	107
HPLC Water Spike 2000 ppt-6-18-02	0.100	2.003	100	2.007	100	1.924	96	1.902	95

a All samples analyzed in Analytical Set #6. The following sample codes were used to identify the field recovery samples: CS = Cool Season Turf. UTC = Control. SP = Spiked Samples. P = Plastic Containers. G = Glass Containers.

b Values shown are the measured residue levels found. ND = none detected. MDL = 0.004 ppb; LOQ = 0.010 ppb.

c Field spike recoveries were not corrected for procedural recoveries.

TABLE 19
Sediment Yields Calculated From Time-Paced and Flow Proportional Runoff Samples

Simulated Rainfall Event	Plot	Buffer Position	Mean TSS Concentration[1] (ppm)	Maximum TSS Concentration[2] (ppm)	Cumulative TSS Export (g) Time-Paced Method[3]	Flow Proportional Method[4]	Method Average	TSS Export (kg/ha)
Event 1, May 16, 2002								
	CST	Top	35	33	42.2	71.4	56.8	6.8
	CSB	Bottom	61	151	104.1	100.7	102.4	12.2
	Percent difference between top buffer and bottom buffer plots[5]							
			-76%	-358%	-147%	-41%	-80%	-80%
Event 2, May 23, 2002								
	CST	Top	17	48	41.1	37.0	39.0	4.7
	CSB	Bottom	28	80	55.1	48.5	51.8	6.2
	Percent difference between top buffer and bottom buffer plots[5]							
			-64%	-67%	-34%	-31%	-33%	-33%

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Sources: SEI field data sheets and ISCO 3230 flowmeter data, 5/16/02 and 5/23/02; Agvise Laboratories Analytical Reports, 6/6/02 and 6/20/02

Notes: 1. Calculated as the mean of the TSS concentrations of the flow proportional composite subsamples

2. The maximum TSS concentration for each plot is the maximum among the time-paced sample data

3. Calculated as the sum of the products of time-paced sample concentration multiplied by cumulative flow for the interval preceding collection of the sample

4. Calculated as the product of the mean TSS concentration in the flow proportional subsamples and total runoff volume

5. Percent difference calculated as: 100 x (Plot CST Value - Plot CSB Value)/Plot CST Value

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int: 10/21/02 DCB; rev. 12/10/03 DCB; rev. 2/5/04 DCB

TABLE 20
Fipronil and Metabolite Residues in Time-Paced Runoff Samples, Event 1

Plot ID	Sample ID	Runoff Duration[1] (minutes)	Interval Flow[2] (L)	Residue Concentration (ppb) Fipronil	MB46513	MB45950	MB46136	Total[3]
CST (Top Buffer)								
	33113-CST-TP-01-R	6	24.5	1.545	(0.004)	0.012	0.079	1.638
	33113-CST-TP-02-R	15	88.3	2.580	(0.006)	0.027	0.096	2.707
	33113-CST-TP-03-R	24	172.1	3.056	(0.006)	0.040	0.186	3.284
	33113-CST-TP-04-R	33	211.6	2.914	(0.006)	0.038	0.200	3.153
	33113-CST-TP-05-R	42	239.2	2.368	(0.005)	0.025	0.108	2.504
	33113-CST-TP-06-R	51	256.0	2.055	(0.006)	0.017	0.071	2.148
	33113-CST-TP-07-R	60	257.3	2.025	(0.006)	0.019	0.073	2.122
	33113-CST-TP-08-R	69	268.3	1.989	(0.006)	0.018	0.069	2.081
	33113-CST-TP-09-R	78	281.5	1.954	(0.005)	0.017	0.071	2.046
	33113-CST-TP-10-R	87	230.0	2.081	(0.007)	0.022	0.104	2.212
	33113-CST-TP-11-R	90	34.4	1.896	(0.006)	0.017	0.093	2.010
	max			3.056	(0.007)	0.040	0.200	3.284
	mean			2.224	(0.006)	0.023	0.105	2.355
CSB (Bottom Buffer)								
	33113-CSB-TP-01-R	6	11.0	ND	ND	ND	ND	(0.008)
	33113-CSB-TP-02-R	15	33.0	ND	ND	ND	ND	(0.008)
	33113-CSB-TP-03-R	24	161.3	0.055	ND	ND	ND	0.061
	33113-CSB-TP-04-R	33	183.7	0.306	ND	ND	(0.007)	0.317
	33113-CSB-TP-05-R	42	205.3	0.508	ND	ND	0.011	0.523
	33113-CSB-TP-06-R	51	222.4	0.664	ND	ND	0.015	0.683
	33113-CSB-TP-07-R	60	233.4	0.760	ND	(0.004)	0.018	0.784
	33113-CSB-TP-08-R	69	245.3	0.856	ND	(0.004)	0.021	0.883
	33113-CSB-TP-09-R	78	245.2	0.940	ND	(0.004)	0.023	0.969
	33113-CSB-TP-10-R	87	110.0	0.975	ND	(0.004)	0.025	1.006
	max			0.975	ND	(0.004)	0.025	1.006
	mean[4]			0.507	ND	ND	0.013	0.524

