Project Progress Report

Using vegetative filter strips to reduce phosphorus runoff transport from reclaimed phosphate mining areas in Central Florida

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EXECUTIVE SUMMARY

Runoff non-point source pollution from phosphate mining areas poses a potential risk to ecosystems in many parts of the world. Mining sand tailings that still contain apatite (phosphate rock) shape the landscapes of reclaimed lands at the upper Peace River basin of Central Florida. Planting or culturing vegetation can be an economical and less labor- intensive method for reclamation of this and other mining areas. In particular, vegetative filter strips (VFS) have been widely recommended as a best management practice (BMP) by many state and federal agencies to control non-point source pollution from disturbed lands. VFS are defined as areas of dense vegetation designed to reduce transport of sediment and pollutants from surface runoff by deposition, infiltration, adsorption, and absorption (Dillaha et al., 1989).
The objectives of this project were: i) assess the potential surface runoff sediment and phosphorus (P) pollution from mining sand tailings in the upper Peace River basin; ii) investigate the efficiency of VFS in reducing P and sediment transport from the surface runoff of reclaimed mining areas; iii) study the relationship between the soil mineral source of P (apatite) and dissolved phosphorus (DP) concentration in runoff water; and iv) simulate VFS phosphorus transport reduction from mining sand tailings in the Upper Peace River basin using the VFSMOD-W model.

Two experimental sites (A and B) containing 16 runoff plots (8 source+8 VFS) were selected and instrumented for this study. The sites represent the range of conditions commonly found in source areas (sand tailings) at the region (i.e. slopes of 2-4.5%, slope lengths of 14-40 m, vegetation properties, and soil hydraulic properties). VFS (vegetation mixture of 90% Bahia grass with Hairy Indigo, Cogon Grass, and Smutgrass making up the remaining 10%) of different flow-lengths (4-13 m) were installed downstream from the source areas. Rainfall intensity, source and VFS runoff flow rate and volume, sediment, and total phosphorus (TP) and dissolved P (DP) of discrete runoff water samples were measured from each runoff event at the sites during 2006. Soil chemical analysis including soil pH, organic carbon (OC), TP, water soluble P, Mehlich-1 extraction, P sorption isotherms, TP in each particle fraction, and P fractionation are investigated. Runoff water samples were also used to determine relative stability of phosphate compounds and minerals in runoff. The numerical model VFSMOD-W (Muñoz-Carpena and Parsons, 1999) was used to predict overland flow and sediment trapping within the filter and was linked to a P transport algorithm developed based on experimental data to predict TP, PP, and DP fractions in the filter outflow. An advanced global inverse optimization technique is used for the model calibration process, and consideration to the uncertainty of the measured data was given.

The **project main findings** are:

- An average value of 2.3 % of total phosphorus (TP) was found in surface soil samples of the reclaimed mining areas in the upper Peace River basin.
- Higher TP concentration was found in the finer soil particles (particle diameter 0.45-37 µm, TP = 30,000 mg/kg) than in the coarser particles (37-2,000 µm, TP = 20,000 mg/kg).
- Phosphorus in sand tailings soils at the sites was in the form of apatite, as indicated by x-ray diffraction (XRD) and chemical fractionation. Results of this study supported the hypothesis that release of P from the soil was primarily from apatite dissolution rather than desorption from metal oxides that is more typical of soil of the region.

- Runoff was produced at the sites during relatively large events with intensities exceeding i_{30}= 10-14 mm/h. A total 40 such events were recorded on the experimental sites during the year (19 and 21 at each site). Of these, only 11 and 14 events (around 60% of the total) at each site produced sufficient runoff to be sampled.
- DP concentrations in runoff from source and VFS areas range from 0.4 to 3.0 mg/L, exceeding the EPA criterion of P concentrations (0.1 mg/L) discharging into a river.
- The slope, flow path length and soil permeability of the source area conditioned the amount of sediment and P observed in surface runoff. The longer, steeper and less permeable **source areas** selected (4.3% slope, runoff lengths of 40 m, saturated hydraulic conductivity K_s=1.6 cm/h) and **yielded 4.5 Tm/ha-year of sediment, 104 kg/ha-year of TP, and 2.21 kg/ha-year of DP**. These numbers were significantly smaller for the flatter, shorter and more permeable (2.0 % slope, K_s =31.0 cm/h and 14.4 m) site studied (240 kg/ha, 6.12 kg/ha, and 0.27 kg/ha, respectively).
- **Runoff volume, sediment, TP, and DP were reduced at least by 62%, 97%, 96%, and 66% with 6 m vegetative filter strips** in these two sites.
- Power equations of the product of total runoff volume and peak flow rate for each runoff event were found to describe well (r^2=0.93-0.96) the relationship between sediment yield and flow from the source areas.
- Runoff sediment concentration and runoff particulate phosphorus (PP) exhibit a strong linear correlation both at the source (r^2>0.98) and VFS areas (r^2>0.99).
- To aid in future BMP design efforts, the source areas curve numbers from the Soil Conservation Service TR-55 methods (SCS, 1986) were fitted to the experimental data collected on-site and a range of values for different antecedent moisture conditions and soil types were obtained (CN=81-95).
- The VFSMOD-W can predict hydrology transport well (Nash and Sutcliffe coefficient of efficiency, C_{eff}= 0.60 - 0.99) for all but small events (peak runoff flow rate in the VFS < 0.4 L/s) due likely to large measurement uncertainty in the small events.
- The new P component developed successfully predicts TP, PP and DP for the area. Good model predictions in runoff and sediment also result in good prediction of PP transport (C_{eff} = 0.96) since apatite exists almost evenly in sediment. Modeling DP considering release of P from apatite into runoff water results in a higher C_{eff} (0.97) than that with dilution from rainfall (C_{eff} = 0.86). This result may be related to rainfall impact on the dissolution of soil apatite.
- The uncertainty of measured data included in the goodness-of-fit indicators is more realistic to evaluate model performance and data sets.
- Based on the successful performance of VFSMOD-W, this tool shows promise for the management agencies involved in mining permitting and reclamation in upper Peace River basin. These agencies could apply VFSMOD-W to design VFS for controlling runoff and P transport in phosphate mining sand tailings.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

Average suction at wetting front	SAV
Best management practice	BMP
Carbonate-fluorapatite	CFA
Concentration of sediment in outflow from filter	CSF
Curve number	CN
Degree of phosphorus saturation	DPS
Dissolved phosphorus	DP
DP trapping efficiency	DPTE
Florida Department of Environmental Protection	FDEP
Flow volume	Q
Flow volume trapping efficiency	QTE
Fluorapatite	FAP
Length	L
Mass of sediment output from filter	MSF
Measured peak flow from VFS	QPF
Nash and Sutcliffe efficiency	C_{eff}
Organic carbon	OC
Particulate phosphorus	PP
Peak flow rate	Qp
Peak flow rate trapping efficiency	QPTE
Phosphorus	P
Phosphorus rock	PR
Phosphorus sorption isotherms	PSI
Probable error range	PER
Runoff delivery ratio	RDR
Sediment trapping efficiency	STE
Slope	S
Specific surface area	SSA
United Nations Environment Programme	UNEP
Total phosphorus	TP
Total runoff output from filter	TRF
TP trapping efficiency	TPTE
Trapping efficiency	TE
U.S. Environmental Protection Agency	USEPA
United States Department of Agriculture	USDA
Vegetative filter strips	VFS
Water soluble phosphorus	WSP
X-ray diffraction	XRD

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CHAPTER 1
INTRODUCTION

1-1. Rationale

Florida is rich in phosphate rock formed millions of years ago in the late Miocene era under ocean waters. Phosphate rock (PR) is usually found about 7.6-12.2 m beneath the ground in a mixture of phosphate pebbles, sand and clay known as phosphate matrix. Phosphate is a key ingredient in fertilizer and cannot be synthesized; so natural phosphate mining is the only supply and for the last 120 years has been one of the main economic activities of Central Florida region. The extraction and beneficiation of phosphate rock to produce fertilizer has the potential to adversely impact the environment. These impacts can be the landscape, water quality, excessive water consumption, and air pollution (UNEP, 2001). The landscape may be disturbed through removing topsoil and vegetation, excavating ore, depositing overburden, and inducing surface subsidence due to underground mining. The water resources may be adversely affected by the release of processing water, the erosion of sediments, and leaching of toxic minerals from overburden and processing wastes. The quality of the air can be affected by emissions such as dust and exhaust gases. The continued mining activities in central Florida has degraded water quality in the upper Peace River basin and has left behind large refuse sand tailings that now shape the landscape surrounding the river. The mound material is essentially homogenous clean sand (>94% in weight) with a high concentration in apatite, the phosphorus (P) mineral ore, and mixed with small pockets of clay in some points.

The Peace River is 190 km in length. Peace River watershed is approximately 5,670 km^2 in size. The largest land uses in the watershed are agricultural and mining. The agricultural lands account for nearly 50 % when pastureland is included (DEP, 2006a). Undeveloped lands consisting of forest, water, and wetlands account for 30 % of the land use. Urban or built-up land makes up 10 % of the land use. The actively mined lands are increased from 0.5% to 10.3% (from 30.4 km^2 to 589.7 km^2) of the watershed area during 1940-1999 (SFWMD, 2004). The agricultural and mining lands are potential pollution sources that can contribute high amounts of DP into water bodies. The average DP concentration in the Peace River at the Bartow sub-basin has declined from 18 mg/L to 1.23±1.93 mg/L from 1965 to 2005 due to the changes in mining practices (DEP, 2006b). The average concentration of total P (TP) was 1.38±1.93 mg/L from 1990 to 1995. However, the TP concentration was still higher than the U.S. Environmental Protection Agency (USEPA) criterion of maximum TP concentration (0.1 mg/L) discharging into a river (USEPA, 1986; Mueller et al., 1995).

Phosphorus carried in surface runoff from agricultural lands has been studied extensively. Phosphorus in runoff is generally divided into particulate and dissolved fraction by filtration through a 0.45 μm filter. Particulate forms include sorbed P, organic P, and mineral P phases. Dissolved forms are normally considered to be orthophosphate, inorganic polyphosphates, and organic P compounds (Nelson and Logan, 1983; McDowell and Sharpley, 2001a). These P compounds exist in dynamic equilibrium between their dissolved and particulate forms and are heavily influenced by soil properties and land management practices (He et al, 2003). Therefore, the factors that affect the mechanism of runoff transport will also govern the P transport.

1-2. Best Management Practice: Vegetative Filter Strips

Runoff easily occurs during rainfall events in disturbed bare lands resulting from mining activities where no vegetation exists to resist flow transport. Thus, the reclamation activities must be conducted to avoid high environmental impacts in the disturbed mining areas. The reclamation activities in mining areas generally involve landscaping, revegetation, and maintenance of disturbed areas (United Nations Environment Programme (UNEP), 2001).

Revegetation is an economical and less labor intensive method. Vegetation can increase surface roughness and infiltration, and decrease runoff volume that can reduce particles and sediment-bound pollutant transport. Vegetative filter strips (VFS) are defined as areas of vegetation designed to reduce transport of sediment and pollutants from surface runoff by deposition, infiltration, adsorption, and absorption (Dillaha et al., 1989). VFS has been recommended as a best management practice (BMP) in controlling non-point source pollution from agricultural lands (USDA, 1976; Barfield et al., 1979). Performance of VFS in reducing runoff pollutants in previous studies is summarized in Table 1-1.

1-3. Model Simulation: (VFSMOD-W and Inverse Modeling Algorithm).

Mathematical models that can simulate water and/or sediment transport in VFS would be good tools for assessing the impact of human activities and natural processes on water resources and for designing BMPs to reduce these impacts. Particularly, the VFS model (VFSMOD-W, Muñoz-Carpena and Parsons, 1999) enables prediction of water and contaminant transport through VFS. VFSMOD-W is a field scale, mechanistic, storm-based model developed to route incoming hydrographs and sedimentographs from an adjacent field through VFS. VFSMOD consists of a series of modules: a time-dependent Green-Ampt infiltration module for calculating the water balance in the soil surface, a kinematic wave overland flow module for determining flow rate and depth on the infiltrating soil surface, and a sedimentation module for simulating transport and deposition of the incoming sediment along the VFS. The model uses time dependent hyetographs and field (inflow) runoff hydrographs, space distributed filter parameters (vegetation roughness or density, slope, infiltration characteristics), and various characteristics of incoming sediment. Model outputs include the infiltration, surface runoff hydrograph, and sedimentograph from the VFS, and its sediment and runoff trapping efficiencies.

USEPA (2005) listed VFSMOD-W as one of models to evaluate the efficiency of the BMP in VFS for protecting watershed environments. VFSMOD-W was successfully tested with natural events data from the Coastal Plain (Muñoz-Carpena, 1993) and the North Carolina Piedmont (Muñoz-Carpena et al, 1999a). Researchers in Canada (Abu-Zreig et al., 2001; Gharabaghi et al., 2001) reported a good agreement (R^2=0.9) with a highly significant ($p<0.01$) linear relationship between model predictions and measured values in infiltration, outflow and sediment trapping efficiency. Abu-Zreig (2001) and Abu-Zreig et al., (2003) also investigated the principal factors that affect trapping performance of VFS using VFSMOD-W. Rudra et al., (2002) incorporated an empirical phosphorus component to the VFSMOD-W to estimate the phosphorus yield. VFSMOD-W has also been used to model the effect of VFS on a small watershed (72 ha) (Kizil and Disrud, 2002), as well as a component to simulate fecal pathogen filtering from runoff (Zhang et al., 2001). VFSMOD-W was conjugated with the AnnAGNPS model to simulate the pollution trapping efficiencies of VFS and to examine cost-effective targeting of land retirement for establishing riparian buffers in an agricultural watershed in Ontario, Canada (Yang and Weersink, 2004). VFSMOD-W was successfully simulated the total suspended sediment removal from an experimental VFS treating highway runoff (Han et al., 2005). Therefore, the VFSMOD-W has been identified as a potential BMP design tool used to reduce surface phosphorus runoff from the reclaimed phosphate mines in Florida (specifically in Polk County) and other similar areas elsewhere.

The success in modeling such processes heavily depends on the quality of the model parameters, i.e. if they are representative of the hydraulic properties of the soil and the vegetated filter. Thus, the first step in applying VFSMOD-W to predict outflows from VFS is to find these optimal parameters. An inverse modeling procedure provides effective parameters in the range of envisaged model applications and overcomes the drawbacks of manual calibration. The GMCS-NMS (Global Multilevel Coordinate Search combined with a Nelder Mead Simplex) is a powerful optimization algorithm to numerically solve inverse problems (Ritter et al., 2003). GMCS-NMS has been integrated within the VFSMOD-W (Ritter et al., 2007) graphical user interface to allow the model users to perform inverse optimization of the parameters of VFSMOD-W.

Uncertainty of measured data can result from field measurement, water sample collection and storage, and water quality analysis (Harmel et al., 2006). The hydrologic/water quality models are increasingly applied to guide decision-making in water resource management. The consideration of uncertainty in measured data can allow decision makers/modelers to more realistically evaluate model performance.

1-4. Objectives

The main objectives of this study were to:

1 Assess the surface runoff P pollution from mining sand tailings in the upper Peace River basin and investigate the efficiency of VFS in reducing P and sediment transports from the surface runoff of reclaimed mining areas.

2 Study the relationship between apatite and DP concentration in runoff water.

3 Model VFS P transport reduction from mining sand tailings using the VFSMOD-W.

These three objectives are developed in Chapters 2-4 of this report.

Table 1-1. Performance of VFS in reducing runoff pollution.

Researchers	Hillslope characteristics (slope; soil; runoff)	Filter length (m)	Trapping efficiency (% of inputs retained) or improvement in water (% change in pollutant concentration)					
			Total Sediment	Total P	PO_4^{2-}	Total N (TKN)	Nitrate (NO_3^-)	NH_3-N
Dillaha et al. (1989)	Slopes 5, 11, 16%; silty loam; crops; simulated rainfall.	4.6 9.1	53~86 70~98	49~73 65~93	-83~69 -31~48	43~82 56~91	2~72 22~78	9~74 42~89
Magette et al. (1989)	Slopes 3–6%; fertilised sandy loam; simulated intense, frequent rainfall.	4.6 9.1	66 82	27 46		-15 35		
Chaubey et al. (1994)	Slope 3%; simulated rainfall at an intensity of 50 mm/h two days following litter application. The duration of simulated rainfall was 1 hour after the beginning of runoff.	3.1 6.1 9.2 15.2 21.4		39.6 58.4 74.0 86.8 91.2	38.8 55.1 70.5 84.9 89.5	39.2 53.5 66.6 75.7 80.5		46.6 69.8 77.6 94.1 98.0
Robinson et al. (1996)	Slopes 7, 12%; soils were 77% silt, 18% clay, 2% organic matter; 13 rainfall events.	3 9.1	70 85					
Patty et al. (1997)	In La Jailliere site: mean plot slope 7%; soil type: silt loam with clay 20%, silt 45%, sand 33%, organic matter 2%.	6 12 18	87 100 100		42 22 89		47 69 99	
	In Bignan site: mean plot slope 10%; soil type: silt loam with clay 16%, silt 43%, sand 34%, organic matter 7%.	6 12 18	98.9 99.0 99.9		0 46 83		85 97 100	
	In Plelo site: mean plot slope 15%; soil type: silt loam with clay 12%, silt 47%, sand 38%, organic matter 3%.	6 12 18	91 97 98		79 89 89		86 95 97	
Abu-Zreig et al. (2003)	Slope 2.3, 5%; artificial runoff with P concentration of 2.37 mg/L and a sediment concentration of 2700 mg/L; soil type is silt loam with sand 38%, silt 54%, and clay 8%.	2 5 10 15	70 83 91 92	32 54 67 79				

CHAPTER 2
RUNOFF WATER QUALITY POLLUTION FROM PHOSPHATE MINING AREAS AND CONTROL BY VEGETATIVE FILTER STRIPS

2-1. Introduction

Florida is rich in phosphate rock formed millions of years ago under ocean waters. Phosphate Rock (PR) was discovered in the late 1880's in central Florida, Polk County. Phosphate is a key ingredient in fertilizer and cannot be synthesized; so phosphate mining is the only supply. Phosphate mining in the Peace River watershed (Polk County, Florida) has disturbed the land and affected water quality. The Peace River is 193 km in length. The Peace River watershed is approximately 5,670 km^2 in size. The largest land uses are agricultural and mining. Agricultural lands account for nearly 50 % including pastureland (SFWMD, 2004). The actively mined lands increased from 0.5 % to 10.3 % (from 30.4 km^2 to 580.7 km^2) of watershed during 1940-1999. Urban or built-up lands account for about 10 %. Undeveloped lands consisting of forest, water, and wetlands make up the remaining 30 % of the land uses.

Hanna and Anazia (1990), He et al. (2003), and Guidry and Mackenzie (2003) investigated the dissolution of Florida's phosphate rock. The dissolution rate of phosphate rock in soil solution is mainly affected by soil pH, moisture content, P and Ca concentrations (Chien and Menon, 1995; Babare et al., 1997). Phosphorus in runoff is generally divided into particulate phosphorus (PP) and dissolved phosphorus (DP) by filtration through a 0.45 μm filter. Surface runoff carries DP in organic and inorganic P forms, while PP is carried in sorbed P, organic P, and mineral P forms (McDowell and Sharpley, 2001a). Loading of P in runoff is heavily influenced by soil properties and land management practices (He et al., 2003). The soil properties such as fractions of clay and silt, organic matter, pH, ion and aluminum oxides affect the desorption of DP from PP and adsorption of DP onto sediment (Sharpley et al., 1981; Vadas and Sims 2002). In addition, rainfall intensity, runoff duration, and a water/soil ratio also dominate the desorption of soil P for a runoff event in agricultural lands (McDowell and Sharpley, 2001b; Storm et al., 1988).

Hanna and Anaziz (1990) found that the main mineral in Florida's PR is carbonate-fluorapatite (CFA, also called francolite). Decreasing particle size or increasing soil moisture content increases the percentage dissolution rate of PR (He et al., 2003). Guidry and Mackenzie (2003) reported that the dissolution rates of fluorapatite (FAP) and CFA are highly dependent on pH. Apatite can be partially dissolved immediately with contacting runoff water. Thus, once runoff occurs in the mining lands, these can be potential sources of DP into surface water bodies. The average DP concentration in the Peace River at the Bartow sub-basin has declined from 18 mg/L to 1.23±1.93 mg/L from 1965 to 2005 due to the changes in mining practices (DEP, 2006 and SFWMD, 2001). Concentration of TP was 1.38±1.93 mg/L from 1990 to 1995. However, the DP concentration was still higher than U.S. Environmental Protection Agency (USEPA) criterion of TP concentration (0.1 mg/L) discharging into a river (USEPA, 1986; Mueller et al., 1995).

The VFS studies have been widely applied in agricultural lands since the late 1970s; however, the VFS studies have not been applied in phosphate mine areas. The primary objectives of this study were to assess the surface runoff P pollution from the mining sand tailings (bare source areas) in the upper Peace River basin and investigate the efficiency of VFS in reducing phosphorus and sediment transports from the surface runoff of reclaimed mining areas under varied lengths, source areas, slopes, incoming flow rates, runoff volumes, rainfall intensities, soil properties, and densities of vegetation cover in experimental sites.

2-2. Methods and Materials

2-2-1. Field Experiments

Two field experiments were conducted in the property of the Bureau of Mine Reclamation, Florida Department of Environmental Protection (FDEP), Bartow, FL (Figure 2-1). The land was originally used for phosphate mining. The phosphate mine company ceased to excavate PR and donated the land to the Bureau of Mine Reclamation in the 1980's. Two experimental sites (site A and site B) 3 km apart were chosen to represent the bare disturbed mining lands in the upper Peace River watershed. Each experimental site contained a set of runoff plots including bare source areas with down slope grass filter of different dimensions (four plots in both VFS and source areas). The bare source areas were kept with no vegetation by gently pulling weeds to avoid disturbing areas.

The dimensions of the plots for sites A and B are shown in Figure 2-2. The average slopes of site A and site B are 2.0 %, and 4.3 %, respectively. The lengths of the source areas at site A and site B are 14.4 m and 40.0 m, respectively. The lengths of the filters were 4.1 m and 5.8 m at site A and 6.8 m and 13.4 m at site B, respectively. Thus, two different source area–to–VFS area ratios of 2.5 and 3.5 in site A and 3.0 and 6.0 in site B were used to determine their effects on performances of VFS. The width of each plot was 3.3 m. Each plot was separated by boards consisting of plastic plates inserted vertically a minimum of 10 cm to avoid lateral runoff losses. Locations of instruments installed in the field to convey runoff, collect water samples, and record data (i.e. flow rate, soil moisture, and rainfall intensity) are shown in Figures 2-2 and 2-3. Runoff was collected in a rain gutter buried at the outlet of each plot from where it flowed into a flume and sampling trough (Figure 2-4). Then, runoff from the source area was redistributed through a runoff spreader into the filter (Figure 2-4). The runoff spreaders were made of perforated PVC pipes installed at the entry of the VFS. A cover was installed to avoid direct rain falling into the runoff gutter (Figure 2-4). Six-inch (15.24 cm) HS flumes were used to measure the flow rate (Figure 2-5). To automatically record flow rate the stage of each flume was recorded using a capacitance probe (ECH$_2$O, model EC-20, Decagon Devices, WA) inserted vertically in the throat of each flume (Figure 2-5). The probes were tested in the laboratory and were found to give an excellent relationship ($R^2 = 0.996$,

Figure 2-7) between depth of submersion into a water column and output voltage. The C_{eff_m} and *RMSE* of measured depth and predicted depth obtained from equation in Figure 2-3 are 0.942 and 0.402. The output voltage-flow rate relationship for the HS-flume was obtained and fitted to an exponential relationship ($R^2 = 0.997$, Figure 2-8). The C_{eff_m} and *RMSE* of measured flow rate and predicted flow rate obtained from equation in Figure 2-4 are 0.959 and 0.00012. The detailed description about C_{eff_m} and *RMSE* are presented in Appendix B.

A field datalogger (CR-10X, Campbell Scientific, UT) was programmed to record flow rate from the capacitance probe in each flume every minute. To avoid changing the measurement of flow rate in the flume, runoff water samples were collected at each trough positioned below the flume outlet by an automatic water sampler containing 24 plastic sampling bottles (ISCO 6712, ISCO, Inc.) as shown in Figure 2-5. The datalogger sent pulses to the ISCO 6712 automatic water sampler based on changes of accumulated runoff volume recorded at each flume in an effect to distribute the 24 samples throughout the runoff event. After activation, the sampler purged the suction hose and then collected runoff water samples from the trough into the 500 mL bottles. Runoff samples were analyzed for concentrations of sediment, TP, and DP. Loads and flow-weighted mean concentration were computed for each collected event.

Another capacitance probe was used to measure soil moisture in each of the plots (Figures 2-2 and 2-5). The soil moisture was measured every minute and the averaged data for every 30 minutes was recorded in the CR-10X datalogger. The capacitance probe was calibrated in a PVC cylinder containing soil with a bulk density similar to the field condition. The soil was saturated and weight and voltage measurements were taken periodically as the water drained and evaporated (Appendix A). To measure rainfall intensity, a rain gauge (Texas Electronics, Inc TR-525M tipping bucket rain gauge) was installed between the source and the filter area. The rainfall data were recorded in the datalogger every minute. All outputs from the sensors were delivered to the CR-10X datalogger through a relay multiplexer (AM416, Campbell Scientific, UT). Two groundwater observation wells with a pressure sensor and a barometric atmosphere sensor (Figure 2-6) were installed to observe groundwater level since the water table in the cannel ever raised a height of three meters during the hurricane season in 2004.

A solar panel was installed to charge the batteries to supply the electric power for the CR-10X and water samplers. In order to download data remotely and audit the field instruments, wireless serial communication equipment (Figure 2-5) using long distance bluetooth (Promi-SD, Initium, Korea) was installed to access each of the sites CR10Xs from a computer at the experimental station office (about 2 km away from the sites). The computer at the experimental station office was then accessed through the telephone modem from the University of Florida main campus in Gainesville (277 km away). Daily remote monitoring of the sites allowed for quick collection of samples after major events.

2-2-2. Characterization of Experimental Sites

Saturated hydraulic conductivity (K_s), soil texture, porosity, grass spacing, and slope were measured to investigate the surface runoff movement and infiltration. Core cylinders made of brass with 5.4 cm diameter and 6.0 cm height (Soilmoisture Equipment Corp, CA) were used to collect undisturbed soil samples. The soil cores were then saturated with 0.005 M $CaSO_4$-thymol solution and the K_s was measured based on the application of Darcy's Law with a constant head permeameter (Klute and Dirksen, 1986). Saturated and final weights of the soil was measured and used to calculate bulk density and soil porosity. The average suction at the wetting front (S_{av}) was also estimated as the area under the unsaturated hydraulic conductivity ($K_{uns}(h)$) curve applying *SoilPrep* model (Workman and Skaggs, 1990). The $K_{uns}(h)$ was obtained from the Millington and

Quirk (1960) procedure. Equipment employing the "Polarization Intensity Differential Scattering" technique (Beckman-Coulter, Inc.) was used to analyze particle size distribution of soil and sediment samples. For this analysis soil samples needed to be pretreated to remove organic matter (Day, 1965). A 0.5 by 0.5 m frame was used to determine the grass spacing by counting the amount of grass stems within the frame area (Appendix A). The main vegetation in the filter areas is Bahia grass which accounts for about 90 %. The remaining vegetation is composed of Hairy Indigo, Cogon grass, and Smutgrass. The detailed description of measured soil physical and field properties (topographical survey and grass height) are presented in Appendix A.

2-2-3. Characterization of Soil and Runoff Water Chemistry

Soil chemical properties were analyzed to provide the information on the dynamics of surface runoff phosphorus transport. Soil samples were collected from the top 2 cm depths of each site since this is the zone of greatest interaction between soil and runoff water. All samples were air-dried and then sieved using a 2.0 mm mesh sieve. Soil pH was measured in a 1:1 mixture of soil:water using a pH meter (pH/Cond 340i/Set, WTW, Germany). TP was determined by ignition method: One gram of dry soil was ashed at 350℃ for 3-hour, 550℃ for 2-hour, and then digested with 6M HCl (Anderson, 1976). The water soluble phosphorus (WSP) of soil samples was measured by 2-hour extraction with deionized water at a solution/soil ratio of 10:1. Soil organic carbon (OC) was measured by the Walkley-Black oxidation procedure (Nelson and Sommers, 1982). TP in water samples was determined by persulfate digestion according to USEPA Method 365.3 (USEPA, 1982). DP in the water sample was determined by filtering through the 0.45 μm membrane filter. The concentrations of DP and TP and WSP were determined by the molybdate blue method (Murphy and Riley, 1962).

2-3. Results and Discussions

Table 2-1 shows the characteristics of experimental sites. USDA soil texture is sandy, where clay and silt fractions are 4.2 % and 5.6 % in sites A and B, respectively. The saturated hydraulic conductivities agree with that of sandy soils, ranging between 20 to 31 cm/h and 1.6 to 6.4 cm/h for sites A and B, respectively. The mean concentration of WSP in site B is 25.6 mg/kg which is higher than 16.2 mg/kg in site A. The TP concentrations of soil in both sites are in the range 19,600 - 27,900 mg/kg. The mean grass spacing was found to be 4.5 cm in site A and 3.7 cm in site B. The pH in both sites ranges from 6.09 to 6.32 with OC ranges of 0.27 to 0.76 % in site A and of 1.11 to 1.70 % in site B.

The field data at site A were collected during 2006 (total rainfall 722 mm), while at site B were collected from June to December during the rainy season (rainfall 506 mm). An approximate annual rainfall of 682 mm was recorded at a weather station near site A (1 km apart). During the rainy season of year 2006, the groundwater tables ranged from 1.9 m to 2.4 m and from 1.5 m to 2.0 m in observation wells 1 and 2, respectively. The runoff was only driven by the excess rainfall instead of the shallow groundwater table. Runoff events recorded in year 2006 at sites A and B are shown in Table 2-2 and Table 2-4, respectively. The recorded runoff events from sources are 21 events in site A and 19 events in site B. The recorded runoff events from VFS are 14 events in site A and 11 events in site B. A higher slope, longer length, and lower K_s source area contributes a higher runoff volume. Consequently, larger runoff events in site B were collected compared to site A during the same monitoring period. The corresponding outflows of pollutants in site A and site B are shown in Table 2-3 and Table 2-5, respectively. As an example, observed hydrographs, pollutographs, and hyetographs of a runoff event that occurred on July 28th, 2006 in site B are shown in Figure 2-9 with the amounts of runoff volume, sediment, TP, and DP also shown in each corresponding sub-figure.

2-3-1. Overland Flow Modification by the Grass Filters

The trapping efficiency (TE) of the filter is defined as the ratio of the difference between inflow and outflow from the filter divided by the inflow of the filter. This concept is applied to overland flow changes happening at the filter expressed both in terms of flow volume (Q) and peak flow rate (Q_P) of the incoming and outgoing hydrographs at the filter. Figures 2-10(a) and 2-10(b) show that the smaller area ratio of source/VFS has a higher runoff volume TE (QTE) and peak flow rate TE (QPTE) compared to the larger ratio in both sites. The mean K_s in filters in sites A and B are 20 and 6.4 cm/h, respectively. Figure 2-10(a) shows that QTE at site A is more variable with area ratio than at site B due to the larger K_s value at site B (mean K_s in VFS in sites A and B are 20 and 6.4 cm.h, respectively). The same results are found in QPTE (Figure 2-10(b)). For each event, the small or negative QTE values occurred in the small rainfall intensity with the lower θ_i in source areas and the higher θ_i in filters. This is because the lower θ_i in source area resulted in the lower incoming runoff volume to VFS, and the higher θ_i in VFS resulted in the higher outflow volume. Figure 2-11 shows that the slope of QTE/QPTE is near zero which means the same factors control Q and Q_P in VFS. Thus, the area ratio, K_s in VFS, rainfall intensity, and difference in initial soil moisture between source and filters affect the QTE and QPTE in VFS.

2-3-2. Trapping Efficiencies of Sediment and Phosphorus Fraction

Based on the hydrological and pollutant transport data, the TE of Q, Q_P , and pollution loads in filters of sites A and B were calculated as shown in the Table 2-10 and Figure 2-10. As results, the sediment TE (STE) and TP TE (TPTE) in both sites are both greater than 0.96 as shown in Figure 2-10(c) and 2-10(d), respectively. Although the QTEs in the VFS areas at both sites are between

0.62 and 0.86, the STEs and TPTEs are higher than 0.96 with small standard deviation error. This is because the high amounts of incoming coarse particles are mostly deposited in the first meter of the filter (Muñoz-Carpena and Parsons, 2004) and apatite (one kind of phosphate rock) was found in experimental sites and distributed in particle sizes from clay to coarse sand (Chapter 3). The TPTEs are smaller than STEs in both sites, since the TP consists of DP and PP, and although PP depends directly on the STE, the DP is related to the flow changes in the filter. In addition, lower QTE in the higher area ratio of site A contributes to the smaller STE and TPTE than in the smaller area ratio. The shorter length in site A should be enlarged to increase STE and TPTE. Figure 2-11 shows that the slope of the TPTE/STE line is approximately zero, and thus their movements in VFS are dominated by the same factors. TP in water samples contain a high fraction of PP (mineral P, apatite), thus STE and TPTE are very close.

The smaller area ratio in site A has a higher DP TE (DPTE) than larger area ratio, but in site B has a lower DPTE than the larger area ratio (Figure 2-10(e)). This resulted from the higher QTE and the mean DP concentrations of collected events from VFS being lower than those from source areas at site A (Figure (2-12)). At site B, the longer filters (smaller area ratio) may increase the runoff travel time, and thus increase the amount of DP released to runoff water. Thus, the mean DP concentrations of collected events from VFS are higher than those from source areas at site B (Figure (2-12)).

2-3-3. Sediment Delivery Capacity in Runoff

In the source areas, the sediment yields can be estimated from equations (2.1) and (2.2) as shown in Figure 2-9. Eq. (2.1) can be applied in areas within the study region with higher saturated hydraulic conductivity and shorter bare source areas. Eq. (2.2) can be applied in areas with lower saturated hydraulic conductivity and longer source areas. The lower slope and higher K_s in site A increase infiltration and decrease Q_P and Q. Thus, even a longer duration rainfall event accumulates higher Q, but Q_P is still lower resulting in the lower sediment capacity.

Site A (slope 2.0%, 14.4m*694m): $Sed = 5{,}609(Q*Q_p)^{0.620}$ $\quad R^2 = 0.955$ (2.1)

Site B (slope 4.3%, 40m*250m): $Sed = 87{,}344(Q*Q_p)^{0.929}$ $\quad R^2 = 0.937$ (2.2)

where *Sed* is sediment yield (kg/ha); *Q* is flow volume (m^3); Q_P is peak flow rate (m^3/s). The power equations similar to the one proposed by Foster et al. (1982) were used to describe the relationships among sediment yields, runoff volume, and peak flow rate for each runoff event.

P concentration in each particle size class of soil was determined in Chapter 3. The P concentration in finer particles is significantly greater than that in coarser particles as shown in Table 3-5. Linear equations were used to describe the relationships between outflows of PP and sediment from VFS and source areas (Figure 2-14).

VFS: $PP = 0.02606 * Sed$ $\quad R^2 = 0.988$ (2.3)

Source: $PP = 0.02270 * Sed$ $\quad R^2 = 0.977$ (2.4)

where *Sed* is weight of sediment (g); *PP* is weight of particulate P (g). Sediment from VFS, after filtering through, contains a high fraction of fine particles and thus contains a high amount of PP based on the same weight from source areas. Thus, the slope coefficient of the linear equation of VFS is higher than that of the source area.

2-3-4. Estimations of Curve Number and Runoff Volume

The USDA Natural Resource Conservation Services (Formerly Soil Conservation Services) curve number (SCS, 1986) method is a simple and widely used method for determining the amount of runoff from a rainfall event in a particular area. The curve number (CN) value is determined from land use, treatment and hydrologic condition. For a rainfall event, when soil and depression area storage approach ultimate saturation, storage will approach the potential soil water retention (*S*) and infiltration rate approaches zero. Three antecedent soil moisture conditions have been defined for both sites. Based on the recorded data in site A, condition I, II, and III represent initial soil moisture (θ_i; units: m^3m^{-3}) at 0-0.04, 0.04-0.08, and 0.08-0.12, respectively. Condition I, II, and III represent initial soil moisture (θ_i) at 0.10-0.20, 0.20-0.30, and 0.30-0.40, respectively, in site B.

Curve number can be obtained from the empirical Eqs. (2.5) and (2.6) as follows:

$$Q = \frac{(P - 0.2S_{max})^2}{(P + 0.8S_{max})}, \qquad P > 0.2S_{max} \tag{2.5}$$

$$S_{max} = \frac{25400}{CN} - 254, \qquad (Q, P, S_{max}: \quad mm) \tag{2.6}$$

S_{max} of each antecedent condition in both sites were obtained from Eq. (2.5) based on the measured Q and P. In site A, S_{max} volumes are 60.5 mm, 58.4 mm, and 45.0 mm, in condition I, II, and III, respectively. In site B, S_{max} volumes are 38.5 mm, 29.4 mm, and 13.2 mm, in condition I, II, and III, respectively. Once S_{max} was obtained, curve number can be calculated from Eq. (2.6). In site A, curve numbers are 81, 82, and 83, in condition I, II, and III, respectively. In site B, curve numbers are 87, 90, and 95, in condition I, II, and III, respectively. The higher slope and higher θ_i in site B resulted that the curve numbers in site B are greater than those in site A. With known S_{max} of each antecedent condition in both sites and the total rainfall, the runoff volume can be estimated from Eq. (2.5) as shown in Figures 2-15 and 2-16. The Nash and Sutcliff coefficient of efficiency (C_{eff}, shown in Appendix B) of estimated and observed runoff volume in sites A and B are 0.87 and 0.92, respectively.

The second antecedent soil moisture condition (θ_i=0.04-0.08 in site A, and θ_i=0.20-0.30 in site B) was applied to estimate curve numbers for antecedent conditions I and III using the standard TR-55 correction equations based on antecedent condition II (SCS, 1986). The curve number in antecedent conditions I and III are 66 and 91, respectively, in site A, and are 78 and 95, respectively, in site B. However, the definition of antecedent condition II is total 5-day antecedent rainfall in range of 1.27 - 2.79 cm (Chow et al., 1988). The antecedent conditions in site A can be one antecedent condition since initial soil moisture only ranges from 0.02 to 0.10 and the three fitted equations are very close as shown in Figure 2-11.

2-3-5. Estimated Yearly Pollutant Yields

For runoff events in plots where insignificant flow was available to collect water samples, the concentrations of pollutants were calculated from regression equations obtained for the appropriate flow rate ranges as presented above. The missing events during year 2006 at site B were assumed to have the same rainfall intensity as site A. The outputs of sediment, Q, TP, and DP for missing events at site B were estimated from the outputs of the approximate rainfall intensity at site B. Consequently, the yearly outflows of sediment, TP, DP, and Q from source and VFS areas are illustrated in Figure 2-17. In the lands with 4.3 % slope, 1.6 cm/h K_s, and runoff lengths of 40 m, yearly outflows of Q, sediment, TP, and DP were 1,300 m^3/ha, 4,550 kg/ha, 104 kg/ha, and 2.21 kg/ha, respectively. In the landscape with 2.0% slope, 31.0 cm/h K_s, and runoff lengths of 14.4 m, yearly outflows of Q, sediment, TP, and DP were 615 m^3/ha, 240 kg/ha, 6.12 kg/ha, and 0.27 kg/ha, respectively. Higher Q_P and Q has a higher transport capacity to deliver sediment and pollutants (Foster et al., 1982). The length of filter should be enlarged to reduce runoff and pollutants transport in higher slope and lower K_s lands, which contribute to the higher Q and Q_P.

2-4. Conclusions

A value of 2.3 % of TP was found in soil samples of the reclaimed mining areas in the upper Peace River basin. DP concentrations from source and VFS areas range from 0.4 to 3.0 mg/L, which exceeds EPA criterion of P concentration (0.1 mg/L) discharging into a river. A range of field conditions were studied and it was found that a significant amount of runoff volume and sediment transport capacity occurred in the exposed surface lands. In the lands with 4.3% slope, 1.6 cm/h K_s, and runoff lengths of 40 m, yearly outflows of Q, sediment, TP, and DP were 1300 m^3/ha, 4550 kg/ha, 104 kg/ha, and 2.21 kg/ha, respectively. In the landscape with 2.0 % slope, 31.0 cm/h K_s, and runoff lengths of 14.4 m, yearly outflows of Q, sediment, TP, and DP were 615 m^3/ha, 240 kg/ha, 6.12 kg/ha, and 0.27 kg/ha, respectively. Vegetative filter strips (grass buffers) adjacent downstream from these source areas considerly reduce runoff and DP (>60%) and also transports of sediment and TP (>96%).

The length of filters, soil saturated hydraulic conductivity (K_s) in filters, rainfall intensity, and initial soil moisture were the main factors controlling the changes of runoff volume and peak flow rate in filters. TP in water samples contained a high fraction of PP (apatite), thus STE and TPTE were closely related in both sites and were controlled by the same factors. Since phosphate rock exists in soil, movement of PP and sediment in VFS are highly correlated (R^2=0.97-0.98). In site A, lower Q obtained in the 4.1 m filters (larger area ratio) resulted in lower STE compared to the 5.8 m filters (smaller area ratio). In site B, there were no significant differences in the STE and TPTE of 6.8 m and 13.4 m filters. The shorter filters (larger area ratio) were almost as effective as the longer filters (smaller area ratio) in trapping sediment and TP since in both cases the removal efficiency was very large. The longer filters with lower K_s at site B increased the runoff travel time, and thus seemed to increase the DP mass released from apatite.

Power equations were found to describe well (R^2=0.93-0.96) the relationships between sediment yields and product of runoff volume and peak flow rate (Q* Q_P), for each runoff event. To aid in future BMP design efforts, the source areas curve numbers from the Soil Conservation Service TR-55 methods (SCS, 1986) were fitted to the experimental data collected on-site. This will be useful in future VFS design efforts.

Table 2-1. Characteristics of the experimental sites A and B.

Site	Plot	Length (m)	Slope (%)	Width (m)	Grass Spacing (cm)	Soil					
						Texture* (%)	K_s (cm/h)	WSP[#] (mg/kg)	TP (mg/kg)	pH	OC (%)
A	Source	14.4	1.9	3.3	--	(1.4,1.7,96.9)	31±8	15.2±3.3	19,600±5,000	6.09±0.15	0.27±0.23
	VFS	5.8 4.1	2.2	3.3	4.49±0.25	(2.5,2.9,94.6)	20±10	17.3±6.2	27,900±4,100	6.37±0.19	0.76±0.40
B	Source	40	4.3	3.3	--	(1.8,3.5,94.7)	1.6±6.8	25.0±3.0	25,700±6,800	6.18±0.13	1.70±0.31
	VFS	13.4 6.8	4.3	3.3	3.73±0.48	(2.5,3.4,94.1)	6.4±6.9	28.6±6.6	20,300±4,300	6.32±0.21	1.11±0.48

*: % (clay, silt, sand) where clay: <2µm, silt: 2-37µm, sand: >37µm.
#: WSP: water soluble phosphorus.

Table 2-2. Intensity, duration, and amount of rainfall with corresponding runoff volume, peak flow rate, and initial water moisture in site A.

Event	Rain	Time	I_{30}[1]	A-Source-1[2]			A-Source-2			A-Source-3			A-Source-4			A-VFS-1			A-VFS-2			A-VFS-3			A-VFS-4		
Date	(mm)	(min)	(mm/h)	Q[3]	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i
01/18	6.9	110	5.6	0.000	0.000	0.04	0.000	0.000	0.03	0.000	0.000	0.03	0.000	0.000	0.02	0.000	0.000	0.03	0.000	0.000	0.11	0.000	0.000	0.15	0.000	0.000	0.09
02/3	33.4	430	32.2	0.867	1.053	0.11	0.969	1.035	0.09	1.083	1.107	0.11	1.048	1.073	0.11	0.051	0.090	0.05	0.053	0.090	0.05	0.018	0.024	0.02	0.056	0.083	0.05
02/26	7.7	42	12.4	0.012	0.010	0.04	0.014	0.017	0.04	0.000	0.000	0.04	0.027	0.024	0.03	0.000	0.000	0.06	0.006	0.011	0.15	0.000	0.000	0.20	0.004	0.005	0.03
03/23	5.8	120	6.2	0.000	0.000	0.03	0.008	0.007	0.02	0.000	0.000	0.03	0.000	0.000	0.02	0.000	0.000	0.02	0.000	0.000	0.08	0.000	0.000	0.13	0.000	0.000	0.05
06/02	2.3	46	4.6	0.000	0.000	0.05	0.000	0.000	0.05	0.000	0.000	0.05	0.000	0.000	0.05	0.000	0.000	0.05	0.000	0.000	0.11	0.000	0.000	0.18	0.000	0.000	0.10
06/02	16.3	38	26.6	0.013	0.010	0.05	0.007	0.008	0.05	0.012	0.013	0.05	0.013	0.010	0.05	0.007	0.009	0.04	0.012	0.010	0.10	0.000	0.000	0.18	0.000	0.000	0.09
06/11	4.2	30	8.4	0.000	0.000	0.04	0.000	0.000	0.04	0.000	0.000	0.04	0.000	0.000	0.03	0.000	0.000	0.02	0.000	0.000	0.08	0.000	0.000	0.15	0.000	0.000	0.04
06/12	64.3	840	26.8	0.172	0.131	0.04	0.464	0.425	0.04	0.493	0.411	0.04	0.394	0.241	0.05	0.007	0.010	0.04	0.028	0.012	0.09	0.006	0.004	0.16	0.025	0.010	0.10
06/13	43.0	610	51.2	0.312	0.735	0.08	0.441	0.702	0.09	0.752	1.110	0.08	0.424	0.700	0.08	0.235	0.545	0.08	0.075	0.060	0.18	0.381	0.892	0.27	0.166	0.454	0.14
06/25	10.9	230	9.6	0.000	0.000	0.06	0.000	0.000	0.05	0.000	0.000	0.07	0.000	0.000	0.07	0.000	0.000	0.06	0.000	0.000	0.12	0.000	0.000	0.18	0.000	0.000	0.13
07/02	6.3	44	12.0	0.000	0.000	0.05	0.000	0.000	0.04	0.000	0.000	0.04	0.000	0.000	0.04	0.000	0.000	0.02	0.000	0.000	0.09	0.000	0.000	0.15	0.000	0.000	0.06
07/07	24.4	44	47.4	0.100	0.203	0.05	0.130	0.305	0.05	0.182	0.485	0.05	0.132	0.285	0.04	0.034	0.056	0.03	0.048	0.107	0.09	0.057	0.123	0.14	0.045	0.091	0.07
07/14	26.3	56	29.2	0.038	0.063	0.07	0.077	0.129	0.07	0.055	0.148	0.07	0.073	0.047	0.06	0.014	0.015	0.08	0.041	0.035	0.18	0.030	0.037	0.23	0.029	0.016	0.07
07/20	20.6	50	37.2	0.028	0.029	0.07	0.036	0.037	0.07	0.037	0.051	0.07	0.027	0.038	0.06	0.013	0.008	0.07	0.013	0.008	0.18	0.016	0.010	0.24	0.017	0.008	0.11
07/23	5.2	14	10.4	0.007	0.010	0.06	0.000	0.000	0.06	0.007	0.010	0.06	0.000	0.000	0.06	0.000	0.000	0.06	0.006	0.008	0.16	0.000	0.000	0.22	0.003	0.005	0.09
07/28	31.4	54	60.2	0.155	0.462	0.05	0.292	0.929	0.05	0.322	1.184	0.05	0.128	0.389	0.05	0.032	0.079	0.05	0.028	0.077	0.13	0.132	0.402	0.18	0.053	0.157	0.08
08/6	5.7	14	11.4	0.000	0.000	0.04	0.001	0.003	0.05	0.000	0.000	0.05	0.000	0.000	0.04	0.000	0.000	0.03	0.000	0.000	0.10	0.000	0.000	0.09	0.000	0.000	0.07
08/14	3.9	12	7.8	0.000	0.000	0.04	0.000	0.000	0.05	0.000	0.000	0.05	0.000	0.000	0.04	0.000	0.000	0.02	0.000	0.000	0.09	0.000	0.000	0.09	0.000	0.000	0.04
08/15	6.9	115	12.2	0.000	0.000	0.05	0.000	0.000	0.05	0.007	0.008	0.05	0.000	0.000	0.05	0.007	0.012	0.03	0.000	0.000	0.10	0.000	0.000	0.09	0.000	0.000	0.06
08/23	11.6	38	16.2	0.014	0.006	0.05	0.003	0.005	0.05	0.015	0.014	0.05	0.006	0.004	0.04	0.000	0.000	0.03	0.000	0.000	0.10	0.000	0.000	0.14	0.003	0.006	0.08
08/27	8.3	77	12.6	0.009	0.006	0.08	0.000	0.000	0.08	0.012	0.010	0.08	0.000	0.000	0.07	0.017	0.027	0.07	0.000	0.000	0.16	0.000	0.000	0.24	0.021	0.014	0.15
09/02	19.2	155	26.6	0.004	0.003	0.07	0.000	0.000	0.07	0.013	0.010	0.07	0.000	0.000	0.06	0.000	0.000	0.08	0.021	0.022	0.18	0.000	0.000	0.23	0.053	0.040	0.13
09/04	11.2	226	13.6	0.020	0.006	0.06	0.000	0.000	0.07	0.000	0.000	0.06	0.000	0.000	0.06	0.000	0.000	0.07	0.000	0.000	0.17	0.000	0.000	0.22	0.006	0.007	0.12
09/06	5.3	28	10.6	0.009	0.005	0.06	0.000	0.000	0.07	0.006	0.012	0.07	0.000	0.000	0.06	0.000	0.000	0.08	0.008	0.006	0.18	0.000	0.000	0.23	0.009	0.025	0.13
09/09	39.1	89.0	42.2	0.000	0.000	0.08	0.042	0.017	0.09	0.010	0.011	0.08	0.091	0.031	0.07	0.000	0.000	0.11	0.061	0.014	0.20	0.000	0.000	0.24	0.075	0.017	0.15
09/10	35.1	81.0	57.6	0.157	0.554	0.09	0.158	0.644	0.10	0.180	0.665	0.08	0.103	0.404	0.07	0.000	0.000	0.12	0.038	0.051	0.21	0.039	0.063	0.25	0.068	0.084	0.15
09/15	8.1	47	12.2	0.050	0.031	0.07	0.000	0.000	0.08	0.000	0.000	0.07	0.000	0.000	0.06	0.013	0.006	0.09	0.010	0.008	0.18	0.000	0.000	0.22	0.012	0.011	0.13
09/19	10.5	212	14.2	0.026	0.020	0.06	0.021	0.019	0.06	0.007	0.017	0.06	0.024	0.015	0.05	0.000	0.000	0.07	0.013	0.012	0.16	0.000	0.000	0.32	0.011	0.021	0.17
10/12	6.4	34	12.6	0.000	0.000	0.04	0.000	0.000	0.04	0.000	0.000	0.04	0.000	0.000	0.03	0.008	0.013	0.02	0.010	0.013	0.02	0.000	0.000	0.05	0.006	0.013	0.03
10/28	19.1	262	14.0	0.012	0.013	0.04	0.015	0.059	0.04	0.024	0.100	0.04	0.014	0.046	0.03	0.004	0.007	0.02	0.009	0.011	0.02	0.011	0.020	0.04	0.015	0.023	0.03
12/14	18.5	172	22.2	0.114	0.408	0.04	0.064	0.239	0.04	0.103	0.356	0.04	0.036	0.151	0.04	0.009	0.020	0.03	0.030	0.023	0.03	0.026	0.110	0.07	0.068	0.178	0.04
12/24	2.3	25	4.6	0.000	0.000	0.06	0.000	0.000	0.05	0.000	0.000	0.06	0.000	0.000	0.05	0.000	0.000	0.06	0.000	0.000	0.09	0.000	0.000	0.20	0.000	0.000	0.11
12/25	23.8	219	25	0.351	0.692	0.06	0.202	0.994	0.05	0.165	0.679	0.06	0.074	0.431	0.05	0.000	0.000	0.06	0.051	0.033	0.10	0.000	0.000	0.19	0.042	0.053	0.12

(1) I_{30}: maximum 30-minute rainfall intensity; (2) A: site A; number is plot ID; (3) Q: runoff volume (m^3), Q_p: peak flow rate (L/s), $\theta_{i:}$ initial soil moisture (%).

Table 2-3. The loads of sediment, TP, and DP of selected events in site A.

Event	A-Source-1[1]			A-Source-2			A-Source-3			A-Source-4			A-VFS-1			A-VFS-2			A-VFS-3			A-VFS-4		
Date	Sed[2] (g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)
01/18	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
02/3	343	7.969	0.409	369	8.396	0.478	421	11.664	0.526	296	9.856	0.462	2.21	0.072	0.016	2.42	0.075	0.014	0.19	0.010	0.005	2.49	0.080	0.017
02/26	0.7	0.03	0.005	1.6	0.05	0.006	0.0	0.00	0.000	2.4	0.08	0.011	0.00	0.000	0.000	0.04	0.003	0.001	0.00	0.000	0.000	0.02	0.002	0.001
03/23	0.0	0.00	0.000	0.4	0.01	0.003	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
06/02	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
06/02	12.5	0.29	0.006	5.6	0.13	0.003	6.1	0.15	0.005	5.4	0.16	0.005	0.11	0.003	0.002	0.09	0.006	0.003	0.00	0.000	0.000	0.00	0.000	0.000
06/11	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
06/12	29.2	0.67	0.061	79	2.18	0.194	87.7	2.44	0.218	46.0	1.06	0.128	0.04	0.003	0.002	0.20	0.011	0.006	0.02	0.002	0.001	0.21	0.010	0.005
06/13	130	3.04	0.116	202	5.00	0.169	303	7.28	0.327	108.0	3.40	0.147	2.20	0.125	0.070	0.60	0.030	0.016	1.36	0.156	0.116	1.43	0.080	0.040
06/25	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
07/02	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.0	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
07/07	38.9	0.78	0.042	43.5	1.00	0.059	62.9	1.92	0.102	36.0	1.02	0.052	1.42	0.048	0.019	1.82	0.066	0.018	2.24	0.081	0.030	2.07	0.067	0.017
07/14	9.6	0.20	0.017	24.8	0.64	0.041	13.9	0.36	0.024	12.6	0.35	0.030	0.13	0.008	0.004	0.27	0.014	0.006	0.21	0.013	0.006	0.14	0.008	0.005
07/20	2.1	0.07	0.012	3.6	0.11	0.017	4.0	0.11	0.016	2.5	0.07	0.011	0.09	0.006	0.003	0.08	0.006	0.003	0.12	0.008	0.004	0.13	0.008	0.004
07/23	0.4	0.01	0.003	0.0	0.00	0.000	0.4	0.01	0.003	0.0	0.00	0.000	0.00	0.000	0.000	0.04	0.003	0.001	0.00	0.000	0.000	0.02	0.001	0.001
07/28	90.1	1.94	0.071	148.9	3.57	0.140	210.6	5.37	0.158	61.3	1.68	0.056	0.32	0.016	0.008	0.26	0.011	0.007	8.99	0.325	0.058	0.06	0.026	0.013
08/6	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
08/14	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
08/15	0.0	0.00	0.000	0.0	0.00	0.000	0.3	0.01	0.003	0.0	0.00	0.000	0.07	0.004	0.002	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
08/23	0.4	0.02	0.005	0.1	0.00	0.001	0.9	0.03	0.006	0.1	0.01	0.002	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.02	0.001	0.001
08/27	0.3	0.01	0.003	0.0	0.00	0.000	0.5	0.02	0.005	0.0	0.00	0.000	0.12	0.008	0.004	0.00	0.000	0.000	0.00	0.000	0.000	0.30	0.013	0.005
09/02	0.1	0.00	0.001	0.0	0.00	0.000	0.4	0.02	0.006	0.0	0.00	0.000	0.00	0.000	0.000	0.15	0.011	0.005	0.00	0.000	0.000	0.57	0.029	0.012
09/04	0.4	0.02	0.007	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.14	0.005	0.002
09/06	0.3	0.01	0.003	0.0	0.00	0.000	0.2	0.01	0.003	0.0	0.00	0.000	0.00	0.000	0.000	0.04	0.004	0.002	0.00	0.000	0.000	0.15	0.007	0.002
09/09	0.0	0.00	0.000	8.0	0.21	0.018	2.5	0.07	0.004	12.6	0.29	0.037	0.00	0.000	0.000	0.25	0.015	0.008	0.00	0.000	0.000	0.35	0.018	0.009
09/10	138	2.91	0.084	158	3.92	0.083	145.2	3.60	0.087	53.9	1.42	0.049	0.00	0.000	0.000	0.40	0.022	0.012	2.12	0.065	0.017	2.81	0.093	0.023
09/15	4.4	0.14	0.022	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.08	0.006	0.003	0.05	0.004	0.002	0.00	0.000	0.000	0.09	0.005	0.003
09/19	5.7	0.12	0.011	4.4	0.12	0.008	2.8	0.08	0.009	2.2	0.06	0.010	0.00	0.000	0.000	0.08	0.005	0.003	0.00	0.000	0.000	0.10	0.005	0.002
10/12	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.06	0.004	0.002	0.07	0.005	0.003	0.00	0.000	0.000	0.06	0.003	0.002
10/28	2.3	0.05	0.005	2.6	0.07	0.006	6.6	0.18	0.010	2.4	0.06	0.005	0.05	0.003	0.001	0.13	0.006	0.003	0.16	0.007	0.003	0.28	0.012	0.004
11/29	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
12/14	21.4	0.53	0.050	14.7	0.34	0.030	24.2	0.58	0.048	6.0	0.14	0.014	0.08	0.004	0.002	0.23	0.015	0.007	0.83	0.035	0.009	1.27	0.051	0.016
12/24	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.0	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
12/25	67.8	1.77	0.164	53.2	1.46	0.099	42.0	1.10	0.079	17.8	0.44	0.032	0.00	0.000	0.000	0.34	0.025	0.012	0.00	0.000	0.000	0.40	0.021	0.010

(1) A: site A; last number is plot ID; (2):Sed: sediment load.

Table 2-4. Intensity, duration, and amount of rainfall with corresponding runoff volume, peak flow rate, and initial water moisture in site B.

Even	Rain	Time	I_{30}[(1)]	B-Source-1[(2)]			B-Source-2			B-Source-3			B-Source-4			B-VFS-1			B-VFS-2			B-VFS-3			B-VFS-4		
Date	(mm	(min	(mm/h	Q[(3)]	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i	Q	Q_p	θ_i
06/13	9.7	54	18.2	0.563	1.007	0.32	0.404	0.722	0.16	0.191	0.451	0.14	0.268	0.365	0.26	0.047	0.112	0.22	0.024	0.067	0.15	0.006	0.009	0.39	0.017	0.019	0.22
06/14	6.1	128	9.2	0.023	0.087	0.38	0.000	0.000	0.29	0.000	0.000	0.14	0.008	0.013	0.17	0.007	0.010	0.12	0.000	0.000	0.24	0.002	0.004	0.24	0.006	0.009	0.19
06/29	2.2	34	4.2	0.000	0.000	0.34	0.000	0.000	0.21	0.000	0.000	0.11	0.000	0.000	0.10	0.000	0.000	0.06	0.000	0.000	0.09	0.000	0.000	0.09	0.000	0.000	0.12
07/02	4.6	46	8.6	0.000	0.000	0.33	0.000	0.000	0.21	0.000	0.000	0.10	0.011	0.010	0.09	0.000	0.000	0.05	0.000	0.000	0.05	0.000	0.000	0.06	0.000	0.000	0.10
07/11	7.4	48.0	14.4	0.041	0.071	0.35	0.015	0.016	0.22	0.000	0.000	0.11	0.008	0.011	0.11	0.009	0.009	0.09	0.015	0.013	0.19	0.003	0.001	0.20	0.013	0.013	0.20
07/14	23.9	70	29.8	1.980	2.229	0.39	1.178	1.436	0.25	1.413	2.148	0.12	0.513	0.676	0.13	0.917	0.893	0.13	0.321	0.590	0.23	0.427	0.757	0.24	0.061	0.069	0.12
07/20	18.9	43	33.8	1.650	3.464	0.40	1.187	2.342	0.27	1.422	2.626	0.13	0.717	1.197	0.15	0.972	1.624	0.14	0.649	1.586	0.23	0.677	1.061	0.24	0.182	0.320	0.15
07/28	20.1	50	38.4	1.185	2.702	0.35	0.596	1.663	0.22	0.925	1.648	0.12	0.384	0.796	0.14	0.593	1.078	0.11	0.150	0.344	0.17	0.262	0.462	0.18	0.022	0.043	0.08
08/05	1.7	18	3.4	0.000	0.000	0.36	0.000	0.000	0.22	0.002	0.003	0.12	0.002	0.003	0.11	0.003	0.005	0.08	0.004	0.006	0.07	0.000	0.000	0.15	0.000	0.000	0.05
08/06	6.0	14	12.0	0.275	1.558	0.36	0.125	0.967	0.22	0.132	0.990	0.12	0.070	0.559	0.11	0.008	0.020	0.08	0.010	0.036	0.07	0.007	0.020	0.14	0.005	0.012	0.05
08/13	1.4	14	2.8	0.000	0.000	0.34	0.000	0.000	0.21	0.000	0.000	0.12	0.000	0.000	0.11	0.002	0.004	0.06	0.004	0.007	0.05	0.000	0.000	0.09	0.000	0.000	0.04
08/14	2.9	15	5.8	0.000	0.000	0.34	0.000	0.000	0.22	0.000	0.000	0.12	0.000	0.000	0.11	0.007	0.008	0.06	0.012	0.016	0.05	0.000	0.000	0.09	0.003	0.003	0.04
08/15	11.0	111	16.8	0.500	0.687	0.35	0.067	0.226	0.22	0.084	0.278	0.12	0.025	0.063	0.11	0.016	0.020	0.07	0.025	0.032	0.06	0.000	0.000	0.09	0.000	0.000	0.04
08/23	4.6	68	5.2	0.010	0.007	0.36	0.000	0.001	0.23	0.000	0.000	0.13	0.000	0.000	0.13	0.005	0.006	0.10	0.010	0.021	0.08	0.000	0.000	0.11	0.002	0.004	0.04
08/26	12.9	136	12.6	0.158	0.386	0.36	0.008	0.012	0.22	0.000	0.000	0.13	0.019	0.003	0.12	0.008	0.008	0.08	0.076	0.026	0.06	0.000	0.000	0.10	0.002	0.006	0.04
08/27	6.7	102	6.8	0.148	0.487	0.39	0.002	0.010	0.29	0.000	0.000	0.16	0.000	0.000	0.17	0.008	0.010	0.16	0.026	0.021	0.18	0.000	0.000	0.15	0.002	0.006	0.07
08/28	11.0	33	21.6	0.677	1.507	0.37	0.167	0.720	0.25	0.089	0.712	0.14	0.044	0.222	0.16	0.065	0.311	0.18	0.031	0.032	0.20	0.000	0.000	0.18	0.000	0.000	0.06
08/30	7.8	137	6.6	0.005	0.009	0.37	0.000	0.000	0.26	0.000	0.000	0.14	0.000	0.000	0.16	0.007	0.008	0.20	0.041	0.016	0.23	0.000	0.000	0.20	0.000	0.000	0.08
08/30	11.2	244	3.4	0.000	0.000	0.39	0.000	0.000	0.29	0.000	0.000	0.16	0.000	0.000	0.18	0.013	0.004	0.22	0.015	0.009	0.25	0.000	0.000	0.22	0.000	0.000	0.09
09/01	10.1	149	5.6	0.004	0.015	0.38	0.000	0.000	0.25	0.000	0.000	0.14	0.000	0.000	0.19	0.042	0.006	0.20	0.037	0.012	0.23	0.000	0.000	0.21	0.000	0.000	0.08
09/02	5.5	58	7.6	0.000	0.000	0.38	0.000	0.000	0.26	0.000	0.000	0.15	0.000	0.000	0.16	0.012	0.005	0.22	0.017	0.012	0.23	0.000	0.000	0.21	0.000	0.000	0.08
09/04	11.8	132	14.4	0.000	0.000	0.38	0.000	0.000	0.24	0.000	0.000	0.15	0.000	0.000	0.17	0.026	0.008	0.21	0.032	0.015	0.21	0.000	0.000	0.21	0.000	0.000	0.08
09/06	13.1	21	17.4	0.814	2.872	0.38	0.662	2.232	0.25	0.507	1.694	0.16	0.346	1.225	0.15	0.463	1.587	0.22	0.286	1.265	0.22	0.014	0.022	0.21	0.034	0.185	0.10
09/09	62.3	210	66.2	6.593	3.324	0.37	4.277	2.839	0.24	3.919	2.518	0.16	3.109	1.981	0.15	4.842	2.037	0.21	3.829	2.364	0.21	3.513	2.172	0.21	2.879	1.563	0.10
09/10	31.0	66	47.6	2.512	2.057	0.38	1.866	1.821	0.27	1.694	1.782	0.18	1.286	1.622	0.16	1.818	1.762	0.25	1.162	1.430	0.25	0.925	1.060	0.24	1.092	1.186	0.22
09/14	8.3	132	10.2	0.014	0.008	0.37	0.025	0.013	0.24	0.000	0.000	0.16	0.000	0.000	0.13	0.001	0.003	0.23	0.000	0.000	0.23	0.000	0.000	0.23	0.000	0.000	0.15
09/15	4.9	84	7.4	0.004	0.006	0.38	0.002	0.003	0.25	0.000	0.000	0.17	0.000	0.000	0.15	0.001	0.004	0.24	0.000	0.000	0.24	0.000	0.000	0.24	0.000	0.000	0.15
09/19	20.1	378	13.2	--	--	0.37	--	--	0.23	--	--	0.15	--	--	0.12	0.016	0.007	0.21	0.009	0.005	0.21	0.000	0.000	0.22	0.000	0.000	0.12
09/20	4.2	143	3.6	0.000	0.000	0.40	0.000	0.000	0.29	0.000	0.000	0.19	0.000	0.000	0.19	0.000	0.000	0.26	0.000	0.000	0.27	0.000	0.000	0.25	0.000	0.000	0.15
10/12	18.2	32	36	0.966	3.460	0.33	0.687	2.573	0.21	0.753	2.502	0.13	0.616	2.248	0.15	0.612	1.910	0.07	0.437	1.863	0.05	0.277	0.974	0.09	0.227	1.217	0.05
11/16	1.8	51	2.2	0.000	0.000	0.32	0.000	0.000	0.20	0.000	0.000	0.14	0.000	0.000	0.11	0.000	0.000	0.04	0.000	0.000	0.05	0.000	0.000	0.11	0.000	0.000	0.06
11/16	1.6	25	3.2	0.000	0.000	0.33	0.000	0.000	0.21	0.000	0.000	0.14	0.000	0.000	0.12	0.000	0.000	0.04	0.000	0.000	0.05	0.000	0.000	0.11	0.000	0.000	0.07
11/29	2.1	55	3.2	0.003	0.008	0.32	0.002	0.007	0.20	0.000	0.000	0.15	0.000	0.000	0.11	0.003	0.006	0.03	0.003	0.005	0.04	0.000	0.000	0.08	0.002	0.004	0.07
12/03	0.2	108	0.2	0.000	0.000	0.32	0.000	0.000	0.20	0.000	0.000	0.15	0.000	0.000	0.11	0.000	0.000	0.04	0.000	0.000	0.05	0.000	0.000	0.08	0.000	0.000	0.07

(1) I_{30}: maximum 30-minute rainfall intensity; (2) B: site B; number is plot ID; (3) Q: runoff volume (m^3), Q_p: peak flow rate (L/s), $\theta_{i:}$ initial soil moisture (%).

Table 2-5. The loads of sediment, TP, and DP of selected events in site B.

Event	B-Source-1[1]			B-Source-2			B-Source-3			B-Source-4			B-VFS-1			B-VFS-2			B-VFS-3			B-VFS-4		
Date	Sed[2] (g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)	Sed(g)	TP(g)	DP(g)
06/13	134	3.04	1.06	94.9	2.35	0.67	20.47	0.50	0.30	22.5	0.522	0.305	3.71	0.126	0.062	1.30	0.071	0.041	0.29	0.010	0.006	0.51	0.036	0.021
06/14	4.22	0.13	0.03	0	0	0	0	0	0	0.29	0.015	0.009	0.05	0.007	0.006	0	0	0	0.009	0.002	0.001	0.06	0.010	0.008
06/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07/02	0	0	0	0	0	0	0	0	0	0.40	0.021	0.012	0	0	0	0	0	0	0	0	0	0	0	0
07/11	7.13	0.22	0.06	0.88	0.04	0.02	0	0	0	0	0	0	0	0	0	0.56	0.03	0.02	0	0	0	0	0	0
07/14	6930	150	4.17	2635	54.1	2.31	4026	100.2	2.64	560	12	0.84	162	5.55	1.81	59.1	1.97	0.60	59.7	2.19	0.80	2.31	0.14	0.09
07/20	7735	186	3.32	4668	110.4	2.24	6815	143	2.29	2099	51	1.16	316	10.1	1.78	202	6.86	1.16	116	4.52	1.17	18.9	0.70	0.27
07/28	5012	121.1	1.49	2140	47.8	0.70	2788	65.3	1.12	724	18	0.39	140	4.46	0.99	9.75	0.46	0.23	34.3	1.33	0.42	0.23	0.04	0.03
08/05	0	0	0	0	0	0	0.036	0.003	0.002	0.04	0.003	0.002	0.029	0.004	0.003	0.11	0.006	0.003	0.000	0.000	0.000	0.000	0.000	0.000
08/06	985	21.4	0.47	343	8.14	0.16	434	10.33	0.21	21	0.49	0.108	0	0	0	0.72	0.03	0.02	0	0	0	0	0	0
08/13	0	0	0	0	0	0	0	0	0	0	0	0	0.018	0.003	0.002	0.13	0.007	0.004	0	0	0	0	0	0
08/14	0	0	0	0	0	0	0	0	0	0	0	0	0.072	0.009	0.006	0.47	0.023	0.013	0	0	0	0.003	0.001	0.001
08/15	1045	22.8	0.77	70.5	1.79	0.11	103.8	2.44	0.15	9.35	0.18	0.028	0	0	0	1.09	0.06	0.04	0	0	0	0	0	0
08/23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08/26	103	2.70	0.24	0	0	0	0	0	0	0	0	0	0	0	0	2.91	0.14	0.08	0	0	0	0	0	0
08/27	134	3.44	0.23	0	0	0	0	0	0	0	0	0	0	0	0	1.06	0.05	0.03	0	0	0	0	0	0
08/28	2864	61.3	1.27	548	12.96	0.33	476	11.20	0.31	63.2	1.48	0.103	4.435	0.23	0.10	2.23	0.09	0.04	0	0	0	0	0	0
08/30	0.15	0.01	0.01	0	0	0	0	0	0	0	0	0	0.081	0.010	0.007	1.46	0.07	0.04	0	0	0	0	0	0
08/30	0	0	0	0	0	0	0	0	0	0	0	0	0.078	0.014	0.011	0.40	0.02	0.01	0	0	0	0	0	0
09/01	0.20	0.01	0.01	0	0	0	0	0	0	0	0	0	0.392	0.052	0.038	1.27	0.06	0.04	0	0	0	0	0	0
09/02	0	0	0	0	0	0	0	0	0	0	0	0	0.105	0.014	0.011	0.58	0.03	0.02	0	0	0	0	0	0
09/04	0	0	0	0	0	0	0	0	0	0	0	0	0.235	0.032	0.024	1.09	0.06	0.03	0	0	0	0	0	0
09/06	6667	144	1.66	3322	78.0	0.99	1991	48.7	0.65	916	22.0	0.478	98	3.33	0.81	49.0	1.81	0.52	1.09	0.04	0.02	2.22	0.09	0.04
09/09	22493	515	11.25	16092	392	6.89	19992	469	6.25	11188	264	4.69	985	35.1	8.98	682	25.9	6.44	545	20.3	5.76	408	22.7	4.56
09/10	8858	192	4.18	5639	138	2.92	5843	146	2.66	3093	72.7	2.15	317	11.9	3.66	139	5.60	2.20	119	4.58	1.44	88.6	3.53	1.19
09/14	0.54	0.03	0.02	1.45	0.06	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09/19	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0	0	0	0	0	0	0
09/20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/12	4391	95.3	1.34	2245	54.1	0.89	2310	53.7	1.06	1766	41.5	0.76	225	5.33	1.14	68.7	2.69	0.69	30.7	1.23	0.42	30.3	1.19	0.34
11/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

(1) B: site B; last number is plot ID; (2):Sed: sediment load.

Table 2-6. Trapping efficiencies of runoff volume, peak flow rate, sediment, TP, and DP in the sites A and B.

Plot	Area ratio	Flow volume	Peak flow rate	Sediment	TP	DP
		Mean ± SE [1] (range)	Mean ± SE (range)	Mean ± SE (range)	Mean ± SE (range)	Mean ± SE (range)
A6[2]	2.5	0.86 ± 0.03 (0.14~1.00)	0.83 ± 0.03 (-0.28~1.00)	0.98 ± 0.01 (0.96~1.00)	0.97 ± 0.02 (0.94~1.00)	0.76 ± 0.04 (0.52~0.98)
A4	3.4	0.67 ± 0.06 (-0.86~1.00)	0.67 ± 0.06 (-0.71~1.00)	0.97 ± 0.03 (0.92~1.00)	0.96 ± 0.04 (0.87~0.99)	0.72 ± 0.05 (0.08~0.97)
B13	3.0	0.68 ± 0.05 (0.02~0.98)	0.69 ± 0.05 (0.14~1.00)	0.98 ± 0.01 (0.96~1.00)	0.97 ± 0.02 (0.95~1.00)	0.66 ± 0.08 (0.09~0.99)
B7	5.9	0.62 ± 0.07 (-0.37~1.00)	0.60 ± 0.08 (-0.33~1.00)	0.98 ± 0.01 (0.96~1.00)	0.97 ± 0.03 (0.92~1.00)	0.70 ± 0.08 (0.05~0.97)

(1) SE: standard error.
(2) A6: includes plots A-VFS-1 and A-VFS-3 (5.8 m long); A4: includes plots A-VFS-2 and A-VFS-4 (4.1 m long); B13: includes plots B-VFS-1 and B-VFS-3 (13.4 m long); B7: includes plots B-VFS-2 and B-VFS-4 (6.8 m long).

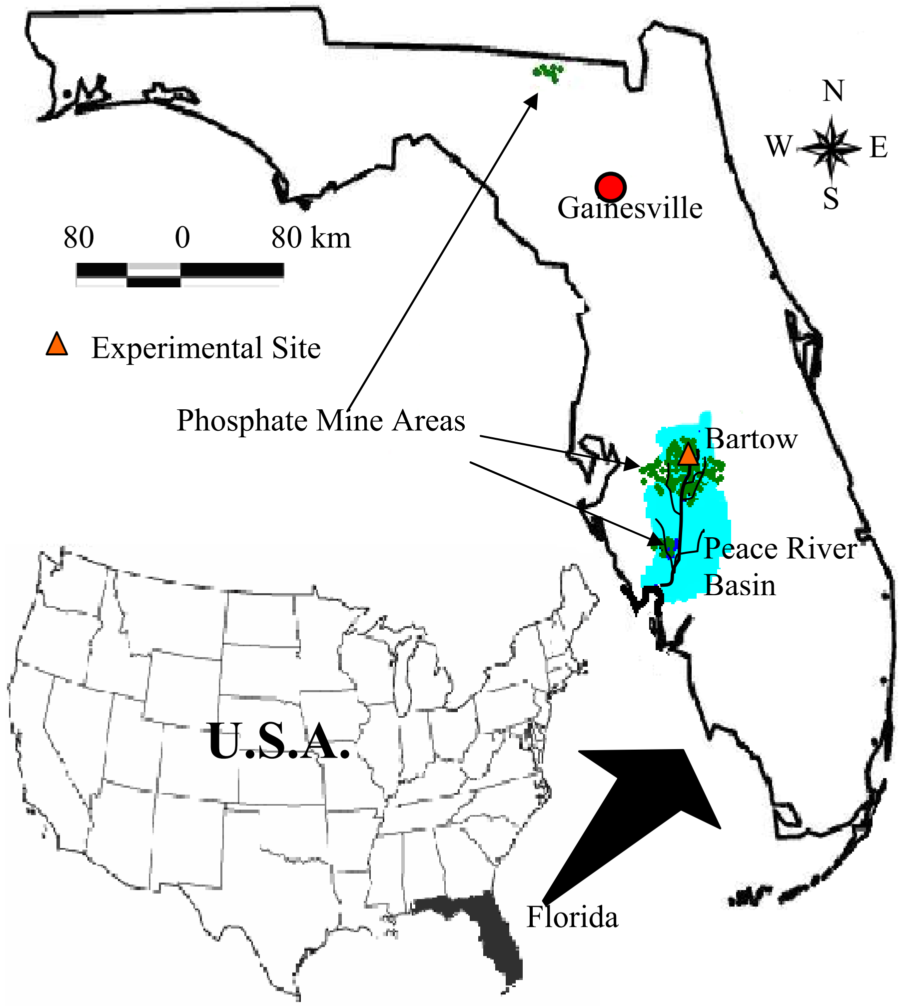


Figure 2-1. Locations of the experimental sites, phosphate mining areas, and Peace River basin in U.S.A.

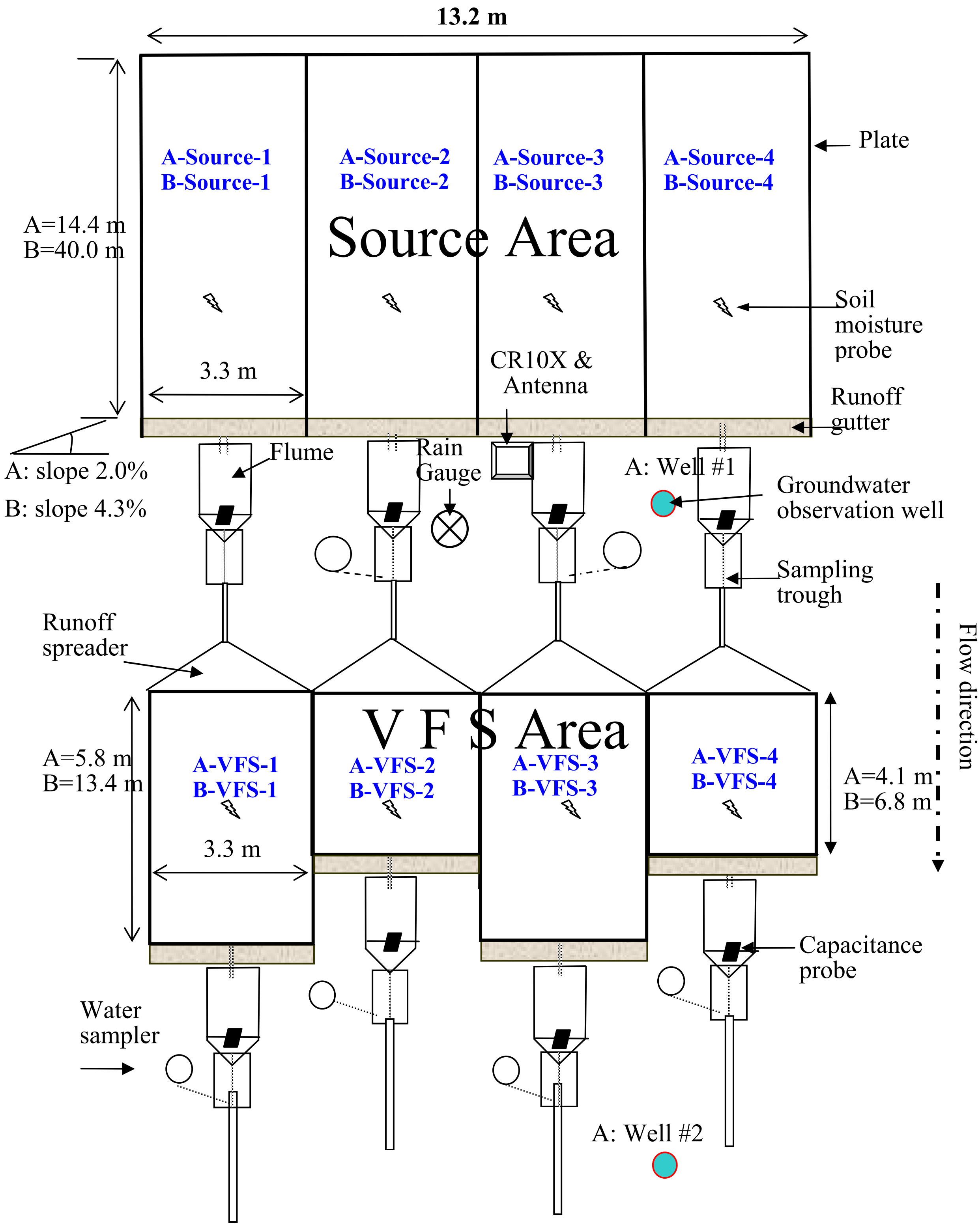


Figure 2-2. Schematic diagram of the experimental sites (sites A and B) in Bartow, FL.

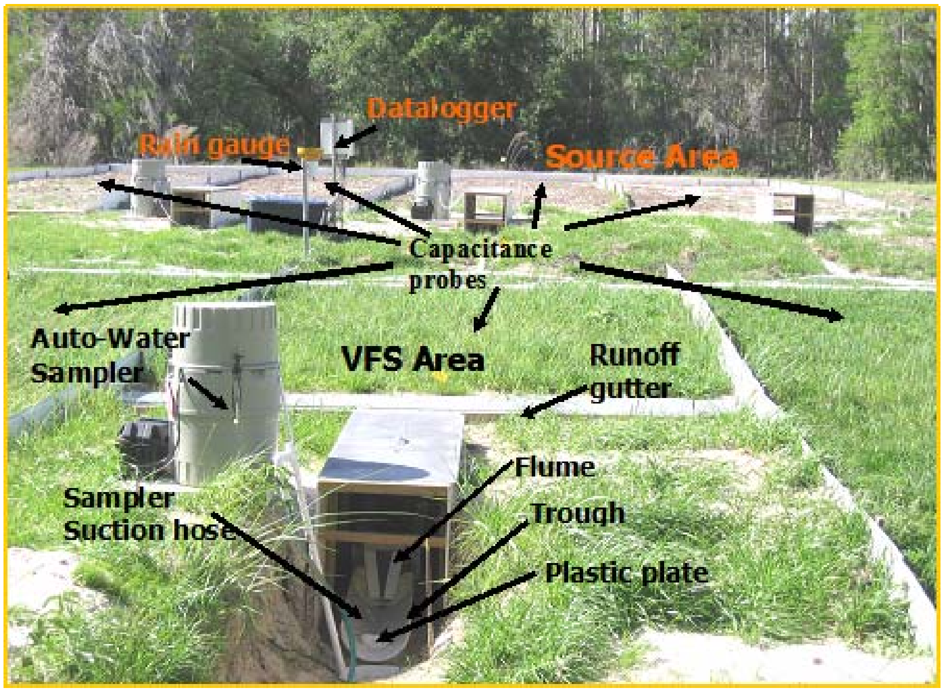


Figure 2-3. Instruments installed in the field to sample runoff and recode data.

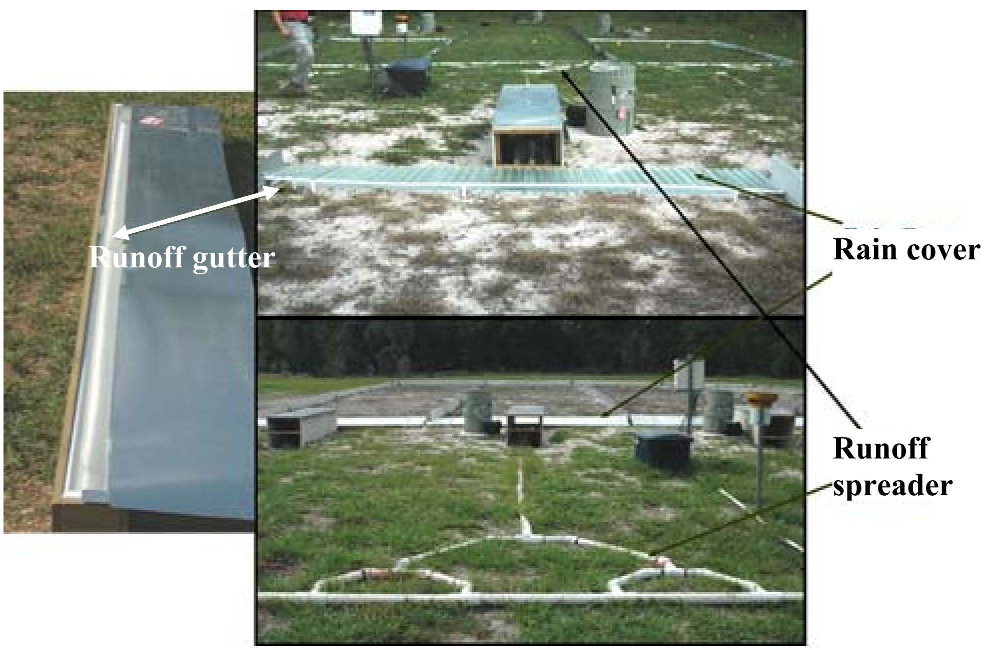
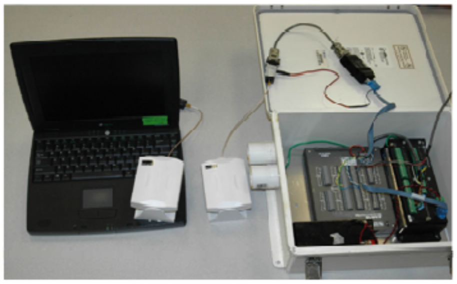


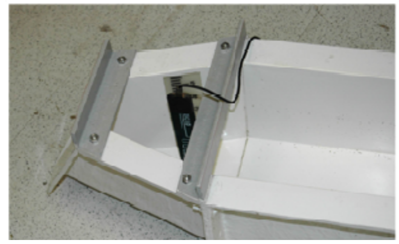
Figure 2-4. Runoff spreader and runoff gutter are used to transmit runoff from source area to VFS, and cover shield protect rainfall into gutter.

Rain cover

Runoff



The wireless serial communication by long distance bluetooth allows access from office to CR10X.



Dielectric (capacitance) probe inserted in a flume to measure the flow rate

Water sampler with 24 bottles for sampling runoff water

Dielectric (capacitance) soil moisture probe

Figure 2-5. Dielectric probe, water sampler, bluetooth, and datalogger were used to record field data.

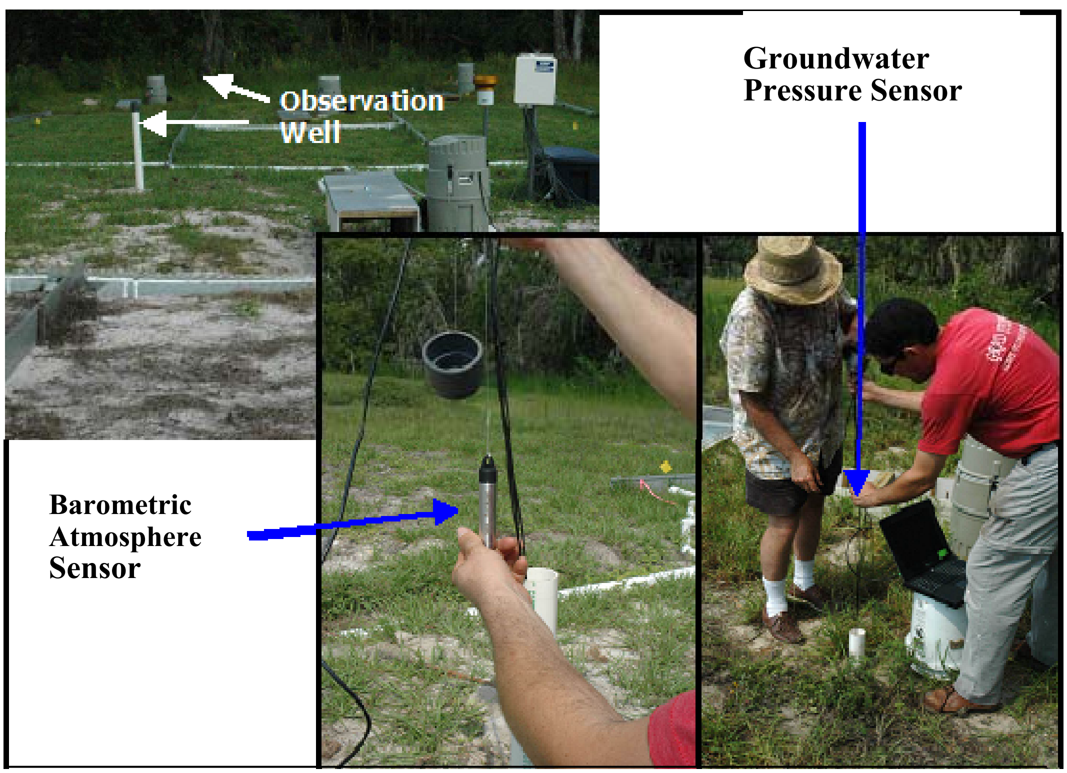


Figure 2-6. The two groundwater observation wells were installed at site A.

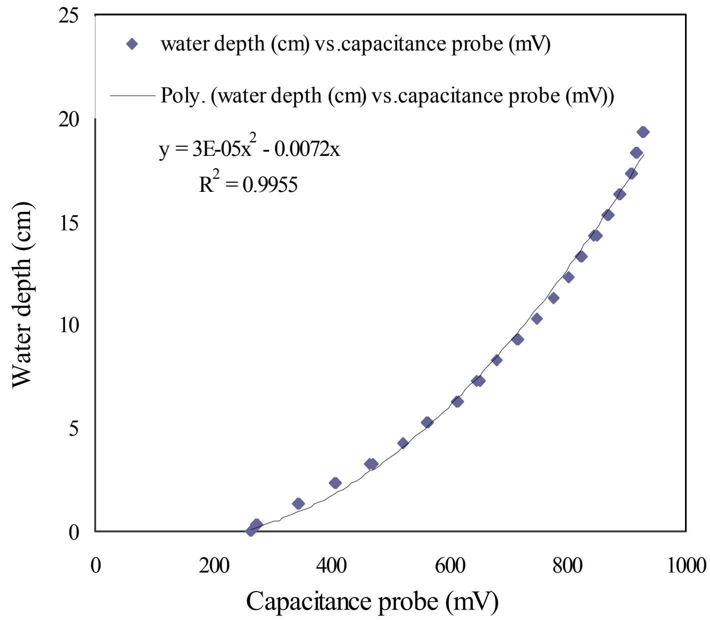


Figure 2-7. Depth of capacitance probe submersion into water column versus capacitance probe output voltage (mV).

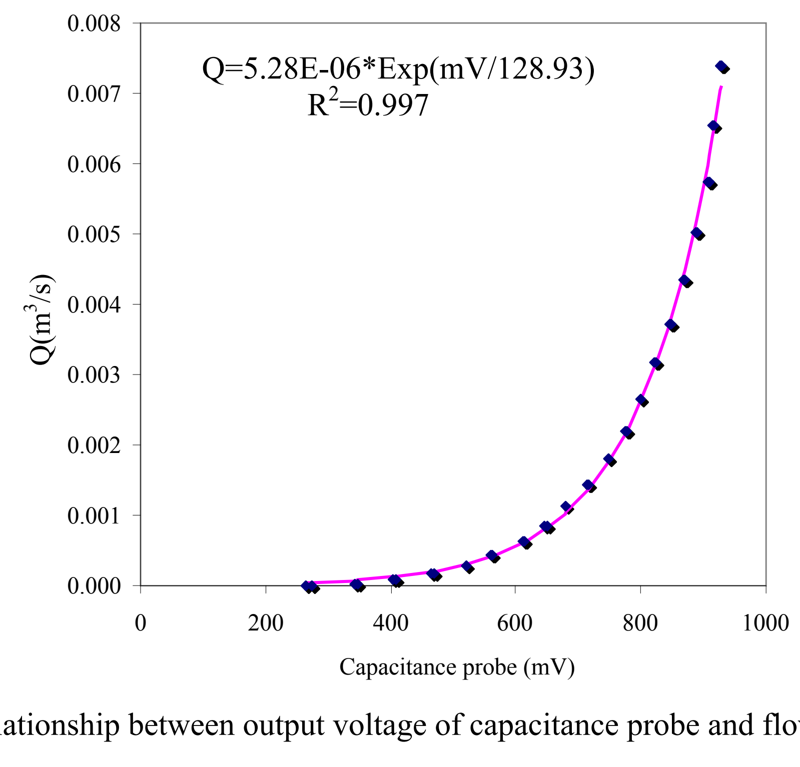


Figure 2-8. Relationship between output voltage of capacitance probe and flow rate.

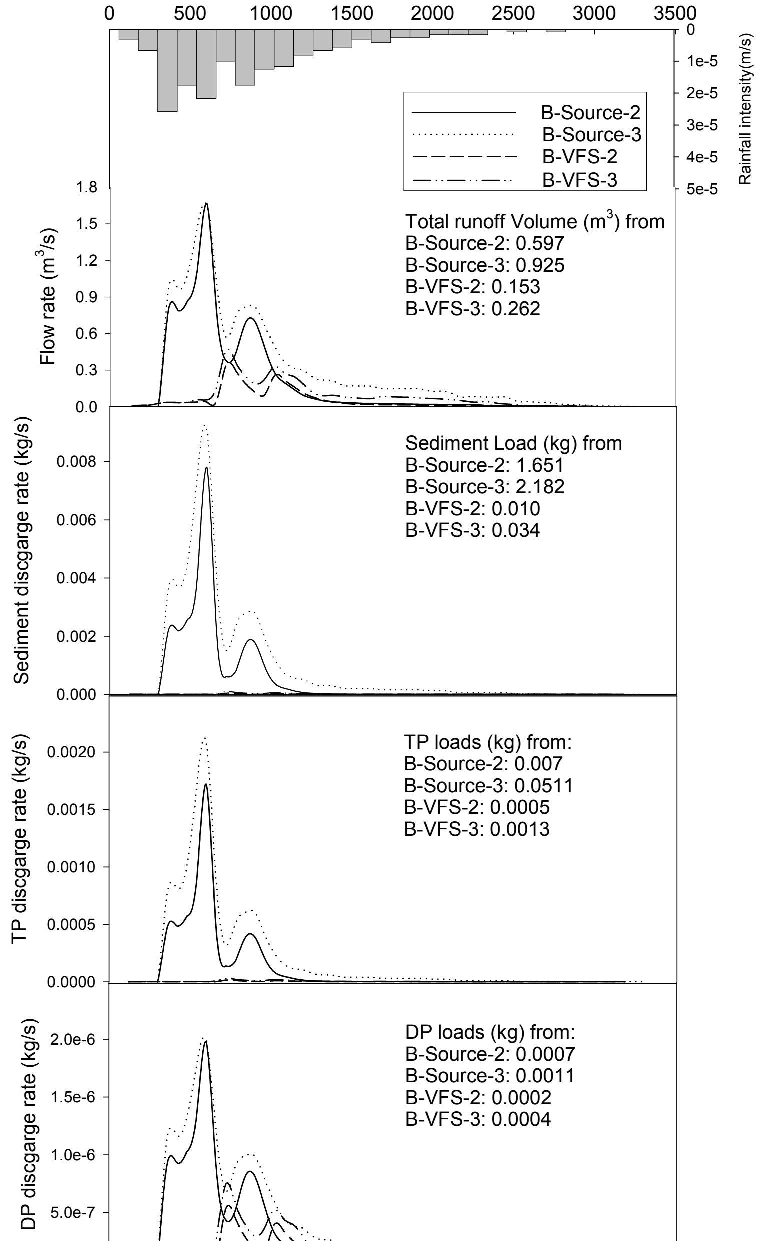


Figure 2-9. Hydrographs, sedimentographs, and hyetograph of Site B on event of July 28, 2006.

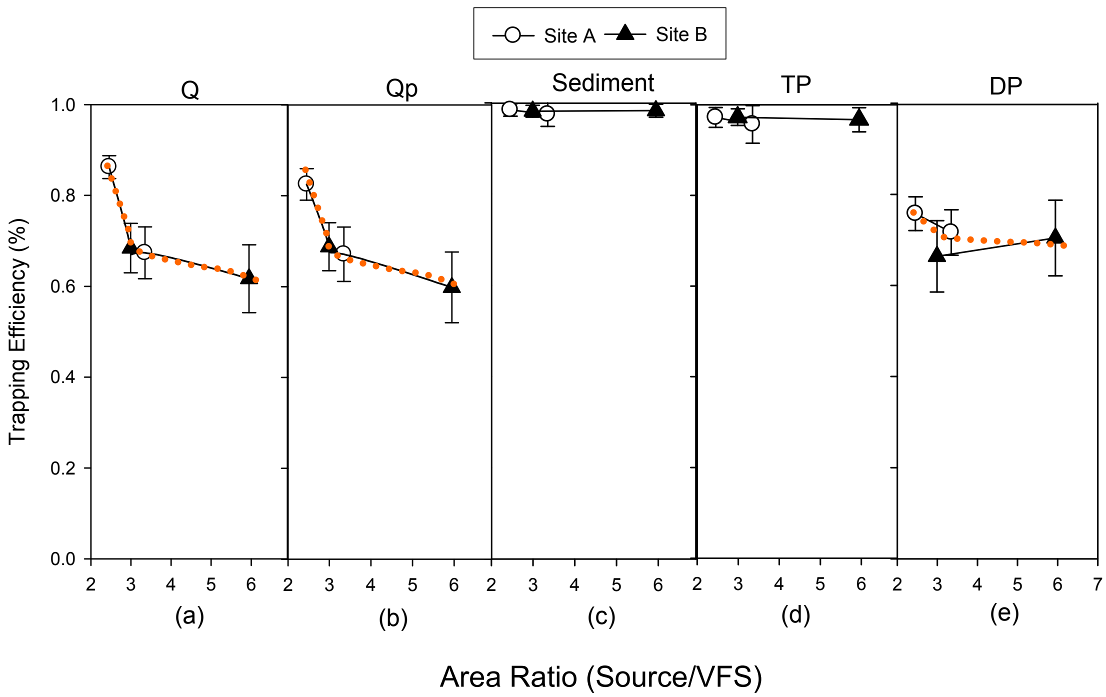


Figure 2-10. Trapping efficiencies of runoff volume (Q), peak flow rate (Qp), sediment, TP, and DP versus source/VFS area ratio.

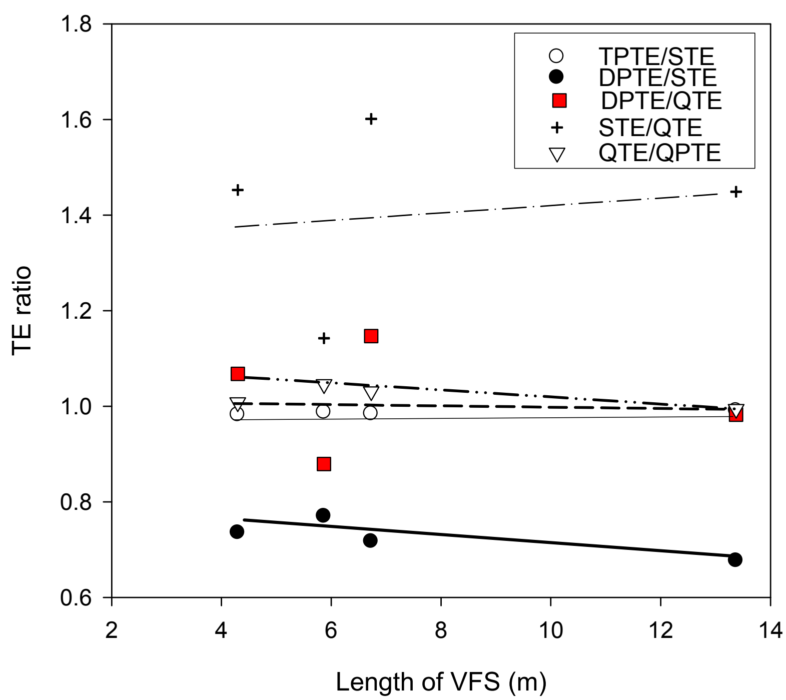


Figure 2-11. The TE ratio of selected variables versus length of VFS.

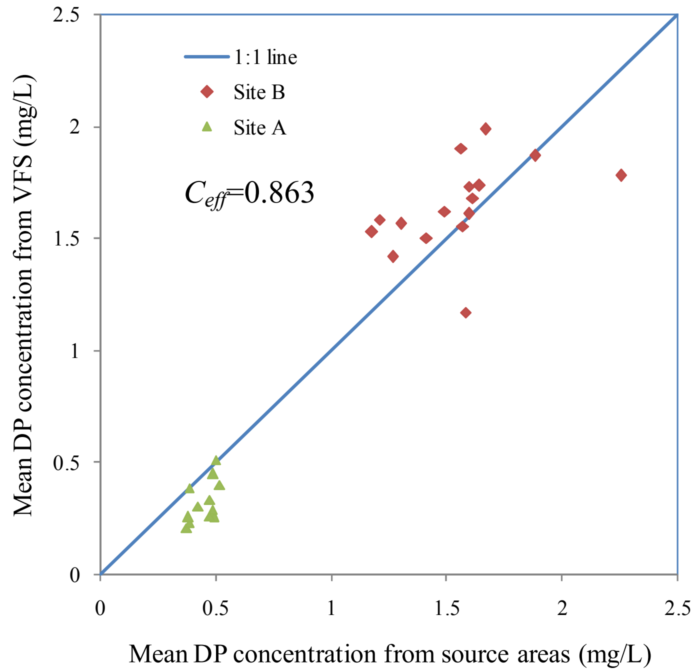


Figure 2-12. Relationship between mean DP concentration output from the VFS and source areas.

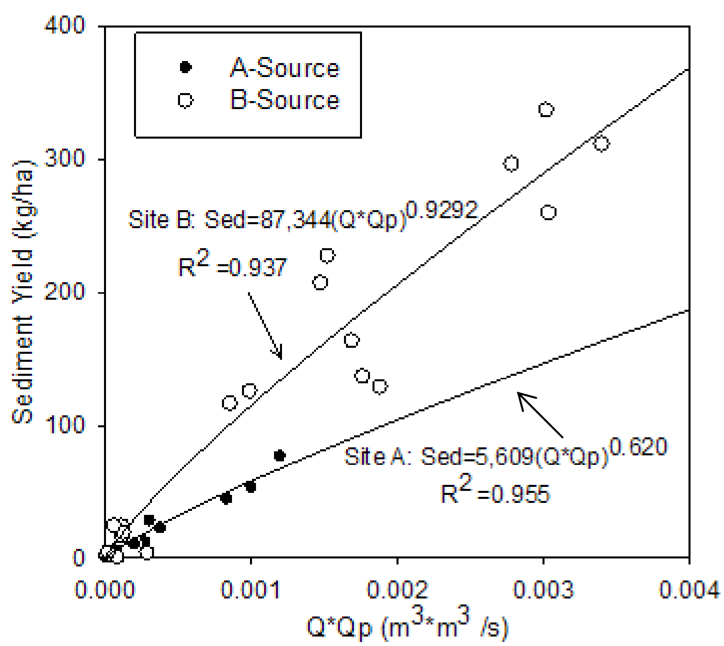


Figure 2-13. Relationships between sediment yield, Q, and Q_p in the VFS and source areas.

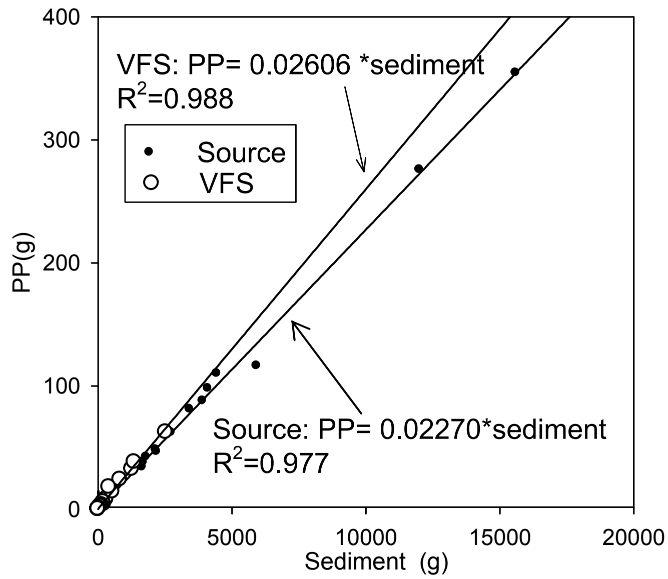


Figure 2-14. Relationships between PP and sediment in water samples collected from VFS and source areas.

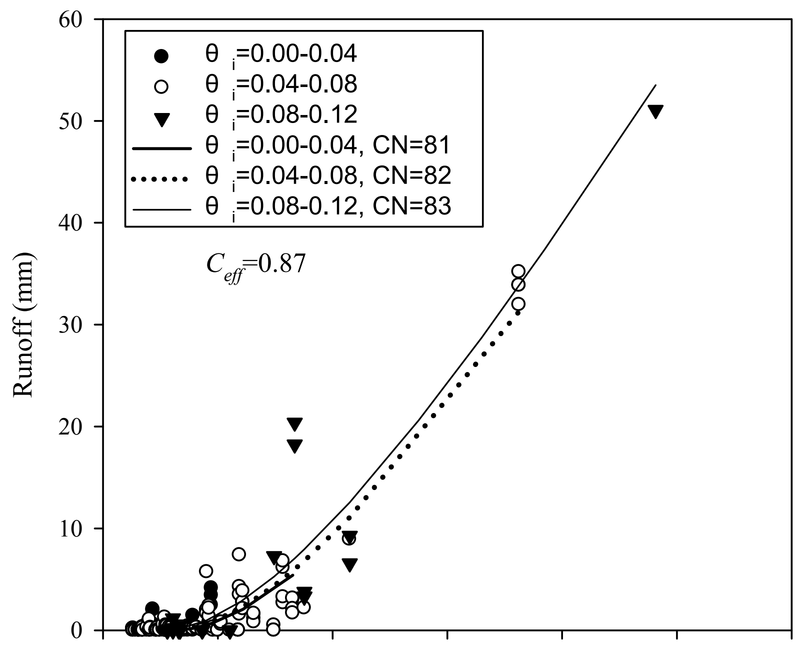


Figure 2-15. Curve numbers of different antecedent soil moisture conditions and relationships between runoff and rainfall in site A.

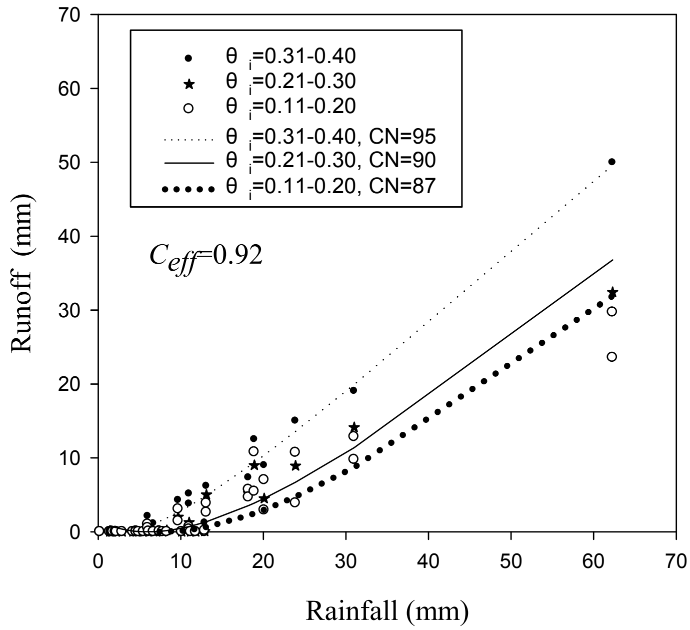


Figure 2-16. Curve numbers of different antecedent soil moisture conditions and relationships between runoff and rainfall in site B.

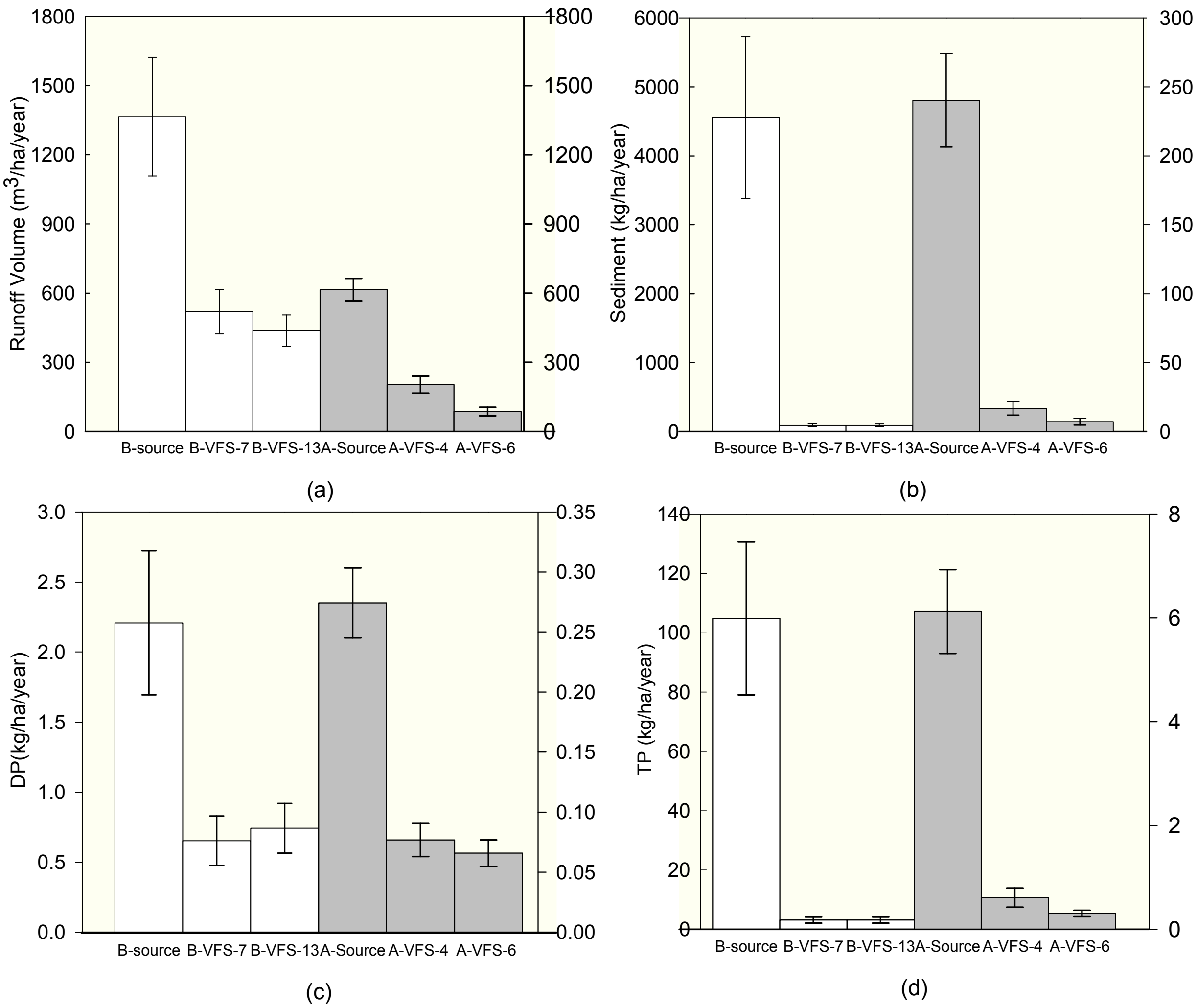


Figure 2-17. Yearly outflows (runoff volume, sediment, DP, TP) collected from VFS and source areas in mining areas.

CHAPTER 3
EVIDENCE FOR APATITE CONTROL OF PHOSPHORUS RELEASE TO RUNOFF FROM SOILS OF PHOSPHATE MINE RECLAMATION AREAS

3-1. Introduction

Phosphorus (P) carried in surface runoff from agricultural lands has been studied extensively and identified as a non-point source pollutant of surface water systems which may degrade water quality. Loading of P in runoff is heavily influenced by soil properties and land management practices (He et al., 2003). Soil properties such as particle size distribution, organic matter, pH, and metal oxides affect P dynamics in soil solution (Sharpley et al., 1981; Vadas and Sims 2002). In addition, rainfall intensity, runoff duration, and a water/soil ratio also dominate the desorption/diffusion of soil P in the runoff water in agricultural lands (Storm et al., 1988; McDowell and Sharpley, 2001b).

Mechanisms controlling P release from soils rich in geologic P (Wang et al., 1989) may deviate from mechanisms typical for soils enriched with fertilizer P. Geologic P can be abundant in anthropogenic soils of reclaimed phosphate mining areas. High dissolved P (DP) has been measured in runoff from two reclaimed phosphate mining sites in Florida (Appendix E) (0.4 - 3.0 mg L^{-1}). The average DP concentration in the upper Peace River at the Bartow sub-basin has been declining from 18 mg L^{-1} to 1.23±1.93 mg L^{-1} due to the changes in mining practices (DEP, 2006 and Southwest Florida Water Management District, 2001) between 1965 and 2005. Total P (TP) concentration is still higher than the U.S. Environmental Protection Agency (USEPA) criterion of TP concentration (0.1 mg L^{-1}) discharging into a river (USEPA, 1986; Mueller et al., 1995). The soils of these sites have very high P concentrations, but very low clay, Fe, and Al concentrations. These conditions led to the suspicion that dissolution rate of residual geologic apatite (carbonate fluorapatite, CFA) is controlling P release from these soils, rather than P adsorption and desorption processes that typically control the fate of P in soils of the southeastern USA coastal plain (Harris et al., 1996).

The dissolution rate of CFA, the phosphate mineral that dominates "phosphate rock" (common term used for the phosphate ore), is mainly affected by soil pH, concentrations of P and Ca (Guidry and Mackenzie, 2003; Babare et al., 1997; Chien and Menon, 1995), moisture content, and particle size (He et al., 2005). The influence of particle size stems from its inverse relation to specific surface area (SSA) in conjunction with dissolution being a surface-controlled process. Dissolution of apatite minerals would ensue immediately upon contact with runoff water. Thus, once runoff occurred in the mining lands, they would be potential sources contributing DP into water bodies.

The objectives of this study were to (i) confirm the presence and particle size distribution of apatite via solid-state and chemical analyses, (ii) determine if CFA is undersaturated in runoff and hence subject to dissolution, and (iii) compare P concentrations predicted from reported CFA dissolution rate constants with observed experimental values.

3-2. Materials and Methods

3-2-1. Field Experiments

Water and soil samples analyzed in this study were collected from a phosphate mining reclamation site near Bartow, FL, where field experiments were conducted to evaluate the efficiency of vegetative cover strips (VFS) in reducing P concentration in runoff. Two experimental sites (A and B) were chosen that were 3 km apart. Source areas were representative of the bare disturbed mining lands in the upper Peace River watershed. Dimensions of the plots for sites A and B are shown in Figure 2-2. The average slopes of site A and site B were 2.0 %, and 4.3 %, respectively. The lengths of the source areas at site A and site B were 14.4 m and 40.0 m, respectively. The lengths of the filters were 4.1 m and 5.8 m at site A and 6.8 m and 13.4 m at site B.

Runoff was collected by a gutter at the outlet of each plot where it then flowed into a flume and trough. Then, runoff was redistributed through a PVC spreader into filters. A cover shield was installed to avoid rain falling into the gutter. Runoff water samples were collected at each trough by an automatic water sampler. The flow rate was measured from a six-inch (15.24 cm) HS flume from each VFS and source plot. A capacitance probe was inserted vertically in each flume throat to measure the flow rate. The capacitance probe detected the flow rate in the flume every minute and stored this data in a datalogger. The datalogger then sent sampling pulses to the ISCO 6712 automatic water sampler (ISCO, Inc.) based on changes in accumulated runoff volume. After activation, the sampler purged the suction hose and then collected runoff water samples from the trough into 500 mL bottles. Runoff samples were analyzed for concentrations of sediment, TP, and DP.

3-2-2. Soil Chemical Properties

Soil samples were collected from the top 2 cm depths of each site since this zone has the greatest interaction between soil and runoff water. All samples were air-dried and then sieved using a 2.0 mm mesh sieve. Soil pH was measured in a 1:1 mixture of soil:water using a pH meter (pH/Cond 340i/Set, WTW, Germany). Soil organic carbon (OC) was measured by the Walkley-Black oxidation procedure (Nelson and Sommers, 1982). Mehlich-1 extraction, degree of phosphorus saturation (DPS), phosphorus sorption isotherms (PSI), phosphorus fractionation, and TP in each particle size class were conducted to investigate the P dynamics in the soil and soil solution. Details of these analyses follow:

3-2-2-1. Mehlich-1 extraction

A combination of HCl and H_2SO_4 acids (Mehlich, 1953) with a 1:4 soil: extractant ratio was used to extract P from soils. The extraction was shaken for 5 minutes and filtered through Whatman # 42 filter paper. Mehlich-1 extraction can dissolve Al- and Fe-phosphates as well as P adsorbed on colloidal surfaces in soils. Mehlich-1 extraction works well for acidic, low cation exchange capacity soils, which are prevalent in the SE USA.

3-2-2-2. Degree of phosphorus saturation (DPS)

The degree of phosphorus saturation (DPS), which relates soil extractable P to extractable Fe and Al, has been introduced as an environmental index of soil adsorbed P available to be released through runoff (Nair et al., 1998, Beck et al. 2004). DPS calculated from Mehlich-1 extraction has been shown to be a valid indicator of P release potential (Nair and Graetz, 2002). Thus, values of Mehlich-1 extractable Fe, Al, and P were used for DPS determination in this study. The following method of calculation was applied:

$$DPS = \frac{P_{Mehlich-1}}{(Fe_{Mehlich-1} + Al_{Mehlich-1})} * 100 \qquad (3.1)$$

where Mehlich-1 extractable P and metal concentrations are expressed as mole kg^{-1}.

3-2-2-3. Phosphorus sorption isotherms (PSI)

Phosphate sorption was measured by using two grams of soil sample with 20 mL of 0.05 M KCl solution containing 0, 1.5, 4.5, 8.5, 15, and 50 mg[P] L^{-1} in a 50 mL centrifuge tube, respectively. Each tube with suspension was shaken for a 2-hour period. After centrifugation at 5000 rpm for 15 minutes, the supernatant was filtered through a 0.45 μm membrane filter. The amount of P adsorbed by soil was determined by the difference between the initial and final concentration of P in the solution.

3-2-2-4. Phosphorus fractionation

The sequential extraction procedure, following the method of Nair et al. (1995), distinguishes six forms of P (Figure 3-1). After the supernatant of one extraction was removed, the tube and soil were re-weighed, and the next extracting solution was added to the tube. All of the supernatants were filtered through 0.45 μm membrane filters and refrigerated at 4 °C until analysis.

3-2-2-5. Total phosphorus in each particle fraction

Particle size fractionation was conducted by sieving and centrifugation using a procedure based on one described by Whittling and Allardice (1989). Samples were initially saturated with Na to promote dispersion. This was accomplished by placing 20 g of soil in a 250 mL centrifuge bottle, adding 1N NaCl to 250 mL volume, shaking, centrifuging, and decanting supernatant. These steps were repeated twice more, after which samples were rinsed free of salt using repeated washings with de-ionized water until the supernatant appeared turbid.

Sand (> 37 μm) was then separated from silt and clay particles by wet sieving. The soil in the bottle was washed into a 37 μm mesh sieve using pH=10 water. The < 37 μm material was collected into centrifuge bottles to separate silt (2-37 μm) and clay (< 2 μm) by centrifugation using time and gravity forces based on principles of Stokes law (Jackson, 1969). Sand was further fractionated by sieving into particle sizes of 37 to 106 μm and 106 to 250 μm. The soil in each particle class was measured for TP. TP is analyzed by ashing and HCl (6N) digestion (Anderson, 1976). All extractions of P were determined by the molybdate blue method of Murphy and Riley (1962). Samples were examined by x-ray diffraction (XRD) for mineral identification, and by X-ray fluorescence (XRF) spectrometry to determine the relative concentrations of elements.