Source: Bayer CropScience Amended Final Analytical Report, January 15, 2004 STONE ENVIRONMENTAL, INC.

Abbreviations: ppb = parts per billion; ND = none detected

Notes: Method Detection Limit (MDL) = 0.004 ppb; Limit of Quantitation (LOQ) = 0.010 ppb

Values in parentheses are greater than or equal to the MDL and less than the LOQ

1. Elapsed time since first observation of runoff from plot
2. Interval runoff flow (L) =current cumulative flow (L) - cumulative flow (L) at previous sample
3. Calculated in parent equivalents as follows: Total (ppb) = A + (B*C1) + (D*C2) + (E*C3), where:
   A = fipronil (ppb), B = MB46513 (ppb), D = MB45950 (ppb), E = MB46136 (ppb),
   C1 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB46513 (389.02 g/mole) = 1.124,
   C2 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB45950 (421.16 g/mole) = 1.038,
   C3 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB46136 (453.1 g/mole) = 0.965
   For analytes with ND residues, a value of ½ the MDL was assumed in the Total Residue calculations
4. For analytes with ND residues, a value of ½ the MDL was assumed in the analyte concentration mean calculations

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int: 10/18/02 DCB; rev. 12/10/03 DCB; rev. 2/5/04 DCB

TABLE 21
Fipronil and Metabolite Residues in Time-Paced Runoff Samples, Event 2

Plot ID	Sample ID	Runoff Duration[1] (minutes)	Interval Flow[2] (L)	Residue Concentration (ppb) Fipronil	MB46513	MB45950	MB46136	Total[3]
CST (Top Buffer)								
	33113-CST-TP-12-R	6	15.2	1.259	(0.005)	0.031	0.096	1.389
	33113-CST-TP-13-R	15	49.0	3.088	(0.007)	0.098	0.185	3.376
	33113-CST-TP-14-R	24	116.9	2.659	(0.007)	0.091	0.165	2.921
	33113-CST-TP-15-R	33	181.1	2.102	(0.006)	0.083	0.146	2.336
	33113-CST-TP-16-R	42	215.5	2.494	(0.007)	0.089	0.222	2.808
	33113-CST-TP-17-R	51	234.1	2.286	(0.007)	0.080	0.150	2.522
	33113-CST-TP-18-R	60	252.1	2.205	(0.008)	0.083	0.146	2.441
	33113-CST-TP-19-R	69	267.1	2.176	(0.008)	0.077	0.138	2.398
	33113-CST-TP-20-R	78	273.0	2.112	0.010	0.076	0.141	2.338
	33113-CST-TP-21-R	87	293.3	1.969	0.010	0.073	0.135	2.186
	33113-CST-TP-22-R	96	240.3	2.084	0.010	0.076	0.135	2.304
	33113-CST-TP-23-R	99	36.5	2.299	0.013	0.082	0.243	2.633
	max			3.088	0.013	0.098	0.243	3.376
	mean			2.228	(0.008)	0.078	0.159	2.471
CSB (Bottom Buffer)								
	33113-CSB-TP-11-R	6	1.3	ND	ND	ND	ND	(0.008)
	33113-CSB-TP-12-R	15	16.1	0.091	ND	(0.004)	(0.009)	0.106
	33113-CSB-TP-13-R	24	68.6	0.182	ND	(0.007)	0.012	0.203
	33113-CSB-TP-14-R	33	147.2	0.406	ND	0.013	0.018	0.439
	33113-CSB-TP-15-R	42	181.1	0.699	ND	0.015	0.021	0.737
	33113-CSB-TP-16-R	51	211.5	0.949	ND	0.018	0.027	0.996
	33113-CSB-TP-17-R	60	228.8	1.147	(0.004)	0.019	0.032	1.202
	33113-CSB-TP-18-R	69	250.8	0.978	ND	0.019	0.032	1.031
	33113-CSB-TP-19-R	78	262.3	1.385	(0.005)	0.025	0.043	1.458
	33113-CSB-TP-20-R	87	258.3	1.435	(0.005)	0.027	0.043	1.510
	33113-CSB-TP-21-R	96	117.4	1.451	(0.004)	0.025	0.041	1.521
	max			1.451	(0.005)	0.027	0.043	1.521
	mean[4]			0.793	ND	0.016	0.025	0.837

Source: Bayer CropScience Amended Final Analytical Report, January 15, 2004 — STONE ENVIRONMENTAL, INC.