3-2-3. Phosphate Solubility Equilibria

Runoff water samples collected from both sites in June 2006 were used for chemical speciation modeling and evaluation with respect to CFA solubility. Each water sample was extracted through a 0.45 μm membrane filter. The concentrations of Ca^{2+}, Fe^{2+}, Mg^{2+}, Al^{3+}, K^{+}, Na^{+}, Cu^{+}, Mn^{2+}, and Zn^{2+} were measured by means of atomic absorption spectrometry (Varian 220FS, Varian Australia Pty Ltd, Mulgrave Victoria, Australia). The concentrations of F^{-}, NO^{2-}, NO^{3-}, $H_2PO_4^{3-}$, $SO4^{2-}$, and Cl^{-} were analyzed using ion chromatography (Dionex LC20 Chromatography Enclosure, Dionex, CA). Ionic strength of solution components were calculated from equation, I=0.013 EC (Griffin and Jurinak, 1973), where EC is expressed in μS cm^{-1}. The pH was measured directly from a pH electrode (pH/Cond 340i/Set, WTW, Germany). Ionic activities of solution components were calculated using the Visual MINTEQ equilibrium speciation program (Department of Land and Water Resources Engineering. 2006).

The thermodynamic solubility product (K_{sp}) was computed for HAP, FAP, and CFA, respectively, using the following equilibrium formulas:

$$Ca_{10}(PO_4)_6OH_2 \leftrightarrow 10Ca^{2+} + 6PO_4^{3-} + 2OH^{-} \quad (3.2)$$

$$Ca_{10}(PO_4)_6F_2 \leftrightarrow 10Ca^{2+} + 6PO_4^{3-} + 2F^{-} \quad (3.3)$$

$$\begin{aligned} &Ca_{10}(PO_4)_{5.83-0.57x}(CO_3)_xF_{2.52-0.3x} + H_2O \leftrightarrow 10Ca^{2+} + \\ &(5.83-0.57x)PO_4^{3-} + (x)CO_3^{2-} + (2.52-0.3x)F^{-} \end{aligned} \quad (3.4)$$

The K_{sp} for HAP was determined to be $10^{-116.6}$ by McDowell et al. (1977). In most natural systems, apatite contains F^{-1} (FAP or CFA) instead of OH^{-1} (HAP), resulting in lower solubility. The K_{sp} for FAP has been reported as $10^{-121.2}$ (Driessens, 1982). Calcium apatite is often found in a non-stoichiometric form which may explain the range in K_{sp} values reported in the literature (e.g. $K_{sp}=10^{-114}$-10^{-119} for HAP, and $K_{sp}=10^{-121}$-10^{-122} for FAP) (McConnell, 1973; Elliott, 1994). The K_{sp} of CFA varies depending on the degree of CO_3 substitution from FAP (Jahnke, 1985). FAP was found to have the lowest solubility ($K_{sp}=10^{-122}$). CFA with the maximum CO_3 substitution (~ 6.5 wt. %) has the highest solubility ($K_{sp}=10^{-107.5}$) among CFA specimens evaluated. With known K_{sp} of HAP and FAP, phosphate-mineral solubility diagram was plotted to show the relationships between log$H_2PO_4^{2-}$ and pH. This solubility diagram is particular useful for determining relative stability of phosphate compounds and minerals in soils at various pH values (Olsen and Khasawneh, 1980).

3-2-4. Approach for Modeling Phosphorus Release

A number of studies have addressed kinetic dissolution of geologically natural FAP and CFA (Lane and Mackenzie, 1990 and 1991; Valsami-Jones et al., 1998; Guidry and Mackenzie, 2000 and 2003, and Welch et al., 2002). The equation applied to simulate FAP and CFA dissolution rates was adopted from the results of Guidry and Mackenzie (2003). They investigated dissolution rates over a range of pH, solution saturation state, temperature, and on FAP and CFA by using both a fluidized-bed and stirred-tank reactor. In their study two of five apatite samples were CFA and obtained from the central Florida. Their results from dissolution rates versus pH experiments showed that all of the experimental solutions were found to be undersaturated with respect to the CFA or FAP. Dissolution rates of apatite dependent on pH can be described using following equation (Blum and Lasaga, 1988)

$$R_{CFA} = k_a \cdot [H^+]^n \tag{3.5}$$

where R_{CFA} is dissolution rate (moles m^{-2} s^{-1}), k_a is rate constant (moles m^{-2} s^{-1}), $[H^+]$ is hydrogen ion activity, and n is reaction order.

In the study of Guidry and Mackenzie (2003), at pH between 4 and 7, a linear regression yielded a $k_a = 6.91\times10^{-8}$ moles m^{-2} s^{-1} and n= -0.67 with $R^2 = 0.79$ for CFA compositions. The k_a changed inversely with pH. Welch et al. (2002) studied the effect of pH on the rate of inorganic FAP dissolution from 2.0< pH< 7.0. From 2.0< pH< 5.5, the regression line of experiments fitted well with the overlapping fluidized-bed and stirred-tank reactor data of Guidry and Mackenzie.

To model P release from CFA, the units of dissolution rate of CFA (R_{CFA}) are converted from moles m^{-2} s^{-1} to mg L^{-1} s^{-1} when considering the ratio of soil/water and SSA of CFA per gram soil. Each particle is assigned a sphere of influence radius, thus SSA can be expressed as:

$$SSA = \frac{surface\ area\ of\ sphere(m^2)}{weight\ of\ particle(g)} = \frac{4\pi(d/2)^2}{(4/3)\pi(d/2)^3 \times 10^6 \times \rho_{CFA}} = \frac{6\times10^{-6}}{\rho_{CFA}\times d} \tag{3.6}$$

where SSA is the specific surface area of a particle (m^2 g^{-1}), d is the particle diameter (m), and ρ_{CFA} is particle density of CFA (g cm^{-3}), which can be calculated from following equation:

$$\rho_{CFA} = \frac{(Molecular\ \ Weight)\times Z}{(Cell\ \ Volume\times 0.60225)} \tag{3.7}$$

where ρ_{CFA} is particle density of CFA (g cm^{-3}), *cell volume* is in Angstroms^3, Z is in formula units per cell, *Molecular Weight* is in g mole^{-1}, and 0.60225 is the Avogadro constant/(1.0×10^{24}).

If a uniform distribution between d_1 and d_2 is assumed, the average SSA ($\overline{SSA_{CFA}}$) can be calculated as (Storm et al., 1988):

$$\overline{SSA_{CFA}} = \frac{6\times10^{-6}}{\rho_{CFA}(d_2-d_1)} ln\left[\frac{d_2}{d_1}\right] \tag{3.8}$$

where $\overline{SSA_{CFA}}$ is the average value of SSA between d_1 and d_2 (m^2 g^{-1}), d_1 and d_2 are the particle diameter (m).

Thus, the equation used to describe the CFA dissolution is shown as follows:

$$
\begin{aligned}
K_{CFA} &= R_{CFA}\left[mole\ \ m^{-2}\ s^{-1}\right]\cdot SSA_{CFA}\left[m^{2}\ \ g^{-1}\right]\cdot\frac{soil\ weight\left[g\right]}{water\ volume\left[cm^{3}\right]}\cdot 31\left[g\ mole^{-1}\right] \\
&= 31\cdot K_{a}\,[H^{+}\,]^{n}\cdot SSA_{CFA}\cdot\frac{soil\ weight}{water\ volume}\left[mg\ L^{-1}\ s^{-1}\right]
\end{aligned} \tag{3.9}
$$

$$
K_{CFA} = 31\cdot K_{a}\,[H^{+}\,]^{n}\cdot SSA_{CFA}\cdot\frac{\rho_{b}\cdot volume}{\eta\cdot volume} = 31\cdot K_{a}\,[H^{+}\,]^{n}\cdot SSA_{CFA}\cdot\frac{\rho_{b}}{\eta}\left[mg\ L^{-1}s^{-1}\right] \tag{3.10}
$$

where η : porosity ($cm^3\ cm^{-3}$), ρ_b : bulk density ($g\ cm^{-3}$), and SSA_{CFA} : the SSA of CFA per gram soil ($m^2\ g^{-1}$) can be calculated from Eq. (3.11).

$$
SSA_{CFA} = \sum_{i=1}^{n}\left(\frac{Particle\ \ size\ (i)\ \ \ *\ P\ concentrat\ ion\ (i)}{0.158}\right) *\ \overline{SSA_{CFA}}\,(i) \tag{3.11}
$$

where *Particle size (i)*: mass fraction of particles representing a given size range (i); *P concentration (i)*: P concentration within a given particle size range (i) (mg/kg) (Table 3-5); $\overline{SSA_{CFA}}$ *(i)*: specific surface area for a given particle size range (i) (m^2/g) (Table 3-7); can be calculated from Eq. (3.8); 0.158: P fraction per unit weight of CFA calculated from the formula of CFA ($Ca_{9.62}Na_{0.273}Mg_{0.106}(PO_4)_{4.976}(CO_3)_{1.024}F_{2.41}$; Hanna and Anazia, 1990).

Eq. (3.9) can be used to calculate DP concentration in batch experiments. Eq. (3.10) can be applied to simulate P release of CFA from the soil profile per unit depth with consideration bulk density and porosity of soil profile under field conditions.

3-3. Results and Discussion

3-3-1. Soil Properties

Physical and chemical properties did not vary appreciably between sites or between source and VFS areas for most properties, with slightly acid pH and relatively low OC (Tables 3-1). A higher fraction of fine particles was found in site B compared to site A. Chemical extractions and P fractionation confirms very high TP concentration and a dominance of Ca-P. A form of apatite in the samples was confirmed by XRD (Figure 3-2). We infer that this apatite is CFA since that is the form that has been well documented in phosphoritic deposits from which the material used to construct the remediated soils was derived (Hanna and Anazia, 1990; Guidry and Mackenzie, 2003). Results of XRF (Table 3-2) showed the main elements to be Si, Ca, Al, P, K, and Fe. Quartz is the main mineral in soil, accounting for the dominance of Si. The second most abundant element is Ca, a major component of CFA. Phosphorus content of 3.7 % as determined by XRF was slightly higher than TP as determined chemically (ranging from 1.7 % to 2.3 %; Table 3-3). These very high P concentrations result from the residual CFA. The P sequential fractionation of soils (Table 3-3) from the two sites is also consistent with a dominance of Ca- (and/or Mg-) bound P (approximately 95 % of TP). Water soluble P is in the range from 15.5 to 24.1 mg kg^{-1}, which represented 0.10 % of TP. Water soluble and exchangeable P fractions are considered available forms of P to crop growth. The sum of these two forms ranged from 29.3 to 35.0 mg kg^{-1} (around 0.16%).

Mehlich-1 P (Table 3-4) P concentration ranges from 740 to 1192 mg kg^{-1}. The major Mehlich-1-extractable element was Ca, whose mean concentration ranges from 1804 to 3490 mg kg^{-1}. The concentration ratio of P/Ca ranges from 33 % to 45 %. The element ratio of P/Ca (0.40) in the formula of CFA is in this range. The DPS values were very high, ranging from 630 to 1620 %, consistent with apatite dissolution from Mehlich-1 extraction. Results of P sorption isotherms (Figures 3-3 and 3-4) confirm a high equilibrium P concentration at zero net P sorption (EPC_0) for soils from both sites (approximately 10-16 mg L^{-1}). If the P concentration of runoff is less than the EPC_0, then there would be a net release from the soil. Thus, only runoff DP concentration greater than 10 mg L^{-1} would result in net P sorption to soil particles.

Total P concentrations were higher in the finer particle-size ranges (Table 3-5). Particles smaller than 37 μm contain about 3.1% P. The concentrations between classes 0 < 2 μm and 2-37 μm were not significantly different. Coarser particles (250-2000 μm) contain about 1.6 % P. The higher P concentration found in finer size fractions relates to a greater abundance of CFA in these fractions, possibly reflecting the predominant particle size of CFA in the ore body. Alternatively, CFA may have been sorted via elutriation or comminuted (being softer that quartz) during the mining process.

Based on the formula of CFA ($Ca_{9.62}Na_{0.273}Mg_{0.106}(PO_4)_{4.976}(CO_3)_{1.024}F_{2.41}$), the P fraction per unit weight of CFA is 0.158. The weight fraction of CFA in each size fraction was calculated using this value in conjunction with TP for that size fraction (Table 3-6). The weight fraction of CFA in each size fraction (Table 3-6) multiplied by SSA of CFA in each size fraction of CFA (as Eq. (3.8)) equals the CFA SSA contribution of each particle size class of soil sample as shown in Table 3-7.

3-3-2. Phosphate Solubility Equilibria

Concentrations of cations and anions, along with pH, EC, and ionic strength of runoff samples (Table 3-8) were used to model chemical speciation for runoff samples. Figure 3-5 presents the soil solution composition in relation to the stability of phosphate minerals in soils. The mean activity of Ca^{2+} (pCa^{2+}= 4.7) was used to develop the diagrams. Since K_{sp} of CFA is varied based on the CO_3 substitution and the line of higher K_{sp} in phosphate-mineral solubility diagram is far away from the intersection of x axis and y axis, the relations between $logH_2PO_4^{2-}$ and pH of CFA are not plotted in figure. A solution point plotted above a certain solubility line represents a solution that is supersaturated relative to the phosphate phase represented by the line, which indicates that the solution and that phase could form and be stable.

Any solution point plotted below a mineral solubility line is undersaturated. The results from Visual MINTEQ and Figure 3-5 show the soil solution is undersaturated. In addition, we found low Al and Fe bound P in P fractionation data and low Al and Fe concentrations in Mehlich-1 extraction. Ca and Mg concentrations were higher in both extractions. Thus, we determined that the high DP concentration in runoff water was P releasing from CFA.

3-3-3. Results of Modeling Phosphorus Release

Linear equation from Guidry and Mackenzie study (2003) was adopted to simulate the dissolution of CFA (k_a =6.91×10^{-8} moles m^{-2} s^{-1} and n =-0.67, at 4 < pH <7). To simulate dissolution of apatite, 2 grams soil with 20 mL deionized water in a 50 mL centrifuge tube were shaken for 15 minutes (soil-water contact time). The pH was measured after batch experiments. After centrifugation at 5000 rpm for 5 minutes, the supernatant was filtered through a 0.45 μm membrane filter. After that, soil samples were analyzed for particle size distribution. Once we know particle size distribution, P concentration in each particle size class (as Table 3-5), P fraction per unit weight of CFA (0.158), and average SSA in each size class, we can calculate the total SSA_{CFA} of soil samples based on Eq. (3.11).

Results of the simulation (Table 3-9) were calculated based on Eq. (3.9). The modified Nash-Sutcliffe efficiency (C_{eff_m}) was used to evaluate the model predictions. The detailed description about C_{eff_m} is presented in Appendix B. Using k_a = 6.91×10^{-8} moles m^{-2} s^{-1} and n = -0.67 (Guidry and Mackenzie, 2003) to predict DP in batch experiments, C_{eff_m} is -0.78 and predicted DP is underestimated for all samples as shown in Figure 3-6. The underestimation relates either to the rate equation or constant not being applicable or to an underestimation of actual CFA SSA. There could be differences in the nature of the CFA of this study and the specimens analyzed by Guidry and Mackenzie (2003) (e.g.,crystallinity) that would result in a different dissolution rate constant. Also, the narrow pH range may have limited the sensitivity of the rate equation used. The calculation of SSA of CFA was based on the Eqs. (3.8) and (3.11) assuming that each particle is a sphere and uniform distribution is assigned in the each particle size class. These two assumptions may result in an underestimation of CFA SSA, which would in turn produce an underestimation of DP release. Despite the underestimation, however, a strong relationship between calculated SSA of CFA and measured DP concentration (R^2=0.93; Figure. 3-7) is supportive of other evidence that CFA dissolution is a major factor controlling P release from these soils.

3-4. Conclusions

Phosphorus in soils at the remediation was in the form of apatite, as indicated by XRD and corroborated by XRF elemental analysis and chemical fractionation. Results of this study supported the hypothesis that release of P from the soils was primarily from apatite dissolution rather than desorption from metal oxides that is more typical of soils of the region. The P release behavior in a batch experiment closely related to the modeled SSA of CFA. The absolute prediction of DP release based on modeled CFA surface area and a CFA rate constant from the literature underestimated observed release, suggesting that the rate equation or constant were not applicable to the CFA of the soils studied or that SSA of CFA was underestimated, or both.

Table 3-1. Results of organic carbon (OC), soil texture, hydraulic conductivity (Ks), and pH.

Site	Plot	N	Soil OC Mean±SD[#]	Soil Texture* (%)	Soil pH Mean±SD
A	Source	8	0.27±0.23	(1.4,1.7,96.9)	6.09±0.15
	VFS	8	0.76±0.4	(2.5,2.9,94.6)	6.37±0.19
B	Source	8	1.70±0.31	(1.8,3.5,94.7)	6.18±0.13
	VFS	8	1.11±0.48	(2.5,3.4,94.1)	6.32±0.21

*: (clay, silt, sand), where clay: <2μm, silt: 2-37μm, sand: >37μm.

[#]: SD: standard deviation.

Table 3-2. Main compounds in soil samples of both sites examined by X-ray fluorescence (XRF).

Site	Plot	N	Main compounds in soil samples (%)							
			Si	P	Ca	Al	K	Fe	Mn	Sr
A	Source	4	47.9±3.3	2.77±0.04	8.82±1.34	4.38±0.54	1.33±0.02	0.50±0.09	0.02±0.001	0.02±0.001
	VFS	4	60.1±0.13	2.92±0.04	6.27±0.29	13.0±1.81	0.59±0.03	0.91±0.06	0.10±0.1	0.15±0.14
B	Source	4	37.6±0.6	3.26±0.18	13.33±1.16	8.66±0.32	0.71±0.01	1.58±0.21	0.01±0.003	0.05±0.002
	VFS	4	44.9±1.02	3.00±0.05	11.55±0.03	9.82±1.83	0.92±0.14	1.44±0.38	0.03±0.013	0.04±0.009

Table 3-3. Average concentration of each soil phosphorus fraction among all samples.

Site	Plot	N	Water mg/kg	KCl mg/kg	Fe/Al-Pi mg/kg	Organic-P mg/kg	Mg/Ca-Pi mg/kg	Residual-P mg/kg	TP mg/kg
A	Source	7	15.5±2.8	13.8±1.2	174±24	184±32	16700±378	158±22	17267±357
	VFS	7	19.9±3.6	11.4±1.2	291±62	401±73	20320±2960	219±52	21267±2960
B	Source	7	23.3±2.3	8.4±8.6	358±46	476±184	21820±2680	177±54	22870±2880
	VFS	7	24.1±4.2	10.9±3.1	234±83	398±103	18417±557	156±37	19240±490

Table 3-4. The results of Mehlich-1 P extraction, degree of P saturation (DPS), ratio of P/Ca.

Site	Plot	N	Fe (mg/kg)	Al (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	P (mg/kg)	DPS %	P/Ca %
A	Source	6	4.30±0.63	57±2.5	2213±62	67±16.7	989±56	552±35	45±2
	VFS	6	4.58±0.69	114±11	1804±104	123±25	738±68	211±30	41±2
B	Source	8	12.91±3.50	140±53	3490±191	158±63	1185±138	297±126	34±3
	VFS	10	13.71±1.49	78±28	3640±52	124±43	1192±44	495±147	33±1

Table 3-5. P concentrations in different particle size classes.

Site	plot	N	P concentration (mg/kg) in each particle size class (μm)				
			0.45<2	2-37	37-100	100-250	250-2000
A	Source	4	29560±2030	28973±2230	20295±2670	17618±1660	15634±1890
	VFS	4	32051±2080	30749±1430	21780±860	19594±1610	17020±1240
B	Source	4	30813±1800	29660±2270	23294±1920	19937±1350	16503±1170
	VFS	4	32318±2200	31158±1580	24669±1770	19766±2020	16762±1450

Table 3-6. Weight of CFA per gram soil sample.

Site	plot	g[CFA]/g[Soil]				
		0.45-2μm	2-37μm	37-100μm	100-250μm	>250μm
A	Source	0.1932±0.0128	0.1831±0.0141	0.1283±0.0169	0.1114±0.0105	0.0988±0.0119
	VFS	0.2026±0.0103	0.1944±0.0091	0.1377±0.0117	0.1238±0.0102	0.1076±0.0079
B	Source	0.1948±0.0114	0.1875±0.0144	0.1472±0.0122	0.1260±0.0086	0.1043±0.0074
	VFS	0.2043±0.0140	0.1969±0.0100	0.1559±0.0111	0.1249±0.0128	0.1059±0.0092

Table 3-7. Surface area of CFA per gram soil.

Site	Plot	N	m^2[CFA]/g[S]				
			0.45-2μm	2-37μm	37-100μm	100-250μm	>250μm
A	Source	4	0.4191±0.0287	0.0586±0.0045	0.0041±0.0005	0.0014±0.0001	0.00053±0.00006
	VFS	4	0.4544±0.0294	0.0622±0.0029	0.0044±0.0004	0.0015±0.0001	0.00057±0.00004
B	Source	4	0.4368±0.0255	0.0600±0.0046	0.00468±0.00039	0.00158±0.00011	0.00056±0.00004
	VFS	4	0.4581±0.0312	0.0630±0.0320	0.00496±0.00036	0.00156±0.00016	0.00056±0.00005

Table 3-8. Concentrations of ions, pH, EC, and ionic strength of runoff samples collected in June 2006.

Samples ID	pH	EC µS/cm	Ionic Strength	F^{-1}	NO^{-2}	NO^{-3}	$PO4^{-3}$	$SO4^{-2}$	Cl^{-1}	Ca^{+2}	Mg^{+2}	Fe^{+2}	Al^{+3}	K^{+1}	Na^{+1}	Cu^{+1}	Mn^{+2}	Zn^{+2}
				mg/L														
A2-5	5.81	21	0.00027	0.39	0.17	0.43	1.45	2.36	12.83	1.13	0.26	0.01	0.11	0.22	1.17	0.00	0.01	0.01
A2-6	6.01	17	0.00022	0.21	0.16	0.25	1.33	1.91	10.60	0.98	0.24	0.00	0.08	0.24	0.82	0.00	0.01	0.03
A2-8	6.09	13	0.00017	0.65	0.14	0.21	1.43	1.55	8.06	0.69	0.15	0.01	0.01	0.14	1.02	0.01	0.01	0.02
A3-17	5.97	17	0.00022	0.08	0.16	0.20	0.97	1.90	10.86	0.51	0.30	0.01	0.12	1.42	0.91	0.01	0.01	0.09
B1-5	6.10	28	0.00036	0.36	0.28	0.26	4.92	1.17	9.64	2.01	1.27	0.46	1.23	2.06	1.01	0.03	0.02	0.08
B4-4	6.20	35	0.00046	0.35	0.33	0.39	5.35	1.38	10.29	2.05	1.25	0.39	1.27	2.34	1.13	0.03	0.02	0.08
A3-24	4.86	15	0.00020	0.07	0.11	0.18	1.01	1.67	9.96	0.28	0.17	0.00	0.22	1.42	0.85	0.02	0.02	0.10
A5-17	4.81	14	0.00018	0.06	0.14	0.17	0.95	1.52	10.66	0.26	0.14	0.01	0.19	1.13	0.90	0.02	0.02	0.09

Table 3-9. Input parameters and simulations results of the CFA dissolution model compared to the DP of batch experiments.

Sample ID	SSA_{CFA} m^2[CFA]/g[S]	pH	Soil/water g/L	Time s	DP* mg/L	Measured DP mg/L
A1	0.00868	5.96	100	900	0.436	0.744
A2	0.01066	6.10	100	900	0.424	0.924
A4	0.01047	6.05	100	900	0.581	0.997
A5	0.01119	6.14	100	900	0.662	1.060
B1	0.01314	6.20	100	900	0.779	1.402
B2	0.01321	6.19	100	900	0.888	1.676
B4	0.01446	6.05	100	900	0.884	1.798
B5	0.01256	6.17	100	900	0.668	1.474

* k_a =6.91E-8 and n=-0.67 used in Eq. (3.9), C_{eff_m}= -0.78 were obtained.

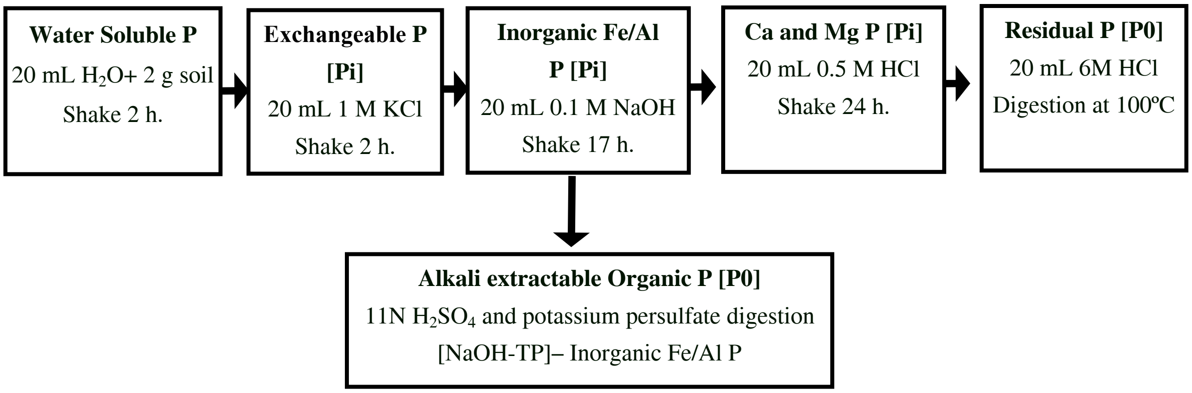


Figure 3-1. Scheme of phosphorus fractionation of phosphate mining soils.

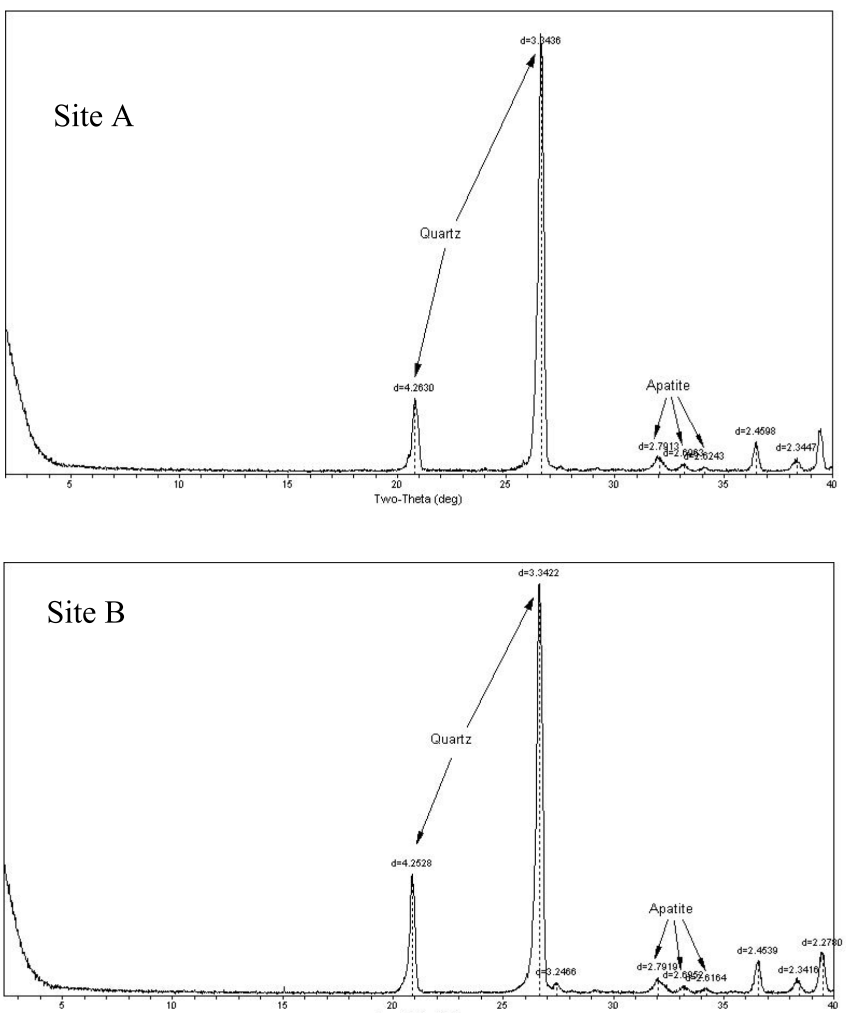


Figure 3-2. Apatite was found in soil samples of sites A and B observed by X-Ray diffraction.

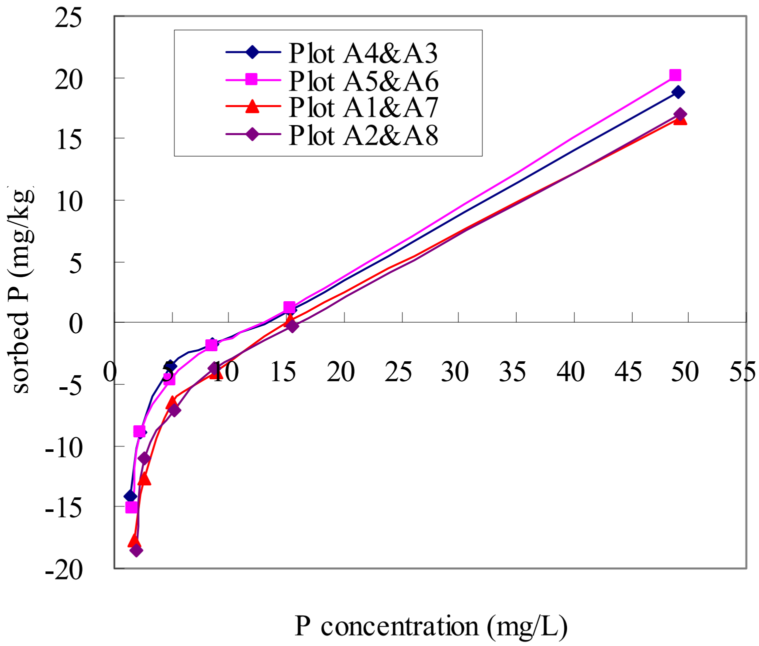


Figure 3-3. P sorption isotherm of soil samples in site A (2 hours shaken).

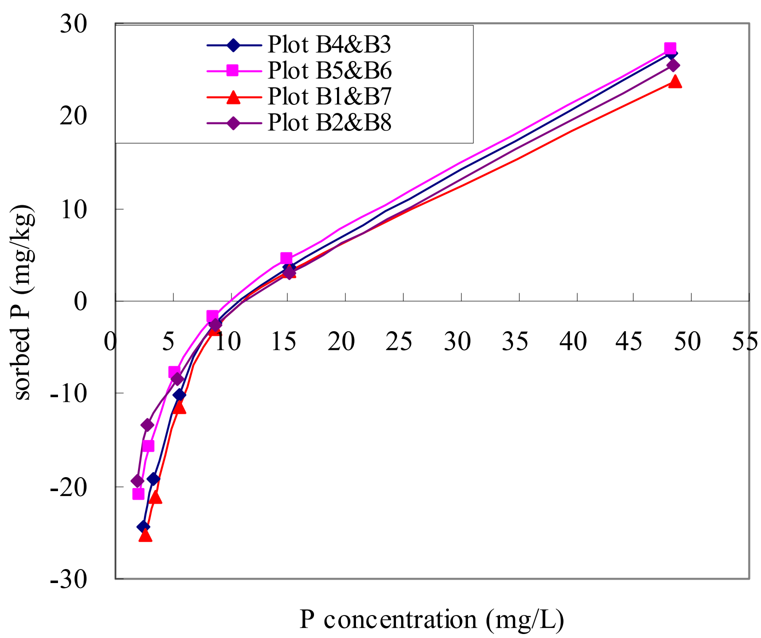


Figure 3-4. P sorption isotherm of soil samples in site B (2 hours shaken).

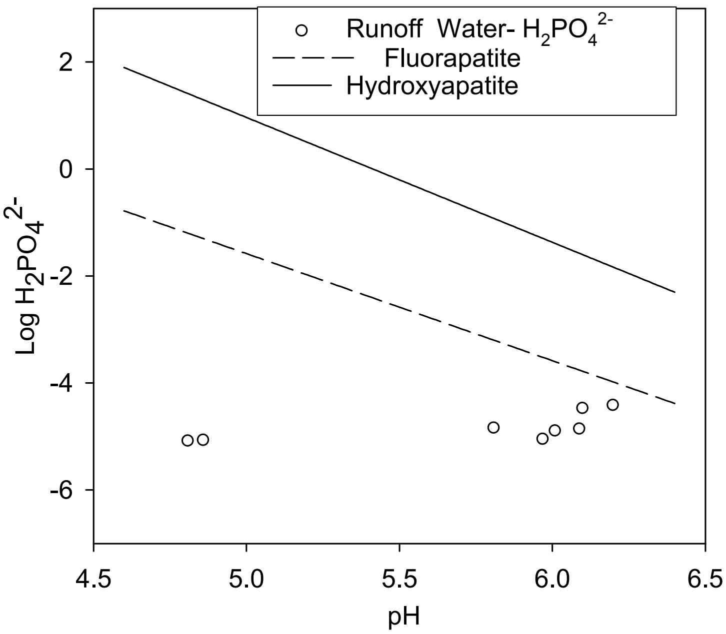


Figure 3-5. Phosphate-mineral solubility diagram relating the log $H_2PO_4^{2-}$ to pH in soil solutions of runoff water samples collected from phosphate mining areas.

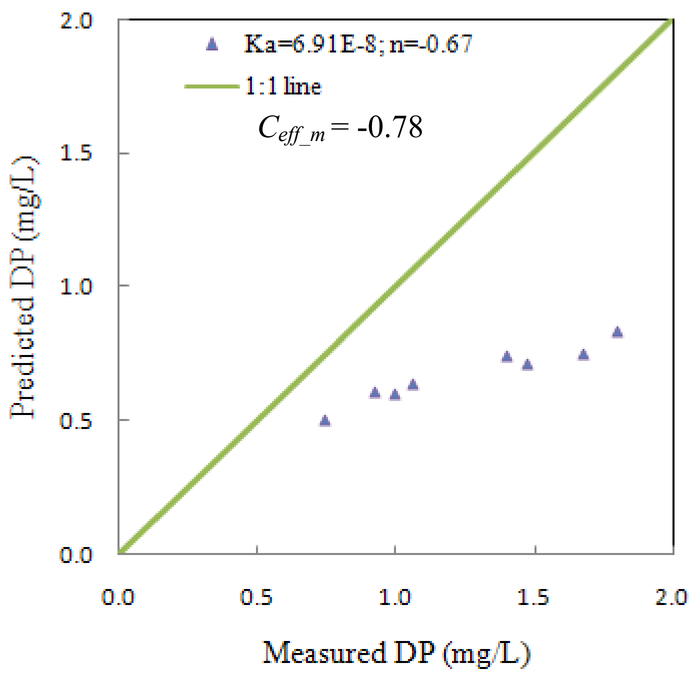


Figure 3-6. The measured value versus predicted value using k_a =6.91×10^{-8} moles m^{-2} s^{-1} and n =-0.67 in Eq. (3.9).

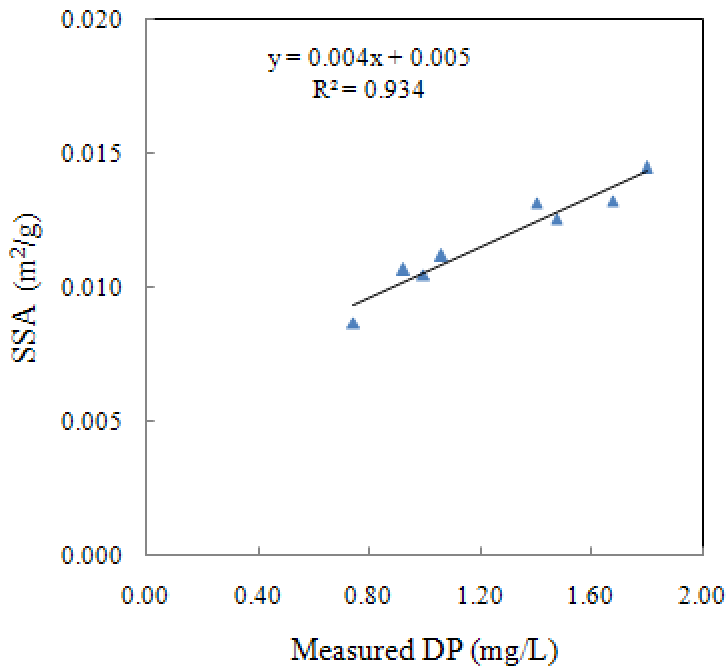


Figure 3-7. The relationship between the calculated SSA of CFA and measured DP concentration.

CHAPTER 4
SIMPLIFIED MODELING OF PHOSPHORUS REMOVAL BY VEGETATIVE FILTER STRIPS TO CONTROL RUNOFF POLLUTION FROM PHOSPHATE MINING AREAS

4.1 Introduction

Florida is rich in phosphate rock formed millions of years ago under ocean waters. Phosphate is a key ingredient in fertilizer and cannot be synthesized; so natural phosphate mining is the only supply and for the last 120 years has been one of the main economic activities in the Florida region. The extraction and beneficiation of phosphate rock to produce fertilizer has the potential to adversely impact the environment. These impacts can be the landscape, water contamination, excessive water consumption, and air pollution (UNEP, 2001). Specifically, the water resources may be adversely affected by the release of processed water, the erosion of sediments, and leaching of toxic minerals from overburden and processing wastes. The continued mining activities in central Florida have degraded water quality in the upper Peace River basin and have left behind large refuse sand tailings that now shape the landscape surrounding the river. The mound material is essentially homogenous clean sand (> 94 % of weight) with a high concentration of apatite, the phosphorus (P) mineral ore, and is mixed with small pockets of clay in some areas. The average dissolved P (DP) concentration in the Peace River at the Bartow sub-basin has declined from 18 mg/L to 1.23 ± 1.93 mg/L from 1965 to 2005 due to the changes in mining practices (DEP, 2006). The average concentration of total P (TP) was 1.38±1.93 mg/L from 1990 to 1995. However, the TP concentration was still higher than the U.S. Environmental Protection Agency (USEPA) criterion of maximum TP concentration (0.1 mg/L) discharging into a river (USEPA, 1986; Mueller et al., 1995). Thus, reclamation activities must be conducted to avoid more environmental impacts in the mining areas.

Field experiments of surface runoff P transport from vegetative filter strips (VFS) and disturbed areas have been conducted in sand tailings (Chapter 3). Fully instrumented runoff plots were constructed at different locations to represent the range of conditions found in the region (landscape slope and lengths, soil variability, locally recommended grasses, climate characteristics, etc.). In 2006, with an annual rainfall of 722 mm about 8.5 % of rainfall volume was diverted as runoff from the bare sand mounds of K_s = 31.0 cm/h and slope =2.0%. However, with an approximate annual rainfall of 682 mm about 20.3 % of rainfall volume was diverted as runoff from the bare sand mounds of K_s = 1.6 cm/h and slope =4.3 %. The runoff carried 4,550 kg/ha/year of sediment, 104 kg/ha/year of total P (TP), 2.21 kg/ha/year of dissolved P (DP) from the 4.3 % slope source area (40 m × 250 m).

The reclamation activities in mining areas generally involve landscaping, revegetation, and maintenance of disturbed areas (UNEP, 2001). Revegetation can be an economical and less laborious method. Vegetation can increase surface roughness and infiltration, and decrease runoff volume that can reduce particles and sediment bound pollutant transport. Vegetative filter strips (VFS) are defined as areas of vegetation designed to reduce transport of sediment and pollutants from surface runoff by deposition, infiltration, adsorption, and absorption (Dillaha et al., 1989). VFS has been recommended as best management practice (BMP) in controlling non-point source pollution from disturbed lands (USDA, 1976; Barfield et al., 1979). However, VFS also effectively reduce surface pollution transport in phosphate mining areas. Runoff volume (Q), sediment, TP, and DP were reduced by VFS at least 62 %, 97 %, 96 %, and 66 % with respect to the amounts measured from the bare sand tailings, respectively (Chapter 2).

Mathematical models that can simulate water and/or sediment transport in VFS can be good tools for assessing the impacts of human activities and natural processes on water resources and for designing optimal BMPs to reduce these impacts. VFSMOD-W, developed by Muñoz-Carpena and Parsons (1999), simulates water and sediment transport in vegetated filter strips based on overland flow hydraulics (Muñoz-Carpena et al., 1993a), Einstein bed load sediment transport equation (Bartfield et al., 1978), suspended sediment transport (Tollner et al., 1976), and infiltration into the soil matrix (Muñoz-Carpena et al., 1993b). The USEPA (2005) listed VFSMOD-W as one of the models to evaluate the efficiency of the BMP in VFS for protecting watershed environments.

The success in modeling such processes heavily depends on the quality of the model parameters, i.e. if they are representative of the hydrologic properties of the soil and the vegetated filter. Thus, the first step of applying VFSMOD-W in predicting outflows from VFS is to identify optimal model parameters. A popular method for parameter estimation is manual calibration by a "trial and error" procedure comparing simulated values with measured values. However, this method is time consuming, quite subjective, and cannot ensure that the best parameter set is found. A more elaborate, complex and increasingly attractive form of parameter estimation is inverse optimization. This procedure can provide effective parameters in the range of the envisaged model application, and overcomes the drawbacks of manual calibration (Ritter et al., 2003).

Uncertainty of measured data can result from field measurements, water sample collection and storage, and water quality chemical analysis (Harmel et al., 2006). The hydrologic/water quality models are increasingly applied to guide decision-making in water resource management. Including the uncertainty of measured data in model goodness-of-fit indicators used during the model testing process can provide important information for decision makers/modelers to more realistically evaluate model performance.

The main objective of this study is to model the efficiency of grass buffers to control surface runoff pollution from phosphate mining sand tailings. For this, the numerical model

VFSMOD-W is used to predict overland flow and sediment trapping within the filter and is linked with a simplified phosphorous transport algorithm based on experimental data to predict total, particulate and dissolved P fractions in the filter outflow. An advanced global inverse optimization technique is used for the model calibration process, and the uncertainty of the measured data is considered in goodness-of-fit indicators of the model testing.

4-2. Methods and Materials

4-2-1. Field Experiments

Two field experiments were conducted on the property of the Bureau of Mine Reclamation, Florida Department of Environmental Protection (FDEP), Bartow, FL. The land was previously used for phosphate mining. Two experimental sites (site A and site B) 3 km apart were chosen to present the bare disturbed sand tailings in the upper Peace River watershed. The dimensions of the plots for sites A and B are shown in Figure 2-2. The average slopes of site A and site B are 2.0 %, and 4.3 %, respectively. The lengths of the source areas at site A and site B are 14.4 m and 40.0 m, respectively. The lengths of the filters are 4.1 m and 5.8 m at site A and 6.8 m and 13.4 m at site B, respectively. The width of each plot is 3.3 m. Thus, two different source area–to–VFS area ratios of 2.5 and 3.5 in site A and 3.0 and 6.0 in site B are used to determine their effects on performances of VFS.

Locations of instruments installed in the field to convey runoff, collect water samples, and record data (i.e. flow rate, soil moisture, and rainfall intensity) are shown in Figure 2-2. Runoff was collected in a rain gutter buried at the outlet of each plot from where it flowed into a flume and sampling trough. Then, runoff was redistributed through a perforated PVC spreader installed at the entry of the VFS. A cover was installed to prevent direct rain from falling into the runoff gutter. Six-inch (15.24 cm) HS flumes were used to measure the flow rate. To automatically record flow rate the stage of each flume was recorded using a capacitance probe

(ECH_2O, model EC-20, Decagon Devices, WA) inserted vertically in the throat of each flume. A field datalogger (CR-10X, Campbell Scientific, UT) was programmed to record flow rate from the capacitance probe in each flume every minute. To avoid changing the measurement of flow rate in the flume, runoff water samples were collected at each trough positioned below the flume outlet by an automatic water sampler containing 24 plastic sampling bottles (ISCO 6712, ISCO, Inc.). The datalogger sent pulses to the ISCO 6712 automatic water sampler based on changes of accumulated runoff volume recorded at each flume in an effort to distribute the 24 samples throughout the runoff event. After activation, the sampler purged the suction hose and then collected runoff water samples from the trough into the 500 mL bottles. Runoff samples were analyzed for concentrations of sediment, TP, and DP. Loads and flow-weighted mean concentration were computed for each collected event.

The field data at site A were collected during the entire 2006 (total rainfall 722 mm), while at site B were collected from June to December during the rainy season (rainfall 506 mm). An approximate annual rainfall of 682 mm was recorded at a weather station near site A (1 km apart). The saturated hydraulic conductivity (VKS) and initial soil moisture significantly influence the overland flow transport in source and VFS areas. Thus, 16 data sets were collected from site B and 9 data sets were collected from site A with low VKS to test VFSMOD-W performances. The hydrographs and pollutographs (sediment, TP, and DP) of inflow and outflow, and a hyetograph of each event are recorded.

4-2-2. Characterization of Experimental Sites

Saturated hydraulic conductivity (K_s), soil texture, porosity, grass spacing, and slope were measured to investigate the surface runoff movement and infiltration. Core cylinders made of brass with 5.4 cm diameter and 6.0 cm height (Soilmoisture Equipment Corp, CA) were used to collect undisturbed soil samples. The soil cores were then saturated with 0.005 M $CaSO_4$-thymol solution and the K_s was measured based on the application of Darcy's Law with a constant head permeameter (Klute and Dirksen, 1986). Saturated and final weights of the soil was measured and used to calculate bulk density and soil porosity. The average suction at the wetting front (S_{av}) was also estimated as the area under the unsaturated hydraulic conductivity ($K_{uns}(h)$) curve applying *SoilPrep* model (Workman and Skaggs, 1990). The $K_{uns}(h)$ was obtained from the Millington and Quirk (1960) procedure. Equipment employing the "Polarization Intensity Differential Scattering" technique (Beckman-Coulter, Inc.) was used to analyze particle size distribution of soil and sediment samples. For this analysis soil samples needed to be pretreated to remove organic matter (Day, 1965). A 0.5 by 0.5 m frame was used to determine the grass spacing by counting the amount of grass stems within the frame area (Appendix A). The main vegetation in filter areas is Bahia grass which accounts for about 90 %, and the remaining vegetation is composed of Hairy Indigo, Cogon grass, and Smutgrass. The detailed description of measured soil physical and field properties (topographical survey and grass height) are presented in Appendix A.

4-2-3. Simplified Phosphorus Modeling

4-2-3-1. Particulate phosphorus transport

Modeling TP phosphorus transport in VFS can be separated into DP and particulate P (PP) transports. Modeling PP transport in VFS can be calculated from the outflow of sediment since the relationship between sediment and PP was obtained from Eq. (4.1) (Chapter 2).

$$PP = 0.02606 * sediment, \text{ with } R^2 = 0.988 \quad (4.1)$$

where: *PP*= PP concentration (g/L); *sediment*= sediment concentration (g/L).

The use of this equation is supported by the TP content found in the soil samples (2.3 % of soil weight), which matches very closely the PP-to-sediment ratio in water samples from VFS obtained in the experimental equation (slope=0.02606). The finer particles transport through VFS which contain higher P concentration; thus, the ratio in Eq. (4.1) is higher than TP fraction in soil.

4-2-3-2. Dissolved phosphorus transport

(1). Release of DP from apatite into runoff water: Since the measured outflow DP concentration was found to be similar to the measured inflow DP concentration ($C_{DP\_out} \cong C_{DP\_in}$) (Chapter 2 and Appendix E), the outflow DP loads can be estimated directly from the accumulation of the product of outflow volume and DP concentration for each time step,

$$DP_{out} = \sum_{l=1}^{n} Q^{l}{}_{out} C^{l}{}_{DP\_in} \tag{4.2}$$

where: DP_{out} = DP outflow mass (g); $Q^{l}{}_{out}$ = runoff outflow volume at time step *l*; $C^{l}{}_{DP\_in}$ =inflow DP concentration at time step *l*.

During a rainfall event, the DP mass in the VFS was in a dynamic equilibrium. VFS receive the input DP loads from a source area and rainfall, and lose the output DP loads by infiltration into soil and discharging to the down slope. Thus, the Eq. (4.2) can be derived from the mass balance of cumulative DP loads in the VFS at the end of a runoff event as,

$$DP_{out} = DP_{in} - DP_{F} + DP_{D} + DP_{rain} \tag{4.3}$$

where: DP_{out} = DP outflow mass (g); DP_{in} = DP inflow mass (g); DP_{F} =DP mass infiltrated to soil (g); DP_{D} =DP mass released from apatite (g). DP_{rain} = DP mass from rainfall (g). Eq. (4.3) can be expressed as Eq. (4.4) assuming that DP concentration of infiltration is the same as inflow DP concentration and DP mass from rainfall is zero.

$$DP_{out} = \sum_{l=1}^{n} (Q^l_{in} C^l_{DP\_in} - Q^l_F C^l_{DP\_in} + Q^l_{out} C^l_{DP\_D}) \quad (4.4)$$

where: l= time step (s); Q^l_{out} = outflow volume (m^3); Q^l_{in} = inflow volume (m^3); Q^l_F = infiltration volume (m^3); $C^l_{DP\_in}$ =inflow DP concentration (mg/L); $C^l_{DP\_D}$ = DP concentration contributed from apatite dissolution (mg/L). The water volume balance in VFS can be expressed as follows:

$$Q^l_{out} = Q^l_{rain} + Q^l_{in} - Q^l_F \quad (4.5)$$

where: Q^l_{rain} = rainfall volume at each time step (m^3).

The first term in left-hand side of Eq. (4.4) was substituted from Eq. (4.2) and Q^l_{out} in the last term of right-hand side was substituted from Eq. (4.5), then Eq. (4.4) can be expressed as follows:

$$\sum_{l=1}^{n} Q^l_{out} C^l_{DP\_in} = \sum_{l=1}^{n} (Q^l_{in} C^l_{DP\_in} - Q^l_F C^l_{DP\_in} + (Q^l_{rain} + Q^l_{in} - Q^l_F) C^l_{DP\_D}) \quad (4.6)$$

By considering the water volume balance (Eq. (4.5)), we obtain,

$$C^l_{DP\_D} = \frac{Q^l_{rain}}{Q^l_{out}} C^l_{DP\_in} \quad (4.7)$$

Eq. (4.7) indicates that DP concentration contributed from apatite dissolution is related to rainfall intensity, inflow concentration, and outflow rate. Thus, DP released from apatite may result from the impact of rainfall intensity as proposed by Gao et al. (2004).

(2). Inflow DP concentration diluted from rainfall: If the dissolution of apatite was not considered in DP transport in the VFS in P mining areas and DP_{rain} =0, the last two terms of Eq. (4.3) can be removed and expressed as,

$$DP_{out} = DP_{in} - DP_F \tag{4.8}$$

We assumed that the inflow DP concentration was diluted from rainfall first, and then the diluted DP concentration was infiltrated into soil. Thus, Eq. (4.8) can be expressed as,

$$DP_{out} = \sum_{l=1}^{n} (Q^l{}_{in} C^l{}_{DP\_in} - (\frac{Q^l{}_{in}}{Q^l{}_{in} + Q^l{}_{rain}}) Q^l{}_F C^l{}_{DP\_in}) \tag{4.9}$$

By considering water volume balance (Eq. (4.5)), we obtain,

$$DP_{out} = \sum_{l=1}^{n} \frac{Q^l{}_{in} C^l{}_{DP\_in}}{(Q^l{}_{in} + Q^l{}_{rain})} \cdot Q^l{}_{out} \tag{4.10}$$

Eq. (4.2) assumes that the dissolution of apatite results from rainfall impact and consequently the assumption of $C_{DP\_in} = C_{DP\_out}$ is made to predict outflow DP loads. Eq. (4.10) does not consider the dissolution of apatite and inflow DP concentration is diluted before infiltration and discharge. These two simplified DP transport models (Eq. (4.2) and Eq. (4.10)) in mining refuse sand tailings may give us the information to determine if apatite dissolves DP into runoff water from the surface soil matrix due to rainfall impact.

4-2-4. Inverse Calibration Methodology

4-2-4-1. Calibration procedure

The flow or sediment parameters were estimated using inverse modeling by minimizing the following objective function:

$$OF(\vec{b}) = \sum_{i=1}^{N} w_i \left[O(t_i) - P(t_i, \vec{b})\right]^2 \tag{4.11}$$

where OF($\vec{b}$) is the objective function of parameter vector $\vec{b}$ that represents the error between measured and simulated values; $O(t_i)$ and $P(t_i)$ are observed and predicted values (hydrographs or sedimentographs) using parameter vector $\vec{b}$, respectively; t is the time; N is the number of measurements available; and w_i is the weight of a particular measurement (Lambot et al., 2002). VFSMOD-W was coupled with the Global Multilevel Coordinate Search (GMCS) algorithm (Huyer and Neumaier, 1999) combined sequentially with the classical Nelder-Mead Simplex (NMS) algorithm (Nelder and Mead, 1965) (GMCS-NMS) to perform the inverse calibration of parameter vector $\vec{b}$ (Ritter et al., 2007). The GMCS can deal with objective functions with complex topography and has the advantage that initial values of the parameters to be optimized are not needed. The NMS method (also known as downhill simplex method) refines the locally optimal solution to a nonlinear problem with several variables when the objective function varies smoothly.

4-2-4-2. Selected input parameters and model outputs

The main parameters of hydrology and sediment transports that can be used in model calibration are listed in Table 4-1. These sensitive parameters were chosen based on an initial sensitivity analysis (Muñoz-Carpena et al., 2007). A global sensitivity analysis was performed to gain insight in the dependence of the VFSMOD-W outputs on certain model parameters, i.e. the most important model parameters (Muñoz-Carpena et al., 2007). These authors reported that for the conditions in the experimental area the saturated hydraulic conductivity (VKS) is a main factor in dominating the runoff delivery ratio (RDR) whereas the order of parameters controlling the total infiltration in filter were VKS, width of the vegetative filter strip (FWIDTH), and wetting front (SAV). The order of important parameters with respect to sediment delivery ratio and (SDR) were median of sediment particle size (d_p), FWIDTH, VKS, and grass modified Manning's n_m (VN). Variations in the Manning's roughness coefficient (RNA) mainly controlled the time to peak of the outgoing hydrograph and had little effect on sediment output (Muñoz-Carpena et al., 1999). The length of the filter (VL) may be changed from the variation of the FWIDTH. The saturated water content (OS) may result in the variation of the SAV. Therefore, VKS, FWIDTH, VL, SAV, OS, and RNA were selected to calibrate the optimal values in hydrology transport. VN, d_p, and incoming flow sediment concentration (CI) were used to calibrate the optimal values in sediment transport.

The values of VKS, FWIDTH, VL, SAV, and OS were measured or calculated from experimental results. The values of VN and RNA were referred from Hann et al., (1994) and Foster et al., (1980), respectively. The CI was selected to calibrate the optimal value since sediment deposited in the runoff gutter and flume was not collected to incorporate with inflow sediment concentration. The mean and range of measured parameters were listed in Table 4-2 as well as the calibrated range of each parameter. Quantities listed in Table 4-2 (TRF, RDR, MSF, SDR, CSF, PP, DP, and TP) are used to evaluate the model's performance based on predicted and measured results.

4-2-5. Goodness-of-Fit Indicators

The goodness-of-fit indicators are used to evaluate the performance of the model simulation during the calibration and testing processes. The Nash-Sutcliffe coefficient of efficiency (C_{eff}, Nash and Sutcliffe, 1970) and root mean square error (*RMSE*) are commonly used goodness-of-fit indicators for hydrologists to evaluate model performance (Legates and McCabe, 1999). However, the C_{eff} is not very sensitive to systematic model over- or under-prediction especially during low flow periods (Krause et al., 2005). To reduce the oversensitivity to extreme values in the C_{eff}, a modified form of C_{eff} (Krause et al., 2005), C_{eff_m}, was applied to evaluate potential systematic (e.g. over- or under-prediction) and dynamic (e.g. timing, and falling or rising lamb) model simulation errors. The detailed description of goodness-of fit indicators is presented in Appendix B. Using a combination of these indicators (C_{eff}, C_{eff_m}, and *RMSE*), we can appropriately evaluate model performance resulting from different types of observed and predicted data.

4-2-6. Consideration of Measured Data Uncertainty in the Model Evaluation

Common sources of measured errors of hydrologic and water quality data are related to flow measurement, sample collection, sample storage, and laboratory analysis (Harmel et al., 2006). The deviation term ($e_i = O_i - P_i$) in goodness-of-fit indicators is normally determined as the difference between observed and predicted data. This deviation term does not account for uncertainty of measured data in indicators. Therefore, Harmel et al. (2007) modified the deviation term in goodness-of-fit indicators based on the cumulative probable error to appropriately compare model predictions and observations (Fig. 4-1).

The probable error range (PER) resulting from the various hydrologic/water quality data collection procedures can be estimated by propagation of errors method in Eq.(4.12) (Topping, 1972).

$$\text{PER} = \sqrt{\sum_{i=1}^{n}\left(E_1^2 + E_2^2 + E_3^2 + E_4^2\right)} \tag{4.12}$$

Where: PER = probable error range (± %); n = number of potential error sources; and E_1, E_2, E_3, and E_4 are uncertainties (%) associated with flow measurement, sample collection, sample storage, and laboratory analysis, respectively. In hydrology, this method has been used for uncertainty estimates related to discharge measurements (Sauer and Meyer, 1992) and water quality (Cuadros-Rodriquez et al., 2002; Harmel et al., 2007).

The measured data uncertainty of each error category (E1 to E4) was determined based on the sample collecting and data analysis procedures (Harmel et al., 2006). The measured data uncertainty of each category is summarized in Table 4-4. The sampling uncertainty (E2) of TP was taken as that of sediment since most P in TP comes from mineral apatite in the soil transported as sediment. Storage uncertainty (E3) of DP was taken as maximum value of the storage error (Kotlash and Chessman, 1998) but was increased up to 45% to account for potential dissolution of carbonate-fluorapatite (CFA, also called francolite), since CFA exists in water/sediment samples. Sediment deposited in the flume can result in errors of measured flows (E1). Thus, flow uncertainty was taken as poor condition (10%) and added up to 20% to account for sediment effect on measurement. Since DP, TP, and sediment were collected from the flow, 20% of measured flow error was chosen. Finally, probable error range (Eq. 4.12) are calculated yielding 50%, 30%, 29%, and 20%, for DP, TP, sediment, and flow, respectively. This measured data can be incorporated into goodness-of-fit indicators following Harmel and Smith (2007) to evaluate the prediction performances of VFSMOD-W. The uncertainty boundaries of the observation were calculated as Eq. (4.13) (Harmel and Smith, 2007).

$$UO_i(u) = O_i + \frac{PER_i * O_i}{100}, \qquad UO_i(l) = O_i - \frac{PER_i * O_i}{100} \tag{4.13}$$

where: $UO_i(u)$ = upper uncertainty boundary for each observed data point; $UO_i(l)$ = lower uncertainty boundary for each observed data point; PER_i = probable error range for each measured data point.

To include PER in goodness-of-fit indicators the deviation term ($e_i = O_i - P_i$) in Eqs. (B.1)-(B.3) in Appendix B is replaced by the modified deviation, em_i, which is defined based on the PER of the measured value and model predicted value. The calculation of em_i is shown in Eq. (4.14) and graphically in Figure 4-1.

$$\left.\begin{array}{ll} em_i = UO_i(l) - P_i & \text{if} \quad UO_i(l) > P_i \\ em_i = UO_i(u) - P_i & \text{if} \quad UO_i(u) < P_i \\ em_i = 0 & \text{if} \quad UO_i(l) < P_i < UO_i(u) \end{array}\right\} \tag{4.14}$$

where em_i is modified deviation between measured and predicted data.

When a predicted value is located outside the uncertainty boundaries, the deviation is calculated as the difference between the predicted value and the nearest uncertainty boundary; otherwise, the deviation is equal to 0. In this study, we assume that all measured data of each category have the same PER during each event.

4-3. Results and Discussion

To verify the robustness of the inverse modeling algorithm integrated in the VFSMOD-W, two conditions, perfect data set and adding random noise to the perfect data set (ARP), were created. The results show that inverse modeling algorithm integrated in the VFSMOD-W is robust since it successfully calibrated the parameters even in the presence of random noise associated with the measured data (Appendix C).

A total of twenty five runoff events were selected to evaluate VFSMOD-W performance in simulating runoff, sediment, and P transport in VFS from refuse mining sand tailings. An example (event on 07/14/06) of observed and predicted hydrographs and sedimentographs is shown in Figures 4-2 and 4-3. Hydrographs and sedimentographs of other remaining events are presented in Appendix D. The VFS sediment trapping efficiency for this event is about 98% in VFS. The inflow mass of sediment was two orders larger than outflow, thus inflow sediment was not included in the sedimentograph (Figure 4-3).

For the 25 events, values of optimal parameters and the quantities of measured QPF (peak flow measured from VFS), TRS, TRF, CSF, and MSF and predicted TRF, CSF, and MSF are listed in Table 4-5. Simulation results expressed in different goodness-of-fit indicators with (PER>0) and without (PER=0) considering measurement uncertainty of runoff and sediment transport are shown in Table 4-6. C_{eff}, sensitive in large volume, is mainly used to evaluate model performance since large value (peak flow volume) has a significant effect on sediment and runoff transport.

The relationship between QPF and C_{eff} of runoff flow simulation was found (Figure 4-4), such that smaller events ($Q_p < 0.4$ L/s) are not simulated well with the model ($C_{eff} < 0.60$), likely due to limitations of the experimental system to register such small events. The low flow velocity of the events may have limited energy to flush deposited sediment in the flume. Under this situation deposited sediment in the flume may raise the water level and consequently increase the measured flow rate. Thus, in some events with a low QPF, the measured runoffs from VFS are far greater than simulated runoffs from VFS as shown in Table 4-5.

Once VFSMOD-W is calibrated for runoff, the model offers good sediment transport predictions, shown in Figure 4-5. For those events (QPF < 0.4 L/s) which were not predicted well in runoff transport, their measured TRFs are less than 60 L and relative measured MSFs are less than 3 g. The relative larger measurement error in low runoff events resulted in poor predictions of VFSMOD-W in runoff and sediment transport. The predicted MSFs are zero in these low runoff events. Thus, similarly to the runoff case the model performed fairly well throughout the range of measured data, except for the low values of measured runoff subject to experimental limitations.

The calibrated ranges of parameters for different events and measured mean value or referred range of parameters in different plots are shown in Table 4-7. The range of calibrated VKS is within one order of magnitude of the measured value for each plot. This is considered an acceptable range since VKS field distribution of values is often described by a lognormal distribution. The minimum calibrated SAV is close to the measured value. The calibrated range of OS is within 100 ± 15 % of measured OS. The minimum calibrated FWIDTH is close to 1.0 which occurred in the highest runoff volume in site B with 6.8 m long filter (B090906V2). The concentrated flow path may occur in the event with a high runoff volume. The ranges of VL are between onefold and twofold of measured length which means the route of runoff transport is not straight. The event with VL < measured length (C_{eff} < 0.6 as well) happened in the small runoff event in the 13.4 m-long filter with a higher initial soil moisture. Calibrated RNA(I)s are usually between 0.1 and 0.60, typical of grass with different density, except event B101206V2. The maximum VN of each plot is slightly greater than the measured range. In most events d_p is greater than 0.0037 µm (COARSE > 0.5 as well) since the source area contains a high fraction of sand (>0.94). The values of d_p and COARSE match the experimental measurements from sediment particle size distribution of water samples.

In Table 4-6 most values of C_{eff} are higher than C_{eff_m} for both hydrology and sediment simulations, which indicates that the model can simulate high volume very well. When considering measured data uncertainty (PER = ± 20 %) in runoff simulation for these 25 events, C_{eff} increased 1 % to 1179 %, C_{eff_m} increased 5 % to 460 %, and *RMSE* decreased -20 % to -51 %. For sediment simulation considering measured data uncertainty (PER = ± 29 %), C_{eff} increased 2% to 1311%, C_{eff_m} increased 7% to 1034%, and *RMSE* decreased -24% to -68%.

The highest increase of C_{eff} occurred in the poor simulation result. The narrow range increased in C_{eff_m} compared to C_{eff} since weight of each point is the same in calculation of C_{eff_m}.

The goodness-of-fit indicators of hydrology, sediment, and P simulations are shown in Table 4-8. Again, VFSMOD-W was not able to predict very well in small events due to the measurement error. In these low runoff events the *RMSE*s are less than 0.0006. The small magnitude did not have a significant effect on goodness-of-fit indicators when bigger events were included in the comparison. Including the probable error range (PER) in goodness-of-fit indicators, the predictions of TRF (C_{eff} = 0.991, C_{eff_m} = 0.888) and MSF (C_{eff} = 0.976, C_{eff_m} = 0.874) are very high for these 25 events.

These good predictions in runoff and sediment also result in good prediction of PP transport (C_{eff} = 0.961, C_{eff_m} = 0.838) since apatite exists almost uniformly in sediment. Good DP predictions (C_{eff} = 0.965) were found based on the assumption of considering rainfall impact on P release from apatite. The release of DP from apatite into runoff water maintains the system equilibrium for the DP loss from infiltration and dilution of DP concentration from rainfall. The C_{eff} of TP transport is also as high as PP since DP is a small fraction of TP.

When uncertainty of measured data is included in these 25 events, the C_{eff} is greater than 0.98 for each output quantity except RDR. This means that VFSMOD-W predicts systematic and dynamic behaviors of runoff, sediment, and P transport very well considering acceptable measured data uncertainties. The C_{eff_m} of each quantity is also significantly increased. The paired predicted and measured values with their measured data error of each quantity are shown from Figures 4-6 to 4-12. Most predicted data including measured data uncertainty cover the 1:1 line.

4-4. Conclusions

The VFSMOD-W parameters obtained by inverse modeling are within acceptable ranges of measured values. The smaller events (peak flow, QPF < 0.4 L/s) are not simulated well with the model (C_{eff} < 0.60), likely due to limitations of the experimental system to register such small events. For those events (QPF < 0.4 L/s) which were not predicted well in runoff transport, their measured TRFs are less than 60 L and relative measured MSFs are less than 3 g. Once VFSMOD-W is calibrated for runoff, the model offers good sediment transport predictions. Similarly to the runoff case the model performed fairly well throughout the range of measured data, except for the low values of measured runoff subject to experimental limitations.

When considering uncertainty of measured data in each quantity for 25 events, the C_{eff} is greater than 0.98 for each quantity except RDR. The C_{eff_m} of each quantity is also significantly increased. The uncertainty of measured data included in the goodness-of-fit indicators is more realistic to evaluate model performance and data sets. The good predictions of TRF (C_{eff} = 0.991, C_{eff_m} = 0.888) and MSF (C_{eff} = 0.976, C_{eff_m} = 0.874) are very high for these 25 events. These good predictions in runoff and sediment also result in good prediction of PP transport (C_{eff} = 0.961, C_{eff_m} = 0.838) since apatite exists almost uniformly in sediment. Good DP predictions (C_{eff} = 0.965) were found based on the assumption of considering rainfall impact on P release from apatite. The release of DP from apatite into runoff water maintains the system equilibrium for the DP loss from infiltration and dilution of DP concentration from rainfall. The C_{eff} of TP transport is also as high as PP since DP is a small fraction of TP.

Based on the successful performance of VFSMOD-W, this tool shows promise for the management agencies involved in mining permitting in upper Peace River basin. These agencies could apply VFSMOD-W to design VFS for controlling runoff and P transport in phosphate mining sand tailings.

Table 4-1. Simulation parameters for the VFSMOD-W model.

#	Parameter	Units	Description
			Hydrology
1	FWIDTH	m	Effective flow width of the strip
2	VL	m	Length of the filter (flow direction)
3	RNA(I)	$s/m^{1/3}$	Filter Manning's roughness *n* for each segment
4	SOA(I)	m/m	Filter slope for each segment
5	VKS	m/s	Soil vertical saturated hydraulic conductivity in the VFS, K_s
6	SAV	m	Green-Ampt's average suction at wetting front
7	OS	m^3/m^3	Saturated soil water content, θ_s
8	OI	m^3/m^3	Initial soil water content, θ_i
9	SM	m	Maximum surface storage
10	SCHK	--	Relative distance from the upper filter edge where check for ponding conditions is made (i.e. 1 = end, 0.5 = mid point, 0 = beginning)
			Sediment transport
11	SS	cm	Average spacing of grass stems
12	VN	$s/cm^{1/3}$	Filter media (grass) modified Manning's n_m (.012 for cylindrical media)
13	H	cm	Filter grass height
14	VN2	$s/m^{1/3}$	Bare surface Manning's *n* for sediment inundated area in grass filter
15	d_p	cm	Sediment particle size diameter (d_{50})
16	COARSE	--	Fraction of incoming sediment with particle diameter > 0.0037 cm (coarse fraction routed through wedge as bed load) [unit fraction, i.e. 100% = 1.0]
17	CI	g/cm^3	Incoming flow sediment concentration
18	POR	m^3/m^3	Porosity of deposited sediment
19	SG	g/cm^3	Sediment particle density

Table 4-2. Selected quantities of hydrology, sediment, and phosphorus transport.

Quantity	Units	Description
		Hydrology
TRF	m^3	Total runoff output from filter
		Sediment
MSF	kg	Mass of sediment output from filter
CSF	g/L	Concentration of sediment in outflow from filter
		Phosphorus
DP	g	DP mass output from filter
PP	g	PP mass output from filter
TP	g	TP mass output from filter

Table 4-3. The range of selected parameters used in calibration and measured data of each parameter at sites A and B.

Component	Parameter	Site B				Site A			
		Measured			Calibrated	Measured			Calibrated
		n	mean	range	range	n	mean	range	range
Hydrology	VKS	8	1.8E-05	2.8E-6 - 1.0E-4	1E-6 - 9E-4	8	5.6E-5	5.9E-5 - 1.1E-4	1E-6 - 9E-4
	SAV	8	0.23	0.05-32	0.1-1	8	0.17	0.14-0.27	0.1-1
	OS	8	0.46	0.40-0.49	0.32-0.56	8	0.40	0.37-0.43	0.32-0.56
	FWIDTH	1	3.30	--	1.0-3.3	1	3.30	--	1.0-3.3
	VL (1)	1	6.8	--	6.6-12	1	4.1	--	4.1-10
		1	13.4	--	13.4-20	1	5.8	--	5.8-12
	RNA(I) (2)	--	--	0.015-0.4	0.01-0.60				0.01-0.60
Sediment	VN (3)	--	--	0.008-0.016	0.008-0.025	--	--	0.008-0.016	0.008-0.025
	CI (4)	--	--	--	0.001-0.05	--	--	--	0.0005-0.020
	d_P	20	0.027	0.018-0.041	0.0037-0.045	10	0.025	0.011-0.038	0.0037-0.045

(1): VL has two lengths at each site; (2): Foster et al., 1980; (3); Haan et al., 1994;

(4): measured values were not provided since measured data did not include sediment deposited in flume and runoff gutter.

--: no value provided.

Table 4-4. Measured data uncertainty of DP, TP, sediment, and flow for each category.

Measured Item	E1=Flow(1)		E2=Sampling(2)		E3=Storage(3)		E4=Analysis(4)(5)		PER
	Range (%) (Central value)	Used (%)	Range (%) (Central value)	Used (%)	Range (%) (Central value)	Used (%)	Range (%) (Central value)	Used (%)	(%)
DP	-5 to 10 (--)	20	0 to 0 (0)	0	-39 to 20 (-17)	45 #	-14 to 22 (8)	8	50
TP	-5 to 10 (--)	20	0 to 17 (0)	20 *	-64 to 9 (-11)	11	-24 to 22 (2)	2	30
Sediment	-5 to 10 (--)	20	14 to 33 (20)	20	0 to 0 (0)	0	-4.9 to -2.5 (--)	5.0	29
Flow	-5 to 10 (--)	20	0 to 0 (0)	0	0 to 0 (0)	0	0 to 0 (0)	0	20

*: Sampling error taken as that of sediment since most P in TP comes from mineral apatite in sediment.

#: Storage taken as max value (39%) but increased 5% (rounded to 45%) to account for potential dissolution of apatite.

(--): no value provided.

Harmel et al., 2006:

(1): Sauer and Meyer (1992); (2): Martin et al. (1992); (3): Kotlash and Chessman (1998);

(4): Gordon et al. (2000); (5): Mercurio et al. (2002).

Table 4-5. Calibrated parameters of hydrology and sediment and measured and predicted selected quantities.

Event ID	Hydrology					Sediment				Measured data					Predicted data		
	VKS (m/s)	SAV (m)	OS (%)	FWIDTH (m)	VL (m)	RNA ($s/m^{1/3}$)	VN ($s/m^{1/3}$)	CI (g/cm^3)	d_p (mm)	QPF (L/s)	TRS (m^3)	CSF (g/L)	TRF (m^3)	MSF (kg)	CSF (g/L)	TRF (m^3)	MSF (kg)
B061306V2*	0.000007	0.66	0.56	3.11	9.74	0.23	0.009	0.028	0.0048	0.067	0.518	0.059	0.020	0.001	0.06	0.010	0.001
B071406V2	0.000007	0.79	0.56	3.26	9.23	0.31	0.011	0.019	0.0018	0.590	1.290	0.184	0.323	0.059	0.191	0.239	0.046
B072006V2	0.000021	0.44	0.35	2.76	8.96	0.60	0.014	0.042	0.0056	1.586	1.181	0.310	0.653	0.202	0.273	0.553	0.151
B072806V2	0.000044	0.37	0.44	2.23	8.22	0.33	0.008	0.026	0.0031	0.344	0.592	0.063	0.154	0.010	0.037	0.048	0.002
B090606V2	0.000025	0.41	0.52	2.38	6.89	0.39	0.017	0.025	0.0067	1.265	0.655	0.170	0.287	0.049	0.172	0.242	0.041
B090906V2	0.000015	1.03	0.46	1.06	8.05	0.44	0.010	0.004	0.0019	2.364	4.261	0.178	3.494	0.623	0	3.381	0.544
B091006V2	0.000027	0.42	0.39	1.74	8.07	0.58	0.019	0.009	0.0038	1.430	1.861	0.124	1.028	0.127	0.127	0.907	0.115
B101206V2	0.000008	0.25	0.46	2.78	12.0	0.79	0.025	0.001	0.0203	1.863	0.676	0.007	0.440	0.003	0	0.431	0.000
B061306V3	0.000005	0.45	0.40	2.40	8.26	0.37	0.014	0.014	0.0129	0.009	0.189	0.052	0.006	0.000	0.001	0.038	0.000
B071406V3	0.000007	0.72	0.56	1.50	16.0	0.09	0.025	0.025	0.0042	0.757	1.035	0.136	0.428	0.058	0.129	0.348	0.045
B072006V3	0.000004	0.68	0.52	1.50	16.6	0.32	0.019	0.025	0.0091	1.061	1.208	0.168	0.887	0.149	0.174	0.742	0.129
B072806V3	0.000031	0.53	0.47	1.84	7.93	0.50	0.008	0.015	0.0023	0.462	0.917	0.129	0.267	0.034	0.196	0.066	0.013
B090606V3	0.000077	0.74	0.48	1.30	8.38	0.15	0.022	0.001	0.0044	0.022	0.500	0.076	0.014	0.001	0.064	0.003	0.000
B090906V3	0.000007	1.01	0.46	2.31	15.6	0.57	0.022	0.015	0.0042	2.133	3.895	0.123	2.681	0.329	0.13	2.627	0.342
B091006V3	0.000009	0.83	0.50	1.50	13.6	0.21	0.019	0.009	0.0037	1.060	1.688	0.127	0.940	0.119	0.107	0.900	0.096
B101206V3	0.000021	0.45	0.48	1.56	17.9	0.17	0.020	0.012	0.0037	0.974	0.743	0.106	0.254	0.027	0.096	0.210	0.020
A020306V2	0.000050	0.81	0.37	2.19	4.34	0.34	0.020	0.012	0.0104	0.090	0.962	0.049	0.050	0.002	0.068	0.017	0.001
A061306V2	0.000026	0.70	0.45	2.06	8.20	0.44	0.023	0.011	0.0046	0.060	0.436	0.010	0.062	0.001	0.011	0.011	0.000
A070706V2	0.000026	0.10	0.45	1.50	4.39	0.05	0.013	0.008	0.0022	0.107	0.128	0.041	0.044	0.002	0.043	0.038	0.002
A072806V2	0.000044	0.69	0.45	2.33	4.39	0.22	0.025	0.021	0.0093	0.077	0.289	0.010	0.027	0.000	0.013	0.008	0.000
A091006V2	0.000100	0.10	0.45	1.57	4.40	0.05	0.021	0.005	0.0180	0.051	0.139	0.010	0.036	0.000	0.07	0.006	0.000
A020306V3	0.000012	0.80	0.42	3.30	11.0	0.11	0.008	0.011	0.0198	0.024	1.076	0.010	0.020	0.000	0.001	0.024	0.000
A070706V3	0.000008	0.80	0.49	2.56	5.98	0.15	0.022	0.018	0.0025	0.892	0.197	0.036	0.062	0.002	0.029	0.043	0.001
A072806V3	0.000014	0.81	0.45	1.49	5.80	0.54	0.018	0.020	0.0037	0.402	0.317	0.063	0.143	0.009	0.108	0.044	0.005
A091006V3	0.000031	0.80	0.45	2.49	7.38	0.17	0.008	0.015	0.0035	0.063	0.177	0.039	0.055	0.002	0.035	0.012	0.000

* In event ID, A: Site A; B: Site B; six numbers succession: Gregorian date; V2: plot number 2 in VFS area.

Table 4-6. Results of runoff and sediment simulations in selected goodness-of-fit indicators with and without including measurement uncertainty (PER=±20% for runoff, PER=±29% for sediment).

Event ID	*Runoff*						*Sediment*					
	PER=0			PER=0.2			PER=0			PER=0.29		
	C_{eff}	C_{eff_m}	*RMSE*#	C_{eff}	C_{eff_m}	*RMSE*	C_{eff}	C_{eff_m}	*RMSE*#	C_{eff}	C_{eff_m}	*RMSE*
B061306V2*	0.628	0.519	9.4E-06	0.794	0.660	7.0E-06	0.422	0.563	0.0009	0.734	0.721	0.0006
B071406V2	0.820	0.681	4.8E-05	0.910	0.797	3.4E-05	0.831	0.726	0.0110	0.935	0.867	0.0068
B072006V2	0.948	0.870	9.7E-05	0.972	0.922	7.1E-05	0.685	0.740	0.0882	0.865	0.862	0.0578
B072806V2	0.315	0.313	6.4E-05	0.579	0.474	5.0E-05	0.591	0.578	0.0048	0.819	0.734	0.0032
B090606V2	0.989	0.894	3.6E-05	0.996	0.940	2.3E-05	0.981	0.909	0.0093	0.998	0.969	0.0030
B090906V2	0.868	0.719	2.5E-04	0.949	0.866	1.5E-04	0.787	0.660	0.0782	0.933	0.841	0.0438
B091006V2	0.908	0.768	1.0E-04	0.953	0.865	7.3E-05	0.946	0.811	0.0138	0.990	0.929	0.0060
B101206V2	0.974	0.888	6.9E-05	0.994	0.962	3.4E-05	0.031	0.419	0.0781	0.442	0.576	0.0593
B061306V3	-1.286	-0.376	3.6E-06	-0.463	-0.101	2.9E-06	-1.183	-0.348	0.0002	-0.100	0.043	0.0001
B071406V3	0.738	0.529	7.3E-05	0.869	0.681	5.2E-05	0.861	0.699	0.0093	0.948	0.841	0.0057
B072006V3	0.810	0.701	1.9E-04	0.926	0.842	1.2E-04	0.948	0.863	0.0193	0.982	0.950	0.0114
B072806V3	0.033	0.050	1.0E-04	0.422	0.280	8.0E-05	0.441	0.376	0.0138	0.749	0.607	0.0093
B090606V3	-0.818	-0.182	9.9E-06	-0.140	0.077	7.8E-06	-0.411	0.085	0.0009	0.289	0.350	0.0006
B090906V3	0.925	0.774	1.6E-04	0.970	0.907	9.9E-05	0.801	0.647	0.0434	0.930	0.832	0.0258
B091006V3	0.587	0.553	1.7E-04	0.802	0.733	1.2E-04	0.739	0.662	0.0204	0.920	0.842	0.0113
B101206V3	0.855	0.765	8.8E-05	0.934	0.872	5.9E-05	0.723	0.656	0.0138	0.923	0.836	0.0073
A020306V2	0.131	0.253	2.2E-05	0.471	0.429	1.7E-05	0.623	0.592	0.0009	0.815	0.729	0.0006
A061306V2	-0.770	-0.259	2.0E-05	-0.103	0.012	1.6E-05	-0.265	0.029	0.0002	0.369	0.326	0.0001
A070706V2	0.733	0.595	1.5E-05	0.872	0.742	1.0E-05	0.707	0.707	0.0008	0.897	0.842	0.0005
A072806V2	0.242	0.062	1.3E-05	0.517	0.256	1.0E-05	0.336	0.120	0.0001	0.674	0.386	0.0001
A091006V2	-0.277	0.182	1.4E-05	0.198	0.358	1.1E-05	-0.206	0.212	0.0002	0.400	0.452	0.0001
A020306V3	-0.339	0.163	8.7E-06	0.161	0.354	6.9E-06	-0.401	0.126	0.0001	0.307	0.391	0.0001
A070706V3	0.723	0.660	1.9E-05	0.866	0.788	1.3E-05	0.356	0.462	0.0012	0.758	0.678	0.0007
A072806V3	0.884	0.755	3.8E-05	0.680	0.624	6.3E-05	0.600	0.605	0.0047	0.819	0.761	0.0032
A091006V3	-0.201	0.256	1.8E-05	0.246	0.417	1.4E-05	0.153	0.369	0.0007	0.598	0.584	0.0005

*In event ID, A: Site A; B: Site B; six numbers succession: Gregorian date; V2: plot number 2 in VFS area.

#units of *RMSE*s in hydrology and sediment are (m^3/s) and (g/s), respectively.

Table 4-7. The calibrated range of parameters compared with the measured value of parameters in different plots.

Component	Parameter	B-VFS-2			B-VFS-3			A-VFS-2			A-VFS-3		
		Measured	Min	Max	Measured	Min	Max	Measured	Min	Max	Measured	Min	Max
Hydrology	VKS	9.08E-06	7.08E-06	4.41E-05	5.13E-05	4.26E-06	7.69E-05	5.76E-05	2.62E-05	9.99E-05	7.78E-05	7.67E-06	3.14E-05
	SAV	0.32	0.25	1.03	0.28	0.45	1.01	0.21	0.10	0.81	0.19	0.80	0.81
	OS	0.47	0.35	0.56	0.49	0.40	0.56	0.43	0.37	0.45	0.45	0.42	0.49
	FWIDTH	3.30	1.06	3.26	3.30	1.30	2.40	3.30	1.50	2.33	3.30	1.49	3.30
	VL	6.80	6.89	12.02	13.40	7.93	17.92	4.10	4.34	8.20	5.80	5.80	11.00
	RNA(I)	0.05-0.4	0.234	0.794	0.05-0.4	0.092	0.567	0.05-0.4	0.050	0.436	0.05-0.4	0.110	0.538
Sediment	VN	0.008-0.016	0.0083	0.0250	0.008-0.016	0.0081	0.0253	0.008-0.016	0.0129	0.0250	0.008-0.016	0.0080	0.0220
	CI	*	0.0013	0.0417	*	0.0014	0.0250	*	0.0054	0.0207	*	0.0110	0.0200
	d_P	0.018-0.041	0.0018	0.0203	0.021-0.039	0.0023	0.0129	0.015-0.038	0.0022	0.0180	0.011-0.036	0.0025	0.0198

*: values not provided, because measured data did not include sediment deposited in flume and runoff gutter.

Table 4-8. The selected goodness-of-fit indicators for each quantity with and without including PER.

Quantity	Error range	Goodness-of-fit indicators		
		C_{eff}	C_{eff_m}	*RMSE*
TRF	PER=0	0.991	0.888	0.078
	PER=0.2	0.998	0.963	0.039
RDR	PER=0	0.706	0.498	0.127
	PER=0.2	0.857	0.721	0.088
MSF	PER=0	0.976	0.874	0.021
	PER=0.29	0.998	0.991	0.002
SDR	PER=0	0.973	0.810	0.001
	PER=0.29	0.996	0.949	0.001
CSF	PER=0	0.901	0.749	0.023
	PER=0.29	0.983	0.936	0.009
PP	PER=0	0.961	0.838	0.688
	PER=0.3	0.994	0.957	0.301
DP*	PER=0	0.857	0.661	0.523
	PER=0.5	0.997	0.964	0.073
DP #	PER=0	0.965	0.792	0.260
	PER=0.5	0.999	0.976	0.054
TP*	PER=0	0.949	0.788	1.093
	PER=0.3	0.994	0.952	0.401
TP #	PER=0	0.967	0.825	0.880
	PER=0.3	0.994	0.957	0.363

*: DP diluted from rainfall.
#: rainfall induces the DP released from apatite.

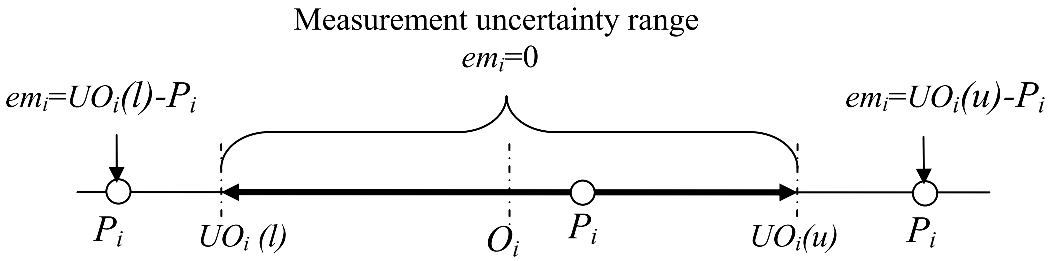


Figure 4-1. Graphical representation to calculate modified deviation between paired observed and predicted data based on the probable measured error range.

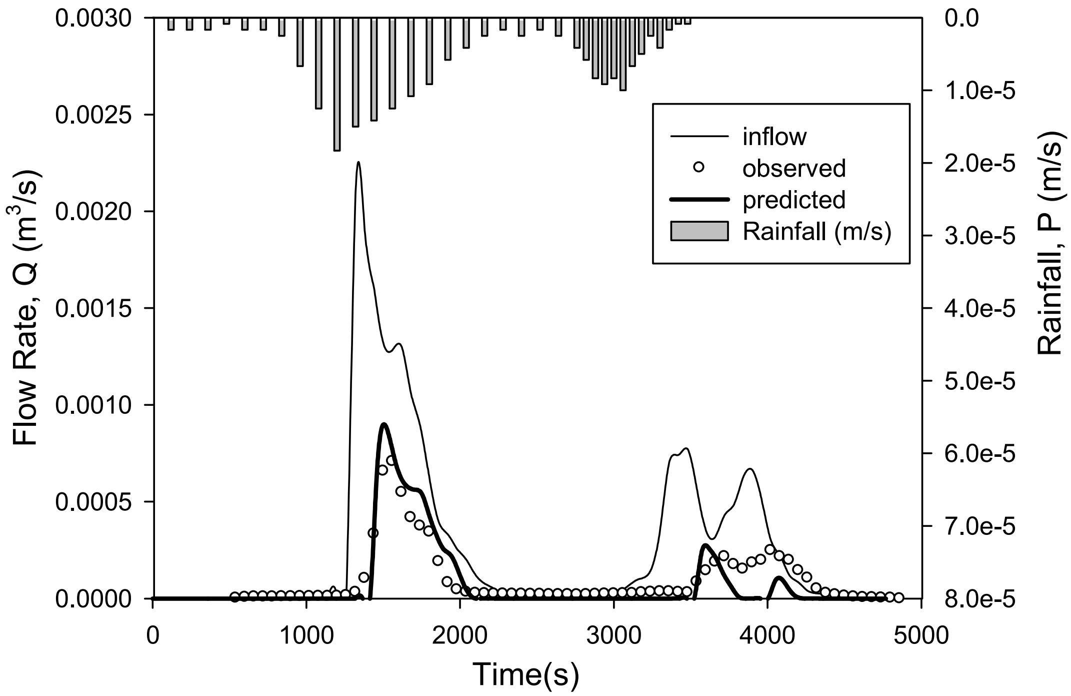


Figure 4-2. Hydrographs of event B071406V3.

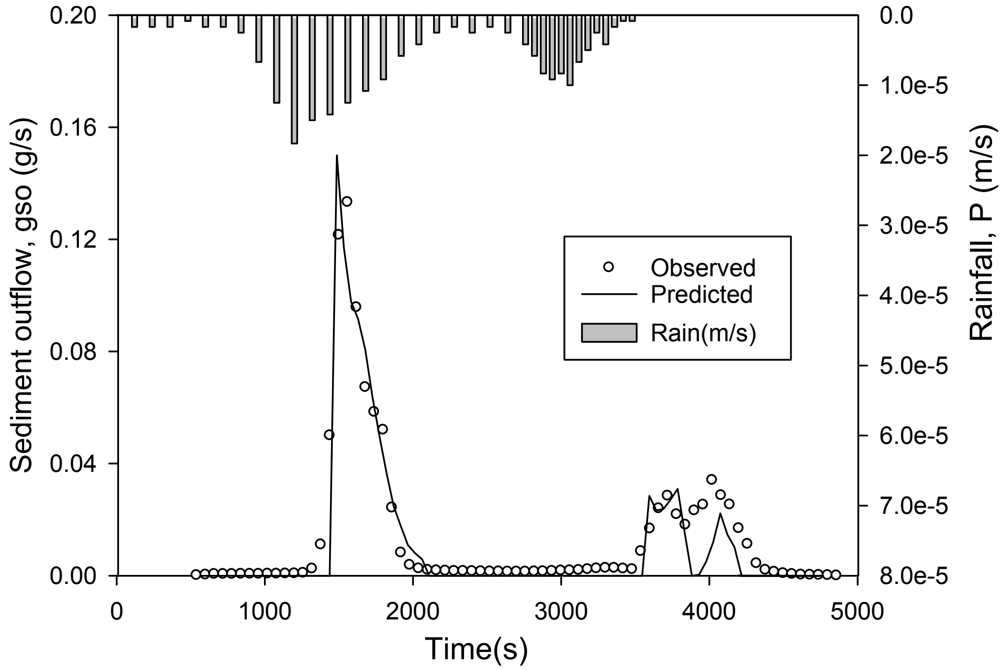


Figure 4-3. Sedimentographs of event B071406V3.

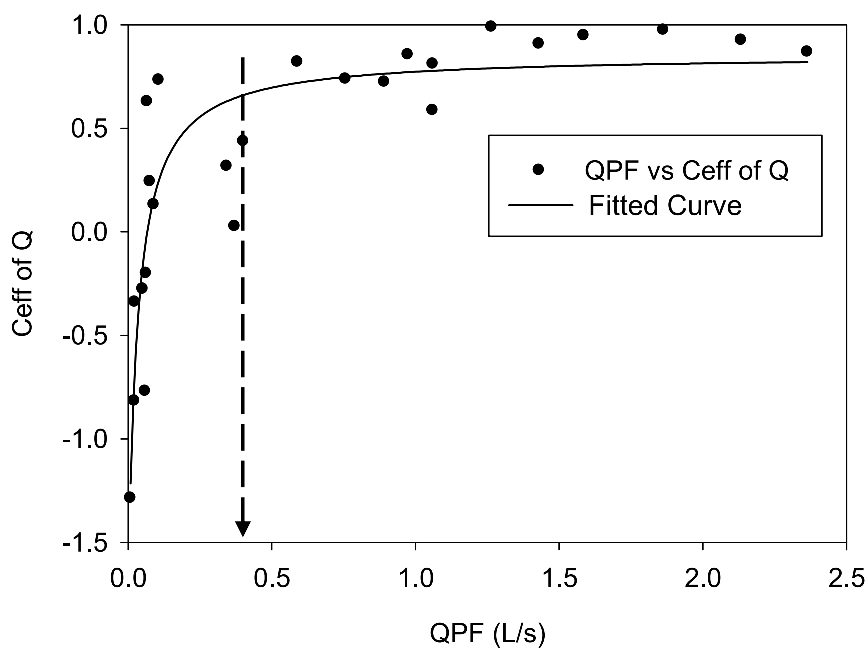


Figure 4-4. Comparison of measured filter strip peak flow measured on the experimental site vs. goodness of fit VFSMOD runoff predictions.

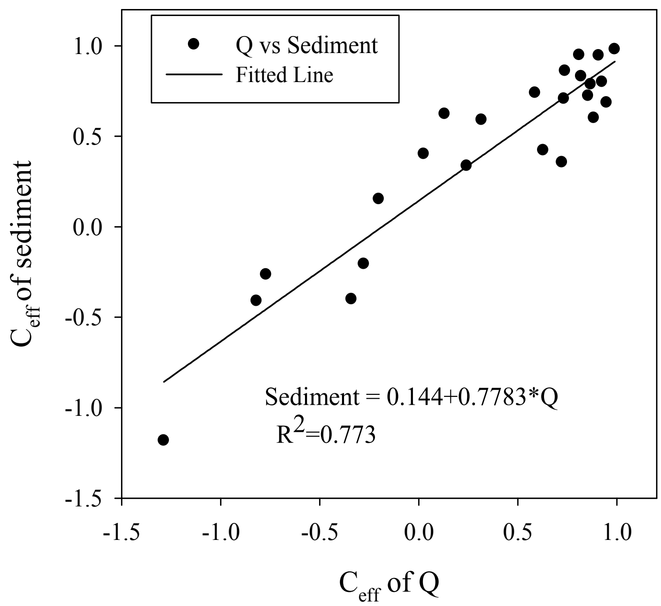


Figure 4-5. C_{eff} of sediment versus C_{eff} of Q for all simulated events.

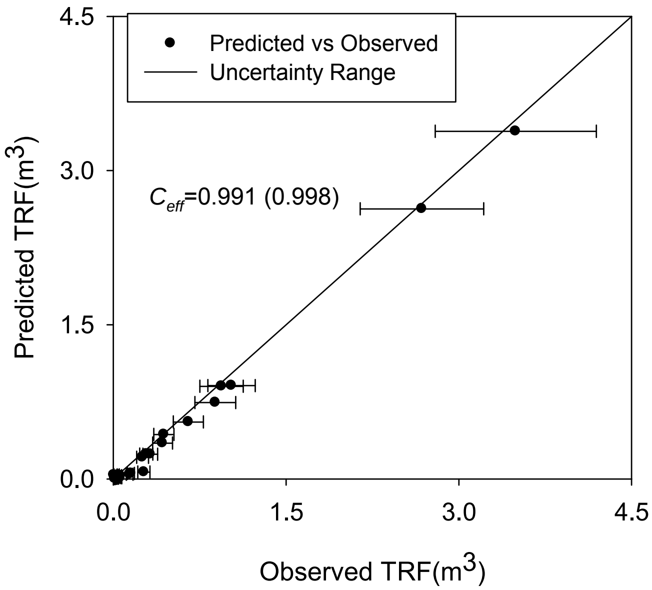


Figure 4-6. Scatterplot of measured and predicted TRF including measurement uncertainty for each measured value plotted as an error bar (PER=±20%, number in brackets is C_{eff} considering the PER).

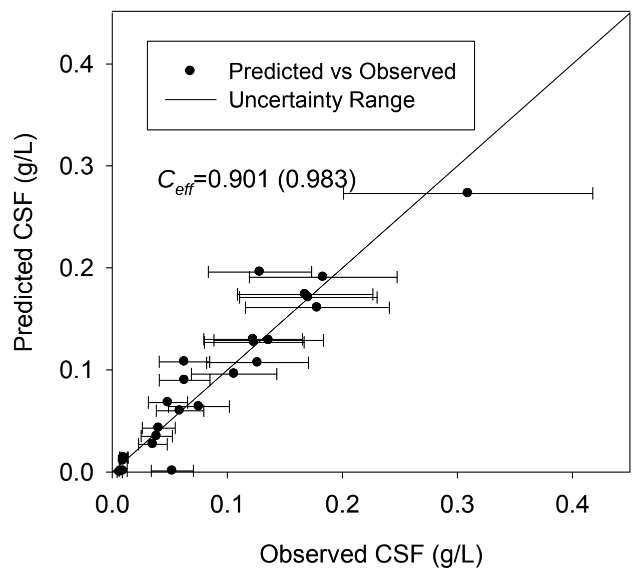


Figure 4-7. Scatterplot of measured and predicted CSF including measurement uncertainty for each measured value plotted as an error bar (PER=±29%, number in brackets is C_{eff} considering the PER).

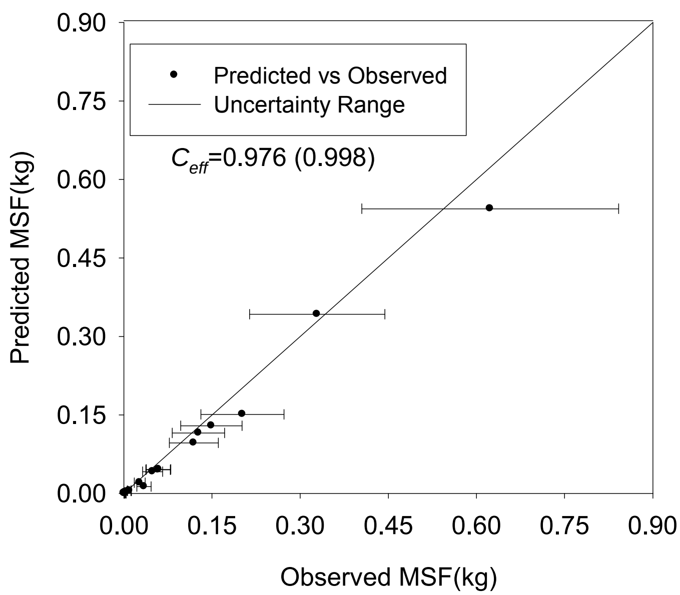


Figure 4-8. Scatterplot of measured and predicted MSF including measurement uncertainty for each measured value plotted as an error bar (PER=±29%, number in brackets is C_{eff} considering the PER).

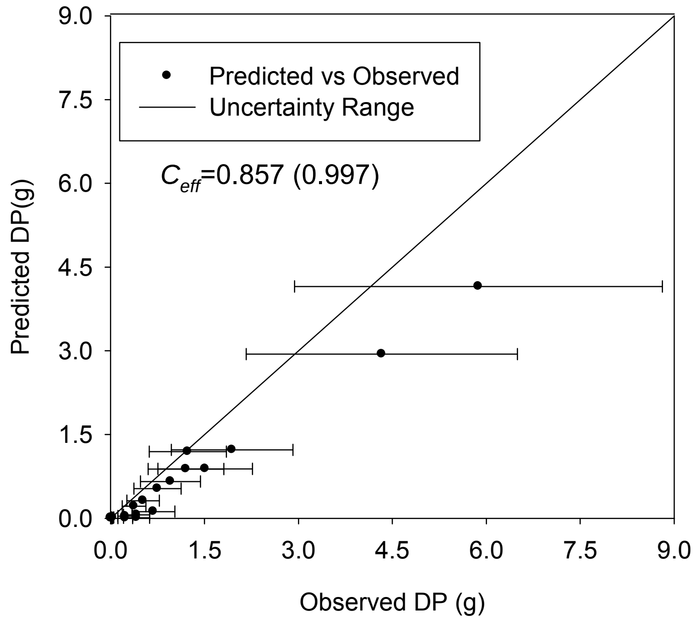


Figure 4-9. Scatterplot of measured and predicted DP diluted from rainfall including measurement uncertainty for each measured value plotted as an error bar (PER=± 50%, number in brackets is C_{eff} considering the PER).

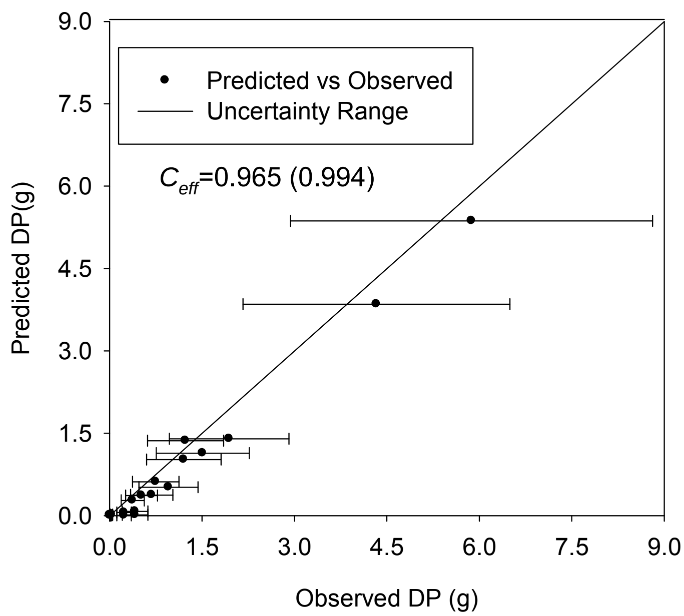


Figure 4-10. Scatterplot of measured and predicted DP without dilution from rainfall including measurement uncertainty for each measured value plotted as an error bar (PER=± 50%, number in brackets is C_{eff} considering the PER).

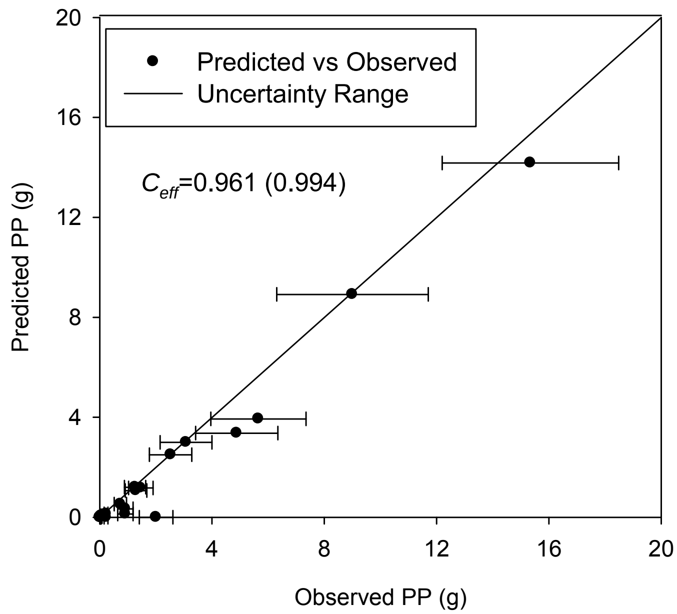


Figure 4-11. Scatterplot of measured and predicted PP including measurement uncertainty for each measured value plotted as an error bar (PER=±30%, number in brackets is C_{eff} considering the PER).

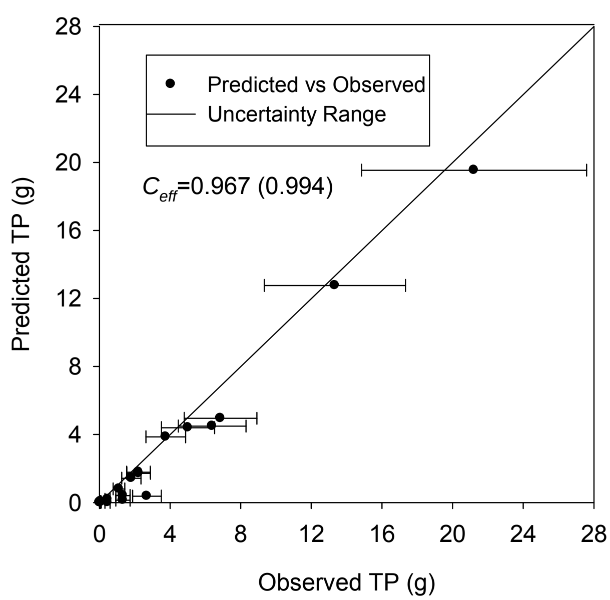


Figure 4-12. Scatterplot of measured and predicted TP including measurement uncertainty for each measured value plotted as an error bar (PER=±30%, number in brackets is C_{eff} considering the PER).

CHAPTER 5
CONCLUSIONS

A value of 2.3 % of TP was found in soil samples of the reclaimed mining areas in the upper Peace River basin. DP concentrations from source and VFS areas range from 0.4 to 3.0 mg/L, which exceeds EPA criterion of P concentration (0.1 mg/L) discharging into a river. A range of field conditions were studied and it was found that a significant amount of runoff volume and sediment transport capacity occurred in the exposed surface lands. In the lands with 4.3% slope, 1.6 cm/h K_s, and runoff lengths of 40 m, yearly outflows of Q, sediment, TP, and DP were 1300 m^3/ha, 4550 kg/ha, 104 kg/ha, and 2.21 kg/ha, respectively. In the landscape with 2.0 % slope, 31.0 cm/h K_s, and runoff lengths of 14.4 m, yearly outflows of Q, sediment, TP, and DP were 615 m^3/ha, 240 kg/ha, 6.12 kg/ha, and 0.27 kg/ha, respectively. Vegetative filter strips (grass buffers) adjacent downstream from these source areas considerly reduce runoff and DP (60%) and also transports of sediment and TP (>96%).

The length of filters, soil saturated hydraulic conductivity (K_s) in filters, rainfall intensity, and initial soil moisture were the main factors controlling the changes of runoff volume and peak flow rate in filters. TP in water samples contained a high fraction of PP (apatite), thus STE and TPTE were closely related in both sites and were controlled by the same factors. Since phosphate rock exists in soil, movement of PP and sediment in VFS are highly correlated (R^2=0.97-0.98). In site A, lower flow volume (Q) obtained in the 4.1 m filters (larger area ratio) resulted in lower STE compared to the 5.8 m filters (smaller area ratio). In site B, there were no significant differences in the STE and TPTE of 6.8 m and 13.4 m filters. The shorter filters (larger area ratio) were almost as effective as the longer filters (smaller area ratio) in trapping sediment and TP since in both cases the removal efficiency was very large. The longer filters with lower K_s at site B increased the runoff travel time, and thus seemed to increase the DP mass released from apatite.

Power equations were found to describe well (R^2=0.93-0.96) the relationships between sediment yields and product of runoff volume and peak flow rate (Q*Qp), for each runoff event. To aid in future BMP design efforts, the source areas curve numbers from the Soil Conservation Service TR-55 methods (SCS, 1986) were fitted to the experimental data collected on-site. This will be useful in future VFS design efforts.

Phosphorus in soils at the remediation was in the form of apatite, as indicated by XRD and corroborated by XRF elemental analysis and chemical fractionation. Results of this study supported the hypothesis that release of P from the soils was primarily from apatite dissolution rather than desorption from metal oxides that is more typical of soils of the region. The P release behavior in a batch experiment closely related to the modeled SSA of CFA. The absolute prediction of DP release based on modeled CFA surface area and a CFA rate constant from the literature underestimated observed release, suggesting that the rate equation or constant were not applicable to the CFA of the soils studied or that SSA of CFA was underestimated, or both.

The calibrated parameters of VFSMOD-W are in the acceptable range of measured data by applying the inverse method. The smaller events (Q_p < 0.4 L/s) are not simulated well with the model (C_{eff} < 0.60), likely due to limitations of the experimental system to register such small events. For those events (Q_p < 0.4 L/s) which were not predicted well in runoff transport, their measured TRFs are less than 60 L and relative measured MSFs are less than 3 g. Once VFSMOD-W is calibrated for runoff, the model offers good sediment transport predictions.

Similarly to the runoff case the model performed fairly well throughout the range of measured data, except for the low values of measured runoff subject to experimental limitations.

When considering uncertainty of measured data in each quantity for 25 events, the C_{eff} is greater than 0.98 for each quantity except RDR. The C_{eff_m} of each quantity is also significantly increased. The uncertainty of measured data included in the goodness-of-fit indicators is more realistic to evaluate model performance and data sets. The good predictions of TRF (C_{eff} = 0.991, C_{eff_m} = 0.888) and MSF (C_{eff} = 0.976, C_{eff_m} = 0.874) are very high for these 25 events. These good predictions in runoff and sediment also result in good prediction of PP transport (C_{eff} = 0.961, C_{eff_m} = 0.838) since apatite exists almost uniformly in sediment. Good DP predictions (C_{eff} =0.965) were found based on the assumption of considering rainfall impact on P release from apatite. The release of DP from apatite into runoff water maintains the system equilibrium for the DP loss from infiltration and dilution of DP concentration from rainfall. The C_{eff} of TP transport is also as high as PP since DP is a small fraction of TP.

Based on the successful performance of VFSMOD-W, this tool shows promise for the management agencies involved in mining permitting in upper Peace River basin. These agencies could apply VFSMOD-W to design VFS for controlling runoff and P transport in phosphate mining sand tailings.

APPENDIX A
SOIL PHYSICAL PROPERTIES AND SIMULATION PARAMETERS

Soil physical properties including soil texture, saturated hydraulic conductivity, soil moisture retention curve, bulk density, and porosity were analyzed to investigate the water movement in the subsurface. These are important factors for affecting hydrograph and infiltration. The calibration of soil moisture probe (capacitance probe) is also included in this Appendix. The surface topography, and grass spacing and height were also measured to supply the model inputs in the modeling of pollution transport.

A-1. Soil Texture (or called particle size distribution)

Equipment employing the "Polarization Intensity Differential Scattering" technique (Beckman-Coulter, Inc.) was used to analyze particle size distribution (PSD) of a soil sample. Organic matter was removed using hydrogen peroxide (Day, 1965) before analyzing PSD.

A-2. Saturated Hydraulic Conductivity (K_s)

The core cylinder made of brass with 5.4 cm diameter and 6.0 cm height (Soil moisture Equipment Corp, CA) was used to collect soil samples and then to measure saturated hydraulic conductivity. The saturated hydraulic conductivity (Ks) of a soil is a measurement of the soil's ability to transmit water when submitted to a hydraulic head gradient. The soil cores were slowly wetting with 0.005 M calcium sulfate ($CaSO_4$)-thymol solution during 2 days to avoid air entrapment. Based on the application of Darcy's Law, the constant head method was implemented to calculate K_s.

A-3. Soil Moisture Retention Curve (θ(h))

In the lab, the soil cores (6 cm of height) saturated with 0.005 M $CaSO_4$-thymol solution were prepared for the soil moisture characteristic curve determination. Soil moisture characteristic curve is measured in drainage curve using a positive pressure with porous ceramic plate device and Tempe cell provided with compressed air (Soilmoisture Equipment Corp., 1995). Ten pressure steps from 0 to 990 cm of water were taken for each soil core. For each pressure step, weights were measured until the weights were not change. After the last pressure step the cores were weighted, and dried in the oven at 105℃ for 48 h. After the cores reached the room temperature, the cores were weighed again to obtain dry soil weight, which was the residual saturation after the last pressure step. The water density was assumed 1.0 g/cm^3 and air entrapment was considered negligible in this procedure.

The soil water retention property was expressed by the van Genucthen (1980) function with *Mualem pore-size distribution* model. Then, the residual soil water content, saturated soil water content and saturated hydraulic conductivity can be obtained from the model. The average suction at the wetting front (Sav) was also estimated as the area under the unsaturated hydraulic conductivity ($K_{uns}(h)$) curve applying *SoilPrep* model (Workman and Skaggs, 1990). Soil moisture retention curve is primarily dependent on the soil texture, and structure or arrangement of the particles (Reeve et al., 1973).

A-3. Soil Bulk Density (d_b) and Porosity (η)

Soil bulk density is an expression of the mass to volume relationship for a given material. Soil bulk density measures total soil volume. After running soil moisture retention curve, the final weight of soil was measured and used to calculate the soil density and porosity. The initial volume of the soil sample was assumed equal to that of the core. The total water content of soil samples at saturation is equal to soil porosity. With these values the following parameters were calculated:

$$\text{Bulk density } (d_b) = \frac{Mass \quad of \quad dry \quad soil[M_s]}{Total \quad volume[V_t]} \tag{A.1}$$

$$\text{Total porosity } (\eta) = \frac{volume \quad of \quad pore \quad space[V_v]}{[V_t]} \tag{A.2}$$

$$\text{Particle density } (d_s) = \frac{[M_s]}{Volume \quad of \quad dry \quad soil[V_s]} = \frac{d_b}{\left(1 - \eta/100\right)} \tag{A.3}$$

$$\text{Void ratio (e)} = \frac{V_v}{V_s} \tag{A.4}$$

A-5. Calibration of a Capacitance Probe (ECH$_2$O probe)

The capacitance probe was calibrated in a PVC cylinder (16.0 cm diameter and 25 cm height) containing soil with a bulk density similar to the field condition. The soil was saturated and the whole cylinder was weighed. Voltage measurements were taken periodically as the water drained and evaporated. After about 20 days (or soil moisture dried to a limited value), the whole cylinder with soil and the probe was weighed to determine the initial soil weight, and initial water volume added into the soil column. The water loss and output voltage of probe were recorded to determine the relationship between soil moisture content and output voltage of probe.

A-6. Topographical Survey

Topographical field survey was conducted to obtain the slopes of plot for simulation purposes. Four points were measured in each transversal direction in 3.3 m wide. The transversal values of slope (to the direction of flow) were averaged to obtain a width averaged set of slopes for each plot. In the flow (longitudinal) direction the elevation was recorded at every 0.8 m and 1.2 m in VFS and source area, respectively.

A-7. Grass Spacing (Ss)

Vegetation cover was collected at the both experimental site to determine the grass spacing (Ss). Vegetation stems within a 50 cm × 50 cm frame was counted to determine grass density (GD, stems/m^2). The grass spacing was calculated as (Wilson et al., 1981):

$$Ss = \mathbf{100}\sqrt{\frac{\mathbf{1}}{\text{GD (stems/m}^2\text{)}}}$$

Three spots were collected in each plot at site A and 6.8 m long VFS areas at site B. Four spots were collected in 13.4 m long VFS areas at site B.

A-8. Grass Height (H)

Five spots in each plot at site A and site B are randomly selected to determine the averaged grass height.

A-9. Results

Table A-1 and Table A-2 summarized the results from the experiments (K_s, d_b, d_s, e, and η), values of S_{av} were calculated from the *SoilPrep* program (Workman and Skaggs, 1990) based on Green-Ampt model, as well as results of parameters (θ_r, θ_s, n, and α) were calculated from retention curve program (RETC) based on Ven Genuchten model. The suction pressure head versus water content for soil cores at site A and site B were shown in Table A-3 and Table A-4. The suction curves of the soil cores collected at site A were illustrated in Figure A-1. The suction curves of soil cores extracted from VFS area at site B are illustrated in Figure A-2. Those of lower-layer and upper-layer soil cores extracted from source area at site B are shown in Figure A-3 and A-4, respectively.

In site A, K_s ranges from 14.2 to 40.3 cm/h with an average of 28.9 cm/h for all soil samples. The average of K_s within VFS area is 26.1 cm/h that is smaller than that within source area is 30.7 cm/h. The smallest value of K_s is 14.2 cm/h, located near river, where the soil sample contains high percentage of clay. The porosity ranges from 0.39 to 0.49 with a mean value 0.44. The mean values of bulk density and particle density are 1.36 g/cm^3 and 2.44 g/cm^3, respectively. In site B, K_s at upper-layer samples extracted from source area range from 1.79 to 37.0 cm/h with an average of 13.14 cm/h. The K_s at lower-layer samples extracted from source area ranges from 0.05 to 40.2 cm/h with an average of 8.44 cm/h. The average of K_s within VFS area is 11.74 cm/h, which is smaller than that of upper-layer samples in the source area and greater than that of lower-layer samples in the source area. The porosity ranges from 0.43 to 0.54 with a mean value 0.49 for all samples. The mean values of bulk density and particle density are 1.33 g/cm^3 and 2.60 g/cm^3, respectively.

The cumulative particle size distributions of site A and site B analyzed by Beckman coulter are shown in Figure A-5 and Figure A-6, respectively. Cumulative percentages of volume for a specific particle size range of each soil sample at site A and site B are shown in Table A-5. The result of the capacitance probe calibration is shown in Figure A-7. Results of topographical field survey in site A and site B are listed in Table A-6 and Table A-7, respectively. The results of grass spacing at two sites are shown in Table A-8 and Table A-9. The results of grass height at two sites are shown in Table A-10.