Abbreviations: ppb = parts per billion; ND = none detected

Notes: Method Detection Limit (MDL) = 0.004 ppb; Limit of Quantitation (LOQ) = 0.010 ppb

Values in parentheses are greater than or equal to the MDL and less than the LOQ

1. Elapsed time since first observation of runoff from plot
2. Interval runoff flow (L) =current cumulative flow (L) - cumulative flow (L) at previous sample
3. Calculated in parent equivalents as follows: Total (ppb) = A + (B*C1) + (D*C2) + (E*C3), where:
   A = fipronil (ppb), B = MB46513 (ppb), D = MB45950 (ppb), E = MB46136 (ppb),
   C1 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB46513 (389.02 g/mole) = 1.124,
   C2 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB45950 (421.16 g/mole) = 1.038,
   C3 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB46136 (453.1 g/mole) = 0.965
   For analytes with ND residues, a value of ½ the MDL was assumed in the Total Residue calculations
4. For analytes with ND residues, a value of ½ the MDL was assumed in the analyte concentration mean calculations

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int: 10/18/02 DCB; rev. 12/10/03 DCB; rev. 2/5/04 DCB

TABLE 22
Fipronil and Metabolite Residues in Flow Proportional Runoff Samples, Events 1 and 2

Plot ID	Sample ID	Residue Concentration (ppb)				
		Fipronil	MB46513	MB45950	MB46136	Total[1]
Simulated Rainfall Runoff Event 1, May 16, 2002						
CST (Top Buffer)	33113-CST-QP-01-R	3.508	ND	0.029	0.079	3.617
	33113-CST-QP-02-R	3.468	ND	0.029	0.077	3.575
	33113-CST-QP-03-R	3.549	ND	0.029	0.078	3.657
	33113-CST-QP-04-R	3.516	ND	0.029	0.078	3.624
	33113-CST-QP-05-R	3.503	ND	0.029	0.076	3.609
	mean[2]	3.509	ND	0.029	0.078	3.616
	standard deviation	0.029	ND	0.000	0.001	0.029
CSB (Bottom Buffer)	33113-CSB-QP-01-R	1.000	ND	(0.004)	(0.009)	1.015
	33113-CSB-QP-02-R	1.063	ND	(0.004)	0.010	1.079
	33113-CSB-QP-03-R	0.917	ND	(0.004)	0.010	0.933
	33113-CSB-QP-04-R	1.028	ND	(0.004)	0.011	1.045
	33113-CSB-QP-05-R	1.028	ND	(0.005)	0.011	1.046
	mean[2]	1.007	ND	(0.004)	0.010	1.024
	standard deviation	0.055	ND	0.000	0.001	0.055
Simulated Rainfall Runoff Event 2, May 23, 2002						
CST (Top Buffer)	33113-CST-QP-06-R	2.527	ND	0.085	0.126	2.739
	33113-CST-QP-07-R	2.931	(0.004)	0.094	0.148	3.176
	33113-CST-QP-08-R	2.970	ND	0.091	0.144	3.206
	33113-CST-QP-09-R	3.231	(0.004)	0.094	0.197	3.523
	33113-CST-QP-10-R	2.658	ND	0.091	0.138	2.888
	mean[2]	2.863	ND	0.091	0.151	3.106
	standard deviation	0.277	ND	0.004	0.027	0.305
CSB (Bottom Buffer)	33113-CSB-QP-06-R	1.219	ND	0.023	0.028	1.272
	33113-CSB-QP-07-R	1.214	ND	0.026	0.029	1.271
	33113-CSB-QP-08-R	1.192	ND	0.024	0.029	1.247
	33113-CSB-QP-09-R	1.215	ND	0.025	0.029	1.271
	33113-CSB-QP-10-R	1.201	ND	0.023	0.028	1.254
	mean[2]	1.208	ND	0.024	0.029	1.263
	standard deviation	0.011	ND	0.001	0.001	0.012

Source: Bayer CropScience Amended Final Analytical Report, January 15, 2004 STONE ENVIRONMENTAL, INC.

Abbreviations: ppb = parts per billion, ND = none detected

Notes: Method Detection Limit (MDL) = 0.004 ppb; Limit of Quantitation (LOQ) = 0.010 ppb

Values in parentheses are greater than or equal to the MDL and less than the LOQ

1. Calculated in parent equivalents as follows: Total (ppb) = A + (B*C1) + (D*C2) + (E*C3), where:
   A = fipronil (ppb), B = MB46513 (ppb), D = MB45950 (ppb), E = MB46136 (ppb),
   C1 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB46513 (389.02 g/mole) = 1.124,
   C2 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB45950 (421.16 g/mole) = 1.038,
   C3 = molecular wt. of fipronil (437.1 g/mole)/molecular wt. of MB46136 (453.1 g/mole) = 0.965
   For analytes with ND residues, a value of ½ the MDL was assumed in the Total Residue calculations
2. For analytes with ND residues, a value of ½ the MDL was assumed in the analyte concentration mean calculations

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_Runoff Data~QP Residue

int: 10/18/02 DCB; rev. 12/10/03 DCB; rev. 2/5/04 DCB

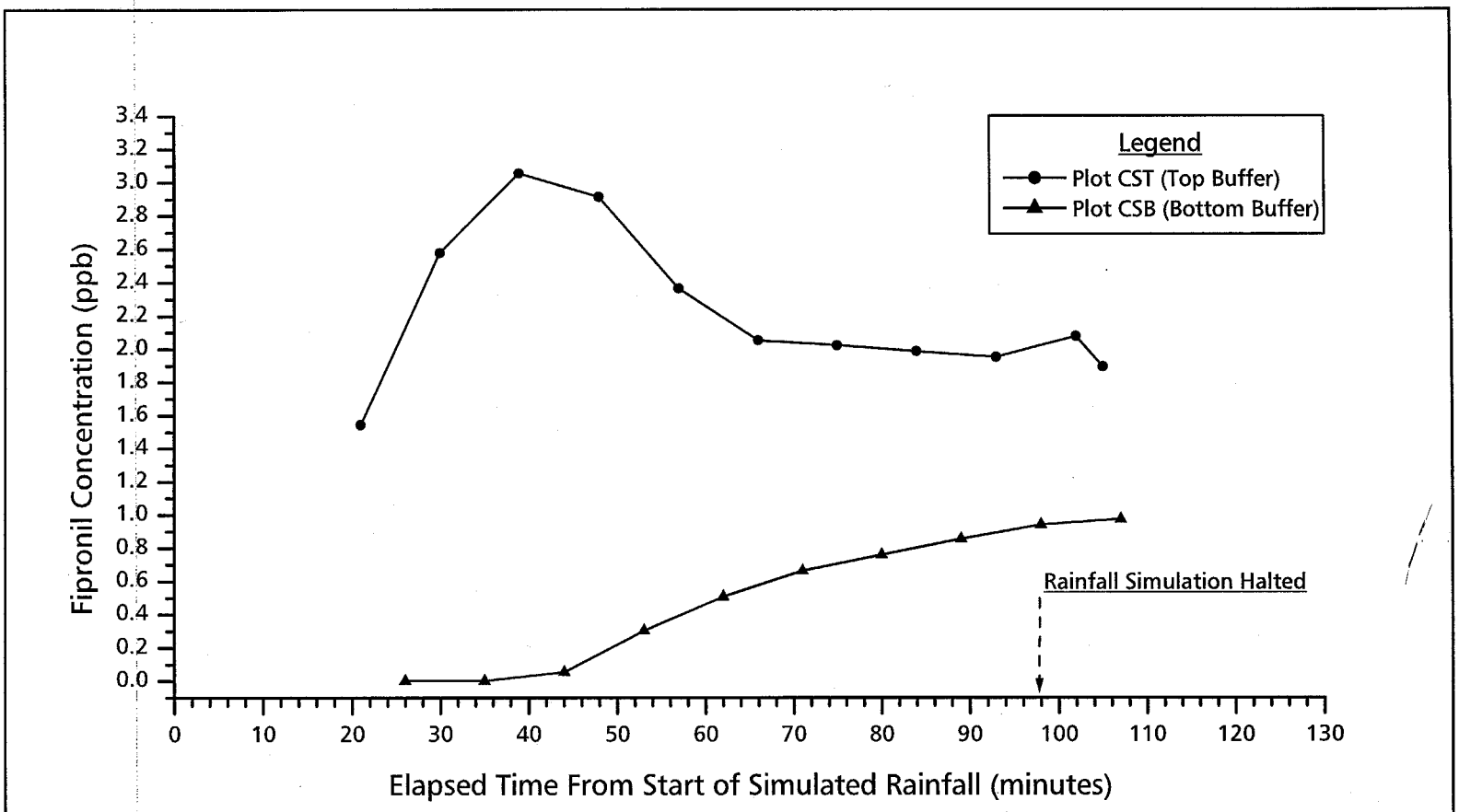

FIGURE 12: FIPRONIL CONCENTRATIONS IN TIME-PACED RUNOFF SAMPLES, EVENT 1

Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco TopChoice™ Treated Turfgrasses Under Simulated Rainfall
Cedar Grove, North Carolina