Table A-1. Soil properties at site A

Sample ID	K_s cm/h	S_{av} cm	θ_r cm³/cm³	θ_s cm³/cm³	α	n	d_b g/cm³	η cm³/cm³	e cm³/cm³	d_s g/cm³
AV-1-1*	36.8	9.9	0.269	0.456	0.039	5.03	1.277	0.491	0.964	2.507
AV-1-2	28.6	12.7	0.219	0.483	0.039	2.70	1.343	0.479	0.920	2.579
AV-2-1	20.7	20.5	0.1936	0.434	0.032	2.72	1.413	0.454	0.832	2.587
AV-3-1	28.0	13.2	0.277	0.452	0.058	0.24	1.399	0.455	0.833	2.564
AV-3-2	14.2	19.1	0.153	0.448	0.032	3.47	1.342	0.480	0.923	2.582
AV-4-1	28.3	13.8	0.266	0.432	0.051	1.92	1.398	0.449	0.815	2.538
AS-1-1*	34.5	13.5	0.198	0.404	0.048	2.79	1.370	0.394	0.651	2.262
AS-1-2	40.3	15.4	0.088	0.37	0.041	6.77	1.356	0.405	0.680	2.277
AS-2-1	38.3	13.5	0.158	0.404	0.036	4.71	1.270	0.444	0.798	2.284
AS-2-2	27.7	26.6	0.077	0.405	0.028	7.13	1.494	0.418	0.718	2.567
AS-3-1	23.0	21.9	0.082	0.402	0.033	6.47	1.321	0.433	0.763	2.330
AS-3-2	40.2	14.5	0.092	0.376	0.046	4.24	1.432	0.389	0.638	2.346
AS-4-1	21.4	15.4	0.119	0.430	0.036	5.59	1.346	0.453	0.828	2.461
AS-4-2	22.4	14.8	0.154	0.407	0.038	2.62	1.284	0.422	0.731	2.223

*A: site A; S: source area; V: VFS; first number is a plot number; second number is a sample number in a plot

Table A-2. Soil properties at site B

Sample ID	K_s cm/h	S_{av} cm	θ_r cm³/cm³	θ_s cm³/cm³	α	n	d_b g/cm³	η cm³/cm³	e cm³/cm³	d_s g/cm³
BS-1-8U*	3.54	17.8	0.31	0.51	0.03	1.82	1.18	0.53	1.14	2.52
BS-1-8L	0.21	33.3	0.36	0.44	0.01	1.96	1.43	0.47	0.87	2.69
BS-1-24U	1.29	21.3	0.33	0.50	0.03	1.81	1.26	0.53	1.11	2.67
BS-1-24L	0.05	14.0	0.18	0.53	0.01	1.09	1.22	0.54	1.17	2.65
BS-2-8U	10.40	30.6	0.00	0.47	0.00	4.01	1.29	0.49	0.97	2.54
BS-2-8L	0.25	18.8	0.34	0.53	0.03	1.59	1.22	0.54	1.18	2.66
BS-2-24U	4.41	12.2	0.00	0.43	0.01	6.27	1.39	0.45	0.80	2.50
BS-2-24L	18.50	16.4	0.00	0.42	0.01	2.37	1.40	0.46	0.86	2.61
BS-3-8U	26.04	25.7	0.20	0.45	0.28	4.88	1.41	0.46	0.85	2.62
BS-3-8L	7.49	7.50	0.02	0.48	0.05	1.53	1.34	0.50	0.99	2.67
BS-3-24U	2.49	24.6	0.27	0.49	0.25	3.15	1.32	0.51	1.03	2.69
BS-3-24L	0.24	37.2	0.28	0.43	0.02	1.36	1.42	0.44	0.79	2.54
BS-4-8U	37.00	15.9	0.17	0.51	0.04	2.73	1.17	0.53	1.14	2.51
BS-4-8L	40.20	12.9	0.19	0.47	0.05	3.07	1.26	0.52	1.07	2.61
BS-4-24U	19.98	17.5	0.21	0.48	0.40	3.32	1.34	0.49	0.97	2.63
BS-4-24L	0.57	16.1	0.30	0.48	0.04	2.22	1.34	0.50	0.99	2.68
BV-1-4U*	3.35	5.3	0.31	0.44	0.05	10.25	1.42	0.45	0.83	2.60
BV-1-4L	0.09	25.5	0.29	0.46	0.02	2.53	1.40	0.48	0.91	2.67
BV-1-11U	4.06	18.0	0.34	0.47	0.04	2.68	1.31	0.49	0.95	2.55
BV-1-11L	21.00	18.2	0.13	0.40	0.03	6.18	1.49	0.43	0.76	2.62
BV-2-4U	5.75	28.4	0.22	0.48	0.03	6.60	1.30	0.48	0.92	2.51
BV-2-4L	0.99	32.1	0.36	0.46	0.02	3.25	1.35	0.48	0.91	2.57
BV-3-4U	18.45	28.4	0.23	0.49	0.03	6.60	1.28	0.50	0.99	2.55
BV-3-11U	37.15	29.3	0.00	0.45	0.02	1.71	1.44	0.44	0.79	2.57
BV-4-4U	14.79	21.2	0.27	0.47	0.03	2.29	1.39	0.49	0.94	2.70

* A: site A; S: source area; first number is a plot number; second number is the distance from runoff gutter; U: upper layer sample; L: lower layer sample

Table A-3. Suction pressure head (cm) versus water content (%) for soil cores extracted from site A

Sample ID	Suction pressure head (cm)									
	0.0	6.9	10.9	24.6	50.8	105.5	253.1	492.1	731.1	900
AV-1-1*	0.467	0.451	0.448	0.385	0.278	0.278	0.277	0.273	0.271	0.250
AV-1-2	0.477	0.477	0.477	0.392	0.296	0.241	0.234	0.224	0.218	0.210
AV-2-1	0.430	0.430	0.430	0.385	0.272	0.237	0.202	0.200	0.198	0.179
AV-3-1	0.444	0.443	0.439	0.350	0.316	0.299	0.297	0.294	0.288	0.254
AV-3-2	0.446	0.446	0.446	0.370	0.224	0.162	0.162	0.159	0.155	0.140
AV-4-1	0.425	0.425	0.418	0.369	0.324	0.300	0.295	0.287	0.283	0.241
AS-1-1	0.375	0.366	0.364	0.297	0.223	0.222	0.214	0.198	0.192	0.184
AS-1-2	0.372	0.368	0.368	0.239	0.092	0.091	0.091	0.089	0.089	0.082
AS-2-1	0.413	0.412	0.383	0.328	0.178	0.167	0.162	0.159	0.158	0.150
AS-2-2	0.406	0.406	0.402	0.386	0.111	0.087	0.082	0.078	0.076	0.061
AS-3-1	0.402	0.402	0.402	0.346	0.100	0.100	0.096	0.096	0.079	0.041
AS-3-2	0.376	0.370	0.370	0.227	0.111	0.101	0.096	0.093	0.090	0.079
AS-4-1	0.432	0.430	0.427	0.342	0.138	0.124	0.120	0.118	0.118	0.118
AS-4-2	0.407	0.400	0.394	0.331	0.221	0.190	0.171	0.156	0.155	0.143

*A: site A; S: source area; V: VFS; first number is a plot number; second number is a sample number in a plot

Table A-4. Suction pressure head (cm) versus water content (%) for soil cores extracted from site B

Sample ID	Suction pressure head (cm)									
	0.0	5.1	14.0	25.4	50.8	105.5	253.1	492.1	731.1	900
BS-1-8U*	0.507	0.504	0.500	0.448	0.437	0.368	0.340	0.328	0.326	0.313
BS-1-24U	0.501	0.500	0.496	0.473	0.443	0.395	0.368	0.354	0.350	0.331
BS-2-8U	0.487	0.487	0.486	0.457	0.446	0.442	0.435	0.419	0.219	0.191
BS-2-24U	0.439	0.438	0.437	0.437	0.435	0.428	0.418	0.416	0.414	0.362
BS-3-8U	0.453	0.452	0.450	0.426	0.257	0.231	0.215	0.205	0.188	0.185
BS-3-24U	0.486	0.485	0.482	0.455	0.370	0.290	0.287	0.279	0.279	0.246
BS-4-8U	0.507	0.499	0.489	0.397	0.263	0.213	0.199	0.177	0.162	0.155
BS-4-24U	0.477	0.472	0.468	0.362	0.259	0.232	0.208	0.207	0.207	0.206
BS-1-8D	0.445	0.440	0.437	0.437	0.431	0.402	0.386	0.373	0.370	0.365
BS-1-24D	0.531	0.526	0.524	0.524	0.515	0.509	0.494	0.482	0.481	0.456
BS-2-8D	0.527	0.527	0.517	0.503	0.454	0.422	0.402	0.388	0.362	0.359
BS-2-24D	0.450	0.442	0.420	0.389	0.365	0.318	0.129	0.044	0.033	0.028
BS-3-8D	0.472	0.469	0.456	0.387	0.293	0.250	0.237	0.219	0.137	0.134
BS-3-24D	0.427	0.426	0.426	0.424	0.410	0.378	0.368	0.357	0.346	0.327
BS-4-8D	0.470	0.461	0.455	0.316	0.245	0.219	0.194	0.188	0.188	0.170
BS-4-24D	0.477	0.477	0.464	0.428	0.382	0.330	0.324	0.313	0.313	0.293
BV-1-11U	0.443	0.443	0.441	0.326	0.319	0.311	0.310	0.308	0.304	0.298
BV-1-11D	0.456	0.451	0.450	0.437	0.389	0.322	0.312	0.298	0.295	0.271
BV-1-11U	0.469	0.469	0.468	0.425	0.374	0.358	0.340	0.338	0.337	0.329
BV-1-11D	0.411	0.401	0.398	0.380	0.168	0.142	0.132	0.126	0.120	0.118
BV-2-11U	0.474	0.474	0.471	0.461	0.389	0.349	0.317	0.293	0.257	0.253
BV-2-11D	0.461	0.461	0.461	0.460	0.419	0.376	0.368	0.362	0.362	0.346
BV-3-11U	0.492	0.491	0.487	0.479	0.278	0.252	0.244	0.233	0.213	0.210
BV-3-11U	0.436	0.436	0.434	0.423	0.252	0.220	0.180	0.080	0.024	0.020
BV-4-11U	0.465	0.464	0.462	0.426	0.330	0.320	0.293	0.279	0.277	0.240

* B: site B; S: source area; V: VFS; first number is a plot number; second number is the distance from runoff gutter; U: upper layer sample; L: lower layer sample

Table A-5. Cumulative percentages for specific particle size ranges of soil samples collected at sites A and B.

plot	Particle size (µm)					
	< 0.45	< 2	< 37	< 100	< 250	< 2000
A-S-1	0.0	1.3	2.6	3.7	44.1	100
A-S-2	0.0	1.5	3.6	4.8	42.1	100
A-S-3	0.0	1.6	3.7	5.0	42.6	100
A-S-4	0.0	1.3	2.6	3.6	43.9	100
A-V-1	0.1	2.2	5.1	7.6	47.8	100
A-V-2	0.1	2.2	5.2	7.6	47.8	100
A-V-3	4.3	8.8	10.3	17.8	50.5	100
A-V-4	0.1	3.0	6.0	8.5	42.5	100
B-S-1	1.2	4.8	8.7	16.6	56.2	100
B-S-2	1.9	5.3	8.4	12.8	54.3	100
B-S-3	1.3	5.2	8.3	10.8	51.3	100
B-S-4	1.4	3.5	9.1	9.6	43.7	100
B-V-1	0.9	6.5	9.8	10.7	48.1	100
B-V-2	0.9	7.3	12.5	16.1	51.4	100
B-V-3	0.8	6.5	9.6	11.7	39.7	100
B-V-4	0.7	4.5	7.5	10.5	48.2	100

* A: site A; B: site B; S: source area; V: VFS; last number: is the plot number.

Table A-6. Average slope at each point in VFS and source areas at site A (X=0 m is in the edge of rain gutter)

X (m)	A-S-1*	A-S-2	A-S-3	A-S-4	X (m)	A-V-1	A-V-2	A-V-3	A-V-4
0.0	1.2%	0.9%	1.3%	0.6%	0.0	0.9%	1.3%	0.8%	1.3%
1.2	2.6%	1.7%	1.3%	0.8%	0.8	3.0%	1.1%	0.7%	1.1%
2.4	2.0%	2.1%	1.4%	1.0%	1.4	2.4%	2.2%	1.9%	2.2%
3.7	1.4%	1.4%	1.4%	2.1%	2.3	4.3%	2.8%	1.9%	2.8%
4.9	1.4%	1.5%	2.4%	2.6%	3.2	4.4%	1.9%	3.4%	1.9%
5.8	0.7%	0.8%	1.7%	0.7%	4.1	2.8%	1.5%	3.1%	1.5%
6.7	1.6%	1.6%	0.8%	0.7%	5.0	1.4%		1.4%	
7.6	2.2%	0.4%	0.3%	0.2%	5.8	1.5%		1.4%	
8.5	3.4%	2.4%	0.5%	0.4%					
9.5	4.0%	3.2%	2.6%	0.9%					
10.4	3.3%	3.0%	2.2%	1.4%					
11.3	3.5%	5.1%	0.5%	0.9%					
12.2	3.1%	3.4%	2.5%	3.7%					
13.2	1.3%	2.2%	5.9%	3.1%					
14.4	1.3%	2.2%	1.0%	3.1%					
Mean	2.2%	2.1%	1.7%	1.5%	Mean	2.6%	1.8%	1.8%	1.8%

* A: site A; S: source area; V: VFS; last number: is the plot number.

Table A-7. Average slope at each point in VFS and source areas at site B (X=0 m is in the edge of rain gutter)

X (m)	B-S-1	B-S-2	B-S-3	B-S-4	X (m)	B-V-1	B-V-2	B-V-3	B-V-4
0.0	4.0%	5.6%	3.2%	3.8%	0.0	5.1%	7.0%	5.2%	5.0%
1.5	5.0%	3.6%	4.0%	4.0%	0.6	4.7%	4.9%	5.3%	4.5%
3.1	5.3%	5.5%	3.7%	4.5%	1.2	3.7%	5.8%	4.6%	4.1%
4.6	5.0%	3.9%	2.7%	3.6%	2.1	3.5%	5.3%	4.9%	4.5%
6.1	7.0%	3.6%	3.3%	3.4%	3.1	3.7%	4.1%	5.8%	4.3%
7.6	6.4%	3.1%	3.7%	3.1%	4.0	3.7%	5.1%	5.8%	4.5%
9.2	3.8%	3.7%	5.2%	4.0%	4.9	4.0%	3.4%	4.4%	3.3%
10.7	5.0%	3.7%	6.2%	4.7%	5.8	4.4%	3.5%	4.7%	3.3%
12.2	3.9%	5.9%	5.5%	6.2%	6.7	4.2%	3.4%	4.5%	3.3%
13.7	3.4%	2.4%	4.9%	5.3%	7.6	4.4%		3.8%	
14.9	4.3%	4.0%	6.4%	5.5%	8.5	3.7%		2.5%	
16.2	3.9%	3.7%	5.3%	5.9%	9.5	3.3%		4.1%	
17.4	4.3%	5.1%	4.4%	5.5%	10.4	3.3%		2.8%	
18.6	4.2%	3.3%	4.0%	6.4%	11.3	3.0%		4.4%	
19.8	3.7%	3.9%	3.1%	3.6%	12.2	1.1%		3.3%	
21.0	5.6%	3.9%	3.7%	2.6%	13.4	1.2%		3.3%	
22.0	3.1%	3.8%	3.9%	3.9%					
22.9	5.6%	3.8%	4.5%	4.7%					
23.8	5.1%	3.4%	4.1%	3.8%					
24.7	3.8%	3.4%	4.0%	3.3%					
25.6	3.8%	3.6%	4.0%	4.0%					
26.5	3.8%	3.4%	2.5%	3.9%					
27.5	3.7%	3.2%	3.3%	2.5%					
28.4	3.6%	3.1%	2.8%	3.4%					
29.3	3.7%	3.1%	2.8%	2.8%					
30.8	3.6%	2.7%	2.7%	3.0%					
32.3	3.6%	2.9%	2.6%	2.9%					
33.8	3.4%	2.6%	2.4%	2.6%					
35.3	3.3%	2.8%	2.5%	2.5%					
36.8	3.3%	2.5%	2.6%	2.7%					
38.3	3.2%	2.7%	2.7%	2.6%					
40.0	3.0%	2.5%	2.5%	2.5%					
mean	4.2%	3.6%	3.7%	3.9%	mean	3.6%	4.7%	4.3%	4.1%

* B: site B; S: source area; V: VFS; last number: is the plot number.

Table A-8. Grass spacing parameters at site A (06/18/06)

X(m)	A-V-1*		A-V-3		X(m)	A-V-2		A-V-4	
	GD	Ss	GD	Ss		GD	Ss	GD	Ss
0-2	528.0	4.35	356.0	5.30	1-1.5	328.0	5.52	432.0	4.81
2-4	324.0	5.56	340.0	5.42	2.5-3	384.0	5.10	440.0	4.77
4-6	360.0	5.27	288.0	5.89	3-4.1	436.0	4.79	392.0	5.05
mean	404.0	5.06	328.0	5.54	mean	382.7	5.14	421.3	4.88

* A: site A; V: VFS; last number: is the plot number; GD: grass density; Ss: grass spacing.

Table A-9. Grass spacing parameters at site B (06/18/06)

X(m)	B-V-1*		B-V-3		X(m)	B-V-2		B-V-4	
	GD	Ss	GD	Ss		GD	Ss	GD	Ss
0-2	704.0	3.77	472.0	4.60	0-2	484.0	4.55	480.0	4.56
2-5	728.0	3.71	620.0	4.02	2-4	712.0	3.75	356.0	5.30
5-9	716.0	3.74	632.0	3.98	4-6.8	568.0	4.20	340.0	5.42
9-13	640.0	3.95	712.0	3.75					
mean	694.7	3.80	654.7	3.91	mean	640.0	3.97	348.0	5.36

* B: site B; V: VFS; last number: is the plot number; GD: grass density; Ss: grass spacing.

Table A-10. The averaged grass height at site A and site B measured at different period in year 2006

Plots	0602-0621 cm	0622-0704 cm	0705-0720 cm	0721-0805 cm	0806-0824 cm	0825-0920 cm	0921-1017 cm	Average cm
A-V-1*	17.8	12.1	14.9	15.0	18.8	18.1	17.8	16.4
A-V-2	18.6	12.9	15.7	15.9	20.1	19.1	18.4	17.3
A-V-3	19.1	14.0	16.2	15.5	19.5	18.6	18.1	17.3
A-V-4	19.3	13.5	16.4	16.2	20.0	19.0	18.4	17.5
B-V-1	21.3	15.5	18.5	18.3	23.7	21.9	21.3	20.1
B-V-2	18.9	13.7	16.0	16.2	20.5	19.4	19.6	17.8
B-V-3	22.7	16.9	20.0	17.9	23.0	21.3	20.9	20.4
B-V-4	22.4	16.9	19.7	19.4	25.4	23.2	22.2	21.3

* A: site A; B: site B; V: VFS; last number: is the plot number;

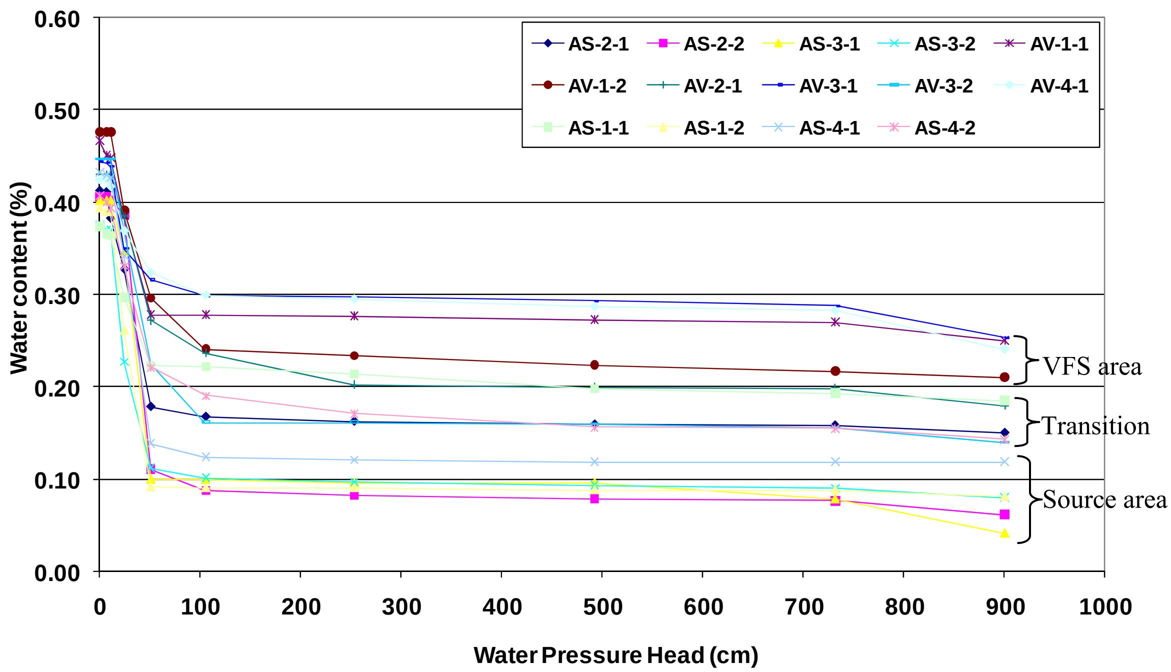


Figure A-1. Suction curves of soil cores extracted from site A

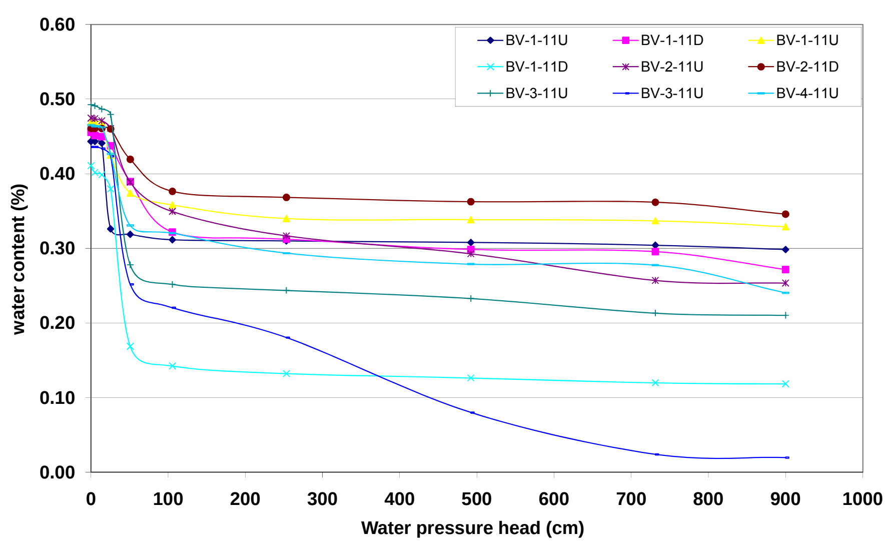


Figure A-2. Suction curves of soil cores extracted from VFS areas at site B

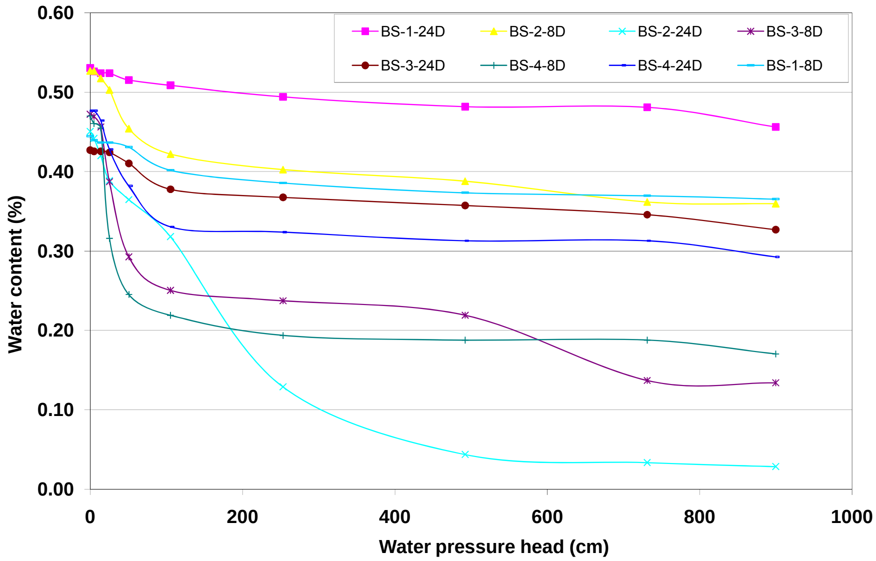


Figure A-3. Suction curves of lower-layer soil cores extracted from source areas at site B

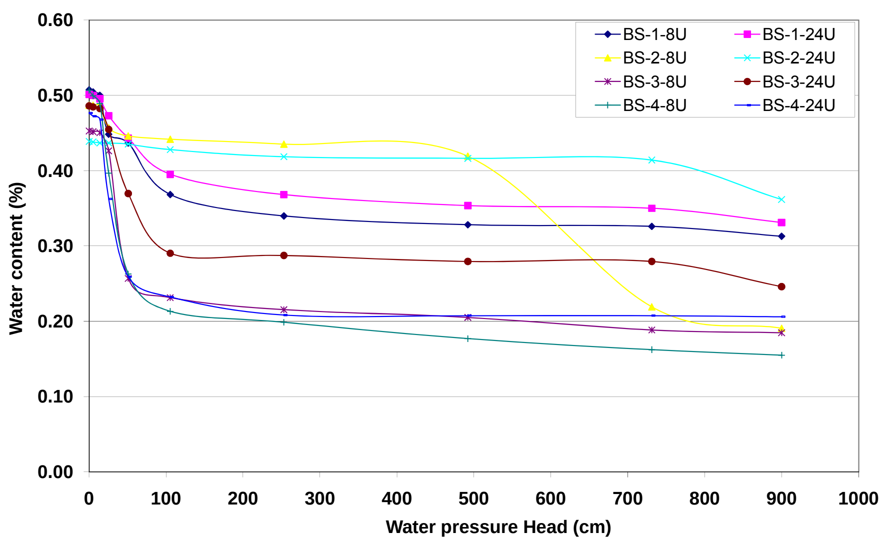


Figure A-4. Suction curves of upper-layer soil cores extracted from source areas at site B

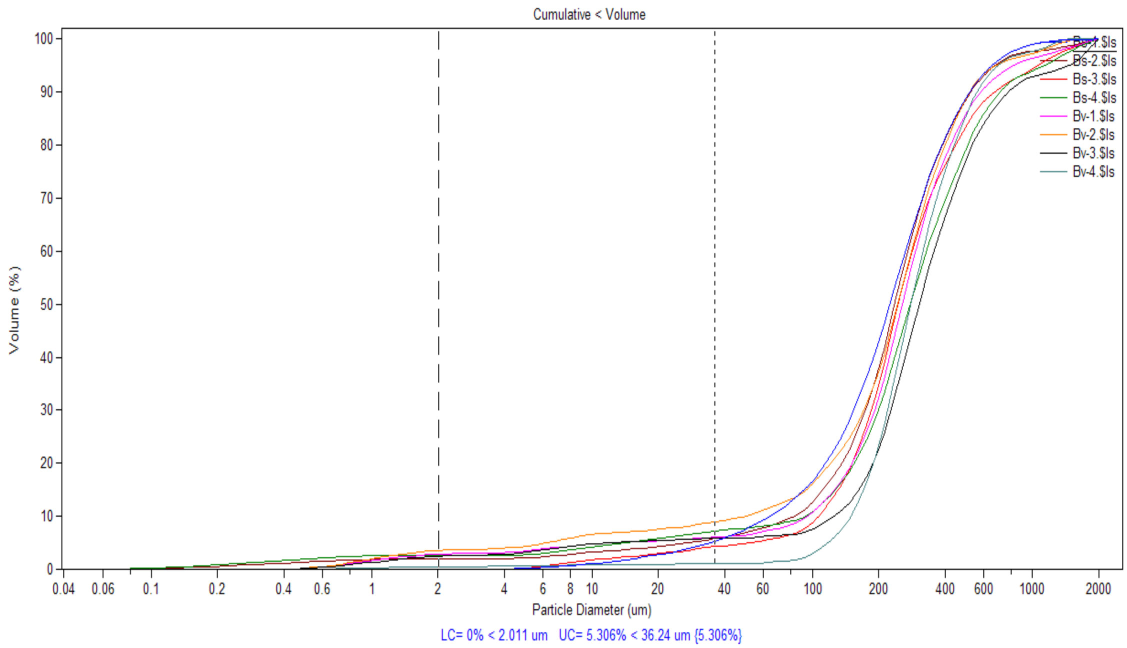


Figure A-5. Cumulative particle size distributions of soil samples collected from site A.

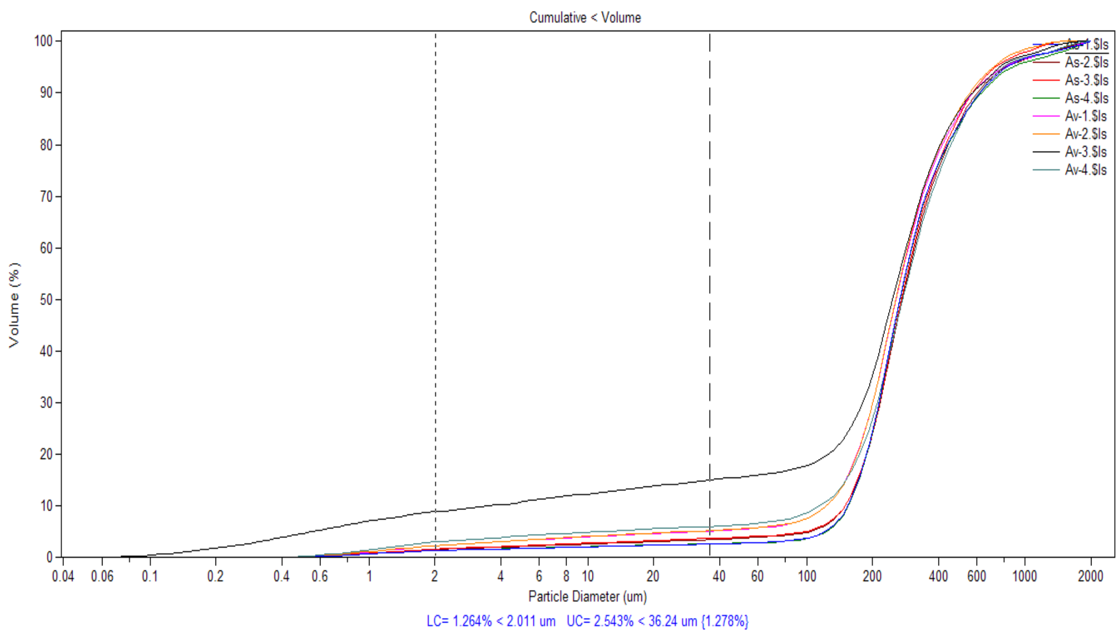


Figure A-6. Cumulative particle size distributions of soil samples collected from site B.

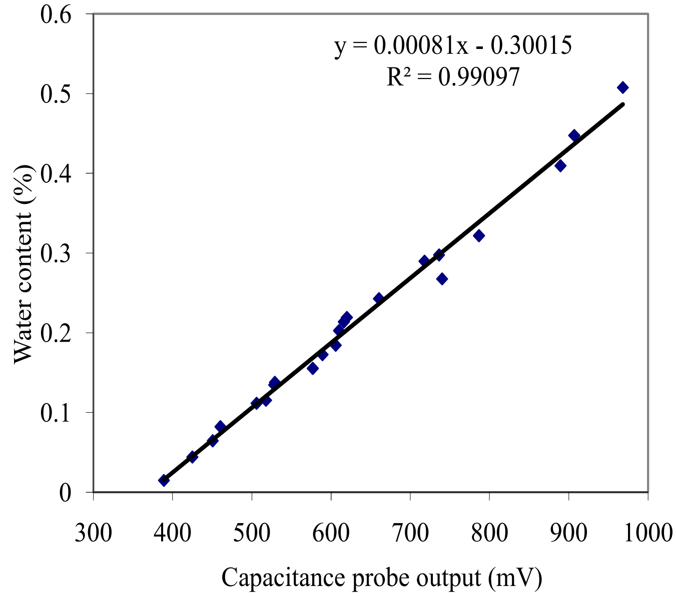


Figure A-7.The relationship between soil moisture content and capacitance probe output voltage

APPENDIX B
GOODNESS-OF-FIT INDICATORS

B-1. Nash and Sutcliffe Coefficient of Efficiency (C_{eff})

The Nash and Sutcliffe coefficient of efficiency (C_{eff}) (Nash and Sutcliffe, 1970) has been widely used to evaluate the performance of hydrologic and water quality models (McCuen et al., 2006, Erpul et al., 2003, Merz and Bloscl 2004). The range of C_{eff} lies between 1.0 and -∞. C_{eff} = 1 implies that the plot of predicted vs. observed values matches the 1:1 line. It is calculated as following:

$$C_{eff} = 1 - \frac{\sum_{i=1}^{N} (O_i - P_i)^2}{\sum_{i=1}^{N} (O_i - \overline{O})^2} \tag{B.1}$$

where O_i =observed data, P_i =predicted data, and $\overline{O}$ =mean of observed data. The C_{eff} can be sensitive to sample size, outliers, and magnitude bias and time-offset bias (McCuen et al., 2006). Since C_{eff} calculated as squared values of the differences between the observations and simulations it significantly overestimated larger values (sensitive) and underestimated the lower values (insensitive) (Legates and McCabe, 1999). This calculation results in high values of C_{eff} even when the fit is relatively poor. Thus, the Nash-Sutcliffe is not very sensitive to systematic model over- or under-prediction especially during low flow periods (Krause et al. 2005).

B-2. Modified Form of C_{eff} (C_{eff_m})

The Modified forms of C_{eff} were developed by Krause et al. (2005) to reduce the overestimation of the peak values with j=1 in modified equation (b).

$$C_{eff\_m} = \mathbf{1} - \frac{\sum_{i=\mathbf{1}}^{N} \left(O_i - P_i\right)^j}{\sum_{i=\mathbf{1}}^{N} \left(O_i - \overline{O}\right)^j} \quad \text{with} \quad j \in N \tag{B.2}$$

The modified forms with $j = 1$ provide boarder range of values for model calibration than the forms with $j > 1$. The modified forms with lower value of j are more sensitive to over- or under-prediction than higher value of j. To evaluate the model prediction in high values of flow rates and sediment loads the value of j should be raised to increase the sensitivity to high values.

B-3. Root Mean Square Error (*RMSE*)

A measure of total error defined as the square root of the sum of the variance and the square of the bias.

$$RMSE = \sqrt{N^{-\mathbf{1}} \sum_{i=\mathbf{1}}^{N} (O_i - P_i)^{\mathbf{2}}} \tag{B.3}$$

APPENDIX C
VERIFICATION OF THE INVERSE MODELING ALGORITHM

To verify the robustness of the inverse modeling algorithm integrated in the VFSMOD-W, two conditions, perfect data set and data set after adding random noise to the perfect data set (ARP), were created. The runoff and sediment simulated outflows from the sample project (sample.prj) in the directory of VFSMOD-W represent the perfect target data sets. Adding random noise to the runoff and sediment outflows in the sample project can represent the measured data uncertainty/error of a field experiment. The range of random noise added to runoff and sediment data was determined based on the PER in measuring flow rate and sampling sediment, respectively (Chapter 4). These two conditions (perfect data set and ARP) were used to verify the robustness of inverse modeling algorithm based on the calibrated results.

Three sensitive parameters (VKS, SAV, and RNA) in the hydrology component and two in the sediment component (dp, and VN) were selected to calibrate the optimal values in the sample project. The measured value, the range used in calibration, and the final calibrated value of each parameter are shown in Table C-1.

In the hydrology component, calibrated values of VKS for these two conditions were similar to the target value. RNA was almost the same as target value, and SAV was slightly higher than the target value. Both C_{eff} and C_{eff_m} were close to 1 with and without considering PER in the goodness-of-fit indicators for the perfect data set (Table C-2). Considering PER, C_{eff} and C_{eff_m} were significantly increased (C_{eff}=0.975) in the ARP tes (Table C-2). The predicted runoff ouflow from filters (TRF) was calculated based on using the optimized value of calibrated parameters in VFSMOD-W. The target and predicted ouflows of these two conditions are shown in the Table C-3. The predicted TRF was higher than target value for both conditions since the calibrated value of VKS was slightly smaller than the target value and VKS was most sensitive parameter in the hydrology component in VFSMOD-W.

In the sediment component, calibrated values of dp in these two conditions were very similar to the target value. The VN was variable but within the calibrated range. Both C_{eff} and C_{eff_m} were also very close to 1 with and without considering PER in the goodness-of-fit indicators for the perfect data set (Table C-2). Considering PER, C_{eff} was increased from 0.934 to 0.960 in the ARP condition (Table C-2). The predicted mass of sediment outflow from filters (MSF) in the perfect data set was very close to the target data set (Table C-3). However, in the ARP condition the predicted MSF was slightly higher than the target MSF (about 9% of target MSF). This may result from lower calibrated dp and higher predicted TRF which increase a higher amount of sediment in runoff. However, these errors are considered small when compared to the PER and typical errors associated to most field values. The hydrographs and sedimentographs of these two tests are shown in Figures C-1 to C-4.

The results show that inverse modeling algorithm integrated in the VFSMOD-W is robust since it successfully calibrated the parameters even in the presence of random noise associated with the measured data.

Table C-1. The measured value, calibration range, and optimized value of each parameter used in the verification of inverse modeling algorithm.

Component	Parameter (units)	Measured value	Calibration range	Optimized value With perfect data	Optimized value with ARP*
Hydrology	VKS (m/s)	0.000013	0.0009-0.000001	0.000012	0.000009
	SAV (m)	0.379	0.29-0.45	0.449	0.439
	RNA ($s/m^{1/3}$)	0.400	0.1-0.5	0.400	0.409
Sediment	VN ($s/m^{1/3}$)	0.012	0.008-0.018	0.008	0.017
	dp (cm)	0.00130	0.0005-0.0020	0.00138	0.00128

*ARP: data set after adding random noise to the perfect data set.

Table C-2. Results of hydrology and sediment simulations in selected goodness-of-fit indicators with and without including measured data uncertainty (PER=0.20 for hydrology, PER=0.29 for sediment).

Event	Hydrology						Sediment					
	PER=0			PER=0.20			PER=0			PER=0.29		
	C_{eff}	C_{eff_m}	$RMSE^{\#}$	C_{eff}	C_{eff_m}	$RMSE$	C_{eff}	C_{eff_m}	$RMSE$	C_{eff}	C_{eff_m}	$RMSE$
Perfect data	1	0.993	0.000007	1	1	0	1	0.996	0.0101	1	1	0
ARP*	0.945	0.861	0.000115	0.975	0.924	0.000085	0.934	0.860	0.2900	0.960	0.950	0.2302

*ARP: data set after adding random noise to the perfect data set.
#units of *RMSE*s in hydrology and sediment are (m^3/s) and (g/s), respectively.

Table C-3. Measured and predicted outputs of perfect data set and ARP.

Output quantity	Perfect data		ARP*	
	Target	Predicted	Target	Predicted
TRF(m^3)	0.732	0.745	0.739	0.871
MSF(kg)	1.111	1.119	1.112	1.216
CSF(g/L)	1.518	1.502	1.505	1.396

*ARP: data set after adding random noise to the perfect data set

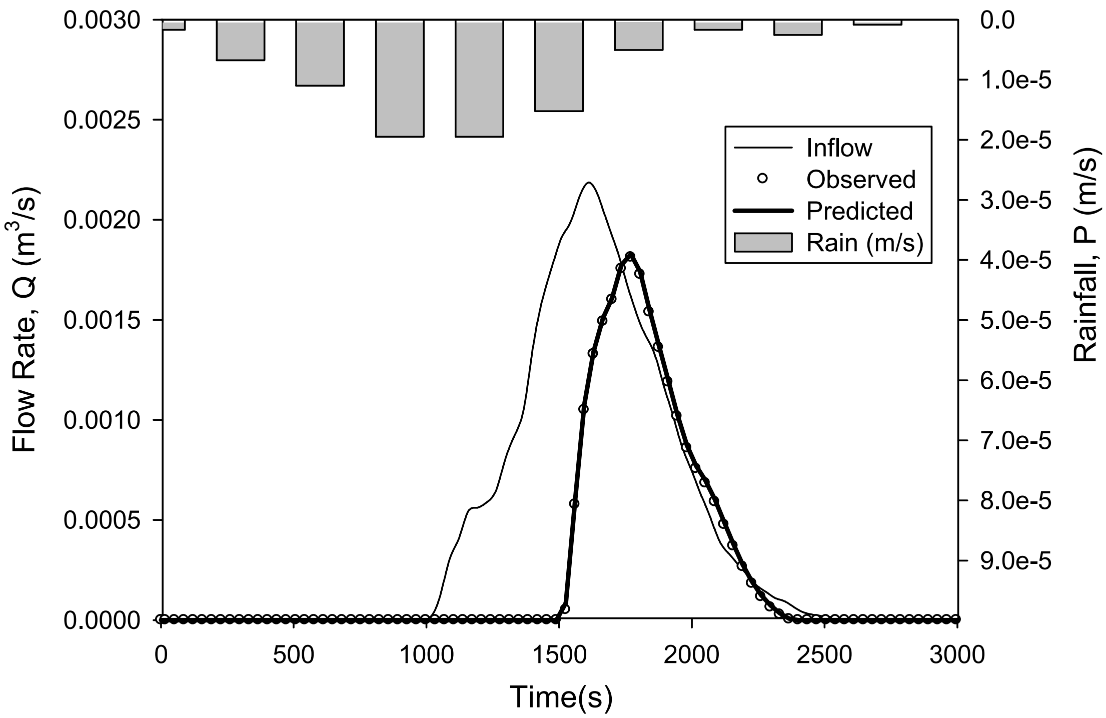


Figure C-1. The target and predicted hydrographs of sample project (perfect data set).

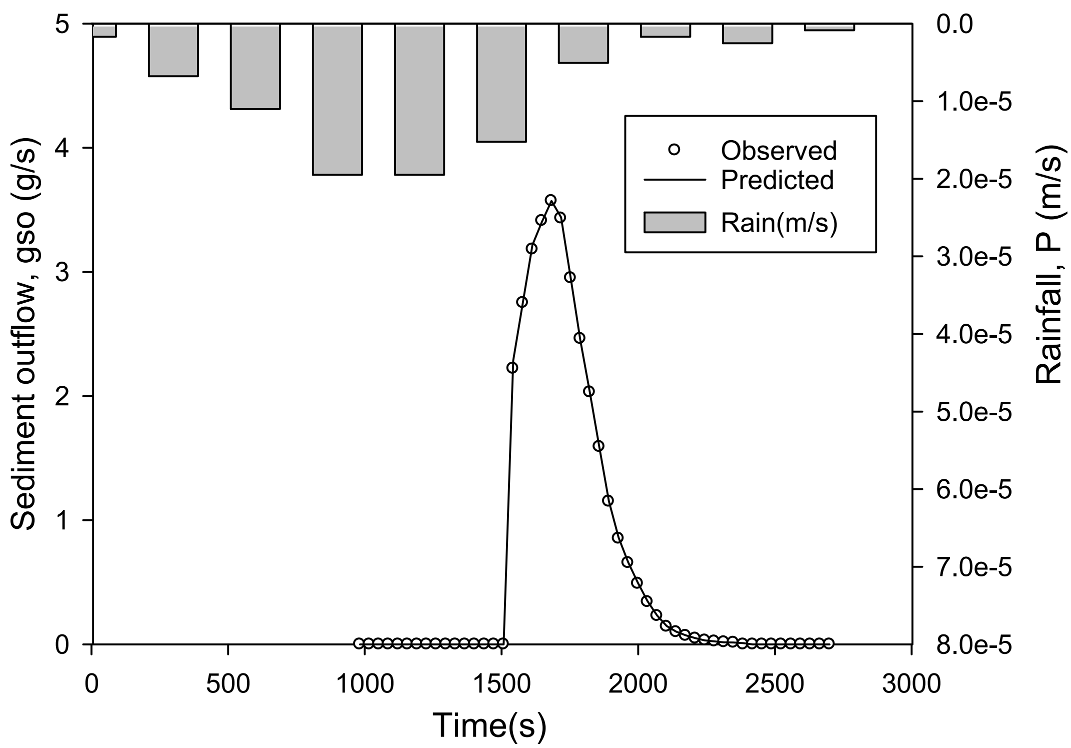


Figure C-2. The target and predicted sedimentographs of sample project (perfect data set).

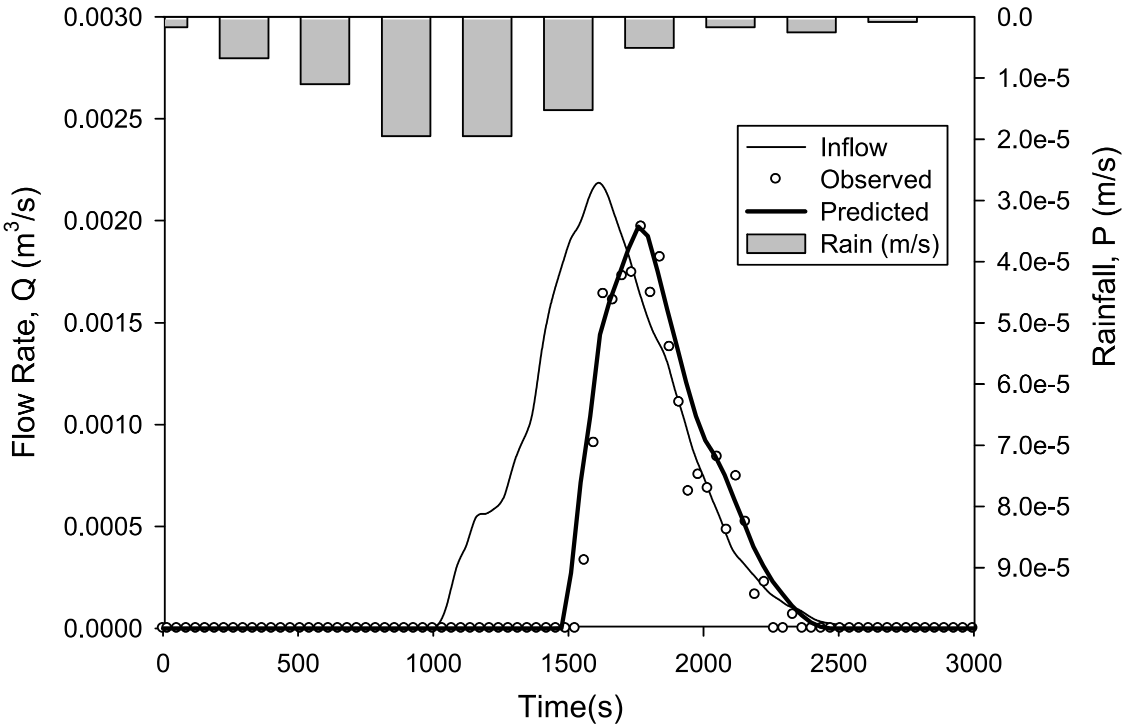


Figure C-3. The target and predicted hydrographs of the ARP condition (adding random noise to the perfect data set).

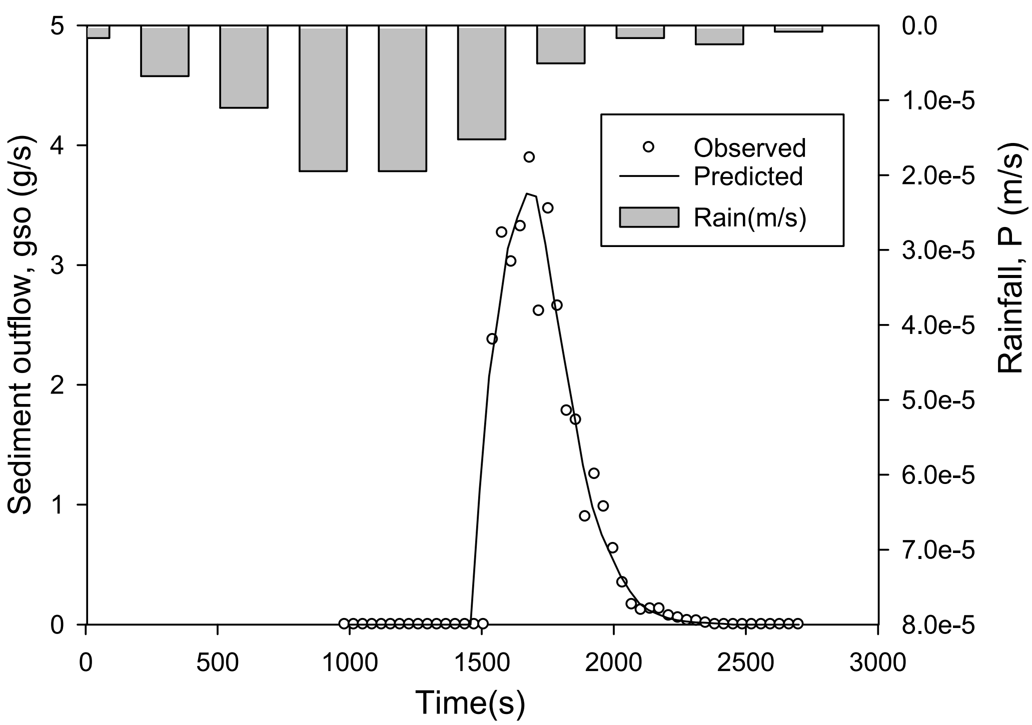


Figure C-4. The target and predicted sedimentographs of the ARP condition (adding random noise to the perfect data set).

APPENDIX D
SIMULATION RESULTS OF CHAPTER 4

The observed and predicted hydrographs and sedimentographs of selected events are shown in this appendix. The alpha-numeric title describes the site and filter area attributes. In Figures A070706V2 and B071406V2 for example, the first letter represents the site location name (A or B). The following six numbers in succession represents Gregorian date. V represents the VFS area; the last number represents the plot number within VFS area.

The lengths of plot 2 (V2) and plot 3 (V3) in VFS area at site A are 4.1 m and 5.8 m, respectively. The lengths of plot 2 (V2) and plot 3 (V3) in VFS area at site B are 6.8 m and 13.4 m, respectively.

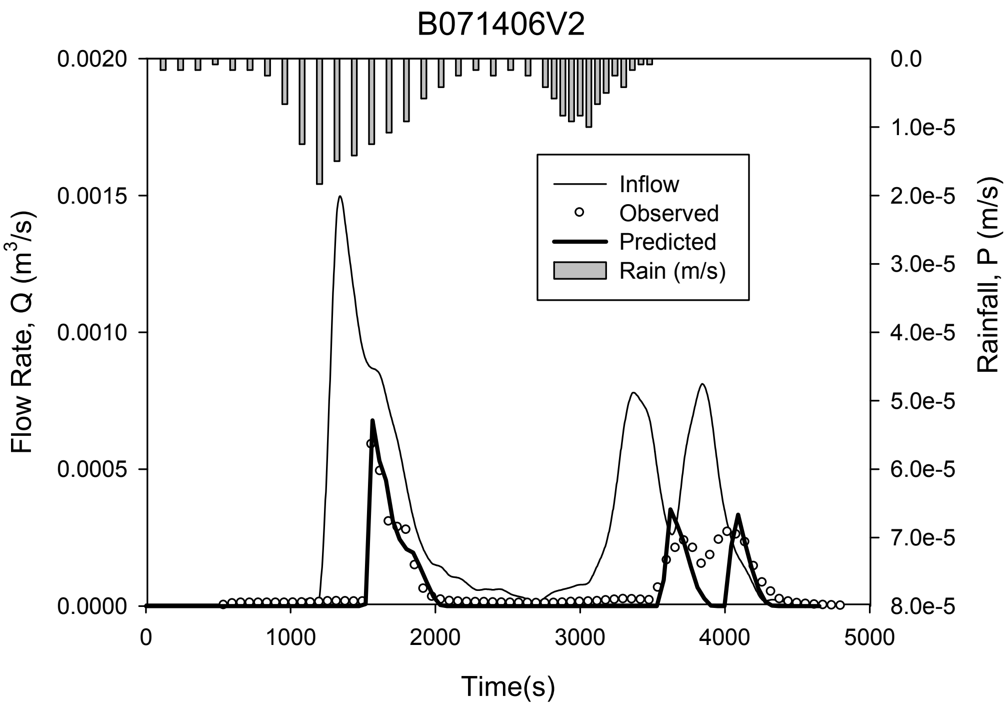


Figure D-1. Hydrographs of plot 2 (length=6.8 m) in VFS area at site B on date 07/14/06

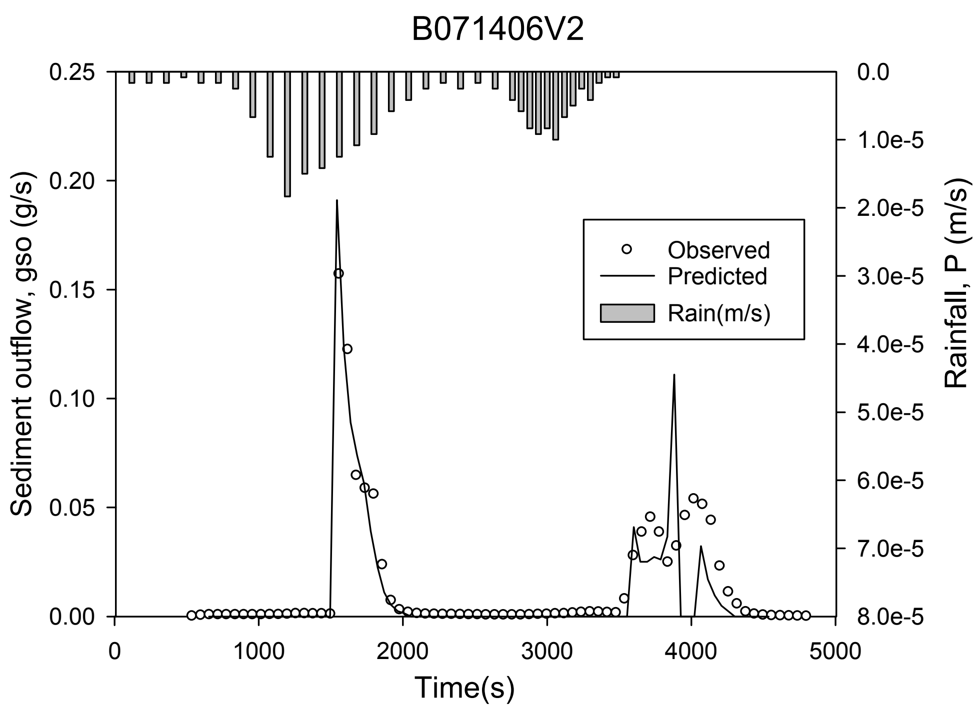


Figure D-2. Sedimentographs of plot 2 (length=6.8 m) in VFS area at site B on date 07/14/06

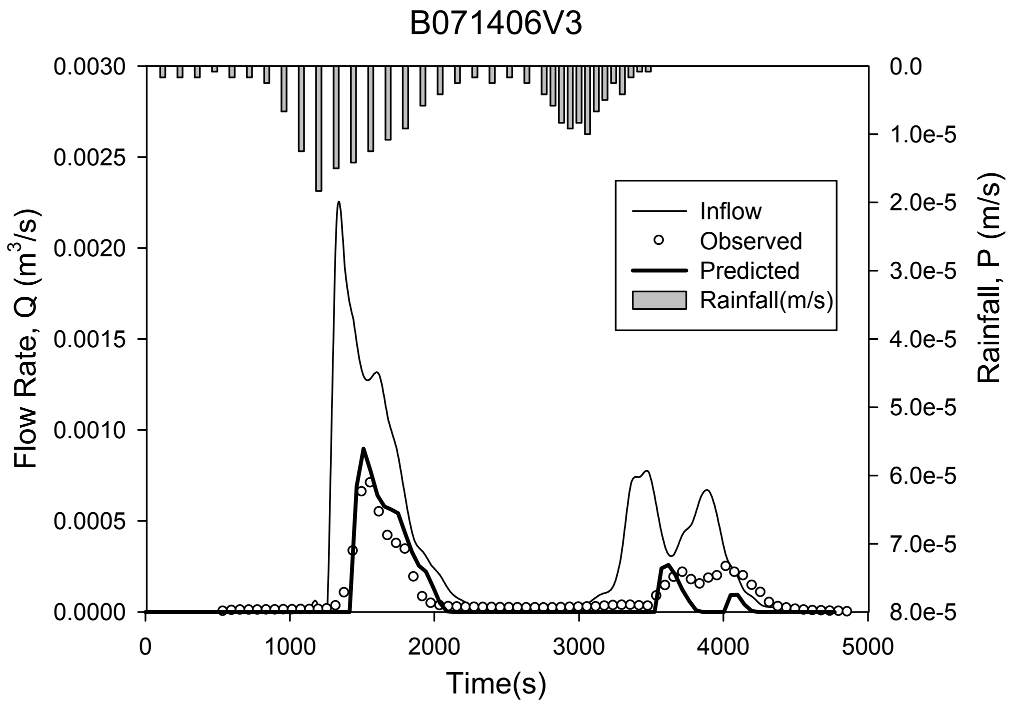


Figure D-3. Hydrographs of plot 3 (length= 13.4 m) in VFS area at site B on date 07/14/06

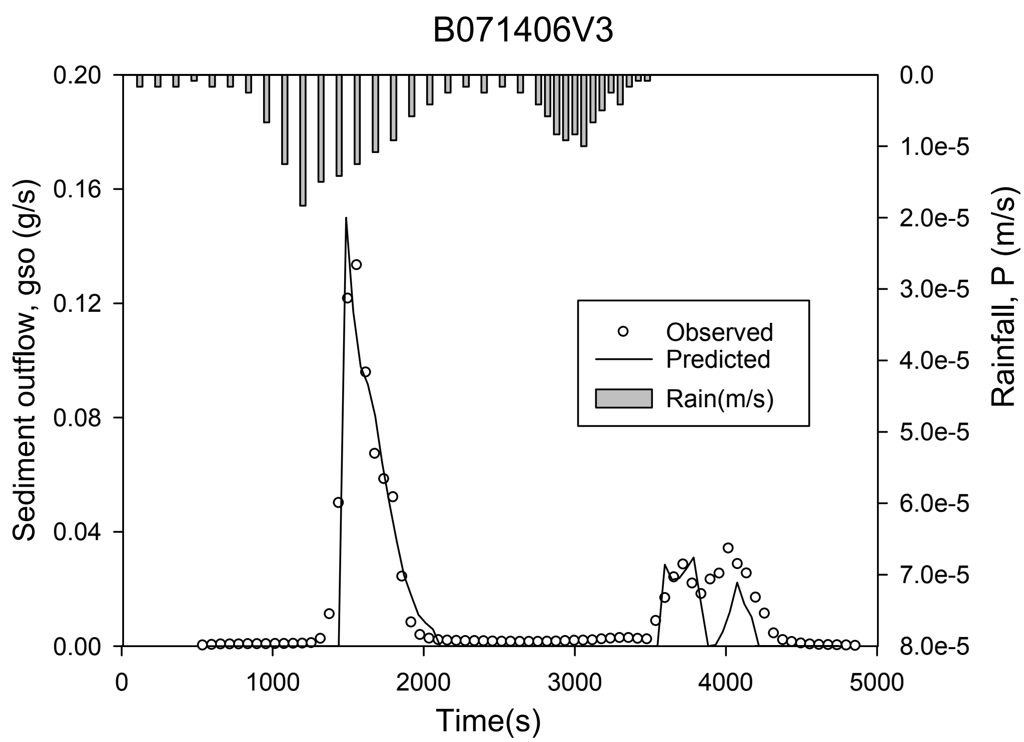


Figure D-4. Sedimentographs of plot 3 (length= 13.4 m) in VFS area at site B on date 07/14/06

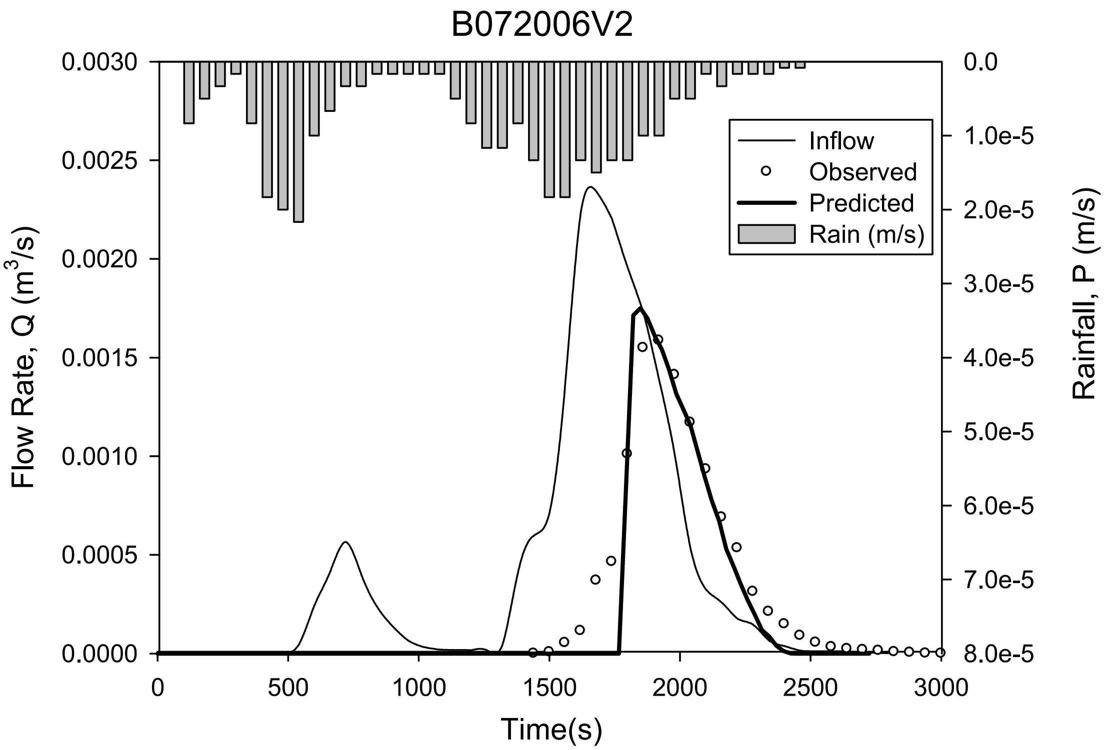


Figure D-5. Hydrographs of plot 2 (length= 6.8 m) in VFS area at site B on date 07/20/06

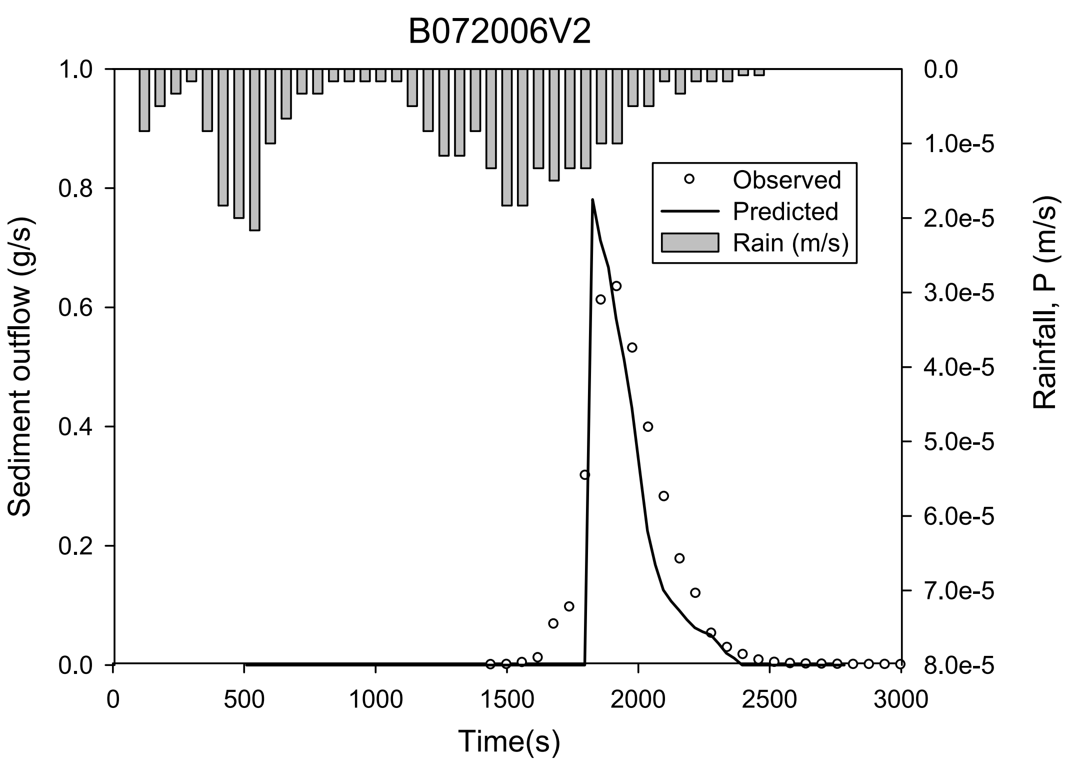


Figure D-6. Hydrographs of plot 2 (length= 6.8 m) in VFS area at site B on date 07/20/06