Source: Bayer CropScience Final Analytical Report, January 28, 2003
Path: O:\Proj-02\1281-F-FipRO\Report_33113\Figures\33113Conc.opj
int: 10/21/02 DCB; rev. 12/11/03 DCB

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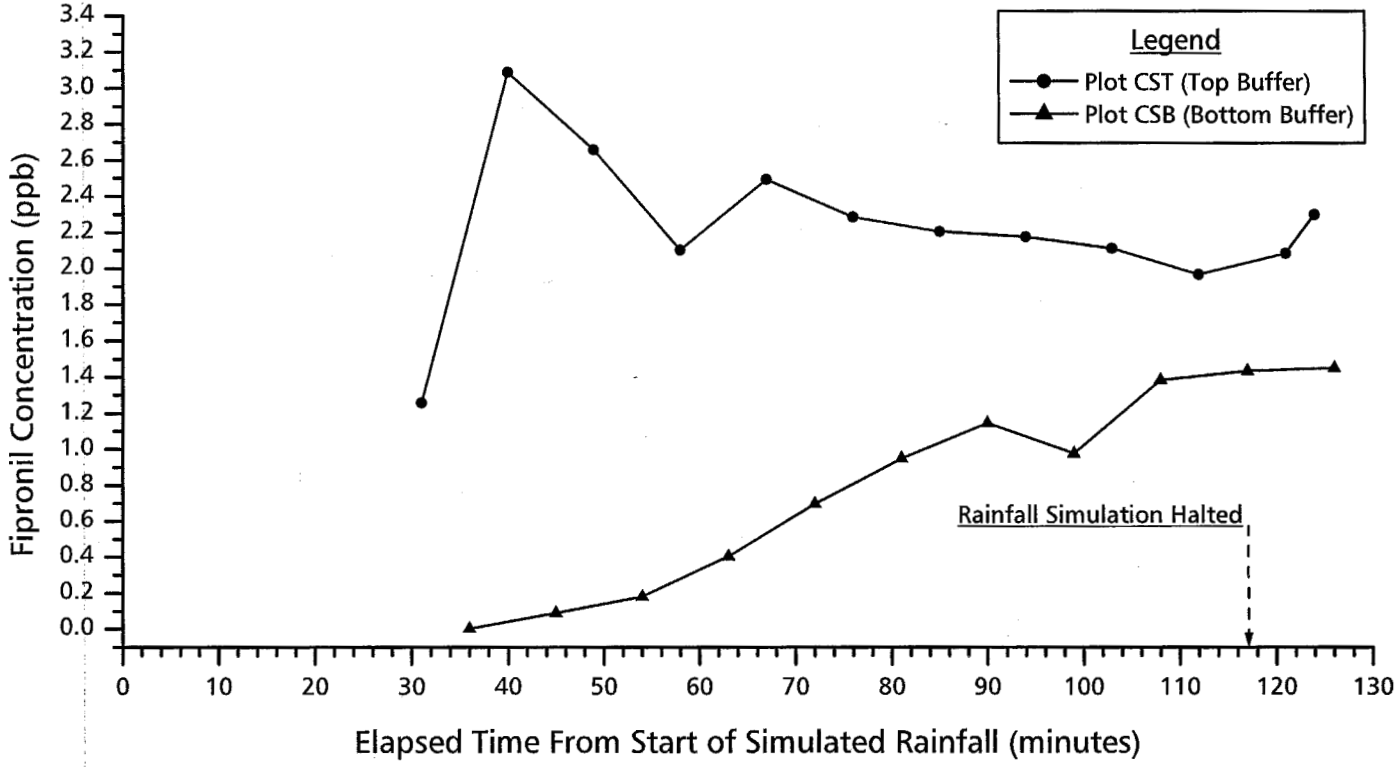

FIGURE 13: FIPRONIL CONCENTRATIONS IN TIME-PACED RUNOFF SAMPLES, EVENT 2

Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco TopChoice™ Treated Turfgrasses Under Simulated Rainfall
Cedar Grove, North Carolina

Source: Bayer CropScience Final Analytical Report, January 28, 2003
Path: O:\Proj-02\1281-F-FipRO\Report_33113\Figures\33113Conc.opj
int: 10/21/02 DCB; rev. 12/11/03 DCB

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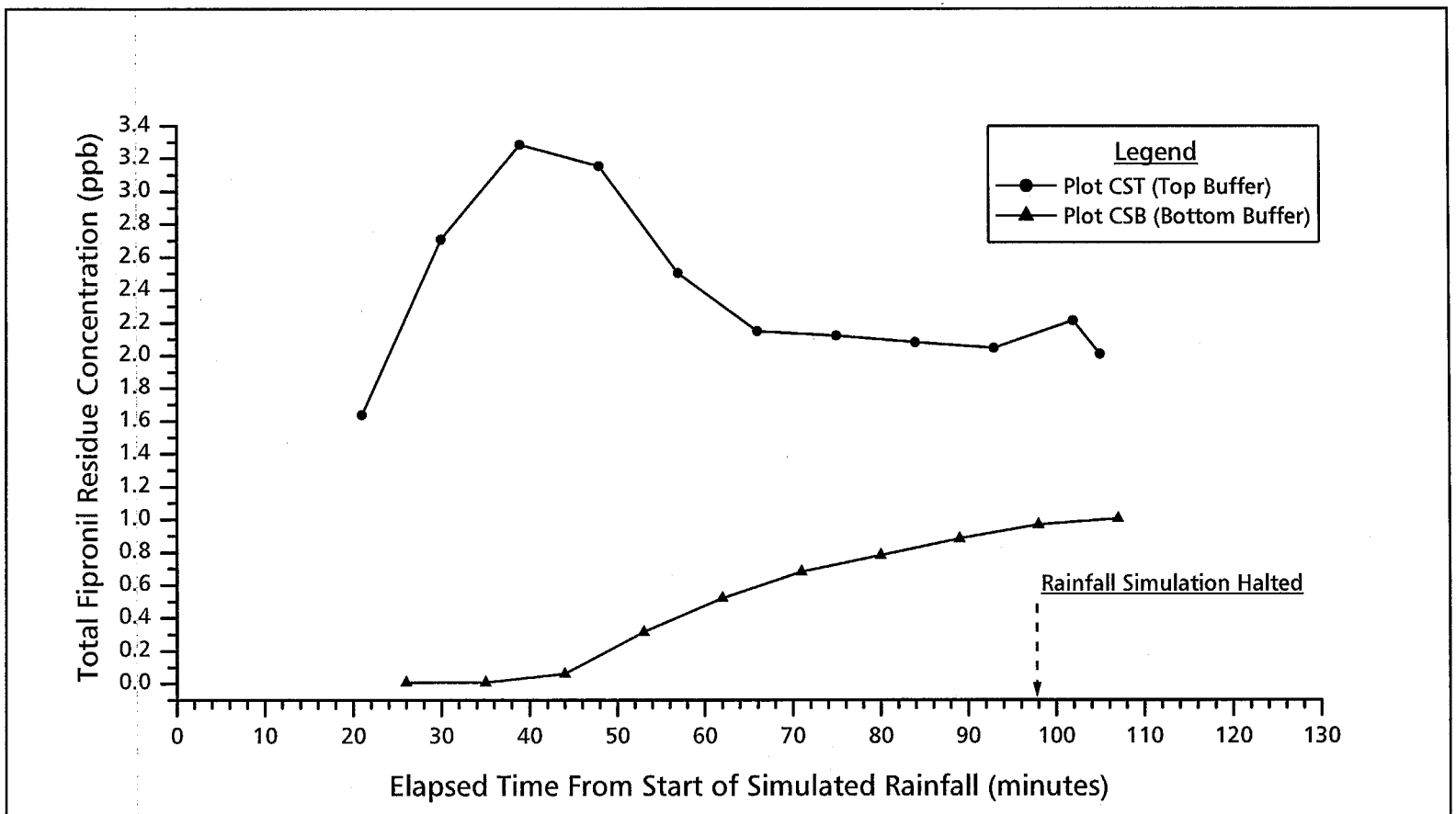

FIGURE 14: TOTAL FIPRONIL RESIDUE CONCENTRATIONS IN TIME-PACED RUNOFF SAMPLES, EVENT 1

Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco TopChoice™ Treated Turfgrasses Under Simulated Rainfall
Cedar Grove, North Carolina