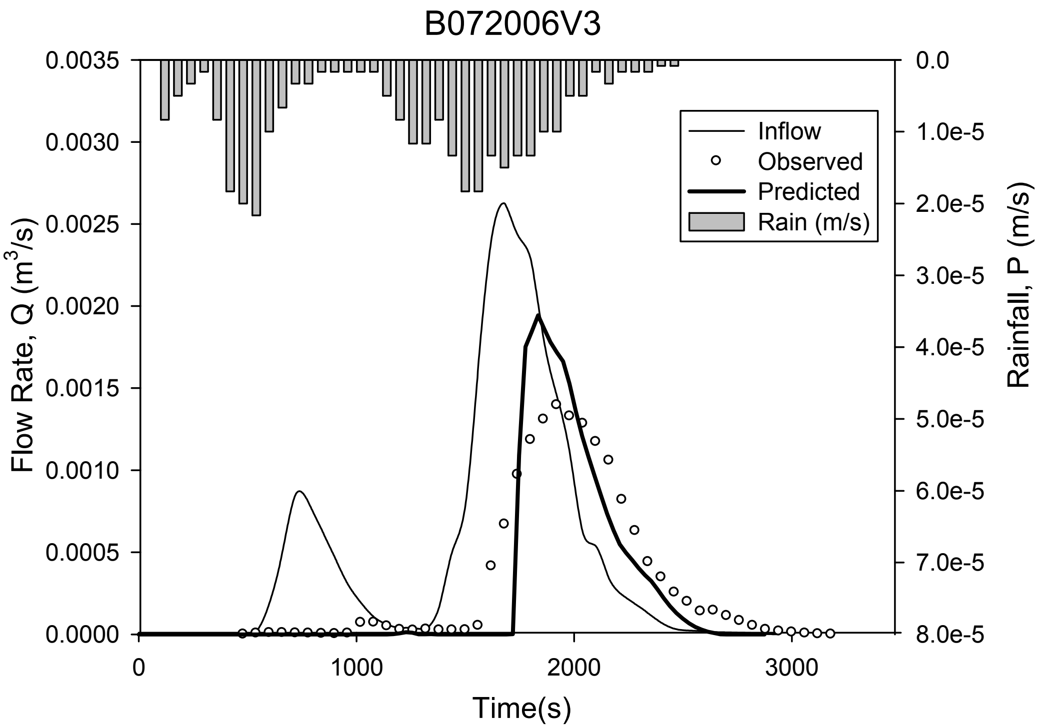


Figure D-7. Hydrographs of plot 3 (length= 13.4 m) in VFS area at site B on date 07/20/06

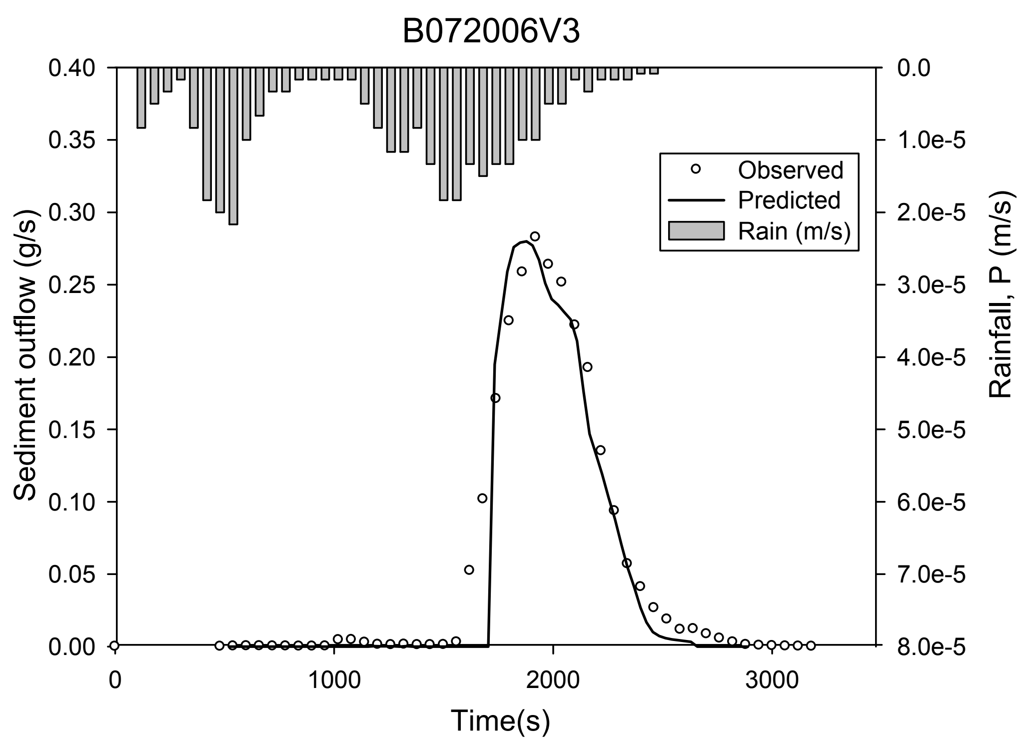


Figure D-8. Sedimentographs of plot 3 (length= 13.4 m) in VFS area at site B on date 07/20/06

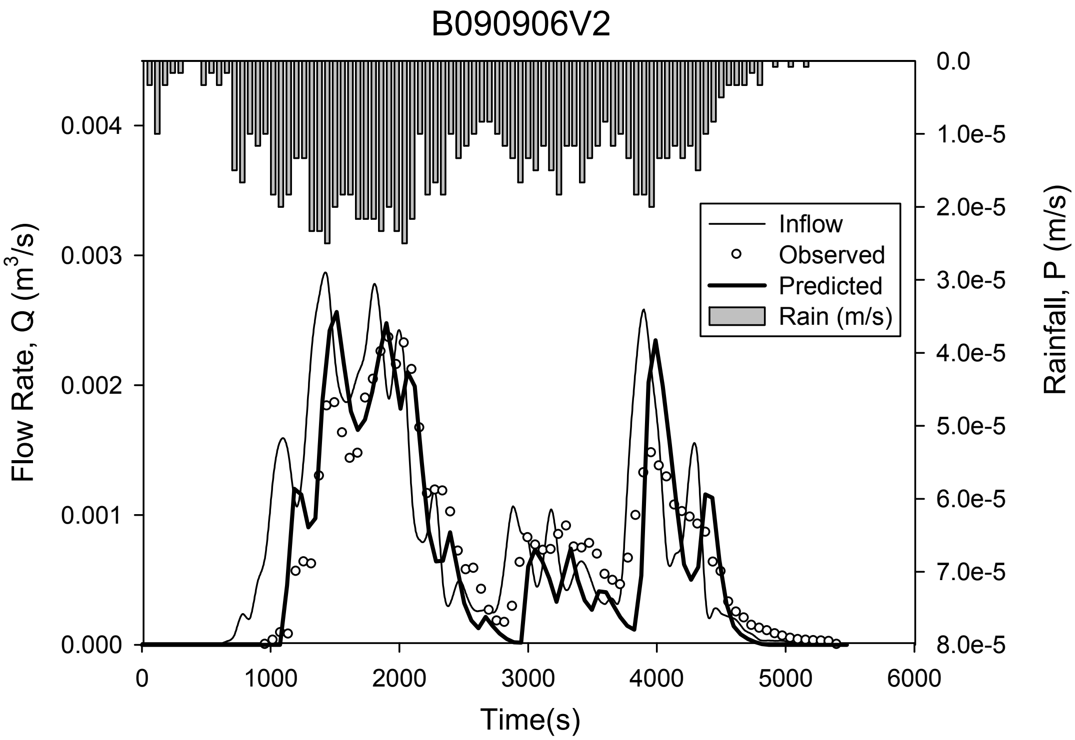


Figure D-9. Hydrographs of plot 2 (length= 6.8 m) in VFS area at site B on date 09/09/06

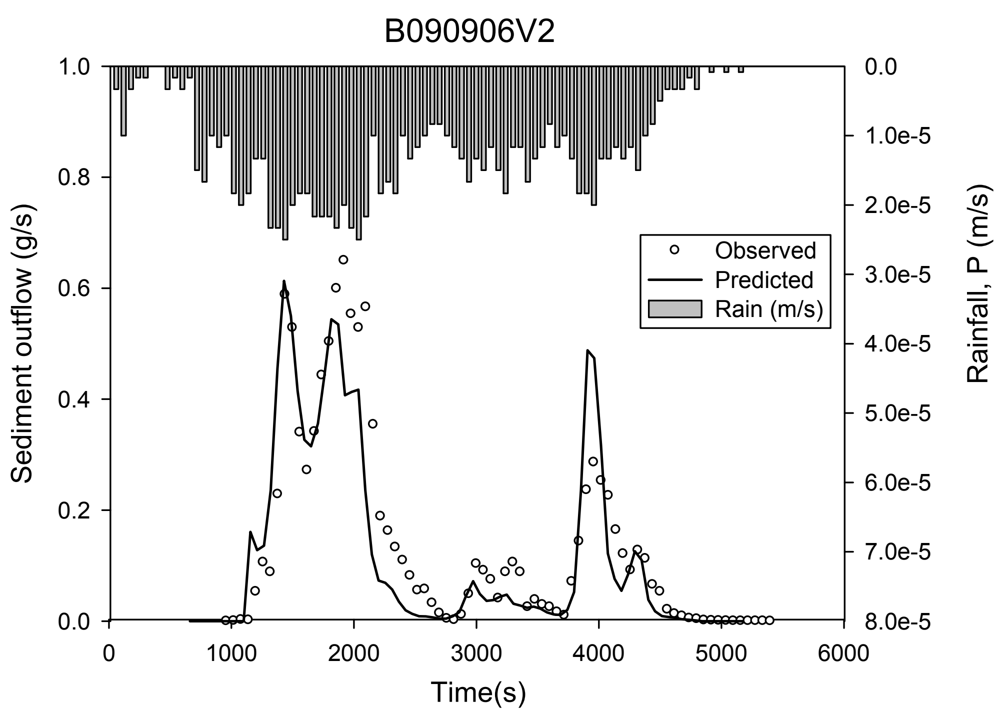


Figure D-10. Sedimentographs of plot 2 (length= 6.8 m) in VFS area at site B on date 09/09/06

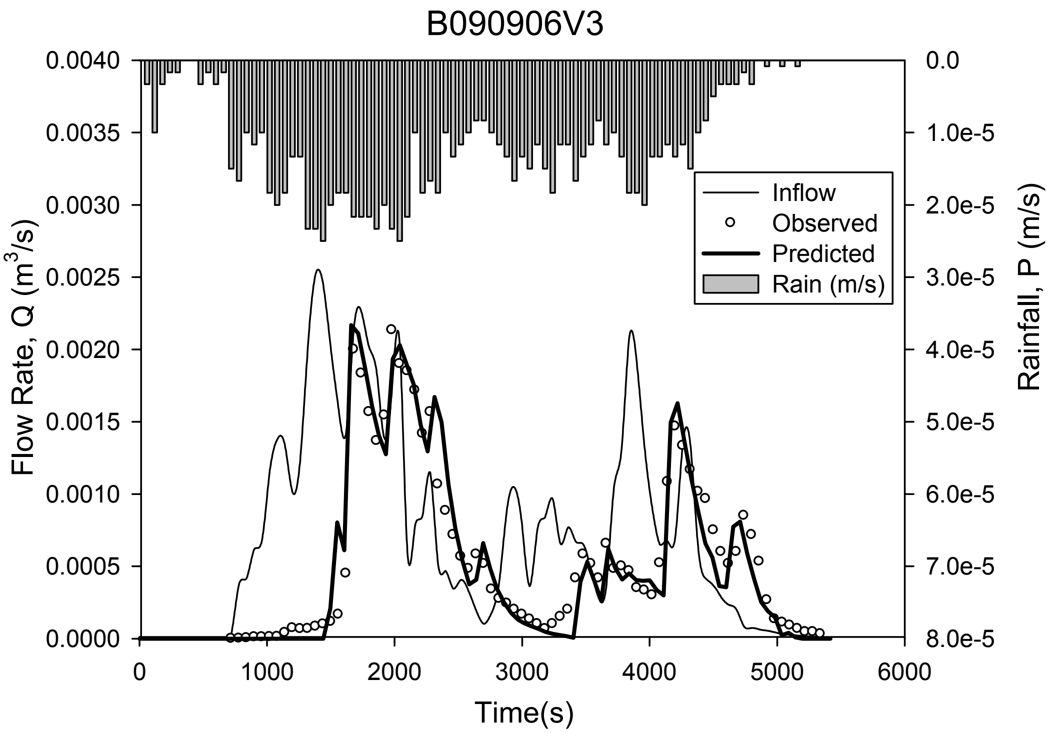


Figure D-11. Hydrographs of plot 3 (length= 13.4 m) in VFS area at site B on date 09/09/06

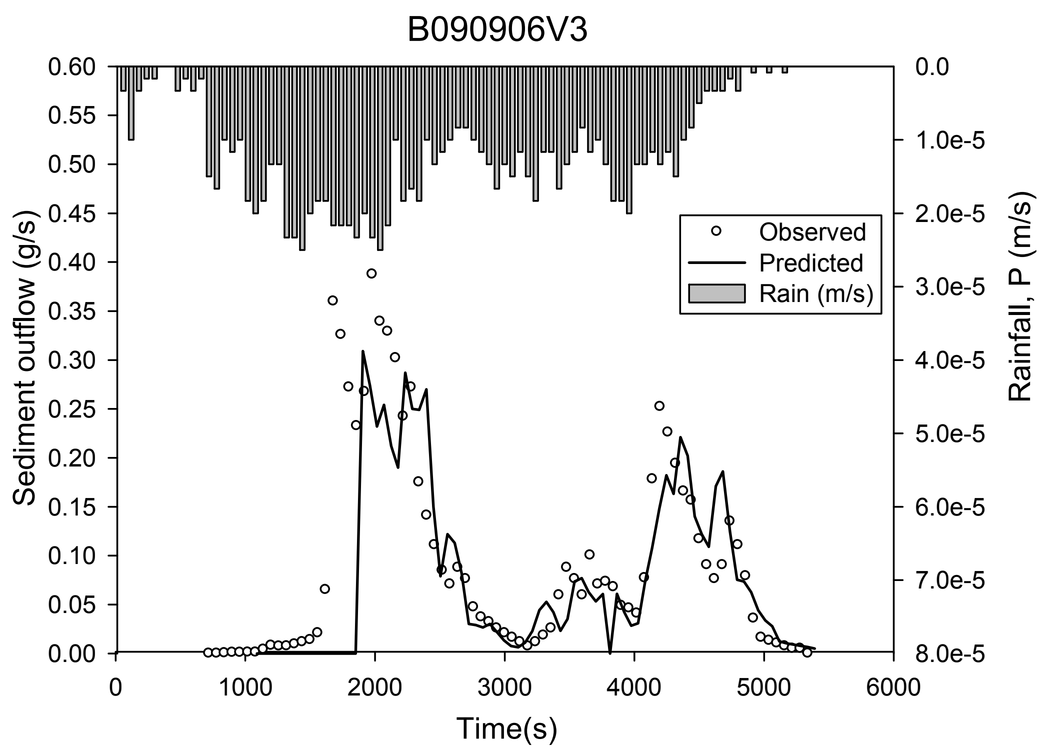


Figure D-12. Sedimentographs of plot 3 (length= 13.4 m) in VFS area at site B on date 09/09/06

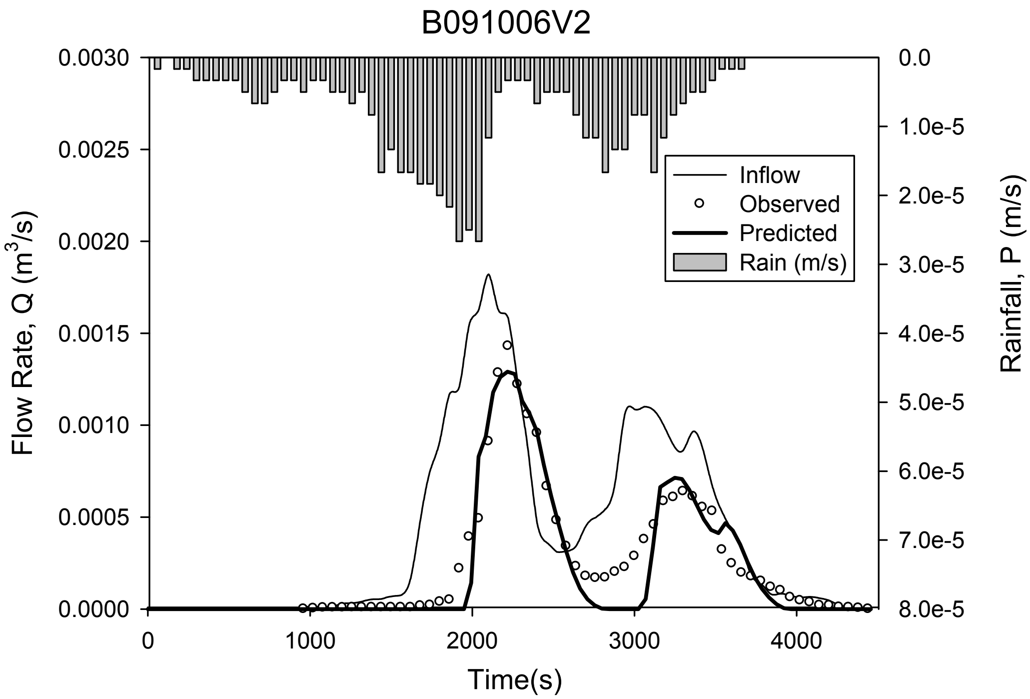


Figure D-13. Hydrographs of plot 2 (length= 6.8 m) in VFS area at site B on date 09/10/06

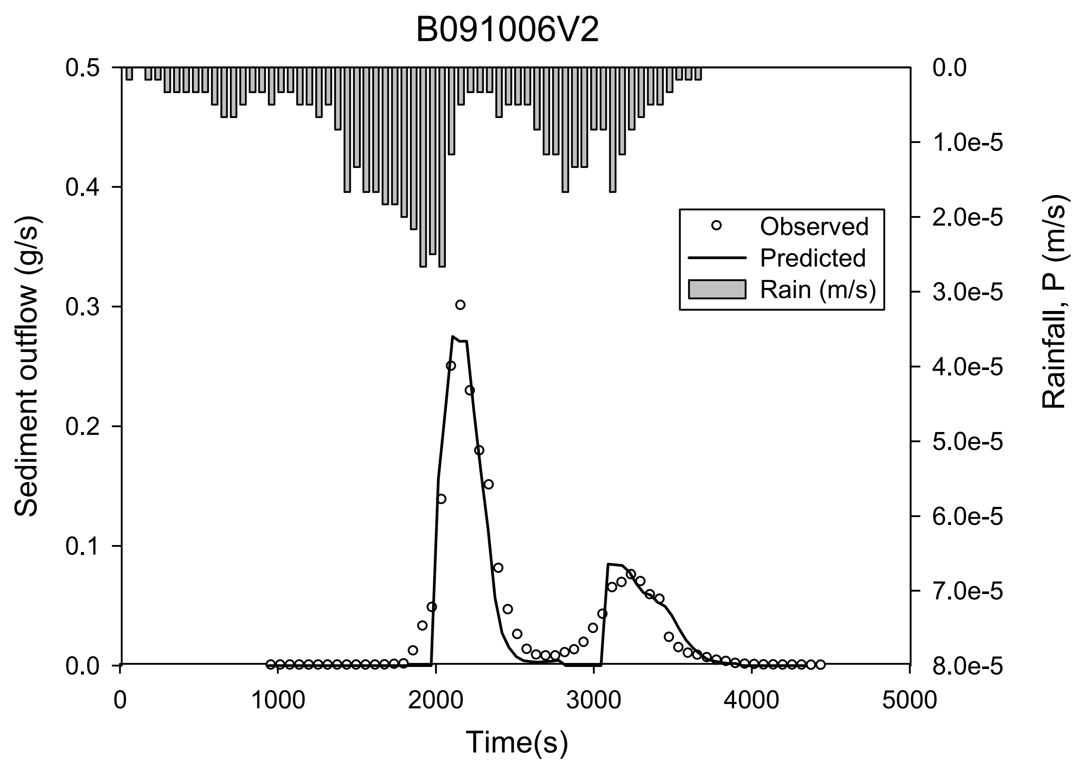


Figure D-14. Sedimentographs of plot 2 (length= 6.8 m) in VFS area at site B on date 09/10/06

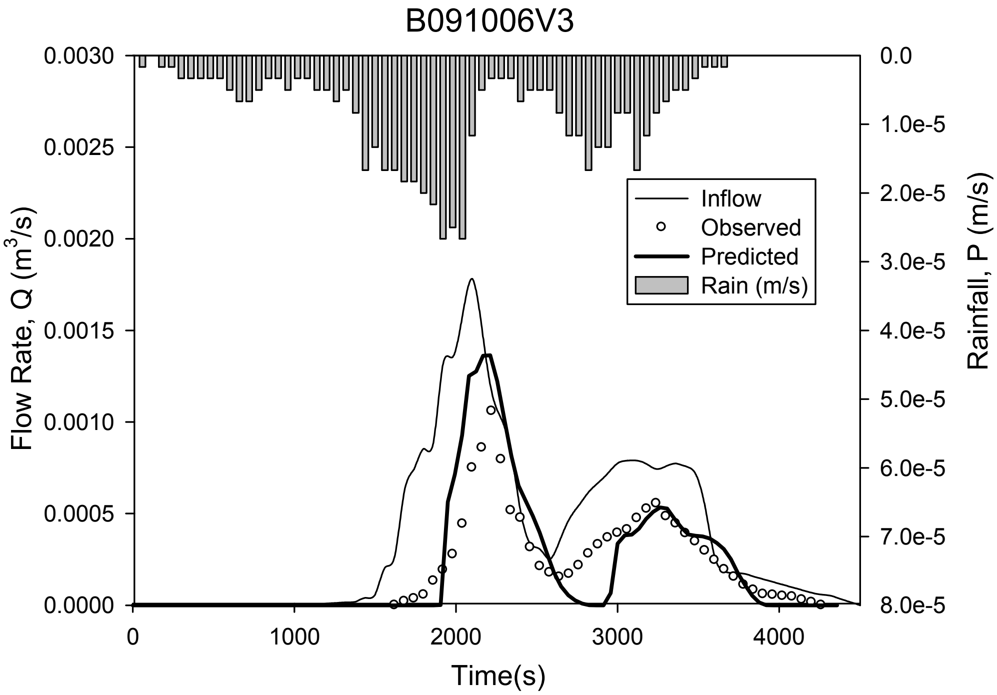


Figure D-15. Hydrographs of plot 3 (length= 13.4 m) in VFS area at site B on date 09/10/06

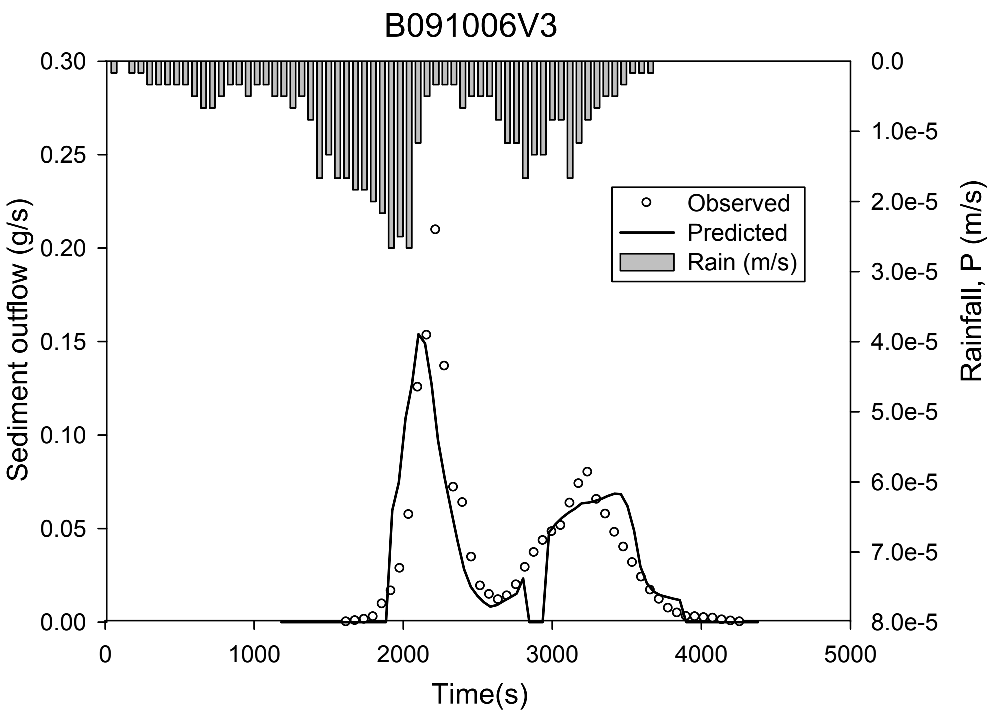


Figure D-16. Sedimentographs of plot 3 (length= 13.4 m) in VFS area at site B on date 09/10/06

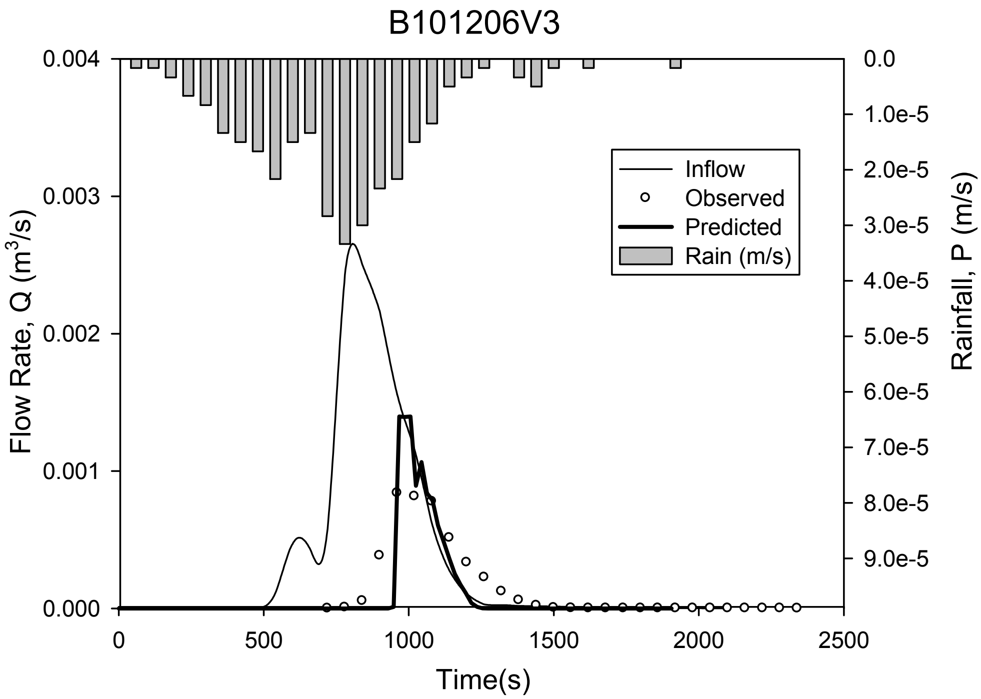


Figure D-17. Hydrographs of plot 3 (length= 13.4 m) in VFS area at site B on date 10/12/06

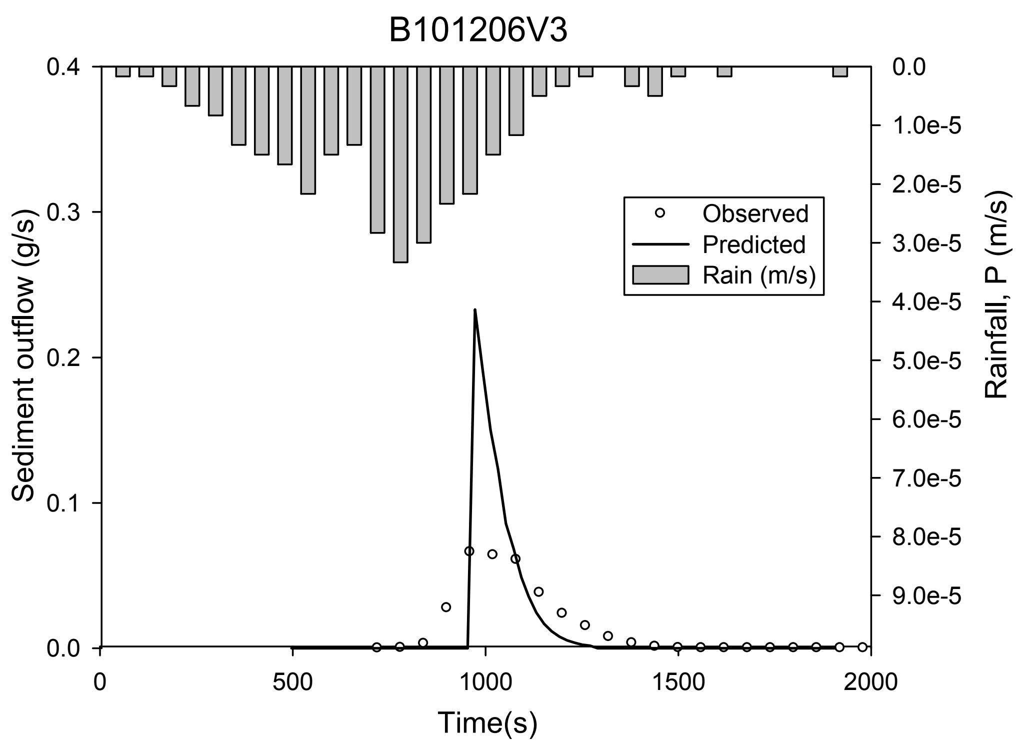


Figure D-18. Sedimentographs of plot 3 (length= 13.4 m) in VFS area at site B on date 10/12/06

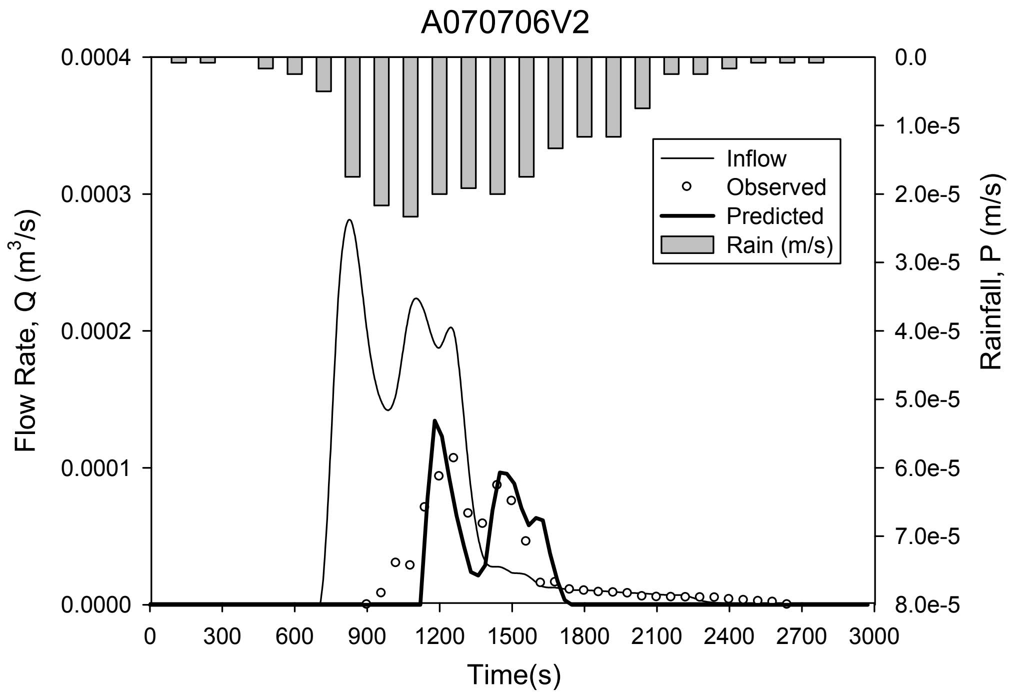


Figure D-19. Hydrographs of plot 2 (length= 4.1 m) in VFS area at site A on date 07/07/06

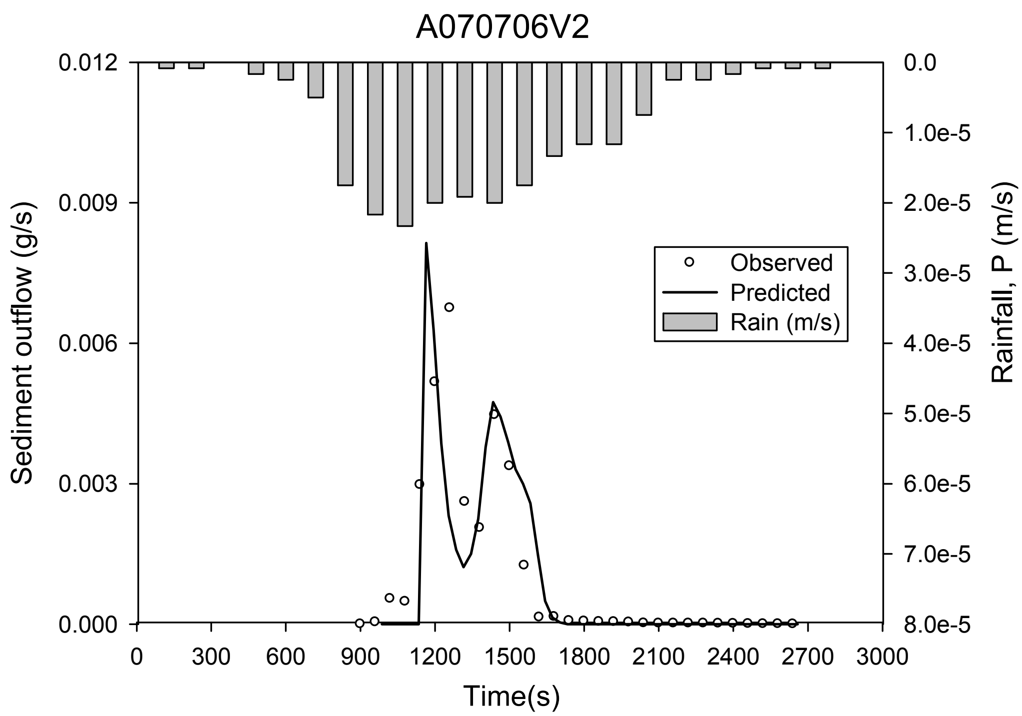


Figure D-20. Sedimentographs of plot 2 (length= 4.1 m) in VFS area at site A on date 07/07/06

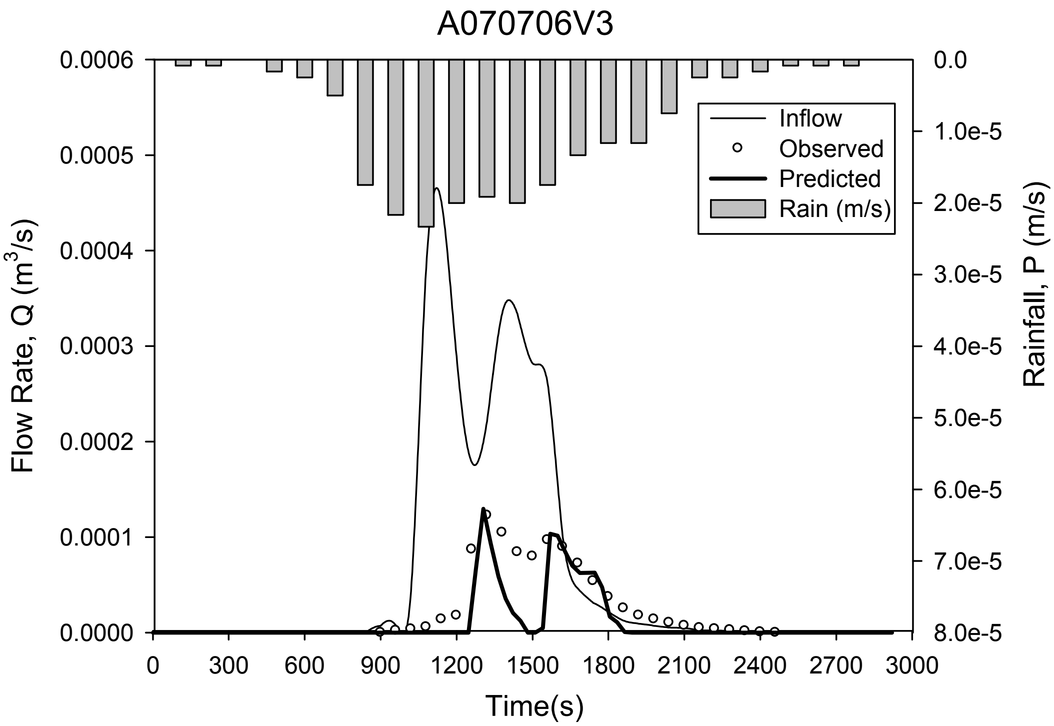


Figure D-21. Hydrographs of plot 3 (length= 5.8 m) in VFS area at site A on date 07/07/06

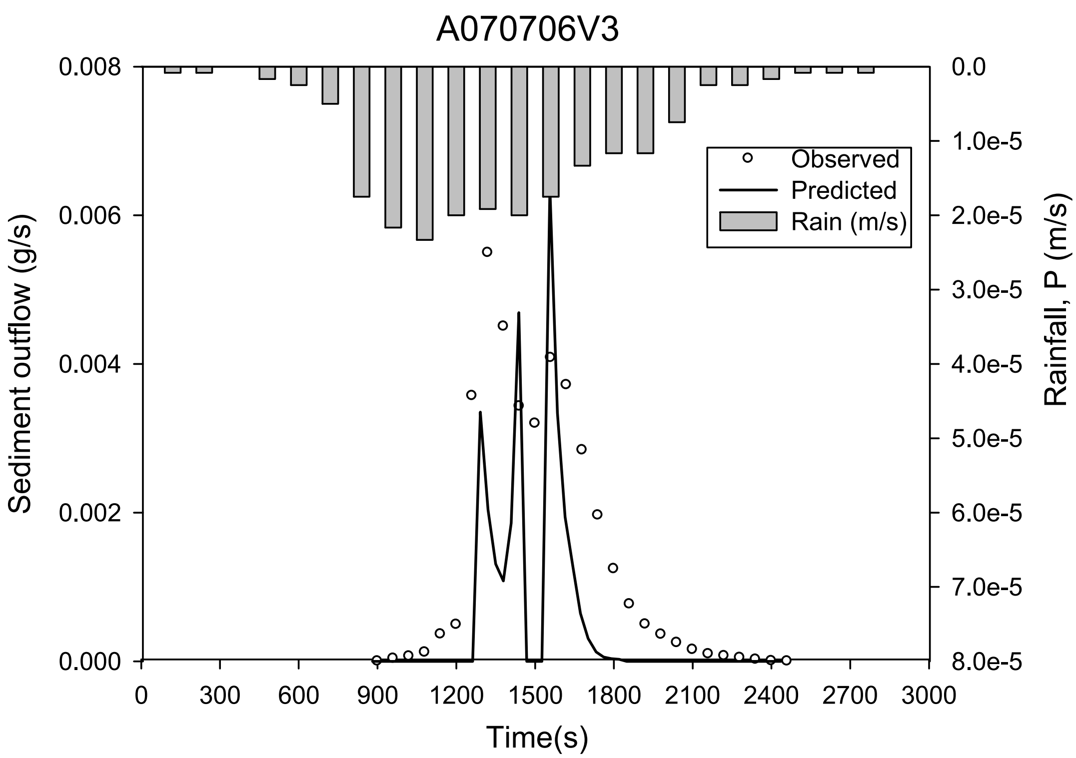


Figure D-22. Sedimentographs of plot 3 (length= 5.8 m) in VFS area at site A on date 07/07/06

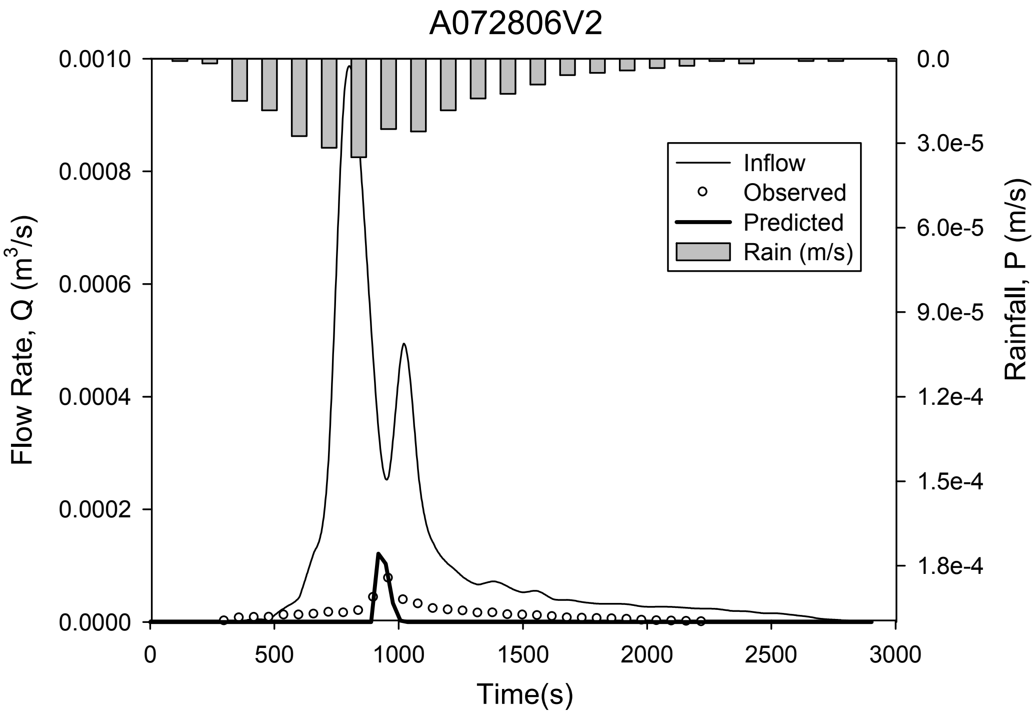


Figure D-23. Hydrographs of plot 2 (length= 4.1 m) in VFS area at site A on date 07/28/06

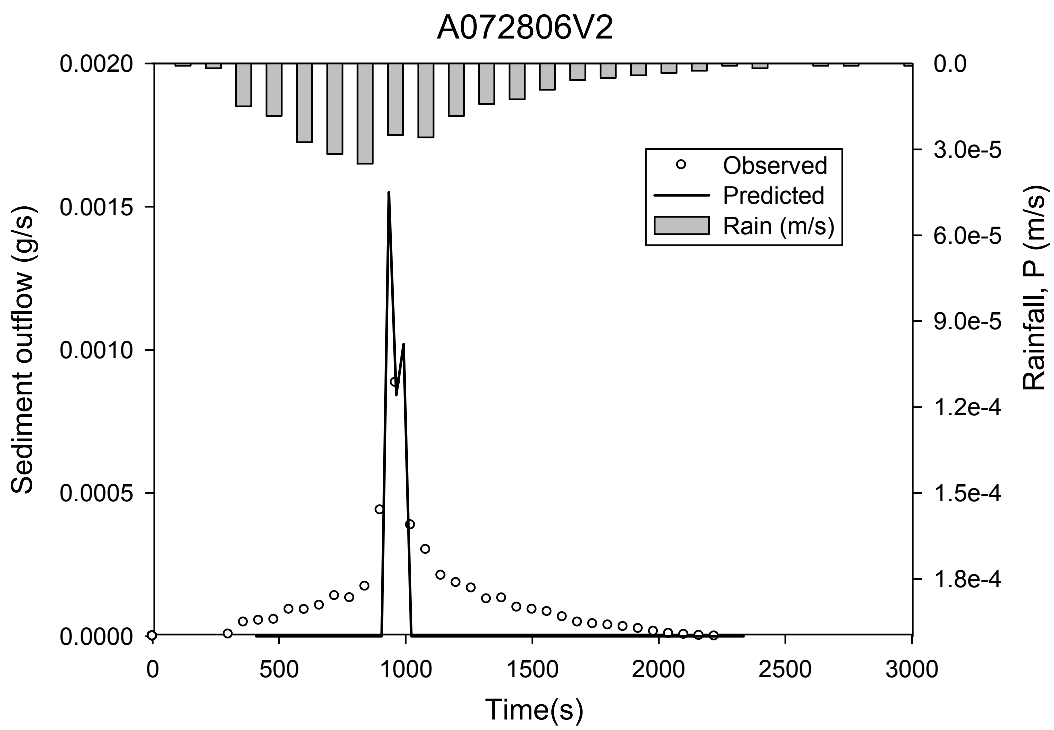


Figure D-24. Sedimentographs of plot 2 (length= 4.1 m) in VFS area at site A on date 07/28/06

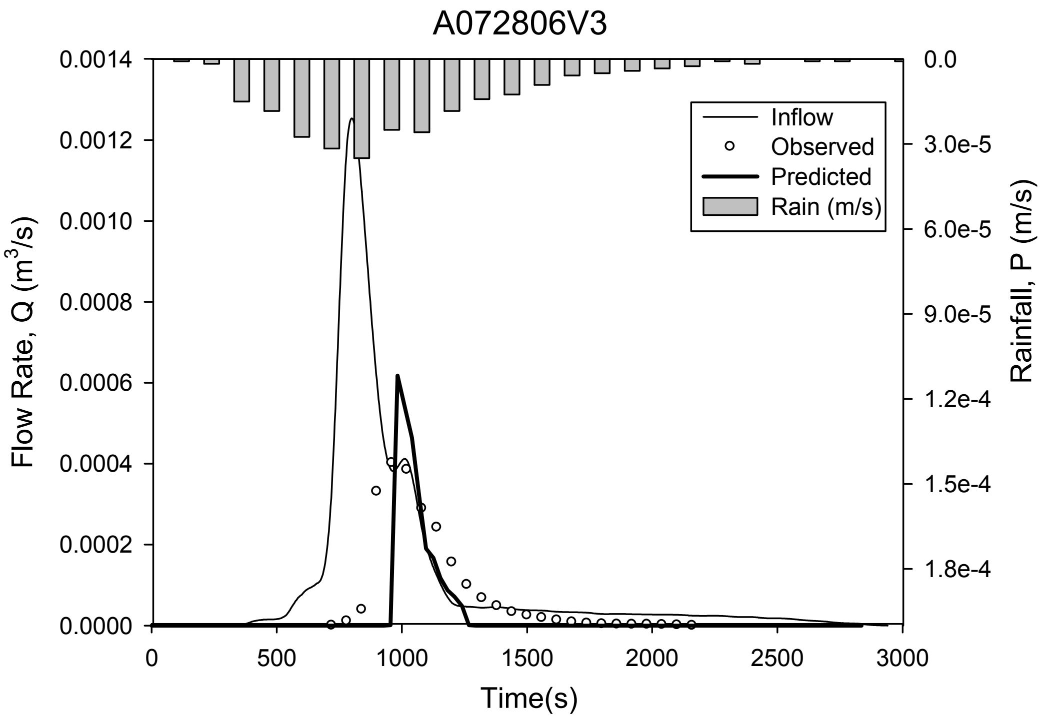


Figure D-25. Hydrographs of plot 3 (length= 5.8 m) in VFS area at site A on date 07/28/06

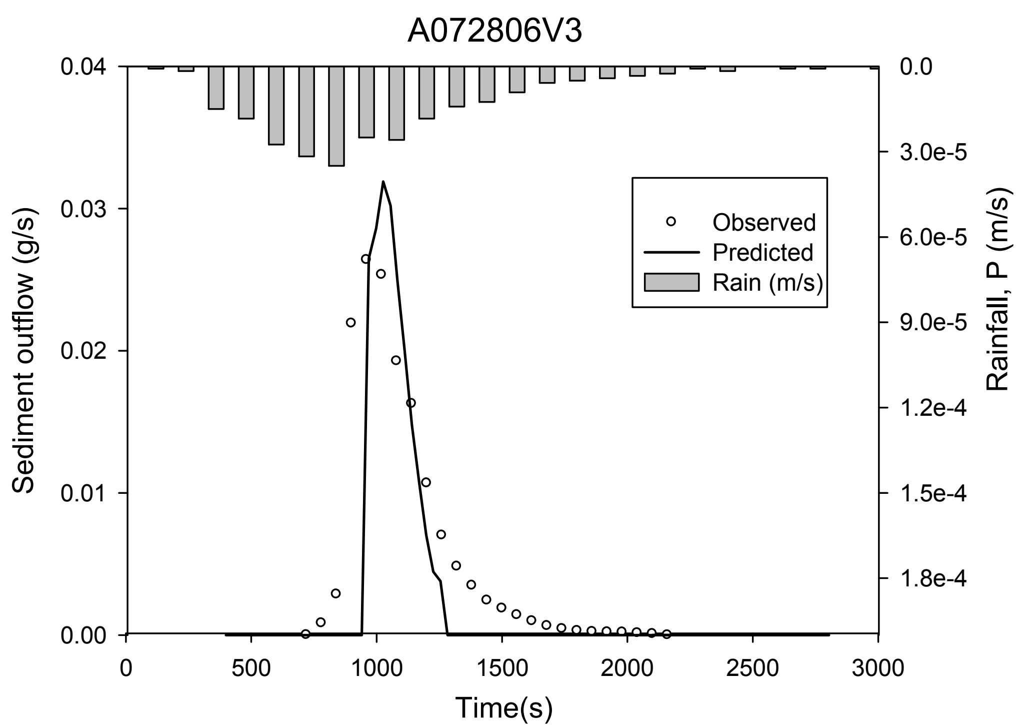


Figure D-26. Sedimentographs of plot 3 (length= 5.8 m) in VFS area at site A on date 07/28/06

APPENDIX E
SUMMARY OF FIELD DATA

A summary of field data was presented in this appendix. All the data used in Chapter 4 for model simulation were all presented in here. In the event ID, B071406V2, listed in the Table 4-5 for example, the data presented in Table E-27 (B071406S2) and Table E-28 (B071406V2) were needed for model simulation. Table E-27 was inputs of plot V2 at site B on date 07/14/2006. Table E-28 was outputs of plot V2 at site B on date 07/14/2006. The rainfall intensity of each event was only presented in the table which contains field data of plot S2. In Table E-1 (A020306S2) and Table E-27 (B071406S2) for example, the rainfall intensity were presented in the first two columns of the table. Note that the events on the tables were only those in which water quality samples were collected.

The table caption contained alpha-numeric describes plot and water samples collected date attributes. In Table E-1 (A020306S2) and Table E-27 (B071406V2) for example, the first letter represents the site location name (A or B). The following six numbers in succession represents Gregorian date. S represents source area; V represents the VFS area; the last number represents the plot number within source or VFS area. The lengths of short filters (plots V2 and V3) and long filters (plot V1 and V3) at site A are 4.1 m and 5.8 m, respectively. The lengths of short filters (plots V2 and V3) and long filters (plot V1 and V3) at site B are 6.8 m and 13.4 m, respectively. The length of source area (plots S1, S2, S3, and S4) at site A is 14.4 m. The length of source area (plots S1, S2, S3, and S4) at site B is 40 m.

Table E-1. Field data of event A020306S2 (site: A, plot: S2, date: 02/03/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc. (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	>37µm (%)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)
0	0.000E+00	780	0.000E+00	0.000	0.000E+00	0.000	0.000								
60	8.333E-07	840	1.564E-05	0.002	3.600E-05	0.417	0.366								
120	8.333E-07	900	2.362E-05	0.004	9.322E-05	0.466	0.380								
180	5.000E-07	960	2.502E-05	0.004	1.064E-04	0.475	0.382								
240	5.000E-07	1020	3.262E-05	0.006	1.965E-04	0.521	0.391								
300	5.000E-07	1080	3.566E-05	0.007	2.413E-04	0.540	0.394								
360	5.000E-07	1140	8.267E-04	0.415	3.432E-01	8.686	0.523								
420	5.000E-07	1200	9.667E-04	0.510	4.925E-01	10.504	0.530								
480	5.000E-07	1260	1.008E-03	0.538	5.429E-01	11.060	0.533								
540	5.000E-07	1320	1.035E-03	0.557	5.767E-01	11.419	0.534								
600	5.000E-07	1380	6.733E-04	0.317	2.137E-01	6.791	0.514								
660	5.000E-07	1440	5.950E-04	0.270	1.606E-01	5.866	0.508								
720	5.000E-07	1500	5.150E-04	0.223	1.150E-01	4.955	0.501								
780	1.233E-05	1560	5.535E-04	0.245	1.359E-01	5.389	0.505								
840	1.233E-05	1620	4.091E-04	0.165	6.760E-02	3.808	0.491								
900	1.233E-05	1680	2.803E-04	0.101	2.823E-02	2.519	0.475								
960	1.233E-05	1740	2.692E-04	0.096	2.571E-02	2.414	0.473								
1020	1.233E-05	1800	2.248E-04	0.075	1.695E-02	2.006	0.465								
1080	1.233E-05	1860	2.447E-04	0.084	2.064E-02	2.187	0.469								
1140	1.233E-05	1920	2.492E-04	0.086	2.151E-02	2.228	0.470								
1200	1.233E-05	1980	4.113E-04	0.166	6.845E-02	3.831	0.491								
1260	1.233E-05	2040	7.267E-04	0.351	2.548E-01	7.439	0.517								
1320	1.233E-05	2100	6.534E-04	0.305	1.993E-01	6.553	0.512								
1380	8.000E-06	2160	5.512E-04	0.244	1.346E-01	5.364	0.504								
1440	8.000E-06	2220	5.268E-04	0.230	1.212E-01	5.088	0.502								
1500	8.000E-06	2280	4.957E-04	0.212	1.053E-01	4.741	0.500								
1560	8.000E-06	2340	5.823E-04	0.262	1.528E-01	5.720	0.507								
1620	8.000E-06	2400	5.268E-04	0.230	1.212E-01	5.088	0.502								
1680	8.000E-06	2460	4.158E-04	0.169	7.017E-02	3.878	0.492	359.7	92.01	2.72	2.26	3.01	1.80	18.42	71.79
1740	8.000E-06	2520	3.291E-04	0.124	4.091E-02	2.992	0.482								
1800	8.000E-06	2580	3.092E-04	0.115	3.540E-02	2.796	0.479								
1860	8.000E-06	2640	2.558E-04	0.089	2.286E-02	2.289	0.471								
1920	8.000E-06	2700	2.336E-04	0.079	1.854E-02	2.086	0.467								
1980	6.500E-06	2760	2.025E-04	0.066	1.333E-02	1.810	0.461								
2040	6.500E-06	2820	1.870E-04	0.059	1.108E-02	1.675	0.458								
2100	6.500E-06	2880	1.759E-04	0.055	9.623E-03	1.581	0.455								
2160	6.500E-06	2940	2.003E-04	0.065	1.299E-02	1.790	0.461								
2220	6.500E-06	3000	1.470E-04	0.043	6.360E-03	1.343	0.448								
2280	6.500E-06	3060	1.226E-04	0.034	4.180E-03	1.150	0.441								
2340	6.500E-06	3120	8.705E-05	0.022	1.896E-03	0.885	0.427								
2400	6.500E-06	3180	6.928E-05	0.016	1.119E-03	0.760	0.419								
2460	6.500E-06	3240	6.928E-05	0.016	1.119E-03	0.760	0.419								
2520	6.500E-06	3300	4.707E-05	0.010	4.583E-04	0.613	0.404								

Table E-1. Continued

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc. (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	>37µm (%)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	> (
2580	5.000E-07	3360	5.818E-05	0.013	7.475E-04	0.685	0.412								
2640	5.000E-07	3420	7.594E-05	0.018	1.383E-03	0.806	0.422								
2700	5.000E-07	3480	4.485E-05	0.009	4.099E-04	0.598	0.403								
2760	5.000E-07	3540	3.819E-05	0.007	2.827E-04	0.556	0.397								
2820	5.000E-07	3600	2.936E-05	0.005	1.541E-04	0.501	0.388								
2880	5.000E-07	3660	1.939E-05	0.003	5.909E-05	0.440	0.373								
2940	5.000E-07	3720	1.554E-05	0.002	3.546E-05	0.416	0.366								
3000	5.000E-07	3780	1.526E-05	0.002	3.398E-05	0.415	0.365								
3060	5.000E-07	3840	1.497E-05	0.002	3.253E-05	0.413	0.365								
3120	5.000E-07	3900	1.469E-05	0.002	3.112E-05	0.411	0.364								
3180	3.333E-07	3960	1.440E-05	0.002	2.974E-05	0.409	0.364								
3240	3.333E-07	4020	1.412E-05	0.002	2.840E-05	0.408	0.363								
3300	3.333E-07	4080	1.383E-05	0.002	2.709E-05	0.406	0.362								
3360	3.333E-07	4140	1.355E-05	0.002	2.582E-05	0.404	0.362								
3420	3.333E-07	4200	1.326E-05	0.002	2.459E-05	0.402	0.361								
3480	3.333E-07	4260	1.298E-05	0.002	2.338E-05	0.400	0.360								
3540	3.333E-07	4320	1.269E-05	0.002	2.221E-05	0.398	0.359								
3600	3.333E-07	4380	1.241E-05	0.002	2.108E-05	0.397	0.359								
3660	3.333E-07	4440	1.212E-05	0.002	1.998E-05	0.395	0.358								
3720	3.333E-07	4500	1.184E-05	0.002	1.891E-05	0.393	0.357								
3780	1.500E-06	4560	1.155E-05	0.002	1.788E-05	0.391	0.356								
3840	1.500E-06	4620	1.127E-05	0.001	1.687E-05	0.389	0.356								
3900	1.500E-06	4680	1.098E-05	0.001	1.591E-05	0.387	0.355								
3960	1.500E-06	4740	1.070E-05	0.001	1.497E-05	0.385	0.354								
4020	1.500E-06	4800	1.041E-05	0.001	1.406E-05	0.383	0.353								
4080	1.500E-06	4860	1.219E-05	0.002	2.025E-05	0.395	0.358								
4140	1.500E-06	4920	3.164E-05	0.006	1.831E-04	0.515	0.390								
4200	1.500E-06	4980	1.483E-05	0.002	3.182E-05	0.412	0.365								
4260	1.500E-06	5040	1.526E-05	0.002	3.398E-05	0.415	0.365								
4320	1.500E-06	5100	1.569E-05	0.002	3.622E-05	0.417	0.366								
4380	6.667E-07	5160	1.611E-05	0.002	3.854E-05	0.420	0.367								
4440	6.667E-07	5220	1.654E-05	0.002	4.094E-05	0.423	0.368								
4500	6.667E-07	5280	1.697E-05	0.003	4.342E-05	0.425	0.369								
4560	6.667E-07	5340	1.739E-05	0.003	4.599E-05	0.428	0.370								
4620	6.667E-07	5400	1.782E-05	0.003	4.864E-05	0.431	0.371								
4680	6.667E-07	5460	1.825E-05	0.003	5.138E-05	0.433	0.371								
4740	6.667E-07	5520	1.868E-05	0.003	5.420E-05	0.436	0.372								
4800	6.667E-07	5580	1.910E-05	0.003	5.711E-05	0.439	0.373								
4860	6.667E-07	5640	1.554E-05	0.002	3.546E-05	0.416	0.366								
4920	6.667E-07	5700	1.399E-05	0.002	2.781E-05	0.407	0.363								
4980	3.000E-06	5760	1.244E-05	0.002	2.119E-05	0.397	0.359								
5040	3.000E-06	5820	1.088E-05	0.001	1.557E-05	0.387	0.355								
5100	3.000E-06	5880	9.331E-06	0.001	1.091E-05	0.376	0.350								

Table E-1. Continued.