Source: Bayer CropScience Final Analytical Report, January 28, 2003
Path: O:\Proj-02\1281-F-FipRO\Report_33113\Figures\33113Conc.opj
int: 10/21/02 DCB; rev. 12/11/03 DCB

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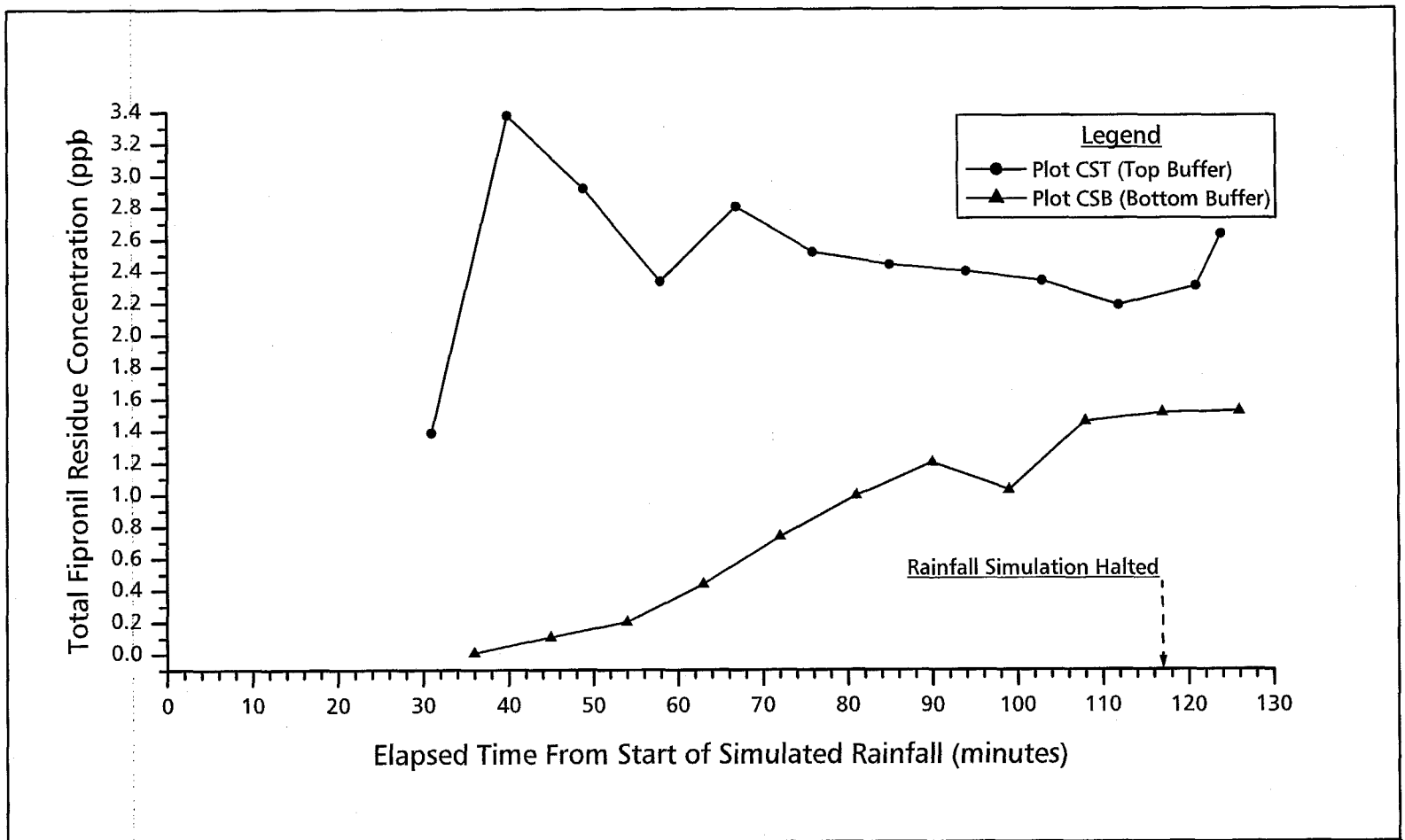

FIGURE 15: TOTAL FIPRONIL RESIDUE CONCENTRATIONS IN TIME-PACED RUNOFF SAMPLES, EVENT 2

Effect of Vegetative Buffer Strips on Fipronil Runoff Losses from Cool Season Chipco TopChoice™ Treated Turfgrasses Under Simulated Rainfall
Cedar Grove, North Carolina