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc. (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	>37µm (%)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)
5160	3.000E-06	5940	7.778E-06	0.001	7.169E-06	0.365	0.344							
5220	3.000E-06	6000	6.226E-06	0.001	4.286E-06	0.353	0.337							
5280	3.000E-06	6060	4.384E-06	0.000	1.906E-06	0.337	0.327							
5340	3.000E-06	6120	3.658E-06	0.000	1.256E-06	0.329	0.322							
5400	3.000E-06	6180	2.933E-06	0.000	7.539E-07	0.321	0.315							
5460	3.000E-06	6240	2.208E-06	0.000	3.913E-07	0.311	0.307							
5520	3.000E-06	6300	1.483E-06	0.000	1.560E-07	0.299	0.296							
5580	5.333E-06	6360	7.579E-07	0.000	3.310E-08	0.280	0.279							
5640	5.333E-06	6420	3.277E-08	0.000	2.341E-11	0.000	0.000							
5700	5.333E-06													
5760	5.333E-06													
5820	5.333E-06													
5880	5.333E-06													
5940	5.333E-06													
6000	5.333E-06													
6060	5.333E-06													
6120	5.333E-06													
6180	1.667E-06													
6240	1.667E-06													
6300	1.667E-06													

Number of field 6
Total sediment mass = 250.434g
Total runoff volume = 0.969m^3
Total phosphorus mass 5.4296g
Total DP mass = 0.4783g

Table E-2. Field data of event A020306V2 (site: A, plot: V2, date: 02/03/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	>37μm (%)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)
1200	0.000E+00	0.000	0.000E+00	0.000	0.000								
1260	2.454E-06	0.005	1.329E-05	0.342	0.205								
1320	4.099E-05	0.041	1.661E-03	1.280	0.257								
1380	8.983E-05	0.071	6.378E-03	2.067	0.273								
1440	8.515E-05	0.068	5.819E-03	1.999	0.272								
1500	7.609E-05	0.063	4.799E-03	1.863	0.270								
1560	4.567E-05	0.044	1.999E-03	1.365	0.259								
1620	3.661E-05	0.037	1.368E-03	1.199	0.254	21.71	26.86	1.22	3.59	68.33	20.23	6.44	0.18
1680	2.023E-05	0.024	4.951E-04	0.861	0.243								
1740	1.335E-05	0.018	2.426E-04	0.694	0.235								
1800	1.324E-05	0.018	2.392E-04	0.691	0.235								
1860	1.313E-05	0.018	2.358E-04	0.688	0.235								
1920	1.302E-05	0.018	2.324E-04	0.685	0.234								
1980	1.291E-05	0.018	2.290E-04	0.682	0.234								
2040	1.280E-05	0.018	2.256E-04	0.679	0.234								
2100	1.268E-05	0.018	2.223E-04	0.676	0.234								
2160	3.161E-05	0.034	1.064E-03	1.102	0.251								
2220	4.060E-05	0.040	1.634E-03	1.273	0.256								
2280	5.728E-05	0.051	2.949E-03	1.564	0.264	15.58	13.13	0.00	3.37	83.50	13.13	0.00	0.00
2340	6.969E-05	0.059	4.128E-03	1.764	0.268								
2400	5.156E-05	0.048	2.462E-03	1.468	0.261								
2460	3.771E-05	0.038	1.440E-03	1.219	0.255								
2520	3.147E-05	0.034	1.056E-03	1.099	0.251								
2580	2.694E-05	0.030	8.089E-04	1.007	0.248								
2640	1.313E-05	0.018	2.358E-04	0.688	0.235								
2700	1.045E-05	0.015	1.594E-04	0.616	0.230								
2760	8.420E-06	0.013	1.101E-04	0.557	0.226								
2820	7.064E-06	0.012	8.146E-05	0.514	0.223								
2880	5.708E-06	0.010	5.653E-05	0.470	0.220								
2940	4.353E-06	0.008	3.551E-05	0.421	0.215								
3000	2.722E-06	0.006	1.588E-05	0.354	0.207								
3060	1.245E-06	0.003	4.150E-06	0.279	0.195								
3120	1.226E-07	0.000	7.793E-08	0.000	0.000								

Number of field samples =	3	
Total sediment mass =	2.42406	g
Total runoff volume =	0.05329	m^3
Total phosphorus mass =	0.07494	g
Total DP mass =	0.01370	g

Table E-3. Field data of event A020306S3 (site: A, plot: S3, date: 02/03/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	>37μm (%)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)
1080	0.000E+00	0.000	0.000E+00	0.000	0.000								
1140	1.463E-04	0.055	7.975E-03	1.739	0.360								
1200	9.576E-04	0.463	4.434E-01	12.276	0.508								
1260	1.052E-03	0.515	5.417E-01	13.608	0.512								
1320	1.107E-03	0.546	6.041E-01	14.395	0.514								
1380	1.058E-03	0.519	5.491E-01	13.703	0.512								
1440	1.035E-03	0.506	5.235E-01	13.371	0.511								
1500	9.119E-04	0.438	3.994E-01	11.635	0.505								
1560	5.576E-04	0.250	1.395E-01	6.833	0.485								
1620	4.605E-04	0.201	9.266E-02	5.580	0.477								
1680	4.446E-04	0.193	8.593E-02	5.377	0.475								
1740	3.995E-04	0.171	6.838E-02	4.810	0.471								
1800	4.008E-04	0.172	6.886E-02	4.827	0.471								
1860	4.021E-04	0.172	6.934E-02	4.843	0.471								
1920	3.628E-04	0.153	5.563E-02	4.354	0.467								
1980	6.259E-04	0.285	1.786E-01	7.732	0.489								
2040	9.096E-04	0.437	3.972E-01	11.602	0.505								
2100	8.048E-04	0.380	3.057E-01	10.150	0.500								
2160	7.155E-04	0.332	2.378E-01	8.933	0.495								
2220	6.996E-04	0.324	2.266E-01	8.718	0.494								
2280	6.768E-04	0.312	2.111E-01	8.412	0.493								
2340	6.961E-04	0.322	2.241E-01	8.671	0.494								
2400	6.648E-04	0.306	2.032E-01	8.251	0.492								
2460	5.799E-04	0.262	1.517E-01	7.125	0.486								
2520	4.546E-04	0.198	9.014E-02	5.505	0.476								
2580	3.722E-04	0.158	5.876E-02	4.470	0.468								
2640	2.639E-04	0.107	2.818E-02	3.159	0.455								
2700	2.005E-04	0.078	1.565E-02	2.420	0.444	348.1	91.79	2.87	2.22	3.11	1.80	18.78	71.22
2760	1.502E-04	0.056	8.441E-03	1.855	0.433								
2820	9.990E-05	0.035	3.529E-03	1.311	0.418								
2880	4.960E-05	0.016	7.896E-04	0.796	0.394								
2940	4.960E-05	0.016	7.896E-04	0.796	0.394								
3000	5.310E-05	0.017	9.135E-04	0.831	0.396								
3060	2.171E-05	0.006	1.349E-04	0.524	0.367								
3120	2.115E-05	0.006	1.276E-04	0.519	0.366								
3180	2.059E-05	0.006	1.204E-04	0.513	0.366								
3240	2.002E-05	0.006	1.135E-04	0.508	0.365								
3300	1.946E-05	0.005	1.068E-04	0.502	0.364								
3360	1.890E-05	0.005	1.003E-04	0.497	0.363								
3420	1.876E-05	0.005	9.876E-05	0.495	0.363								
3480	1.862E-05	0.005	9.719E-05	0.494	0.363								
3540	1.848E-05	0.005	9.563E-05	0.493	0.362								
3600	1.834E-05	0.005	9.409E-05	0.491	0.362								
3660	1.820E-05	0.005	9.256E-05	0.490	0.362								
3720	1.806E-05	0.005	9.104E-05	0.489	0.362								
3780	1.792E-05	0.005	8.953E-05	0.487	0.361								

Table E-3. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	>37µm (%)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)
3840	1.778E-05	0.005	8.804E-05	0.486	0.361								
3900	1.764E-05	0.005	8.656E-05	0.484	0.361								
3960	1.750E-05	0.005	8.510E-05	0.483	0.361								
4020	1.736E-05	0.005	8.364E-05	0.482	0.360								
4080	1.722E-05	0.005	8.221E-05	0.480	0.360								
4140	1.708E-05	0.005	8.078E-05	0.479	0.360								
4200	1.694E-05	0.005	7.937E-05	0.478	0.360								
4260	1.680E-05	0.005	7.797E-05	0.476	0.359								
4320	1.666E-05	0.005	7.658E-05	0.475	0.359								
4380	1.652E-05	0.005	7.521E-05	0.474	0.359								
4440	1.638E-05	0.005	7.385E-05	0.472	0.359								
4500	1.624E-05	0.004	7.251E-05	0.471	0.358								
4560	1.610E-05	0.004	7.117E-05	0.469	0.358								
4620	1.596E-05	0.004	6.985E-05	0.468	0.358								
4680	1.582E-05	0.004	6.855E-05	0.467	0.357								
4740	1.649E-05	0.005	7.494E-05	0.473	0.359								
4800	1.454E-05	0.004	5.726E-05	0.454	0.355								
4860	1.287E-05	0.003	4.412E-05	0.438	0.351								
4920	1.171E-05	0.003	3.602E-05	0.426	0.348								
4980	9.883E-06	0.003	2.508E-05	0.407	0.343								
5040	7.625E-06	0.002	1.440E-05	0.383	0.336								
5100	6.419E-06	0.002	9.964E-06	0.370	0.331								
5160	5.030E-06	0.001	5.916E-06	0.354	0.324								
5220	7.260E-06	0.002	1.297E-05	0.379	0.334								
5280	6.699E-06	0.002	1.092E-05	0.373	0.332								
5340	5.998E-06	0.001	8.619E-06	0.365	0.329								
5400	5.030E-06	0.001	5.916E-06	0.354	0.324								
5460	4.216E-06	0.001	4.057E-06	0.344	0.319								
5520	5.311E-06	0.001	6.644E-06	0.357	0.326								
5580	2.884E-06	0.001	1.801E-06	0.325	0.309								
5640	4.651E-06	0.001	5.004E-06	0.349	0.322								
5700	4.483E-06	0.001	4.625E-06	0.347	0.321								
5760	7.555E-06	0.002	1.412E-05	0.383	0.336								
5820	6.419E-06	0.002	9.964E-06	0.370	0.331								
5880	6.138E-06	0.001	9.056E-06	0.367	0.330								
5940	5.759E-06	0.001	7.903E-06	0.362	0.328								
6000	5.381E-06	0.001	6.833E-06	0.358	0.326								
6060	4.776E-06	0.001	5.296E-06	0.351	0.323								
6120	4.172E-06	0.001	3.965E-06	0.343	0.319								
6180	3.567E-06	0.001	2.837E-06	0.335	0.315								
6240	2.962E-06	0.001	1.907E-06	0.326	0.310								
6300	1.987E-06	0.000	8.118E-07	0.310	0.299								
6360	9.446E-07	0.000	1.655E-07	0.285	0.281								
6420	0.000E+00	0.000	0.000E+00	0.000	0.000								

Number of field samples =	6	
Total sediment mass =	359.731	g
Total runoff volume =	1.08269	m^3
Total phosphorus mass =	9.66526	g
Total DP mass =	0.52665	g

Table E-4. Field data of event A020306V3 (site: A, plot: V3, date: 02/03/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	>37µm (%)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)
1200	0.000E+00	0.000	0.000E+00	0.000	0.000								
1260	4.287E-06	0.005	2.235E-05	0.325	0.193								
1320	7.162E-06	0.007	4.969E-05	0.430	0.254								
1380	8.635E-06	0.008	6.647E-05	0.458	0.263								
1440	1.455E-05	0.010	1.498E-04	0.551	0.289								
1500	2.437E-05	0.014	3.343E-04	0.668	0.318								
1560	1.918E-05	0.012	2.303E-04	0.610	0.304	22.05	30.00	1.36	3.17	65.46	17.46	9.94	2.60
1620	1.624E-05	0.011	1.776E-04	0.574	0.295								
1680	1.329E-05	0.010	1.301E-04	0.534	0.284								
1740	1.011E-05	0.008	8.494E-05	0.484	0.270								
1800	1.158E-05	0.009	1.050E-04	0.508	0.277								
1860	1.372E-05	0.010	1.366E-04	0.540	0.286								
1920	9.761E-06	0.008	8.045E-05	0.478	0.269								
1980	9.909E-06	0.008	8.235E-05	0.481	0.269								
2040	1.011E-05	0.008	8.494E-05	0.484	0.270								
2100	1.158E-05	0.009	1.050E-04	0.508	0.277								
2160	1.305E-05	0.010	1.265E-04	0.530	0.283								
2220	1.439E-05	0.010	1.471E-04	0.549	0.289								
2280	1.692E-05	0.011	1.894E-04	0.583	0.297								
2340	2.381E-05	0.014	3.224E-04	0.662	0.316								
2400	2.101E-05	0.013	2.652E-04	0.632	0.309								
2460	1.610E-05	0.011	1.753E-04	0.572	0.295								
2520	1.175E-05	0.009	1.074E-04	0.511	0.278								
2580	5.715E-06	0.006	3.496E-05	0.399	0.244								
2640	8.711E-07	0.002	1.871E-06	0.227	0.173								
2700	8.641E-07	0.002	1.848E-06	0.226	0.172								

Number of field samples = 3

Total sediment mass = 0.1927 g

Total runoff volume = 0.01854 m^3

Total phosphorus mass = 0.01025 g

Total DP mass = 0.00534 g

Table E-5. Field data of event A020306V1 (site: A, plot: V1, date: 02/03/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	>37µm (%)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)
1140	0.000E+00	0.0000	0.000E+00	0.000	0.000								
1200	1.033E-05	0.0208	2.144E-04	0.717	0.195								
1260	1.279E-05	0.0231	2.953E-04	0.824	0.243								
1320	3.154E-05	0.0360	1.136E-03	1.200	0.290								
1380	6.534E-05	0.0516	3.372E-03	1.645	0.335								
1440	8.994E-05	0.0604	5.433E-03	1.894	0.356								
1500	8.758E-05	0.0596	5.222E-03	1.872	0.354	26.42	34.87	1.34	2.84	60.95	25.85	8.49	0.53
1560	6.451E-05	0.0513	3.308E-03	1.635	0.334								
1620	5.447E-05	0.0472	2.569E-03	1.519	0.323								
1680	4.806E-05	0.0443	2.131E-03	1.438	0.315								
1740	4.827E-05	0.0444	2.145E-03	1.441	0.315								
1800	4.315E-05	0.0420	1.814E-03	1.373	0.309								
1860	3.674E-05	0.0388	1.427E-03	1.281	0.299								
1920	2.943E-05	0.0348	1.025E-03	1.165	0.286								
1980	3.024E-05	0.0353	1.067E-03	1.179	0.288								
2040	2.852E-05	0.0343	9.779E-04	1.150	0.285								
2100	3.290E-05	0.0368	1.210E-03	1.222	0.293								
2160	2.618E-05	0.0329	8.604E-04	1.109	0.280								
2220	2.489E-05	0.0321	7.980E-04	1.086	0.277								
2280	2.247E-05	0.0305	6.847E-04	1.040	0.272								
2340	1.653E-05	0.0262	4.331E-04	0.916	0.256								
2400	1.034E-05	0.0208	2.149E-04	0.756	0.234								
2460	8.613E-06	0.0190	1.636E-04	0.703	0.225								
2520	5.557E-06	0.0153	8.501E-05	0.591	0.207								
2580	5.009E-06	0.0145	7.280E-05	0.567	0.203								
2640	3.880E-06	0.0128	4.971E-05	0.514	0.193								
2700	2.750E-06	0.0108	2.974E-05	0.451	0.180								
2760	1.621E-06	0.0083	1.351E-05	0.371	0.163								
2820	0.000E+00	0.0000	0.000E+00	0.000	0.000								

Number of field samples = 3
Total sediment mass = 2.2051 g
Total runoff volume = 0.0505 m^3
Total phosphorus mass = 0.0715 g
Total DP mass = 0.0156 g

Table E-6. Field data of event A020306V4 (site: A, plot: V4, date: 02/03/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	>37μm (%)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)
1140	0.000E+00	0.0000	0.000E+00	0.000	0.000								
1200	2.775E-06	0.0136	3.775E-05	0.504	0.163								
1260	3.018E-05	0.0371	1.120E-03	1.210	0.277								
1320	5.020E-05	0.0459	2.306E-03	1.467	0.311								
1380	6.152E-05	0.0500	3.078E-03	1.586	0.325								
1440	8.259E-05	0.0566	4.677E-03	1.775	0.347								
1500	8.118E-05	0.0562	4.564E-03	1.764	0.346								
1560	5.981E-05	0.0494	2.957E-03	1.569	0.323								
1620	5.126E-05	0.0463	2.376E-03	1.479	0.312								
1680	2.873E-05	0.0363	1.044E-03	1.187	0.274	14.95	23.04	1.57	4.29	71.10	3.80	13.06	6.17
1740	1.170E-05	0.0249	2.916E-04	0.850	0.225								
1800	1.159E-05	0.0248	2.877E-04	0.847	0.224								
1860	1.148E-05	0.0247	2.838E-04	0.844	0.224								
1920	1.137E-05	0.0246	2.799E-04	0.841	0.223								
1980	1.126E-05	0.0245	2.760E-04	0.838	0.223								
2040	1.115E-05	0.0244	2.722E-04	0.834	0.222								
2100	1.229E-05	0.0254	3.123E-04	0.865	0.227								
2160	2.996E-05	0.0370	1.108E-03	1.206	0.277								
2220	5.490E-05	0.0477	2.618E-03	1.518	0.317								
2280	5.472E-05	0.0476	2.606E-03	1.516	0.317								
2340	6.259E-05	0.0504	3.154E-03	1.596	0.326								
2400	4.900E-05	0.0455	2.228E-03	1.454	0.309								
2460	3.845E-05	0.0411	1.579E-03	1.326	0.293								
2520	3.777E-05	0.0408	1.540E-03	1.317	0.292								
2580	3.476E-05	0.0394	1.368E-03	1.276	0.286								
2640	1.900E-05	0.0305	5.802E-04	1.017	0.250								
2700	1.037E-05	0.0237	2.454E-04	0.812	0.219								
2760	6.775E-06	0.0198	1.341E-04	0.695	0.199								
2820	5.420E-06	0.0180	9.768E-05	0.641	0.189								
2880	4.064E-06	0.0160	6.490E-05	0.578	0.178								
2940	2.708E-06	0.0135	3.647E-05	0.500	0.162								
3000	1.353E-06	0.0101	1.361E-05	0.391	0.139								
3060	2.712E-07	0.0051	1.388E-06	0.225	0.097								
3120	0.000E+00	0.0000	0.000E+00	0.000	0.000								

Number of field samples = 3
Total sediment mass = 2.4853 g
Total runoff volume = 0.0560 m^3
Total phosphorus mass = 0.0795 g
Total DP mass = 0.0170 g

Table E-7. Field data of event A061306S2 (site: A, plot: S2, date: 06/13/06)

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	660	4.886E-07	0.000	8.529E-10	0.000	0.000									
300	6.667E-07	720	3.606E-06	0.001	2.801E-06	0.116	0.295									
900	4.167E-06	780	3.392E-06	0.001	2.370E-06	0.110	0.294									
1500	8.000E-06	840	3.435E-06	0.001	2.452E-06	0.111	0.294									
2100	2.217E-05	900	3.392E-06	0.001	2.370E-06	0.110	0.294									
2700	1.250E-05	960	3.563E-06	0.001	2.711E-06	0.114	0.294									
3300	3.167E-06	1020	3.734E-06	0.001	3.082E-06	0.119	0.295									
3900	3.667E-06	1080	4.446E-06	0.001	4.969E-06	0.138	0.298									
4500	2.000E-06	1140	4.617E-06	0.001	5.509E-06	0.142	0.299									
4800	3.333E-07	1200	4.261E-06	0.001	4.423E-06	0.133	0.298									
4860	0.000E+00	1260	4.261E-06	0.001	4.423E-06	0.133	0.298									
		1320	4.617E-06	0.001	5.509E-06	0.142	0.299									
		1380	5.159E-06	0.001	7.462E-06	0.156	0.301									
		1440	6.412E-06	0.002	1.353E-05	0.188	0.305									
		1500	6.925E-06	0.002	1.670E-05	0.200	0.306									
		1560	7.210E-06	0.003	1.865E-05	0.207	0.307									
		1620	2.809E-04	0.108	3.030E-02	4.516	0.379									
		1680	6.313E-04	0.440	2.777E-01	8.927	0.397	384.4	1.09	1.10	2.00	2.39	21.77	71.65	5.82	0.032
		1740	4.828E-04	0.276	1.333E-01	7.124	0.391									
		1800	6.712E-04	0.489	3.283E-01	9.399	0.398								6.20	0.021
		1860	7.017E-04	0.528	3.708E-01	9.757	0.399								6.13	0.017
		1920	6.668E-04	0.484	3.226E-01	9.348	0.398									
		1980	6.008E-04	0.404	2.425E-01	8.563	0.396									
		2040	4.042E-04	0.203	8.199E-02	6.134	0.387									
		2100	2.170E-04	0.069	1.495E-02	3.634	0.373									
		2160	8.461E-05	0.013	1.136E-03	1.645	0.354									
		2220	2.090E-04	0.065	1.349E-02	3.521	0.372									
		2280	3.587E-04	0.165	5.913E-02	5.547	0.384									
		2340	4.835E-04	0.277	1.339E-01	7.132	0.391								5.89	0.024
		2400	4.042E-04	0.203	8.199E-02	6.134	0.387									
		2460	4.493E-04	0.244	1.095E-01	6.705	0.389									
		2520	1.512E-04	0.037	5.567E-03	2.682	0.366	368.8	0.53	0.76	3.06	3.66	23.09	68.90	6.00	0.029
		2580	5.322E-05	0.006	3.196E-04	1.114	0.344									
		2640	3.223E-05	0.003	8.099E-05	0.730	0.334									
		2700	2.418E-05	0.002	3.690E-05	0.573	0.329									
		2760	1.838E-05	0.001	1.742E-05	0.455	0.324									
		2820	1.913E-05	0.001	1.945E-05	0.471	0.324									
		2880	1.913E-05	0.001	1.945E-05	0.471	0.324									
		2940	2.042E-05	0.001	2.323E-05	0.497	0.326									
		3000	1.965E-05	0.001	2.091E-05	0.481	0.325									
		3060	1.939E-05	0.001	2.017E-05	0.476	0.325									
		3120	1.913E-05	0.001	1.945E-05	0.471	0.324									

Table E-7. Continued.

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
		3180	1.814E-05	0.001	1.680E-05	0.450	0.323									
		3240	1.715E-05	0.001	1.443E-05	0.429	0.322									
		3300	1.667E-05	0.001	1.334E-05	0.419	0.322									
		3360	1.596E-05	0.001	1.184E-05	0.404	0.321									
		3420	1.573E-05	0.001	1.138E-05	0.399	0.321									
		3480	1.549E-05	0.001	1.091E-05	0.394	0.321									
		3540	1.537E-05	0.001	1.069E-05	0.392	0.320									
		3600	1.526E-05	0.001	1.047E-05	0.389	0.320									
		3660	1.389E-05	0.001	8.101E-06	0.360	0.319									
		3720	1.252E-05	0.000	6.100E-06	0.330	0.317									
		3780	1.116E-05	0.000	4.446E-06	0.299	0.315									
		3840	9.789E-06	0.000	3.108E-06	0.268	0.312									
		3900	8.848E-06	0.000	2.358E-06	0.246	0.310									
		3960	7.908E-06	0.000	1.734E-06	0.224	0.308									
		4020	6.968E-06	0.000	1.226E-06	0.201	0.306									
		4080	6.170E-06	0.000	8.793E-07	0.182	0.304									
		4140	5.372E-06	0.000	6.020E-07	0.162	0.302									
		4200	4.932E-06	0.000	4.765E-07	0.150	0.300									
		4260	4.492E-06	0.000	3.689E-07	0.139	0.298									
		4320	4.052E-06	0.000	2.782E-07	0.127	0.297									
		4380	3.611E-06	0.000	2.031E-07	0.116	0.295									
		4440	3.171E-06	0.000	1.423E-07	0.104	0.293									
		4500	2.731E-06	0.000	9.455E-08	0.091	0.290									
		4560	2.291E-06	0.000	5.845E-08	0.079	0.287									
		4620	1.241E-06	0.000	1.091E-08	0.047	0.277									
		4680	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 9
Total sediment mass = 132.4836 g
Total runoff volume = 0.4410 m^3
Total phosphorus mass = 3.0363 g
Total DP mass = 0.1699 g

Table E-8. Field data of event A061306V2 (site: A, plot: V2, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
300	0.000E+00	0.000	0.000E+00	0.000	0.000									
360	3.775E-06	0.006	2.168E-05	0.328	0.200									
420	4.132E-06	0.006	2.427E-05	0.333	0.203									
480	4.392E-06	0.006	2.619E-05	0.337	0.204									
540	4.474E-06	0.006	2.680E-05	0.338	0.205									
600	4.844E-06	0.006	2.960E-05	0.343	0.207									
660	5.749E-06	0.006	3.664E-05	0.353	0.212									
720	6.653E-06	0.007	4.397E-05	0.363	0.216									
780	7.558E-06	0.007	5.156E-05	0.371	0.220									
840	8.462E-06	0.007	5.937E-05	0.379	0.223	25.36	0.98	2.94	60.26	12.35	17.69	5.79	5.77	0.034
900	9.367E-06	0.007	6.739E-05	0.386	0.226									
960	1.027E-05	0.007	7.561E-05	0.392	0.229									
1020	1.118E-05	0.008	8.400E-05	0.398	0.231									
1080	1.208E-05	0.008	9.257E-05	0.404	0.234									
1140	1.298E-05	0.008	1.013E-04	0.409	0.236									
1200	1.389E-05	0.008	1.102E-04	0.414	0.238									
1260	1.479E-05	0.008	1.192E-04	0.419	0.240									
1320	1.570E-05	0.008	1.284E-04	0.424	0.242									
1380	1.660E-05	0.008	1.377E-04	0.428	0.243									
1440	1.751E-05	0.008	1.471E-04	0.432	0.245									
1500	2.001E-05	0.009	1.738E-04	0.443	0.250								6.12	0.024
1560	2.038E-05	0.009	1.779E-04	0.444	0.250									
1620	2.134E-05	0.009	1.884E-04	0.448	0.252									
1680	2.178E-05	0.009	1.932E-04	0.450	0.252									
1740	2.243E-05	0.009	2.004E-04	0.452	0.253									
1800	2.303E-05	0.009	2.071E-04	0.455	0.254									
1860	2.345E-05	0.009	2.119E-04	0.456	0.255									
1920	2.388E-05	0.009	2.167E-04	0.458	0.255									
1980	3.116E-05	0.010	3.020E-04	0.481	0.264									
2040	6.015E-05	0.011	6.864E-04	0.543	0.288									
2100	5.502E-05	0.011	6.142E-04	0.534	0.285									
2160	4.402E-05	0.011	4.649E-04	0.512	0.277	14.52	2.85	4.51	81.89	10.59	0.16	0.00	5.89	0.019
2220	3.941E-05	0.010	4.049E-04	0.502	0.273									
2280	3.934E-05	0.010	4.041E-04	0.502	0.273									
2340	4.199E-05	0.010	4.382E-04	0.508	0.275									
2400	5.161E-05	0.011	5.669E-04	0.528	0.283									
2460	5.302E-05	0.011	5.864E-04	0.530	0.284									
2520	4.631E-05	0.011	4.952E-04	0.517	0.279									
2580	3.733E-05	0.010	3.785E-04	0.497	0.271									
2640	3.881E-05	0.010	3.972E-04	0.500	0.272									
2700	2.565E-05	0.009	2.369E-04	0.464	0.258									
2760	2.713E-05	0.009	2.541E-04	0.468	0.260									
2820	2.565E-05	0.009	2.369E-04	0.464	0.258									

Table E-8. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
2880	2.570E-05	0.009	2.375E-04	0.464	0.258									
2940	2.585E-05	0.009	2.393E-04	0.464	0.258									
3000	2.570E-05	0.009	2.375E-04	0.464	0.258									
3060	2.684E-05	0.009	2.507E-04	0.468	0.259									
3120	9.421E-06	0.007	6.788E-05	0.386	0.226									
3180	8.777E-06	0.007	6.214E-05	0.381	0.224									
3240	8.818E-06	0.007	6.250E-05	0.382	0.224									
3300	8.421E-06	0.007	5.901E-05	0.379	0.223									
3360	8.229E-06	0.007	5.734E-05	0.377	0.222									
3420	7.983E-06	0.007	5.520E-05	0.375	0.221									
3480	7.640E-06	0.007	5.226E-05	0.372	0.220									
3540	7.640E-06	0.007	5.226E-05	0.372	0.220									
3600	7.448E-06	0.007	5.063E-05	0.370	0.219									
3660	7.681E-06	0.007	5.261E-05	0.372	0.220									
3720	7.887E-06	0.007	5.437E-05	0.374	0.221									
3780	8.476E-06	0.007	5.949E-05	0.379	0.223									
3840	9.024E-06	0.007	6.433E-05	0.383	0.225									
3900	6.648E-06	0.007	4.393E-05	0.363	0.216									
3960	6.717E-06	0.007	4.450E-05	0.363	0.216									
4020	5.867E-06	0.006	3.759E-05	0.355	0.212									
4080	5.017E-06	0.006	3.092E-05	0.345	0.208									
4140	4.167E-06	0.006	2.453E-05	0.334	0.203									
4200	3.318E-06	0.006	1.845E-05	0.321	0.197									
4260	2.468E-06	0.005	1.275E-05	0.304	0.190									
4320	1.618E-06	0.005	7.529E-06	0.282	0.179									
4380	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 0.6813 g
Total runoff volume = 0.0735 m^3
Total phosphorus mass = 0.0341 g
Total DP mass = 0.0189 g

Table E-9. Field data of event A061306S3 (site: A, plot: S3, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
360	3.697E-0	0.000	6.568E-05	0.000	0.000									
420	3.922E-0	0.063	2.477E-04	1.647	0.230									
480	4.048E-0	0.064	2.580E-04	1.661	0.231									
540	4.497E-0	0.066	2.956E-04	1.709	0.234									
600	6.741E-0	0.074	4.991E-04	1.909	0.246									
660	1.032E-0	0.084	8.658E-04	2.147	0.259								6.21	0.030
720	1.294E-0	0.090	1.161E-03	2.285	0.267									
780	1.015E-0	0.084	8.475E-04	2.137	0.259									
840	9.547E-0	0.082	7.829E-04	2.101	0.257								6.02	0.028
900	1.228E-0	0.088	1.085E-03	2.252	0.265									
960	1.141E-0	0.086	9.863E-04	2.207	0.263									
1020	1.068E-0	0.085	9.055E-04	2.167	0.261									
1080	1.457E-0	0.093	1.353E-03	2.361	0.271	348.8	0.63	0.86	4.39	5.50	23.50	65.12	5.98	0.026
1140	1.371E-0	0.091	1.251E-03	2.322	0.269									
1200	1.164E-0	0.087	1.012E-03	2.219	0.263									
1260	1.042E-0	0.084	8.764E-04	2.152	0.260									
1320	1.405E-0	0.092	1.291E-03	2.337	0.270									
1380	1.674E-0	0.097	1.619E-03	2.454	0.275									
1440	2.233E-0	0.105	2.350E-03	2.658	0.285									
1500	2.941E-0	0.114	3.357E-03	2.870	0.295									
1560	7.011E-0	0.147	1.033E-02	3.660	0.329									
1620	4.612E-0	0.256	1.182E-01	6.238	0.415									
1680	8.955E-0	0.311	2.789E-01	7.539	0.451									
1740	7.828E-0	0.299	2.343E-01	7.255	0.444	321.3	0.73	0.98	5.91	7.41	24.23	60.74	5.94	0.024
1800	9.670E-0	0.319	3.080E-01	7.707	0.455									
1860	1.110E-0	0.332	3.682E-01	8.018	0.463									
1920	1.018E-0	0.323	3.290E-01	7.821	0.458									
1980	9.613E-0	0.318	3.057E-01	7.694	0.455									
2040	8.050E-0	0.302	2.429E-01	7.313	0.445									
2100	5.073E-0	0.264	1.337E-01	6.410	0.420									
2160	3.833E-0	0.243	9.303E-02	5.918	0.406									
2220	5.617E-0	0.272	1.525E-01	6.598	0.426									
2280	6.298E-0	0.281	1.769E-01	6.818	0.432									
2340	7.188E-0	0.292	2.098E-01	7.080	0.439									
2400	6.910E-0	0.289	1.994E-01	7.001	0.437									
2460	5.310E-0	0.267	1.418E-01	6.494	0.423									
2520	2.849E-0	0.222	6.337E-02	5.439	0.391									
2580	7.836E-0	0.152	1.193E-02	3.776	0.334									
2640	2.843E-0	0.113	3.212E-03	2.843	0.294									
2700	2.754E-0	0.112	3.084E-03	2.818	0.293									
2760	2.645E-0	0.111	2.926E-03	2.786	0.292									
2820	3.088E-0	0.116	3.576E-03	2.909	0.297									
2880	2.874E-0	0.113	3.258E-03	2.851	0.295									
2940	3.642E-0	0.122	4.427E-03	3.046	0.303									
3000	2.725E-0	0.112	3.041E-03	2.809	0.293									

Table E-9. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3060	3.119E-05	0.116	3.622E-03	2.917	0.298									
3120	2.813E-05	0.113	3.169E-03	2.834	0.294									
3180	2.551E-05	0.109	2.792E-03	2.758	0.290									
3240	2.495E-05	0.109	2.713E-03	2.741	0.289									
3300	2.488E-05	0.109	2.703E-03	2.739	0.289									
3360	2.516E-05	0.109	2.743E-03	2.748	0.290									
3420	2.495E-05	0.109	2.713E-03	2.741	0.289									
3480	2.467E-05	0.108	2.674E-03	2.733	0.289									
3540	2.460E-05	0.108	2.664E-03	2.730	0.289									
3600	2.439E-05	0.108	2.635E-03	2.724	0.289									
3660	2.439E-05	0.108	2.635E-03	2.724	0.289									
3720	2.622E-05	0.110	2.894E-03	2.780	0.291									
3780	3.026E-05	0.115	3.484E-03	2.893	0.296									
3840	3.433E-05	0.119	4.101E-03	2.996	0.301									
3900	6.338E-05	0.143	9.064E-03	3.557	0.325									
3960	7.066E-05	0.148	1.043E-02	3.668	0.329									
4020	3.151E-05	0.116	3.671E-03	2.926	0.298									
4080	2.747E-05	0.112	3.074E-03	2.816	0.293									
4140	2.343E-05	0.107	2.502E-03	2.694	0.287									
4200	1.939E-05	0.101	1.959E-03	2.556	0.281									
4260	1.535E-05	0.094	1.448E-03	2.396	0.273									
4320	1.131E-05	0.086	9.754E-04	2.202	0.262									
4380	7.274E-06	0.076	5.508E-04	1.950	0.248									
4440	2.355E-06	0.000	1.280E-04	1.434	0.216									
4500	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples =	10	
Total sediment mass =	209.8747	g
Total runoff volume =	0.7523	m^3
Total phosphorus mass =	5.0952	g
Total DP mass =	0.3214	g

Table E-10. Field data of event A061306V3 (site: A, plot: V3, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
660	3.010E-06	0.000	8.660E-09	0.000	0.000									
720	3.178E-06	0.000	9.852E-09	0.402	0.399									
780	3.178E-06	0.000	9.852E-09	0.402	0.399									
840	3.221E-06	0.000	1.016E-08	0.402	0.399									
900	3.221E-06	0.000	1.016E-08	0.402	0.399									
960	3.361E-06	0.000	1.124E-08	0.401	0.398									
1020	3.529E-06	0.000	1.263E-08	0.400	0.397									
1080	3.880E-06	0.000	1.580E-08	0.398	0.395									
1140	4.048E-06	0.000	1.748E-08	0.397	0.394									
1200	4.048E-06	0.000	1.748E-08	0.397	0.394									
1260	4.048E-06	0.000	1.748E-08	0.397	0.394									
1320	4.230E-06	0.000	1.940E-08	0.396	0.393									
1380	4.623E-06	0.000	2.394E-08	0.394	0.391									
1440	5.128E-06	0.000	3.061E-08	0.392	0.389									
1500	5.128E-06	0.000	3.061E-08	0.392	0.389									
1560	5.479E-06	0.000	3.580E-08	0.391	0.388								6.13	0.021
1620	5.479E-06	0.000	3.580E-08	0.391	0.388									
1680	5.297E-06	0.000	3.304E-08	0.391	0.388									
1740	5.297E-06	0.000	3.304E-08	0.391	0.388									
1800	5.479E-06	0.000	3.580E-08	0.391	0.388									
1860	4.240E-04	0.003	1.071E-03	0.383	0.306									
1920	7.253E-04	0.005	3.824E-03	0.448	0.297	21.56	2.64	4.04	74.26	17.46	1.59	0.00	5.82	0.016
1980	8.917E-04	0.007	6.237E-03	0.491	0.293									
2040	7.592E-04	0.006	4.260E-03	0.457	0.296								5.83	0.021
2100	6.077E-04	0.004	2.514E-03	0.421	0.300									
2160	4.942E-04	0.003	1.540E-03	0.397	0.303									
2220	3.741E-04	0.002	7.964E-04	0.375	0.308									
2280	2.969E-04	0.002	4.606E-04	0.363	0.312								6.04	0.019
2340	2.628E-04	0.001	3.449E-04	0.358	0.314									
2400	2.536E-04	0.001	3.170E-04	0.357	0.314								5.59	0.018
2460	2.819E-04	0.001	4.070E-04	0.361	0.312									
2520	2.913E-04	0.002	4.399E-04	0.362	0.312									
2580	2.486E-04	0.001	3.023E-04	0.356	0.315	24.49	2.84	4.00	63.92	23.69	5.56	0.00	5.81	0.023
2640	1.498E-04	0.001	9.095E-05	0.348	0.323									
2700	7.816E-05	0.000	1.948E-05	0.349	0.335									
2760	4.291E-05	0.000	4.702E-06	0.355	0.346									
2820	2.820E-05	0.000	1.739E-06	0.361	0.354									
2880	1.914E-05	0.000	6.941E-07	0.367	0.362									
2940	1.217E-05	0.000	2.373E-07	0.375	0.371									
3000	8.340E-06	0.000	9.692E-08	0.383	0.379									
3060	5.759E-06	0.000	4.030E-08	0.390	0.387									
3120	4.399E-06	0.000	2.128E-08	0.395	0.392									
3180	1.030E-06	0.000	6.812E-10	0.427	0.425									
3240	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 13
Total sediment mass = 1.3580 g
Total runoff volume = 0.3806 m^3
Total phosphorus mass = 0.1565 g
Total DP mass = 0.1164 g

Table E-11. Field data of event A061306V1 (site: A, plot: V1, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
300	4.351E-06	0.0000	1.045E-05	0.072	0.000									
360	4.927E-06	0.0025	1.232E-05	0.261	0.186									
420	5.379E-06	0.0026	1.383E-05	0.265	0.188									
480	5.708E-06	0.0026	1.496E-05	0.268	0.189									
540	6.078E-06	0.0027	1.626E-05	0.270	0.191									
600	6.681E-06	0.0028	1.842E-05	0.275	0.193									
660	7.064E-06	0.0028	1.983E-05	0.277	0.194									
720	7.448E-06	0.0029	2.127E-05	0.280	0.195									
780	6.818E-06	0.0028	1.892E-05	0.276	0.193									
840	6.818E-06	0.0028	1.892E-05	0.276	0.193									
900	6.681E-06	0.0028	1.842E-05	0.275	0.193									
960	6.640E-06	0.0028	1.827E-05	0.274	0.193									
1020	6.873E-06	0.0028	1.913E-05	0.276	0.193									
1080	7.064E-06	0.0028	1.983E-05	0.277	0.194									
1140	7.256E-06	0.0028	2.055E-05	0.278	0.195									
1200	7.640E-06	0.0029	2.200E-05	0.281	0.196									
1260	7.585E-06	0.0029	2.179E-05	0.280	0.196									
1320	7.681E-06	0.0029	2.215E-05	0.281	0.196									
1380	6.681E-06	0.0028	1.842E-05	0.275	0.193									
1440	6.735E-06	0.0028	1.862E-05	0.275	0.193									
1500	6.873E-06	0.0028	1.913E-05	0.276	0.193									
1560	6.914E-06	0.0028	1.928E-05	0.276	0.194									
1620	6.955E-06	0.0028	1.943E-05	0.276	0.194									
1680	6.996E-06	0.0028	1.958E-05	0.277	0.194									
1740	7.051E-06	0.0028	1.978E-05	0.277	0.194									
1800	7.078E-06	0.0028	1.989E-05	0.277	0.194									
1860	3.337E-04	0.0097	3.236E-03	0.549	0.303									
1920	5.447E-04	0.0114	6.183E-03	0.603	0.321									
1980	4.785E-04	0.0109	5.210E-03	0.588	0.316									
2040	4.384E-04	0.0106	4.641E-03	0.578	0.313									
2100	3.997E-04	0.0103	4.108E-03	0.568	0.310	24.69	1.50	2.48	66.10	21.92	7.88	0.13	5.76	0.018
2160	3.621E-04	0.0100	3.605E-03	0.558	0.306									
2220	3.241E-04	0.0096	3.113E-03	0.546	0.302									
2280	2.775E-04	0.0091	2.536E-03	0.530	0.297								5.90	0.015
2340	2.066E-04	0.0083	1.717E-03	0.502	0.287									
2400	1.173E-04	0.0069	8.126E-04	0.452	0.269									
2460	6.331E-05	0.0057	3.598E-04	0.404	0.250									
2520	3.531E-05	0.0047	1.663E-04	0.364	0.234	26.79	1.57	3.30	64.78	30.36	0.00	0.00	5.79	0.021
2580	2.811E-05	0.0044	1.231E-04	0.350	0.228									
2640	2.258E-05	0.0041	9.210E-05	0.337	0.222									
2700	1.842E-05	0.0038	7.041E-05	0.326	0.217									
2760	1.553E-05	0.0036	5.619E-05	0.316	0.213									
2820	1.404E-05	0.0035	4.916E-05	0.311	0.210									
2880	1.255E-05	0.0034	4.237E-05	0.305	0.207									
2940	1.105E-05	0.0032	3.583E-05	0.299	0.204									
3000	9.558E-06	0.0031	2.958E-05	0.291	0.201									

Table E-11. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3060	8.065E-06	0.0029	2.363E-05	0.283	0.197									
3120	6.571E-06	0.0027	1.803E-05	0.274	0.192									
3180	5.077E-06	0.0025	1.282E-05	0.262	0.187									
3240	3.584E-06	0.0023	8.089E-06	0.248	0.179									
3300	2.090E-06	0.0019	3.967E-06	0.228	0.169									
3360	1.564E-06	0.0017	2.703E-06	0.217	0.163									
3420	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples 6
Total sediment mass = 2.2042 g
Total runoff volume = 0.2348 m^3
Total phosphorus mass = 0.1108 g
Total DP mass = 0.0608 g

Table E-12. Field data of event A061306V4 (site: A, plot: V4, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
180	0.000E+00	0.0000	0.000E+00	0.000	0.000									
240	5.708E-06	0.0049	2.806E-05	0.285	0.248									
300	6.872E-06	0.0051	3.498E-05	0.325	0.247									
360	5.571E-06	0.0049	2.727E-05	0.279	0.248									
420	6.872E-06	0.0051	3.498E-05	0.325	0.247									
480	6.585E-06	0.0050	3.325E-05	0.317	0.247									
540	9.627E-06	0.0054	5.216E-05	0.382	0.246									
600	9.833E-06	0.0054	5.349E-05	0.385	0.246									
660	1.108E-05	0.0056	6.162E-05	0.400	0.246									
720	9.421E-06	0.0054	5.084E-05	0.379	0.246									
780	9.216E-06	0.0054	4.953E-05	0.376	0.246									
840	1.172E-05	0.0056	6.589E-05	0.407	0.246									
900	1.237E-05	0.0057	7.021E-05	0.413	0.246									
960	1.024E-05	0.0055	5.615E-05	0.390	0.246									
1020	1.067E-05	0.0055	5.892E-05	0.396	0.246									
1080	1.135E-05	0.0056	6.343E-05	0.403	0.246									
1140	1.087E-05	0.0055	6.027E-05	0.398	0.246									
1200	9.833E-06	0.0054	5.349E-05	0.385	0.246									
1260	1.113E-05	0.0056	6.198E-05	0.401	0.246									
1320	1.204E-05	0.0056	6.800E-05	0.410	0.246									
1380	1.467E-05	0.0059	8.596E-05	0.430	0.245									
1440	1.308E-05	0.0057	7.503E-05	0.419	0.246									
1500	1.237E-05	0.0057	7.021E-05	0.413	0.246									
1560	1.393E-05	0.0058	8.084E-05	0.425	0.245									
1620	1.589E-05	0.0059	9.450E-05	0.437	0.245									
1680	1.292E-05	0.0057	7.391E-05	0.418	0.246									
1740	1.444E-05	0.0058	8.434E-05	0.429	0.245									
1800	1.571E-05	0.0059	9.324E-05	0.436	0.245								5.69	0.013
1860	2.528E-05	0.0065	1.639E-04	0.468	0.244									
1920	2.461E-04	0.0099	2.435E-03	0.511	0.238									
1980	4.542E-04	0.0111	5.036E-03	0.512	0.236									
2040	4.417E-04	0.0110	4.872E-03	0.512	0.236	23.46	2.10	3.59	70.32	21.39	2.60	0.00	5.93	0.021
2100	2.987E-04	0.0103	3.063E-03	0.512	0.237									
2160	1.983E-04	0.0095	1.884E-03	0.510	0.238									
2220	1.164E-04	0.0086	1.002E-03	0.507	0.240									
2280	6.383E-05	0.0077	4.915E-04	0.499	0.241								6.03	0.032
2340	4.270E-05	0.0071	3.051E-04	0.489	0.242									
2400	3.228E-05	0.0068	2.190E-04	0.479	0.243									
2460	2.251E-05	0.0063	1.428E-04	0.462	0.244									
2520	1.793E-05	0.0061	1.091E-04	0.447	0.245									
2580	1.600E-05	0.0060	9.527E-05	0.438	0.245									
2640	1.708E-05	0.0060	1.030E-04	0.443	0.245	12.25	4.87	8.08	57.63	11.23	16.38	1.80	6.09	0.019
2700	1.438E-05	0.0058	8.396E-05	0.428	0.245									
2760	1.460E-05	0.0059	8.548E-05	0.430	0.245									
2820	1.648E-05	0.0060	9.867E-05	0.440	0.245									

Table E-12. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
2880	1.837E-05	0.0061	1.122E-04	0.448	0.245									
2940	2.099E-05	0.0063	1.314E-04	0.457	0.244									
3000	1.830E-05	0.0061	1.117E-04	0.448	0.245									
3060	1.818E-05	0.0061	1.108E-04	0.448	0.245									
3120	1.893E-05	0.0061	1.163E-04	0.451	0.245									
3180	1.589E-05	0.0059	9.450E-05	0.437	0.245									
3240	1.415E-05	0.0058	8.235E-05	0.427	0.245									
3300	1.314E-05	0.0057	7.540E-05	0.419	0.246									
3360	1.415E-05	0.0058	8.235E-05	0.427	0.245									
3420	1.303E-05	0.0057	7.465E-05	0.419	0.246									
3480	1.281E-05	0.0057	7.317E-05	0.417	0.246									
3540	1.237E-05	0.0057	7.021E-05	0.413	0.246									
3600	1.286E-05	0.0057	7.354E-05	0.417	0.246									
3660	1.237E-05	0.0057	7.021E-05	0.413	0.246									
3720	2.059E-05	0.0062	1.285E-04	0.456	0.244									
3780	2.085E-05	0.0063	1.304E-04	0.457	0.244									
3840	2.073E-05	0.0062	1.295E-04	0.457	0.244									
3900	1.830E-05	0.0061	1.117E-04	0.448	0.245									
3960	1.932E-05	0.0062	1.191E-04	0.452	0.245									
4020	1.823E-05	0.0061	1.112E-04	0.448	0.245									
4080	1.715E-05	0.0060	1.035E-04	0.443	0.245									
4140	1.544E-05	0.0059	9.132E-05	0.435	0.245									
4200	1.372E-05	0.0058	7.943E-05	0.424	0.245									
4260	1.201E-05	0.0056	6.781E-05	0.410	0.246									
4320	1.030E-05	0.0055	5.650E-05	0.391	0.246									
4380	8.585E-06	0.0053	4.554E-05	0.365	0.247									
4440	6.872E-06	0.0051	3.498E-05	0.325	0.247									
4500	5.160E-06	0.0048	2.490E-05	0.259	0.248									
4560	3.447E-06	0.0045	1.543E-05	0.249	0.249									
4620	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples = 5

Total sediment mass = 1.4617 g

Total runoff volume = 0.1655 m^3

Total phosphorus mass = 0.0799 g

Total DP mass = 0.0397 g

Table E-13. Field data of event A070706S2 (site: A, plot: S2, date: 07/07/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
0	0.000E+00	660	9.228E-09	0.000	7.087E-11	0.000	0.000									
120	8.333E-07	720	2.327E-05	0.021	4.960E-04	0.994	0.174									
240	8.333E-07	780	2.231E-04	0.210	4.685E-02	4.833	0.437									
360	0.000E+00	840	2.772E-04	0.262	7.250E-02	5.642	0.477									
480	1.667E-06	900	1.995E-04	0.188	3.740E-02	4.463	0.418									
600	2.500E-06	960	1.481E-04	0.139	2.054E-02	3.612	0.370									
720	5.000E-06	1020	1.542E-04	0.145	2.230E-02	3.718	0.376									
840	1.750E-05	1080	2.171E-04	0.204	4.437E-02	4.741	0.432	156.9	6.47	5.62	22.34	9.53	21.73	34.31	6.0	0.023
960	2.167E-05	1140	2.126E-04	0.200	4.253E-02	4.670	0.429									
1080	2.333E-05	1200	1.877E-04	0.176	3.311E-02	4.275	0.407									
1200	2.000E-05	1260	1.988E-04	0.187	3.717E-02	4.453	0.417									
1320	1.917E-05	1320	1.002E-04	0.093	9.357E-03	2.741	0.315								5.9	0.030
1440	2.000E-05	1380	3.520E-05	0.032	1.140E-03	1.321	0.206									
1560	1.750E-05	1440	2.768E-05	0.025	7.029E-04	1.120	0.187									
1680	1.333E-05	1500	2.327E-05	0.021	4.960E-04	0.994	0.174									
1800	1.167E-05	1560	2.165E-05	0.020	4.289E-04	0.946	0.169									
1920	1.167E-05	1620	1.374E-05	0.013	1.718E-04	0.695	0.141									
2040	7.500E-06	1680	1.242E-05	0.011	1.403E-04	0.649	0.135									
2160	2.500E-06	1740	1.084E-05	0.010	1.067E-04	0.593	0.128									
2280	2.500E-06	1800	1.058E-05	0.010	1.015E-04	0.583	0.126									
2400	1.667E-06	1860	1.005E-05	0.009	9.158E-05	0.563	0.124									
2520	8.333E-07	1920	9.406E-06	0.009	8.012E-05	0.539	0.120									
2640	8.333E-07	1980	8.773E-06	0.008	6.964E-05	0.514	0.117									
2760	8.333E-07	2040	8.272E-06	0.007	6.187E-05	0.495	0.114									
2820	0.000E+00	2100	7.521E-06	0.007	5.108E-05	0.464	0.110									
		2160	7.033E-06	0.006	4.464E-05	0.444	0.107									
		2220	6.545E-06	0.006	3.863E-05	0.424	0.104									
		2280	3.184E-06	0.003	9.058E-06	0.265	0.077									
		2340	1.391E-06	0.001	1.711E-06	0.156	0.055									
		2400	9.294E-07	0.001	7.605E-07	0.122	0.047									
		2460	6.921E-07	0.001	4.202E-07	0.102	0.042									
		2520	3.493E-07	0.000	1.062E-07	0.068	0.032									
		2580	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 22.2213 g
Total runoff volume = 0.1297 m^3
Total phosphorus mass = 0.5298 g
Total DP mass = 0.0504 g

Table E-14. Field data of event A070706V2 (site: A, plot: V2, date: 07/07/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
900	0.000E+00	0.000	0.000E+00	0.000	0.000									
960	8.264E-06	0.005	4.063E-05	0.411	0.330									
1020	3.028E-05	0.018	5.438E-04	0.759	0.370									
1080	2.850E-05	0.017	4.819E-04	0.730	0.368									
1140	7.085E-05	0.042	2.972E-03	1.481	0.398								5.90	0.023
1200	9.346E-05	0.055	5.169E-03	1.920	0.408									
1260	1.068E-04	0.063	6.750E-03	2.189	0.413									
1320	6.640E-05	0.039	2.611E-03	1.398	0.396									
1380	5.892E-05	0.035	2.056E-03	1.259	0.392	8.76	5.1	8	78.4	4.21	4.29	0	5.78	0.032
1440	8.688E-05	0.051	4.467E-03	1.790	0.405									
1500	7.549E-05	0.045	3.373E-03	1.570	0.400									
1560	4.593E-05	0.027	1.250E-03	1.026	0.383									
1620	1.561E-05	0.009	1.448E-04	0.524	0.349									
1680	1.613E-05	0.010	1.545E-04	0.532	0.350								6.04	0.026
1740	1.092E-05	0.006	7.086E-05	0.452	0.338									
1800	1.001E-05	0.006	5.963E-05	0.438	0.336									
1860	8.986E-06	0.005	4.803E-05	0.423	0.332									
1920	8.736E-06	0.005	4.540E-05	0.419	0.332									
1980	8.139E-06	0.005	3.941E-05	0.410	0.330									
2040	5.958E-06	0.004	2.114E-05	0.376	0.321									
2100	5.361E-06	0.003	1.712E-05	0.366	0.318									
2160	5.250E-06	0.003	1.641E-05	0.364	0.317									
2220	5.125E-06	0.003	1.564E-05	0.362	0.317									
2280	5.083E-06	0.003	1.539E-05	0.362	0.316									
2340	4.944E-06	0.003	1.456E-05	0.359	0.316									
2400	3.722E-06	0.002	8.257E-06	0.339	0.308									
2460	3.069E-06	0.002	5.617E-06	0.327	0.303									
2520	2.417E-06	0.001	3.484E-06	0.315	0.296									
2580	1.764E-06	0.000	1.857E-06	0.301	0.288									
2640	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 1.8238 g
Total runoff volume = 0.0476 m^3
Total phosphorus mass = 0.0663 g
Total DP mass = 0.0184 g

Table E-15. Field data of event A070706S3 (site: A, plot: S3, date: 07/07/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
840	7.250E-08	0.000	1.016E-06	0.000	0.000									
900	6.980E-06	0.071	4.938E-04	1.283	0.206									
960	7.652E-06	0.073	5.593E-04	1.336	0.211									
1020	4.346E-05	0.135	5.879E-03	2.926	0.322									
1080	3.820E-04	0.292	1.116E-01	7.988	0.549									
1140	4.510E-04	0.310	1.398E-01	8.632	0.572									
1200	2.893E-04	0.265	7.660E-02	7.017	0.513								5.67	0.013
1260	1.785E-04	0.223	3.983E-02	5.607	0.456									
1320	2.213E-04	0.241	5.327E-02	6.195	0.480	167.5	4.73	3.96	19.28	12.99	18.21	40.83	5.96	0.023
1380	3.343E-04	0.279	9.317E-02	7.506	0.531									
1440	3.339E-04	0.279	9.302E-02	7.502	0.531									
1500	2.821E-04	0.262	7.403E-02	6.935	0.510									
1560	2.611E-04	0.255	6.668E-02	6.691	0.500									
1620	9.978E-05	0.182	1.812E-02	4.285	0.395									
1680	4.601E-05	0.138	6.350E-03	3.003	0.327								5.94	0.019
1740	3.110E-05	0.120	3.737E-03	2.512	0.297									
1800	2.145E-05	0.105	2.260E-03	2.123	0.271									
1860	1.249E-05	0.087	1.086E-03	1.663	0.238									
1920	9.379E-06	0.079	7.367E-04	1.463	0.222									
1980	7.204E-06	0.072	5.154E-04	1.301	0.208									
2040	5.359E-06	0.064	3.452E-04	1.141	0.193									
2100	4.765E-06	0.062	2.945E-04	1.083	0.188									
2160	2.590E-06	0.050	1.290E-04	0.829	0.162									
2220	2.221E-06	0.047	1.047E-04	0.775	0.156									
2280	1.668E-06	0.043	7.102E-05	0.684	0.145									
2340	1.298E-06	0.039	5.061E-05	0.614	0.137									
2400	9.426E-07	0.035	3.279E-05	0.536	0.126									
2460	3.230E-07	0.024	7.688E-06	0.341	0.097									
2520	3.230E-07	0.024	7.688E-06	0.341	0.097									
2580	9.887E-08	0.016	1.547E-06	0.210	0.073									
2640	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 47.3265g
Total runoff volume = 0.1823m^3
Total phosphorus mass = 1.2577g
Total DP mass = 0.0917g

Table E-16. Field data of event A070706V3 (site: A, plot: V3, date: 07/07/06).