Source: Bayer CropScience Final Analytical Report, January 28, 2003
Path: O:\Proj-02\1281-F-FipRO\Report_33113\Figures\33113Conc.opj
int: 10/21/02 DCB; rev. 12/11/03 DCB

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TABLE 23
Fipronil Concentration and Yield Calculated From Time-Paced and Flow Proportional Samples

Simulated Rainfall Event	Plot	Buffer Position	Mean Fipronil Concentration[1] (ppb)	Maximum Fipronil Concentration[2] (ppb)	Cumulative Fipronil Export: Time-Paced Method[3] (mg)	Cumulative Fipronil Export: Flow Proportional Method[4] (mg)	Cumulative Fipronil Export: Method Average (mg)	Percent of Applied Fipronil[5]
Event 1, May 16, 2002								
	CST	Top	3.509	3.056	4.6	7.2	5.9	4.8
	CSB	Bottom	1.007	0.975	1.0	1.7	1.4	1.2
	Percent difference between top buffer and bottom buffer plots[6]							
			71%	68%	78%	77%	77%	75%
Event 2, May 23, 2002								
	CST	Top	2.863	3.088	4.8	6.2	5.5	4.4
	CSB	Bottom	1.208	1.451	1.8	2.1	2.0	1.7
	Percent difference between top buffer and bottom buffer plots[6]							
			58%	53%	62%	66%	64%	62%

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Sources: SEI field data sheets and ISCO 3230 flowmeter data, 5/16/02 and 5/23/02; Bayer CropScience Amended Final Analytical Report, January 15, 2004

Notes: 1. Calculated as the mean of the fipronil concentrations of the flow proportional composite subsamples

2. The maximum fipronil concentration for each plot is the maximum among the time-paced sample data

3. Calculated as the sum of the products of time-paced sample concentration multiplied by cumulative flow for the interval preceding collection of the sample

4. Calculated as the product of the mean fipronil concentration in the flow proportional subsamples and total runoff volume

5. Calculated as: 100 x cumulative fipronil export ("Method Average")/(mass active ingredient applied/plot)

6. Percent difference calculated as: 100 x (Plot CST Value - Plot CSB Value)/Plot CST Value

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_Runoff Data~Yield Summary_Fipronil

int: 10/18/02 DCB; rev. 12/10/03 DCB; rev. 2/5/04 DCB

TABLE 24

Total Fipronil Residue Concentration and Yield Calculated From Time-Paced and Flow Proportional Samples

Simulated Rainfall Event	Plot	Buffer Position	Mean Total Residue Concentration[1] (ppb)	Maximum Total Residue Concentration[2] (ppb)	Cumulative Total Fipronil Residue Export: Time-Paced Method[3] (mg)	Cumulative Total Fipronil Residue Export: Flow Proportional Method[4] (mg)	Cumulative Total Fipronil Residue Export: Method Average (mg)	Percent of Applied Fipronil[5]
Event 1, May 16, 2002								
	CST	Top	3.616	3.284	4.9	7.5	6.2	5.0
	CSB	Bottom	1.024	1.006	1.1	1.7	1.4	1.2
	Percent difference between top buffer and bottom buffer plots[6]							
			72%	69%	78%	77%	78%	76%
Event 2, May 23, 2002								
	CST	Top	3.106	3.376	5.3	6.8	6.0	4.9
	CSB	Bottom	1.263	1.521	1.9	2.2	2.1	1.8
	Percent difference between top buffer and bottom buffer plots[6]							
			59%	55%	64%	67%	66%	63%

STONE ENVIRONMENTAL, INC.

Sources: SEI field data sheets and ISCO 3230 flowmeter data, 5/16/02 and 5/23/02; Bayer CropScience Amended Final Analytical Report, January 15, 2004

Notes: 1. Calculated as the mean of the total residue concentrations (sum of fipronil parent plus metabolites) of the flow proportional composite subsamples

2. The maximum total residue concentration for each plot is the maximum of the sums of fipronil plus metabolites among the time-paced sample data

3. Calculated as the sum of the products of time-paced sample concentration multiplied by cumulative flow for the interval preceding collection of the sample

4. Calculated as the product of the mean total residue concentration in the flow proportional subsamples and total runoff volume

5. Calculated as: 100 x cumulative total residue export ("Method Average")/(mass active ingredient applied/plot)

6. Percent difference calculated as: 100 x (Plot CST Value - Plot CSB Value)/Plot CST Value

Path: O:\Proj-02\1281-F-FipRO\Report_33113\Tables\33113_Runoff Data--Yield Summary_TotalRes

int: 10/18/02 DCB; rev. 12/10/03 DCB; rev. 2/5/04 DCB