Time (s)	Q (m^3/s)	Sed. (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
900	0.000E+00	0.000	0.000E+00	0.000	0.000									
960	2.143E-06	0.016	3.444E-05	0.784	0.440									
1020	3.581E-06	0.018	6.553E-05	0.846	0.450									
1080	5.755E-06	0.021	1.187E-04	0.909	0.460									
1140	1.402E-05	0.026	3.622E-04	1.050	0.478									
1200	1.786E-05	0.027	4.907E-04	1.094	0.483									
1260	8.702E-05	0.041	3.569E-03	1.456	0.518									
1320	1.228E-04	0.045	5.494E-03	1.556	0.526									
1380	1.047E-04	0.043	4.502E-03	1.509	0.522									
1440	8.428E-05	0.041	3.429E-03	1.447	0.517									
1500	7.969E-05	0.040	3.197E-03	1.432	0.516	19.96	0.000	2.280	75.520	22.190	0.000	0.000	5.960	0.034
1560	9.686E-05	0.042	4.082E-03	1.486	0.521									
1620	8.986E-05	0.041	3.716E-03	1.465	0.519									
1680	7.248E-05	0.039	2.838E-03	1.407	0.514									
1740	5.400E-05	0.036	1.963E-03	1.332	0.507									
1800	3.743E-05	0.033	1.240E-03	1.246	0.499									
1860	2.546E-05	0.030	7.651E-04	1.163	0.491									
1920	1.799E-05	0.028	4.951E-04	1.096	0.484									
1980	1.394E-05	0.026	3.597E-04	1.049	0.478									
2040	1.033E-05	0.024	2.471E-04	0.998	0.472	15.87	2.430	5.250	82.540	8.770	1.000	0.000	6.03	0.023
2100	7.130E-06	0.022	1.553E-04	0.941	0.464									
2160	4.893E-06	0.020	9.688E-05	0.887	0.457									
2220	3.770E-06	0.019	6.990E-05	0.852	0.451									
2280	2.648E-06	0.017	4.490E-05	0.809	0.445									
2340	1.526E-06	0.015	2.250E-05	0.748	0.434									
2400	4.040E-07	0.011	4.256E-06	0.628	0.409									
2460	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 2.242g
Total runoff volume = $0.058m^3$
Total phosphorus mass = 0.081g
Total DP mass = 0.030g

Table E-17. Field data of event A091006S2 (site: A, plot: S2, date: 09/10/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	1740	6.954E-06	0.000	1.431E-04	0.000	0.000									
60	1.667E-06	1800	1.099E-04	0.261	2.870E-02	7.429	0.511									
180	8.333E-07	1860	6.442E-04	1.329	8.562E-01	33.214	0.543									
300	1.667E-06	1920	5.753E-04	1.198	6.892E-01	30.126	0.541									
420	3.333E-06	1980	2.327E-04	0.521	1.212E-01	13.891	0.524									
540	2.500E-06	2040	6.217E-05	0.155	9.607E-03	4.696	0.500									
660	6.667E-06	2100	3.610E-05	0.094	3.382E-03	3.094	0.491									
780	5.833E-06	2160	3.268E-05	0.085	2.794E-03	2.875	0.489									
900	6.667E-06	2220	3.006E-05	0.079	2.380E-03	2.705	0.488								6.03	0.023
1020	2.500E-06	2280	2.848E-05	0.075	2.145E-03	2.601	0.487									
1140	1.667E-06	2340	2.832E-05	0.075	2.123E-03	2.591	0.487									
1260	1.667E-06	2400	2.848E-05	0.075	2.145E-03	2.601	0.487									
1380	1.667E-06	2460	2.794E-05	0.074	2.068E-03	2.565	0.487									
1500	4.167E-06	2520	2.724E-05	0.072	1.969E-03	2.519	0.486									
1620	1.417E-05	2580	2.694E-05	0.072	1.928E-03	2.499	0.486	145.6	5.03	4.15	20.6	13.46	18.99	37.78	5.85	0.015
1740	2.917E-05	2640	2.694E-05	0.072	1.928E-03	2.499	0.486									
1860	3.500E-05	2700	2.755E-05	0.073	2.013E-03	2.540	0.486									
1980	2.250E-05	2760	2.785E-05	0.074	2.055E-03	2.560	0.487									
2100	1.667E-05	2820	2.755E-05	0.073	2.013E-03	2.540	0.486									
2220	1.500E-05	2880	2.701E-05	0.072	1.938E-03	2.504	0.486									
2340	1.417E-05	2940	2.557E-05	0.068	1.745E-03	2.408	0.485									
2460	1.167E-05	3000	2.543E-05	0.068	1.726E-03	2.399	0.485									
2580	1.083E-05	3060	2.513E-05	0.067	1.687E-03	2.379	0.485									
2700	1.750E-05	3120	2.506E-05	0.067	1.678E-03	2.374	0.485									
2820	1.250E-05	3180	2.483E-05	0.066	1.649E-03	2.359	0.485									
2940	8.333E-06	3240	2.439E-05	0.065	1.593E-03	2.329	0.484									
3060	1.000E-05	3300	2.425E-05	0.065	1.575E-03	2.320	0.484									
3180	8.333E-06	3360	2.418E-05	0.065	1.566E-03	2.315	0.484									
3300	7.500E-06	3420	2.396E-05	0.064	1.540E-03	2.301	0.484									
3420	6.667E-06	3480	1.399E-05	0.039	5.479E-04	1.608	0.475									
3540	4.167E-06	3540	1.392E-05	0.039	5.425E-04	1.603	0.475									
3660	2.500E-06	3600	1.371E-05	0.038	5.266E-04	1.587	0.475									
3780	1.667E-06	3660	1.349E-05	0.038	5.110E-04	1.572	0.474									
3900	8.333E-07	3720	1.057E-05	0.030	3.199E-04	1.356	0.470									
4020	8.333E-07	3780	1.034E-05	0.030	3.068E-04	1.339	0.470									
4140	8.333E-07	3840	1.027E-05	0.029	3.027E-04	1.334	0.470									
4260	8.333E-07	3900	7.068E-06	0.021	1.476E-04	1.086	0.464									
4380	8.333E-07	3960	6.868E-06	0.020	1.397E-04	1.070	0.463									
4440	0.000E+00	4020	6.854E-06	0.020	1.392E-04	1.069	0.463									
		4080	3.862E-06	0.012	4.625E-05	0.820	0.454									
		4140	8.704E-07	0.003	2.645E-06	0.530	0.431									
		4200	8.704E-07	0.003	2.645E-06	0.530	0.431									
		4260	6.710E-07	0.002	1.605E-06	0.506	0.427									
		4320	5.998E-07	0.002	1.294E-06	0.497	0.426									
		4380	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 105.242 g
Total runoff volume = 0.142 m^3
Total phosphorus mass = 2.689 g
Total DP mass = 0.074 g

Table E-18. Field data of event A091006V2 (site: A, plot: V2, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1620	1.314E-05	0.000	1.037E-04	0.000	0.000									
1680	2.470E-05	0.010	2.447E-04	0.550	0.301									
1740	3.172E-05	0.011	3.438E-04	0.584	0.312									
1800	3.538E-05	0.011	3.987E-04	0.600	0.317									
1860	5.075E-05	0.013	6.512E-04	0.656	0.333									
1920	4.357E-05	0.012	5.293E-04	0.632	0.326									
1980	2.988E-05	0.011	3.170E-04	0.576	0.310									
2040	2.470E-05	0.010	2.447E-04	0.550	0.301									
2100	2.973E-05	0.011	3.148E-04	0.575	0.309									
2160	2.594E-05	0.010	2.615E-04	0.556	0.303									
2220	2.143E-05	0.009	2.017E-04	0.531	0.295									
2280	2.266E-05	0.010	2.176E-04	0.539	0.298									
2340	2.022E-05	0.009	1.864E-04	0.524	0.293									
2400	2.246E-05	0.010	2.150E-04	0.537	0.297	13.25	4.31	7.25	73.68	14.55	0.22	0	5.74	0.012
2460	2.115E-05	0.009	1.982E-04	0.530	0.295									
2520	1.969E-05	0.009	1.798E-04	0.521	0.292									
2580	1.911E-05	0.009	1.727E-04	0.517	0.291									
2640	2.022E-05	0.009	1.864E-04	0.524	0.293									
2700	2.102E-05	0.009	1.965E-04	0.529	0.295									
2760	2.280E-05	0.010	2.194E-04	0.539	0.298									
2820	1.956E-05	0.009	1.782E-04	0.520	0.292								5.83	0.025
2880	1.436E-05	0.008	1.170E-04	0.483	0.279									
2940	1.403E-05	0.008	1.134E-04	0.481	0.278									
3000	1.340E-05	0.008	1.065E-04	0.476	0.277									
3060	1.129E-05	0.007	8.439E-05	0.457	0.270									
3120	8.272E-06	0.007	5.531E-05	0.426	0.259									
3180	8.574E-06	0.007	5.807E-05	0.429	0.260									
3240	7.258E-06	0.006	4.630E-05	0.413	0.254									
3300	4.641E-06	0.005	2.521E-05	0.374	0.238									
3360	4.230E-06	0.005	2.222E-05	0.367	0.235									
3420	3.709E-06	0.005	1.859E-05	0.356	0.231									
3480	2.859E-06	0.005	1.305E-05	0.337	0.223									
3540	2.530E-06	0.004	1.105E-05	0.328	0.219									
3600	1.420E-06	0.004	5.043E-06	0.291	0.202									
3660	5.571E-07	0.003	1.413E-06	0.240	0.177									
3720	2.261E-08	0.001	1.814E-08	0.133	0.113									
3780	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 3
Total sediment mass = 0.368g
Total runoff volume = 0.037m^3
Total phosphorus mass = 0.020g
Total DP mass = 0.011g

Table E-19. Field data of event A091006S3 (site: A, plot: S3, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1620	0.000E+00	0.000	0.000E+00	0.000	0.000									
1680	1.029E-05	0.038	3.863E-04	1.436	0.460									
1740	1.254E-05	0.043	5.432E-04	1.586	0.461									
1800	6.685E-05	0.146	9.789E-03	4.233	0.473									
1860	5.581E-04	0.686	3.826E-01	17.927	0.488									
1920	6.648E-04	0.779	5.176E-01	20.283	0.489								5.96	0.023
1980	2.790E-04	0.414	1.155E-01	11.043	0.483									
2040	1.012E-04	0.198	2.004E-02	5.549	0.476									
2100	6.353E-05	0.141	8.964E-03	4.097	0.472									
2160	5.432E-05	0.126	6.840E-03	3.709	0.471									
2220	5.017E-05	0.119	5.961E-03	3.527	0.471									
2280	4.910E-05	0.117	5.743E-03	3.480	0.471									
2340	4.925E-05	0.117	5.774E-03	3.487	0.471	112.6	6.17	5.12	23.19	13.63	14.98	36.91	5.67	0.024
2400	4.925E-05	0.117	5.774E-03	3.487	0.471									
2460	4.800E-05	0.115	5.524E-03	3.431	0.470									
2520	4.800E-05	0.115	5.524E-03	3.431	0.470									
2580	4.770E-05	0.115	5.463E-03	3.418	0.470									
2640	4.879E-05	0.116	5.681E-03	3.466	0.471									
2700	4.971E-05	0.118	5.867E-03	3.507	0.471									
2760	4.986E-05	0.118	5.898E-03	3.514	0.471									
2820	4.739E-05	0.114	5.403E-03	3.404	0.470									
2880	4.678E-05	0.113	5.282E-03	3.376	0.470									
2940	4.739E-05	0.114	5.403E-03	3.404	0.470									
3000	4.739E-05	0.114	5.403E-03	3.404	0.470									
3060	4.678E-05	0.113	5.282E-03	3.376	0.470									
3120	4.678E-05	0.113	5.282E-03	3.376	0.470									
3180	3.663E-05	0.095	3.463E-03	2.905	0.469									
3240	3.645E-05	0.094	3.433E-03	2.896	0.469									
3300	3.645E-05	0.094	3.433E-03	2.896	0.469									
3360	3.683E-05	0.095	3.495E-03	2.914	0.469									
3420	3.606E-05	0.093	3.370E-03	2.877	0.468									
3480	2.783E-05	0.077	2.154E-03	2.465	0.467									
3540	2.745E-05	0.077	2.103E-03	2.445	0.467									
3600	2.715E-05	0.076	2.064E-03	2.430	0.467									
3660	1.951E-05	0.060	1.166E-03	2.011	0.464									
3720	1.921E-05	0.059	1.136E-03	1.994	0.464									
3780	1.903E-05	0.059	1.117E-03	1.984	0.464									
3840	1.875E-05	0.058	1.089E-03	1.967	0.464									
3900	1.308E-05	0.045	5.848E-04	1.622	0.462									
3960	1.289E-05	0.044	5.697E-04	1.609	0.461									
4020	1.279E-05	0.044	5.622E-04	1.603	0.461									
4080	1.251E-05	0.043	5.411E-04	1.585	0.461									
4140	9.577E-06	0.036	3.411E-04	1.386	0.459									
4200	9.212E-06	0.035	3.190E-04	1.361	0.459									
4260	4.106E-07	0.004	1.479E-06	0.536	0.439									
4320	2.283E-07	0.002	5.366E-07	0.499	0.435									
4380	4.595E-08	0.001	3.365E-08	0.445	0.425									
4440	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 70.950 g
Total runoff volume = 0.180 m^3
Total phosphorus mass = 1.894 g
Total DP mass = 0.086 g

Table E-20. Field data of event A091006V3 (site: A, plot: V3, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
1800	0.000E+00	0.000	0.000E+00	0.000	0.000									
1860	1.013E-05	0.015	1.531E-04	0.664	0.286									
1920	2.951E-05	0.034	1.009E-03	1.186	0.331									
1980	4.881E-05	0.050	2.450E-03	1.611	0.354									
2040	5.467E-05	0.055	2.992E-03	1.730	0.360									
2100	4.667E-05	0.049	2.264E-03	1.566	0.352									
2160	5.162E-05	0.052	2.705E-03	1.668	0.357								5.75	0.023
2220	4.696E-05	0.049	2.289E-03	1.572	0.352									
2280	4.044E-05	0.043	1.759E-03	1.434	0.345									
2340	3.510E-05	0.039	1.370E-03	1.315	0.339									
2400	3.292E-05	0.037	1.223E-03	1.266	0.336									
2460	3.093E-05	0.035	1.096E-03	1.220	0.333									
2520	3.184E-05	0.036	1.154E-03	1.241	0.334									
2580	2.682E-05	0.032	8.523E-04	1.122	0.326									
2640	2.467E-05	0.030	7.356E-04	1.069	0.323									
2700	2.545E-05	0.031	7.770E-04	1.088	0.324	24.70	2.89	4.98	58.8	32.4	0.93	0	5.79	0.017
2760	2.809E-05	0.033	9.245E-04	1.152	0.328									
2820	2.969E-05	0.034	1.020E-03	1.191	0.331									
2880	2.749E-05	0.032	8.903E-04	1.138	0.327									
2940	2.451E-05	0.030	7.273E-04	1.065	0.322									
3000	2.069E-05	0.026	5.393E-04	0.967	0.315									
3060	1.912E-05	0.025	4.693E-04	0.926	0.312									
3120	1.597E-05	0.021	3.416E-04	0.839	0.304									
3180	1.502E-05	0.020	3.067E-04	0.812	0.302									
3240	1.233E-05	0.018	2.166E-04	0.733	0.294									
3300	1.003E-05	0.015	1.503E-04	0.661	0.285									
3360	8.588E-06	0.013	1.144E-04	0.613	0.280									
3420	7.007E-06	0.011	7.990E-05	0.557	0.272									
3480	5.016E-06	0.009	4.432E-05	0.481	0.260									
3540	3.658E-06	0.007	2.540E-05	0.423	0.249									
3600	2.485E-06	0.005	1.284E-05	0.365	0.236									
3660	1.562E-06	0.004	5.664E-06	0.312	0.222									
3720	8.239E-07	0.002	1.833E-06	0.259	0.203									
3780	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 1.722g
Total runoff volume = 0.046m^3
Total phosphorus mass = 0.058g
Total DP mass = 0.015g

Table E-21. Field data of event A09106V4 (site: A, plot: V4, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1560	1.389E-05	0.0163	2.266E-04	0.000	0.000									
1620	5.708E-06	0.0049	2.806E-05	0.285	0.248									
1680	6.872E-06	0.0051	3.498E-05	0.325	0.247									
1740	5.571E-06	0.0049	2.727E-05	0.279	0.248									
1800	6.872E-06	0.0051	3.498E-05	0.325	0.247									
1860	6.585E-06	0.0050	3.325E-05	0.317	0.247									
1920	9.627E-06	0.0054	5.216E-05	0.382	0.246									
1980	9.833E-06	0.0054	5.349E-05	0.385	0.246								5.89	0.023
2040	1.108E-05	0.0056	6.162E-05	0.400	0.246									
2100	9.421E-06	0.0054	5.084E-05	0.379	0.246									
2160	9.216E-06	0.0054	4.953E-05	0.376	0.246									
2220	1.172E-05	0.0056	6.589E-05	0.407	0.246									
2280	1.237E-05	0.0057	7.021E-05	0.413	0.246									
2340	1.024E-05	0.0055	5.615E-05	0.390	0.246	21.28	2	4.39	72.18	17.82	3.61	0	5.94	0.032
2400	1.067E-05	0.0055	5.892E-05	0.396	0.246									
2460	1.135E-05	0.0056	6.343E-05	0.403	0.246									
2520	1.087E-05	0.0055	6.027E-05	0.398	0.246									
2580	9.833E-06	0.0054	5.349E-05	0.385	0.246									
2640	1.113E-05	0.0056	6.198E-05	0.401	0.246									
2700	1.204E-05	0.0056	6.800E-05	0.410	0.246									
2760	1.467E-05	0.0059	8.596E-05	0.430	0.245									
2820	1.308E-05	0.0057	7.503E-05	0.419	0.246									
2880	1.237E-05	0.0057	7.021E-05	0.413	0.246									
2940	1.393E-05	0.0058	8.084E-05	0.425	0.245									
3000	1.589E-05	0.0059	9.450E-05	0.437	0.245									
3060	1.292E-05	0.0057	7.391E-05	0.418	0.246									
3120	1.444E-05	0.0058	8.434E-05	0.429	0.245									
3180	1.571E-05	0.0059	9.324E-05	0.436	0.245									
3240	2.528E-05	0.0065	1.639E-04	0.468	0.244									
3300	2.461E-04	0.0099	2.435E-03	0.511	0.238									
3360	4.542E-04	0.0111	5.036E-03	0.512	0.236									
3420	4.417E-04	0.0110	4.872E-03	0.512	0.236									
3480	2.987E-04	0.0103	3.063E-03	0.512	0.237									
3540	1.983E-04	0.0095	1.884E-03	0.510	0.238									
3600	1.164E-04	0.0086	1.002E-03	0.507	0.240									
3660	6.383E-05	0.0077	4.915E-04	0.499	0.241									
3720	4.270E-05	0.0071	3.051E-04	0.489	0.242									
3780	3.228E-05	0.0068	2.190E-04	0.479	0.243									
3840	2.251E-05	0.0063	1.428E-04	0.462	0.244									
3900	1.793E-05	0.0061	1.091E-04	0.447	0.245									
3960	1.600E-05	0.0060	9.527E-05	0.438	0.245									
4020	1.708E-05	0.0060	1.030E-04	0.443	0.245									
4080	1.438E-05	0.0058	8.396E-05	0.428	0.245									
4140	1.460E-05	0.0059	8.548E-05	0.430	0.245									
4200	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 1.3177 g
Total runoff volume = 0.1398 m^3
Total phosphorus mass = 0.0684 g
Total DP mass = 0.0332 g

Table E-22. Field data of event B061306S2 (site: B, plot: S2, date: 06/13/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	900	0.000E+00	0.000	0.000E+00	0.000	0.000									
600	2.167E-06	960	1.899E-05	0.080	1.518E-03	3.252	1.955									
1200	9.333E-06	1020	1.990E-04	0.114	2.265E-02	4.152	1.722									
1800	3.667E-06	1080	9.395E-04	0.144	1.351E-01	4.879	1.584									
2400	5.000E-07	1140	1.005E-03	0.145	1.459E-01	4.913	1.578									
2580	1.667E-07	1200	9.243E-04	0.143	1.326E-01	4.871	1.585									
2640	0.000E+00	1260	7.575E-04	0.139	1.054E-01	4.771	1.602									
		1320	6.580E-04	0.136	8.967E-02	4.702	1.615	248.6	2.66	2.55	14.68	12.13	19.06	48.92	5.75	0.036
		1380	5.875E-04	0.134	7.871E-02	4.647	1.624									
		1440	5.023E-04	0.131	6.573E-02	4.572	1.638									
		1500	4.130E-04	0.127	5.247E-02	4.479	1.656									
		1560	3.716E-04	0.125	4.646E-02	4.430	1.665									
		1620	2.994E-04	0.121	3.624E-02	4.332	1.685									
		1680	2.674E-04	0.119	3.182E-02	4.281	1.695									
		1740	2.618E-04	0.119	3.106E-02	4.272	1.697									
		1800	2.581E-04	0.118	3.055E-02	4.266	1.698									
		1860	2.323E-04	0.117	2.707E-02	4.219	1.708	256.7	2.26	2.27	13.25	12.12	19.41	50.68	5.93	0.018
		1920	2.279E-04	0.116	2.647E-02	4.211	1.710									
		1980	1.914E-04	0.113	2.167E-02	4.135	1.726									
		2040	1.515E-04	0.109	1.655E-02	4.036	1.748									
		2100	1.148E-04	0.105	1.203E-02	3.921	1.774									
		2160	7.517E-05	0.098	7.391E-03	3.752	1.815								5.76	0.032
		2220	5.478E-05	0.094	5.136E-03	3.631	1.846									
		2280	3.825E-05	0.089	3.398E-03	3.497	1.883									
		2340	3.119E-05	0.086	2.686E-03	3.424	1.903									
		2400	2.496E-05	0.083	2.079E-03	3.346	1.927									
		2460	1.987E-05	0.081	1.600E-03	3.267	1.950									
		2520	1.594E-05	0.078	1.241E-03	3.193	1.974									
		2580	1.349E-05	0.076	1.025E-03	3.138	1.992									
		2640	1.150E-05	0.074	8.524E-04	3.086	2.009									
		2700	1.037E-05	0.073	7.571E-04	3.054	2.020									
		2760	8.776E-06	0.071	6.247E-04	3.001	2.038									
		2820	7.365E-06	0.069	5.107E-04	2.947	2.058									
		2880	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 7
Total sediment mass = 68.220 g
Total runoff volume = 0.522 m^3
Total phosphorus mass = 2.380 g
Total DP mass = 0.857 g

Table E-23. Field data of event B061306V2 (site: B, plot: V2, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
420	0.000E+00	0.000	0.000E+00	0.000	0.000									
480	5.663E-07	0.013	7.183E-06	0.050	0.000									
540	2.681E-07	0.010	2.555E-06	0.027	0.000									
600	1.250E-07	0.007	8.893E-07	0.015	0.000									
660	1.250E-07	0.007	8.893E-07	0.015	0.000									
720	2.681E-07	0.010	2.555E-06	0.027	0.000									
780	3.754E-07	0.011	4.069E-06	2.935	2.899									
840	4.470E-07	0.012	5.180E-06	2.880	2.838									
900	1.222E-06	0.017	2.081E-05	2.606	2.513									
960	2.665E-06	0.023	6.117E-05	2.460	2.287									
1020	2.057E-06	0.021	4.276E-05	2.501	2.360									
1080	1.115E-06	0.016	1.833E-05	2.627	2.541									
1140	1.294E-06	0.017	2.252E-05	2.593	2.496									
1200	1.520E-06	0.019	2.815E-05	2.558	2.448									
1260	1.294E-06	0.017	2.252E-05	2.593	2.496									
1320	9.598E-07	0.016	1.490E-05	2.664	2.588									
1380	6.683E-05	0.079	5.266E-03	3.857	1.549	18.91	2.27	4.92	77.25	15.56	0	0	5.78	0.023
1440	5.533E-05	0.073	4.055E-03	3.568	1.584									
1500	4.865E-05	0.070	3.394E-03	3.398	1.609									
1560	3.851E-05	0.064	2.457E-03	3.138	1.655									
1620	2.498E-05	0.054	1.350E-03	2.792	1.744									
1680	1.966E-05	0.049	9.697E-04	2.660	1.796								5.96	0.021
1740	1.557E-05	0.045	7.023E-04	2.563	1.847									
1800	1.113E-05	0.040	4.417E-04	2.471	1.924									
1860	7.531E-06	0.034	2.573E-04	2.416	2.017									
1920	5.861E-06	0.031	1.819E-04	2.406	2.079									
1980	5.265E-06	0.030	1.568E-04	2.406	2.106									
2040	4.335E-06	0.028	1.199E-04	2.413	2.156									
2100	4.001E-06	0.027	1.073E-04	2.418	2.177									
2160	3.595E-06	0.026	9.255E-05	2.426	2.206									
2220	3.273E-06	0.025	8.129E-05	2.435	2.231									
2280	2.498E-06	0.022	5.594E-05	2.470	2.305									
2340	2.224E-06	0.021	4.763E-05	2.488	2.338									
2400	1.584E-06	0.019	2.978E-05	2.550	2.436									
2460	1.226E-06	0.017	2.090E-05	2.605	2.512									
2520	4.000E-07	0.011	4.442E-06	2.915	2.877									
2580	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples =	3	
Total sediment mass =	1.203	g
Total runoff volume =	0.020	m^3
Total phosphorus mass =	0.064	g
Total DP mass =	0.035	g

Table E-24. Field data of event B061306S3 (site: B, plot: S3, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1020	0.000E+00	0.000	0.000E+00	0.000	0.000									
1080	6.767E-06	0.002	1.358E-05	1.465	1.405									
1140	4.725E-05	0.013	5.940E-04	1.799	1.501									
1200	4.509E-04	0.106	4.770E-02	3.541	1.621									
1260	4.311E-04	0.101	4.372E-02	3.469	1.618								5.86	0.020
1320	3.727E-04	0.088	3.294E-02	3.251	1.610									
1380	3.249E-04	0.078	2.523E-02	3.068	1.603									
1440	2.796E-04	0.067	1.884E-02	2.889	1.595									
1500	2.296E-04	0.056	1.285E-02	2.684	1.584									
1560	1.783E-04	0.044	7.859E-03	2.463	1.571									
1620	1.444E-04	0.036	5.210E-03	2.309	1.559	231.3	2.48	2.45	14.68	13.07	19.27	48.04	5.87	0.023
1680	1.248E-04	0.031	3.927E-03	2.216	1.552									
1740	1.166E-04	0.030	3.440E-03	2.176	1.548									
1800	1.062E-04	0.027	2.866E-03	2.125	1.543									
1860	8.350E-05	0.022	1.797E-03	2.007	1.531									
1920	5.933E-05	0.016	9.249E-04	1.873	1.513									
1980	4.032E-05	0.011	4.364E-04	1.755	1.493									
2040	3.141E-05	0.009	2.686E-04	1.693	1.481									
2100	2.576E-05	0.007	1.826E-04	1.651	1.471									
2160	2.120E-05	0.006	1.250E-04	1.615	1.461									
2220	1.754E-05	0.005	8.648E-05	1.583	1.452									
2280	1.588E-05	0.004	7.134E-05	1.568	1.447									
2340	1.497E-05	0.004	6.360E-05	1.559	1.444									
2400	1.404E-05	0.004	5.610E-05	1.550	1.441									
2460	1.310E-05	0.004	4.905E-05	1.540	1.437									
2520	1.083E-05	0.003	3.389E-05	1.516	1.428									
2580	8.562E-06	0.003	2.145E-05	1.489	1.417									
2640	6.292E-06	0.002	1.179E-05	1.458	1.402									
2700	4.743E-06	0.001	6.805E-06	1.433	1.388									
2760	3.195E-06	0.001	3.155E-06	1.402	1.370									
2820	1.646E-06	0.001	8.691E-07	1.358	1.339									
2880	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 12.560 g
Total runoff volume = 0.191 m^3
Total phosphorus mass = 0.540 g
Total DP mass = 0.302 g

Table E-25. Field data of event B061306V3 (site: B, plot: V3, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
480	1.344E-06	0.048	6.451E-05	1.387	0.941									
540	3.644E-06	0.053	1.916E-04	1.827	1.121									
600	3.111E-06	0.052	1.612E-04	1.749	1.090									
660	3.111E-06	0.052	1.612E-04	1.749	1.090									
720	2.929E-06	0.052	1.510E-04	1.720	1.079									
780	3.462E-06	0.052	1.812E-04	1.801	1.111									
840	3.995E-06	0.053	2.118E-04	1.874	1.139									
900	7.263E-06	0.056	4.067E-04	2.210	1.266									
960	9.844E-06	0.058	5.667E-04	2.403	1.335	21.27	2.48	4.86	67.31	13.99	10.61	0.76	5.78	0.034
1020	7.011E-06	0.056	3.913E-04	2.188	1.258									
1080	5.103E-06	0.054	2.767E-04	2.005	1.190									
1140	5.664E-06	0.055	3.100E-04	2.063	1.212									
1200	5.846E-06	0.055	3.209E-04	2.081	1.218									
1260	5.061E-06	0.054	2.742E-04	2.000	1.188									
1320	4.542E-06	0.054	2.437E-04	1.941	1.165									
1380	4.360E-06	0.053	2.330E-04	1.919	1.157								5.76	0.024
1440	4.051E-06	0.053	2.151E-04	1.881	1.142									
1500	3.812E-06	0.053	2.013E-04	1.850	1.130									
1560	3.574E-06	0.052	1.876E-04	1.817	1.117									
1620	2.991E-06	0.052	1.544E-04	1.730	1.083									
1680	2.407E-06	0.051	1.219E-04	1.629	1.042									
1740	1.823E-06	0.049	9.001E-05	1.509	0.992									
1800	1.240E-06	0.048	5.909E-05	1.357	0.927									
1860	6.565E-07	0.045	2.952E-05	1.138	0.829									
1920	7.294E-08	0.037	2.685E-06	0.621	0.563									
1980	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 3
Total sediment mass = 0.312 g
Total runoff volume = 0.006 m^3
Total phosphorus mass = 0.011 g
Total DP mass = 0.007 g

Table E-26. Field data of event B061306V1 (site: B, plot: V1, date: 06/13/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1140	0.000E+00	0.0000	0.000E+00	0.000	0.000									
1200	1.366E-05	0.0133	1.818E-04	1.812	1.078									
1260	1.432E-05	0.0187	2.675E-04	1.840	1.083									
1320	1.439E-05	0.0192	2.766E-04	1.843	1.083									
1380	1.439E-05	0.0192	2.766E-04	1.843	1.083								5.58	0.043
1440	1.448E-05	0.0200	2.893E-04	1.847	1.084									
1500	1.461E-05	0.0209	3.057E-04	1.852	1.085									
1560	1.539E-05	0.0265	4.078E-04	1.884	1.089									
1620	1.908E-05	0.0467	8.905E-04	2.022	1.109									
1680	2.474E-05	0.0660	1.632E-03	2.202	1.134									
1740	2.446E-05	0.0652	1.596E-03	2.193	1.133									
1800	2.292E-05	0.0608	1.393E-03	2.147	1.126									
1860	2.265E-05	0.0600	1.359E-03	2.139	1.125									
1920	2.292E-05	0.0608	1.393E-03	2.147	1.126	18.20	2.24	4.74	79.46	12.81	0.75	0	5.67	0.023
1980	2.265E-05	0.0600	1.359E-03	2.139	1.125									
2040	2.193E-05	0.0576	1.264E-03	2.116	1.122									
2100	2.648E-05	0.0702	1.860E-03	2.251	1.140									
2160	8.380E-05	0.1117	9.363E-03	3.285	1.256									
2220	1.118E-04	0.1165	1.303E-02	3.611	1.287									
2280	9.422E-05	0.1138	1.073E-02	3.414	1.268									
2340	5.939E-05	0.1038	6.167E-03	2.934	1.220									
2400	3.869E-05	0.0894	3.458E-03	2.549	1.177									
2460	2.807E-05	0.0737	2.067E-03	2.295	1.146								5.90	0.032
2520	1.745E-05	0.0388	6.774E-04	1.963	1.101									
2580	1.366E-05	0.0133	1.818E-04	1.812	1.078									
2640	9.878E-06	0.0978	9.656E-04	1.629	1.049									
2700	6.092E-06	0.0772	4.701E-04	1.390	1.008									
2760	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples =	4	
Total sediment mass =	3.7113	g
Total runoff volume =	0.0463	m^3
Total phosphorus mass =	0.1234	g
Total DP mass =	0.0548	g

Table E-27. Field data of event B071406S2 (site: B, plot: S2, date: 07/14/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	600	0.000E+00	0.000	0.000E+00	0.000	0.000									
120	1.667E-06	660	6.312E-06	0.018	1.167E-04	3.305	2.877									
240	1.667E-06	720	5.778E-06	0.017	9.803E-05	3.263	2.870									
360	1.667E-06	780	5.364E-06	0.016	8.471E-05	3.230	2.864									
480	8.333E-07	840	4.659E-06	0.014	6.420E-05	3.173	2.853									
600	1.667E-06	900	8.720E-06	0.025	2.204E-04	3.488	2.902									
720	1.667E-06	960	9.518E-06	0.028	2.618E-04	3.546	2.909									
840	2.500E-06	1020	1.093E-05	0.031	3.436E-04	3.649	2.920									
960	6.667E-06	1080	1.240E-05	0.036	4.403E-04	3.753	2.929									
1080	1.250E-05	1140	1.261E-05	0.036	4.553E-04	3.768	2.931									
1200	1.833E-05	1200	3.307E-05	0.092	3.035E-03	5.135	3.008									
1320	1.500E-05	1260	6.433E-04	1.622	1.044E+00	40.776	3.259									
1440	1.417E-05	1320	1.436E-03	3.530	5.070E+00	84.920	3.331									
1560	1.250E-05	1380	1.388E-03	3.416	4.743E+00	82.289	3.328	185.8	3.15	16.68	13.36	22.65	41.18	41.18	5.84	0.023
1680	1.083E-05	1440	1.141E-03	2.825	3.223E+00	68.613	3.310									
1800	9.167E-06	1500	9.338E-04	2.327	2.173E+00	57.093	3.292									
1920	5.833E-06	1560	8.689E-04	2.170	1.886E+00	53.463	3.286									
2040	4.167E-06	1620	8.417E-04	2.104	1.771E+00	51.940	3.283									
2160	2.500E-06	1680	7.203E-04	1.810	1.304E+00	45.122	3.269									
2280	1.667E-06	1740	6.012E-04	1.520	9.137E-01	38.397	3.253									
2400	2.500E-06	1800	4.415E-04	1.127	4.977E-01	29.299	3.226									
2520	1.667E-06	1860	2.947E-04	0.762	2.246E-01	20.823	3.191									
2640	2.500E-06	1920	2.046E-04	0.535	1.096E-01	15.551	3.160									
2760	4.167E-06	1980	1.542E-04	0.407	6.278E-02	12.560	3.136									
2820	5.833E-06	2040	1.426E-04	0.378	5.383E-02	11.867	3.129	205.6	5.05	16.36	9.07	21.54	42.59	42.59	5.98	0.033
2880	8.333E-06	2100	1.099E-04	0.294	3.227E-02	9.902	3.107									
2940	9.167E-06	2160	1.028E-04	0.275	2.829E-02	9.471	3.102									
3000	8.333E-06	2220	8.134E-05	0.219	1.784E-02	8.160	3.082									
3060	1.000E-05	2280	5.918E-05	0.161	9.539E-03	6.789	3.056									
3120	6.667E-06	2340	6.091E-05	0.166	1.010E-02	6.897	3.058									
3180	5.000E-06	2400	5.938E-05	0.162	9.603E-03	6.801	3.056									
3240	2.500E-06	2460	6.010E-05	0.164	9.836E-03	6.847	3.057									
3300	4.167E-06	2520	4.364E-05	0.120	5.240E-03	5.812	3.031									
3360	1.667E-06	2580	3.405E-05	0.094	3.215E-03	5.198	3.011									
3420	8.333E-07	2640	2.385E-05	0.067	1.596E-03	4.532	2.982									
3480	8.333E-07	2700	1.366E-05	0.039	5.329E-04	3.842	2.937									
3540	0.000E+00	2760	3.141E-05	0.087	2.744E-03	5.028	3.004									
		2820	5.132E-05	0.140	7.208E-03	6.297	3.044									
		2880	6.002E-05	0.163	9.809E-03	6.842	3.057									
		2940	6.872E-05	0.186	1.280E-02	7.382	3.068									
		3000	7.742E-05	0.209	1.619E-02	7.919	3.078									
		3060	8.611E-05	0.232	1.996E-02	8.453	3.087									

Table E-27. Continued.

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
		3120	1.488E-04	0.393	5.854E-02	12.239	3.133									
		3180	2.296E-04	0.599	1.374E-01	17.019	3.170									
		3240	3.975E-04	1.018	4.048E-01	26.771	3.217									
		3300	6.435E-04	1.623	1.044E+00	40.789	3.259									
		3360	7.776E-04	1.949	1.516E+00	48.347	3.276									
		3420	7.491E-04	1.880	1.408E+00	46.744	3.273									
		3480	6.805E-04	1.713	1.166E+00	42.878	3.264									
		3540	4.719E-04	1.202	5.672E-01	31.035	3.232									
		3600	2.978E-04	0.770	2.293E-01	21.005	3.192									
		3660	2.879E-04	0.745	2.145E-01	20.429	3.189									
		3720	5.372E-04	1.363	7.322E-01	34.763	3.243									
		3780	6.990E-04	1.758	1.229E+00	43.921	3.266								5.86	0.026
		3840	8.111E-04	2.030	1.647E+00	50.225	3.280									
		3900	7.143E-04	1.796	1.283E+00	44.787	3.268									
		3960	4.694E-04	1.196	5.614E-01	30.893	3.232									
		4020	2.941E-04	0.761	2.238E-01	20.793	3.191									
		4080	1.917E-04	0.503	9.635E-02	14.787	3.154									
		4140	1.365E-04	0.362	4.938E-02	11.500	3.125									
		4200	7.350E-05	0.199	1.461E-02	7.678	3.074								5.80	0.015
		4260	2.109E-05	0.059	1.252E-03	4.348	2.972									
		4320	2.271E-05	0.064	1.449E-03	4.456	2.978									
		4380	1.748E-05	0.050	8.660E-04	4.105	2.957									
		4440	1.240E-05	0.036	4.403E-04	3.753	2.929									
		4500	3.079E-06	0.009	2.841E-05	3.036	2.821									
		4560	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 10
Total sediment mass = 2151.78 g
Total runoff volume = 1.1780 m^3
Total phosphorus mass = 34.0331 g
Total DP mass = 1.9730 g

Table E-28. Field data of event B071406V2 (site: B, plot: V2, date: 07/14/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
540	2.089E-06	0.000	7.011E-05	0.000	0.000									
600	8.221E-06	0.055	4.561E-04	3.508	2.211									
660	1.041E-05	0.060	6.294E-04	3.675	2.261									
720	1.060E-05	0.061	6.456E-04	3.688	2.265									
780	1.060E-05	0.061	6.456E-04	3.688	2.265									
840	1.045E-05	0.061	6.329E-04	3.677	2.262									
900	1.055E-05	0.061	6.410E-04	3.684	2.264								5.87	0.024
960	1.081E-05	0.061	6.631E-04	3.702	2.269									
1020	1.106E-05	0.062	6.842E-04	3.719	2.274									
1080	1.163E-05	0.063	7.329E-04	3.757	2.285									
1140	1.185E-05	0.063	7.521E-04	3.771	2.289									
1200	1.313E-05	0.066	8.653E-04	3.850	2.312									
1260	1.570E-05	0.070	1.104E-03	3.993	2.351									
1320	1.610E-05	0.071	1.143E-03	4.014	2.357	18.46	2.19	5.43	75.99	14.28	2.11	0	5.98	0.032
1380	1.558E-05	0.070	1.093E-03	3.987	2.350									
1440	1.496E-05	0.069	1.034E-03	3.953	2.341									
1500	1.468E-05	0.069	1.007E-03	3.938	2.336									
1560	5.898E-04	0.266	1.570E-01	9.483	3.326									
1620	4.915E-04	0.249	1.224E-01	9.029	3.268									
1680	3.079E-04	0.210	6.457E-02	7.981	3.125									
1740	2.871E-04	0.204	5.868E-02	7.838	3.105									
1800	2.774E-04	0.202	5.597E-02	7.768	3.094									
1860	1.476E-04	0.160	2.363E-02	6.626	2.913									
1920	6.178E-05	0.116	7.184E-03	5.383	2.681									
1980	3.231E-05	0.092	2.962E-03	4.654	2.520								5.64	0.025
2040	2.208E-05	0.080	1.761E-03	4.288	2.429									
2100	1.698E-05	0.072	1.229E-03	4.058	2.369									
2160	1.473E-05	0.069	1.013E-03	3.941	2.337									
2220	1.323E-05	0.066	8.741E-04	3.856	2.313									
2280	1.259E-05	0.065	8.168E-04	3.817	2.302									
2340	1.242E-05	0.065	8.020E-04	3.807	2.300									
2400	1.201E-05	0.064	7.654E-04	3.781	2.292									
2460	1.132E-05	0.062	7.066E-04	3.737	2.279									
2520	1.075E-05	0.061	6.584E-04	3.699	2.268									
2580	1.018E-05	0.060	6.111E-04	3.659	2.256									
2640	9.794E-06	0.059	5.794E-04	3.631	2.248									
2700	9.738E-06	0.059	5.749E-04	3.627	2.247									
2760	9.585E-06	0.059	5.626E-04	3.615	2.243									
2820	1.030E-05	0.060	6.203E-04	3.667	2.259									
2880	1.132E-05	0.062	7.066E-04	3.737	2.279									
2940	1.286E-05	0.065	8.403E-04	3.833	2.307									
3000	1.383E-05	0.067	9.286E-04	3.891	2.323									

Table E-28. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3060	1.483E-05	0.069	1.022E-03	3.947	2.339									
3120	1.615E-05	0.071	1.148E-03	4.016	2.358									
3180	1.927E-05	0.076	1.462E-03	4.166	2.398									
3240	2.187E-05	0.079	1.738E-03	4.279	2.427									
3300	2.393E-05	0.082	1.965E-03	4.362	2.448									
3360	2.373E-05	0.082	1.942E-03	4.353	2.446									
3420	2.155E-05	0.079	1.703E-03	4.266	2.424									
3480	1.970E-05	0.076	1.506E-03	4.186	2.403									
3540	6.599E-05	0.119	7.861E-03	5.465	2.697									
3600	1.660E-04	0.167	2.775E-02	6.822	2.946									
3660	2.112E-04	0.183	3.856E-02	7.246	3.015									
3720	2.379E-04	0.191	4.537E-02	7.468	3.049									
3780	2.112E-04	0.183	3.856E-02	7.246	3.015									
3840	1.530E-04	0.162	2.482E-02	6.685	2.923									
3900	1.849E-04	0.174	3.216E-02	7.007	2.977									
3960	2.409E-04	0.192	4.616E-02	7.492	3.053									
4020	2.695E-04	0.200	5.382E-02	7.711	3.086	23.28	1.66	3.99	63.98	23.29	6.9	0.18	5.73	0.019
4080	2.602E-04	0.197	5.129E-02	7.642	3.075									
4140	2.324E-04	0.189	4.396E-02	7.424	3.042									
4200	1.448E-04	0.159	2.301E-02	6.594	2.908									
4260	8.510E-05	0.131	1.113E-02	5.801	2.764									
4320	5.173E-05	0.109	5.636E-03	5.168	2.635									
4380	2.403E-05	0.082	1.976E-03	4.365	2.449									
4440	1.472E-05	0.069	1.011E-03	3.941	2.337									
4500	9.376E-06	0.058	5.459E-04	3.600	2.238									
4560	6.189E-06	0.050	3.094E-04	3.322	2.151									
4620	3.921E-06	0.042	1.657E-04	3.052	2.059									
4680	2.362E-06	0.035	8.290E-05	2.788	1.962									
4740	8.587E-07	0.024	2.079E-05	2.355	1.781									
4800	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 8
Total sediment mass = 59.1528 g
Total runoff volume = 0.3207 m^3
Total phosphorus mass = 2.3282 g
Total DP mass = 0.9578 g

Table E-29. Field data of event B071406S3 (site: B, plot: S3, date: 07/14/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
540	0.000E+00	0.000	0.000E+00	0.000	0.000									
600	6.161E-06	0.040	2.454E-04	3.147	2.220									
660	9.531E-06	0.057	5.397E-04	3.540	2.223									
720	9.873E-06	0.058	5.752E-04	3.578	2.224									
780	9.730E-06	0.058	5.603E-04	3.562	2.223									
840	9.331E-06	0.056	5.195E-04	3.517	2.223									
900	9.132E-06	0.055	4.996E-04	3.495	2.223									
960	9.175E-06	0.055	5.038E-04	3.500	2.223									
1020	9.531E-06	0.057	5.397E-04	3.540	2.223									
1080	9.930E-06	0.059	5.812E-04	3.584	2.224									
1140	1.100E-05	0.064	6.991E-04	3.701	2.224									
1200	1.393E-05	0.077	1.072E-03	4.013	2.226									
1260	1.586E-05	0.085	1.354E-03	4.210	2.227									
1320	2.098E-03	4.400	9.232E+00	103.887	2.260									
1380	1.902E-03	4.064	7.728E+00	96.135	2.259									
1440	1.607E-03	3.547	5.699E+00	84.206	2.258									
1500	1.320E-03	3.027	3.995E+00	72.198	2.256									
1560	1.283E-03	2.959	3.797E+00	70.627	2.256									
1620	1.300E-03	2.990	3.887E+00	71.342	2.256	213.0	4.78	5.14	19.43	8.53	16.58	45.53	5.77	0.013
1680	1.062E-03	2.540	2.699E+00	60.964	2.255									
1740	8.935E-04	2.209	1.974E+00	53.318	2.254									
1800	6.227E-04	1.651	1.028E+00	40.419	2.251									
1860	3.983E-04	1.151	4.585E-01	28.876	2.248									
1920	3.311E-04	0.992	3.284E-01	25.191	2.247									
1980	2.561E-04	0.806	2.064E-01	20.895	2.245									
2040	2.012E-04	0.663	1.335E-01	17.601	2.244									
2100	1.220E-04	0.443	5.402E-02	12.499	2.240									
2160	7.717E-05	0.306	2.363E-02	9.332	2.237									
2220	5.089E-05	0.219	1.113E-02	7.307	2.234									
2280	2.079E-05	0.106	2.209E-03	4.695	2.228									
2340	2.104E-05	0.107	2.258E-03	4.719	2.229									
2400	1.830E-05	0.096	1.754E-03	4.454	2.228									
2460	1.386E-05	0.077	1.062E-03	4.006	2.226									
2520	1.396E-05	0.077	1.076E-03	4.016	2.226									
2580	1.590E-05	0.086	1.360E-03	4.214	2.227									
2640	1.783E-05	0.094	1.674E-03	4.408	2.227									
2700	1.827E-05	0.096	1.748E-03	4.450	2.228									
2760	1.902E-05	0.099	1.882E-03	4.524	2.228									
2820	1.978E-05	0.102	2.019E-03	4.598	2.228									
2880	2.054E-05	0.105	2.161E-03	4.671	2.228									
2940	2.129E-05	0.108	2.307E-03	4.744	2.229									
3000	2.458E-05	0.122	2.989E-03	5.052	2.230								5.93	0.018

Table E-29. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µ (%)	100-250µ (%)	>250µm (%)	pH	EC (S/m)
3060	4.562E-05	0.200	9.140E-03	6.879	2.234									
3120	8.102E-05	0.318	2.580E-02	9.616	2.238									
3180	1.038E-04	0.389	4.034E-02	11.245	2.239									
3240	1.461E-04	0.512	7.483E-02	14.104	2.242									
3300	3.522E-04	1.042	3.670E-01	26.358	2.247									
3360	7.023E-04	1.819	1.278E+00	44.309	2.252									
3420	7.413E-04	1.900	1.409E+00	46.182	2.252									
3480	7.717E-04	1.963	1.515E+00	47.626	2.253									
3540	5.668E-04	1.530	8.674E-01	37.635	2.251	298.3	1.13	2.29	9.8	4.16	24.14	58.48	5.73	0.021
3600	3.488E-04	1.034	3.608E-01	26.174	2.247									
3660	3.183E-04	0.961	3.058E-01	24.473	2.247									
3720	4.305E-04	1.226	5.276E-01	30.596	2.249									
3780	4.843E-04	1.348	6.528E-01	33.421	2.250									
3840	6.243E-04	1.654	1.033E+00	40.501	2.251									
3900	6.640E-04	1.739	1.154E+00	42.449	2.252								5.73	0.017
3960	5.168E-04	1.420	7.341E-01	35.096	2.250									
4020	3.042E-04	0.926	2.817E-01	23.672	2.246									
4080	2.225E-04	0.720	1.601E-01	18.898	2.244									
4140	1.223E-04	0.444	5.427E-02	12.520	2.240									
4200	8.352E-05	0.326	2.726E-02	9.800	2.238									
4260	4.014E-05	0.181	7.252E-03	6.423	2.233									
4320	2.686E-05	0.131	3.509E-03	5.262	2.230									
4380	2.270E-05	0.114	2.588E-03	4.876	2.229									
4440	2.028E-05	0.104	2.113E-03	4.647	2.228								5.93	0.024
4500	1.875E-05	0.098	1.833E-03	4.498	2.228									
4560	1.513E-05	0.082	1.245E-03	4.137	2.226									
4620	9.580E-06	0.057	5.448E-04	3.545	2.223									
4680	4.695E-06	0.032	1.502E-04	2.963	2.219									
4740	1.524E-06	0.013	1.966E-05	2.512	2.211									
4800	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 10
Total sediment mass = 3130.923 g
Total runoff volume = 1.3010 m^3
Total phosphorus mass = 75.2857 g
Total DP mass = 2.9309 g

Table E-30. Field data of event B071406V3 (site: B, plot: V3, date: 07/14/06).

Time (s)	Q (m^3/s)	Sed. (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
540	2.089E-06	0.000	6.756E-05	0.000	0.000									
600	6.688E-06	0.046	3.075E-04	3.080	2.011									
660	8.890E-06	0.050	4.455E-04	3.156	1.991									
720	9.087E-06	0.050	4.583E-04	3.162	1.990									
780	9.087E-06	0.050	4.583E-04	3.162	1.990									
840	1.019E-05	0.052	5.324E-04	3.196	1.982									
900	1.029E-05	0.052	5.391E-04	3.199	1.981									
960	1.056E-05	0.053	5.574E-04	3.207	1.979									
1020	1.081E-05	0.053	5.748E-04	3.214	1.978									
1080	1.139E-05	0.054	6.149E-04	3.230	1.974									
1140	1.161E-05	0.054	6.308E-04	3.236	1.973									
1200	1.290E-05	0.056	7.236E-04	3.269	1.966									
1260	1.548E-05	0.059	9.176E-04	3.331	1.953									
1320	3.286E-05	0.074	2.445E-03	3.633	1.902									
1380	1.045E-04	0.106	1.103E-02	4.282	1.827									
1440	3.331E-04	0.150	4.995E-02	5.242	1.754									
1500	6.591E-04	0.184	1.215E-01	6.001	1.713									
1560	7.073E-04	0.188	1.332E-01	6.089	1.709	24.26	2.2	4.23	65.3	26.56	1.71	0	5.93	0.023
1620	5.485E-04	0.174	9.564E-02	5.780	1.724									
1680	4.181E-04	0.161	6.716E-02	5.477	1.740									
1740	3.752E-04	0.155	5.833E-02	5.363	1.747									
1800	3.435E-04	0.151	5.199E-02	5.273	1.752									
1860	1.909E-04	0.127	2.418E-02	4.736	1.789									
1920	8.251E-05	0.098	8.112E-03	4.128	1.842									
1980	4.547E-05	0.082	3.733E-03	3.790	1.881									
2040	3.328E-05	0.075	2.486E-03	3.638	1.901									
2100	2.813E-05	0.071	1.998E-03	3.564	1.913									
2160	2.588E-05	0.069	1.791E-03	3.528	1.918								5.58	0.018
2220	2.436E-05	0.068	1.656E-03	3.503	1.922									
2280	2.372E-05	0.067	1.599E-03	3.492	1.924									
2340	2.355E-05	0.067	1.584E-03	3.489	1.925									
2400	2.313E-05	0.067	1.548E-03	3.482	1.926									
2460	2.244E-05	0.066	1.488E-03	3.470	1.928									
2520	2.187E-05	0.066	1.438E-03	3.459	1.930									
2580	2.129E-05	0.065	1.389E-03	3.449	1.931									
2640	2.090E-05	0.065	1.356E-03	3.441	1.933								5.84	0.024
2700	2.084E-05	0.065	1.351E-03	3.440	1.933									
2760	2.069E-05	0.065	1.338E-03	3.438	1.933									
2820	2.140E-05	0.065	1.399E-03	3.451	1.931									
2880	2.244E-05	0.066	1.488E-03	3.470	1.928									
2940	2.398E-05	0.068	1.623E-03	3.496	1.923									
3000	2.496E-05	0.068	1.710E-03	3.513	1.921									

Table E-30. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3060	2.597E-05	0.069	1.800E-03	3.529	1.918									
3120	2.731E-05	0.070	1.921E-03	3.551	1.915									
3180	3.045E-05	0.073	2.214E-03	3.598	1.907									
3240	3.307E-05	0.075	2.466E-03	3.636	1.902									
3300	3.515E-05	0.076	2.669E-03	3.664	1.898									
3360	3.494E-05	0.076	2.649E-03	3.661	1.898									
3420	3.275E-05	0.074	2.435E-03	3.631	1.902									
3480	3.088E-05	0.073	2.256E-03	3.605	1.906									
3540	8.676E-05	0.100	8.660E-03	4.160	1.839									
3600	1.436E-04	0.116	1.670E-02	4.511	1.807									
3660	1.893E-04	0.126	2.393E-02	4.729	1.789								5.91	0.032
3720	2.162E-04	0.132	2.845E-02	4.841	1.781									
3780	1.762E-04	0.124	2.180E-02	4.670	1.794									
3840	1.526E-04	0.118	1.807E-02	4.557	1.803									
3900	1.848E-04	0.125	2.318E-02	4.709	1.791									
3960	1.974E-04	0.128	2.527E-02	4.764	1.787	27.30	1.67	3.87	58.6	32.51	3.35	0	5.73	0.026
4020	2.482E-04	0.137	3.404E-02	4.963	1.772									
4080	2.169E-04	0.132	2.857E-02	4.844	1.781									
4140	1.977E-04	0.128	2.531E-02	4.765	1.786									
4200	1.443E-04	0.116	1.680E-02	4.514	1.806									
4260	1.060E-04	0.106	1.124E-02	4.292	1.826									
4320	5.052E-05	0.085	4.282E-03	3.845	1.874									
4380	2.823E-05	0.071	2.007E-03	3.565	1.912									
4440	2.025E-05	0.064	1.302E-03	3.429	1.935									
4500	1.346E-05	0.057	7.648E-04	3.283	1.963									
4560	8.848E-06	0.050	4.427E-04	3.155	1.992									
4620	6.562E-06	0.046	2.999E-04	3.075	2.013									
4680	4.991E-06	0.042	2.100E-04	3.010	2.032									
4740	3.476E-06	0.038	1.311E-04	2.935	2.058									
4800	2.059E-06	0.000	6.629E-05	0.000	0.000									
4860	0.00000	0.000	0.00000	0.00	0.00									

Number of field samples = 9
Total sediment mass = 58.276 g
Total runoff volume = 0.4213 m^3
Total phosphorus mass = 2.1054 g
Total DP mass = 0.7501 g

Table E-31. Field data of event B071406V1 (site: B, plot: V1, date: 07/14/06).

Time (s)	Q (m3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
600	0.000E+00	0.0000	0.000E+00	0.000	0.000									
660	6.312E-06	0.0185	1.167E-04	3.305	2.877									
720	5.778E-06	0.0170	9.803E-05	3.263	2.870									
780	5.364E-06	0.0158	8.471E-05	3.230	2.864									
840	4.659E-06	0.0138	6.420E-05	3.173	2.853									
900	8.720E-06	0.0253	2.204E-04	3.488	2.902									
960	9.518E-06	0.0275	2.618E-04	3.546	2.909									
1020	1.093E-05	0.0314	3.436E-04	3.649	2.920									
1080	1.240E-05	0.0355	4.403E-04	3.753	2.929									
1140	1.261E-05	0.0361	4.553E-04	3.768	2.931									
1200	3.307E-05	0.0918	3.035E-03	5.135	3.008									
1260	6.433E-04	1.6224	1.044E+00	40.776	3.259									
1320	1.436E-03	3.5297	5.070E+00	84.920	3.331									
1380	1.388E-03	3.4160	4.743E+00	82.289	3.328	22.08	2.84	5.39	63.6	26.36	1.81	0	5.83	0.031
1440	1.141E-03	2.8248	3.223E+00	68.613	3.310									
1500	9.338E-04	2.3271	2.173E+00	57.093	3.292									
1560	8.689E-04	2.1702	1.886E+00	53.463	3.286									
1620	8.417E-04	2.1045	1.771E+00	51.940	3.283								5.78	0.022
1680	7.203E-04	1.8100	1.304E+00	45.122	3.269									
1740	6.012E-04	1.5197	9.137E-01	38.397	3.253									
1800	4.415E-04	1.1273	4.977E-01	29.299	3.226									
1860	2.947E-04	0.7621	2.246E-01	20.823	3.191									
1920	2.046E-04	0.5355	1.096E-01	15.551	3.160									
1980	1.542E-04	0.4072	6.278E-02	12.560	3.136									
2040	1.426E-04	0.3775	5.383E-02	11.867	3.129								5.83	0.016
2100	1.099E-04	0.2935	3.227E-02	9.902	3.107									
2160	1.028E-04	0.2751	2.829E-02	9.471	3.102									
2220	8.134E-05	0.2193	1.784E-02	8.160	3.082									
2280	5.918E-05	0.1612	9.539E-03	6.789	3.056									
2340	6.091E-05	0.1658	1.010E-02	6.897	3.058									
2400	5.938E-05	0.1617	9.603E-03	6.801	3.056									
2460	6.010E-05	0.1636	9.836E-03	6.847	3.057									
2520	4.364E-05	0.1201	5.240E-03	5.812	3.031									
2580	3.405E-05	0.0944	3.215E-03	5.198	3.011									
2640	2.385E-05	0.0669	1.596E-03	4.532	2.982									
2700	1.366E-05	0.0390	5.329E-04	3.842	2.937									
2760	3.141E-05	0.0873	2.744E-03	5.028	3.004									
2820	5.132E-05	0.1405	7.208E-03	6.297	3.044									
2880	6.002E-05	0.1634	9.809E-03	6.842	3.057									
2940	6.872E-05	0.1863	1.280E-02	7.382	3.068									
3000	7.742E-05	0.2091	1.619E-02	7.919	3.078									
3060	8.611E-05	0.2318	1.996E-02	8.453	3.087									
3120	1.488E-04	0.3935	5.854E-02	12.239	3.133	19.47	2.11	4.76	73.33	15.07	3.71	1.02	5.83	0.019
3180	2.296E-04	0.5986	1.374E-01	17.019	3.170									
3240	3.975E-04	1.0183	4.048E-01	26.771	3.217									
3180	2.296E-04	0.5986	1.374E-01	17.019	3.170									

Table E-31. Continued.

Time (s)	Q (m3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3240	3.975E-04	1.0183	4.048E-01	26.771	3.217									
3300	6.435E-04	1.6230	1.044E+00	40.789	3.259									
3360	7.776E-04	1.9493	1.516E+00	48.347	3.276									
3420	7.491E-04	1.8800	1.408E+00	46.744	3.273									
3480	6.805E-04	1.7131	1.166E+00	42.878	3.264									
3540	4.719E-04	1.2021	5.672E-01	31.035	3.232									
3600	2.978E-04	0.7700	2.293E-01	21.005	3.192									
3660	2.879E-04	0.7452	2.145E-01	20.429	3.189								5.52	0.021
3720	5.372E-04	1.3629	7.322E-01	34.763	3.243									
3780	6.990E-04	1.7582	1.229E+00	43.921	3.266									
3840	8.111E-04	2.0304	1.647E+00	50.225	3.280									
3900	7.143E-04	1.7955	1.283E+00	44.787	3.268									
3960	4.694E-04	1.1960	5.614E-01	30.893	3.232									
4020	2.941E-04	0.7609	2.238E-01	20.793	3.191									
4080	1.917E-04	0.5027	9.635E-02	14.787	3.154									
4140	1.365E-04	0.3618	4.938E-02	11.500	3.125									
4200	7.350E-05	0.1988	1.461E-02	7.678	3.074									
4260	2.109E-05	0.0594	1.252E-03	4.348	2.972									
4320	2.271E-05	0.0638	1.449E-03	4.456	2.978									
4380	1.748E-05	0.0495	8.660E-04	4.105	2.957									
4440	1.240E-05	0.0355	4.403E-04	3.753	2.929									
4500	3.079E-06	0.0092	2.841E-05	3.036	2.821									
4560	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples 13
Total sediment mass = 2151.78 g
Total runoff volume = 1.1780 m^3
Total phosphorus mass = 53.5810 g
Total DP mass = 3.8294 g

Table E-32. Field data of event B072006S2 (site: B, plot: S2, date: 07/20/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
120	8.333E-06	540	4.363E-05	0.550	2.402E-02	14.769	1.635									
180	5.000E-06	600	2.430E-04	1.348	3.274E-01	30.400	1.760									
240	3.333E-06	660	4.115E-04	1.774	7.300E-01	38.181	1.800									
300	1.667E-06	720	5.663E-04	2.095	1.187E+00	43.881	1.825									
360	8.333E-06	780	4.007E-04	1.749	7.009E-01	37.740	1.798									
420	1.833E-05	840	2.381E-04	1.333	3.175E-01	30.135	1.758									
480	2.000E-05	900	1.377E-04	1.002	1.380E-01	23.848	1.718									
540	2.167E-05	960	6.526E-05	0.679	4.432E-02	17.432	1.664									
600	1.000E-05	1020	3.265E-05	0.473	1.545E-02	13.130	1.615								5.84	0.023
660	6.667E-06	1080	1.992E-05	0.366	7.285E-03	10.781	1.581									
720	3.333E-06	1140	1.730E-05	0.340	5.877E-03	10.200	1.571									
780	3.333E-06	1200	1.658E-05	0.332	5.513E-03	10.034	1.569									
840	1.667E-06	1260	1.711E-05	0.338	5.782E-03	10.158	1.571									
900	1.667E-06	1320	4.243E-05	0.543	2.302E-02	14.602	1.633									
960	1.667E-06	1380	4.107E-04	1.772	7.277E-01	38.146	1.800									
1020	1.667E-06	1440	5.965E-04	2.153	1.284E+00	44.888	1.829									
1080	1.667E-06	1500	7.112E-04	2.359	1.678E+00	48.480	1.843									
1140	5.000E-06	1560	1.353E-03	3.300	4.466E+00	64.353	1.895									
1200	8.333E-06	1620	2.232E-03	4.283	9.558E+00	80.317	1.936									
1260	1.167E-05	1680	2.342E-03	4.392	1.028E+01	82.052	1.940									
1320	1.167E-05	1740	2.202E-03	4.253	9.363E+00	79.835	1.935	342.3	0.47	1.98	11.93	6.47	17.84	61.3	5.81	0.026
1380	8.333E-06	1800	1.957E-03	3.999	7.825E+00	75.763	1.925									
1440	1.333E-05	1860	1.727E-03	3.747	6.469E+00	71.677	1.914									
1500	1.833E-05	1920	1.388E-03	3.344	4.643E+00	65.083	1.897									
1560	1.833E-05	1980	1.008E-03	2.830	2.854E+00	56.518	1.871									
1620	1.333E-05	2040	5.353E-04	2.034	1.089E+00	42.813	1.821									
1680	1.500E-05	2100	3.238E-04	1.565	5.069E-01	34.411	1.782									
1740	1.333E-05	2160	2.578E-04	1.390	3.584E-01	31.188	1.765								5.92	0.031
1800	1.333E-05	2220	1.766E-04	1.141	2.015E-01	26.511	1.736									
1860	1.000E-05	2280	1.464E-04	1.035	1.514E-01	24.474	1.722									
1920	1.000E-05	2340	6.684E-05	0.688	4.596E-02	17.605	1.665									
1980	5.000E-06	2400	3.761E-05	0.509	1.916E-02	13.903	1.625									
2040	5.000E-06	2460	1.496E-05	0.315	4.713E-03	9.641	1.562									
2100	1.667E-06	2520	1.183E-05	0.279	3.296E-03	8.807	1.546									
2160	3.333E-06	2580	1.111E-05	0.270	2.999E-03	8.601	1.542									
2220	1.667E-06	2640	1.054E-05	0.263	2.768E-03	8.431	1.538									
2280	1.667E-06	2700	6.046E-06	0.196	1.188E-03	6.857	1.502									
2340	1.667E-06	2760	2.930E-06	0.135	3.946E-04	5.310	1.456									
2460	8.333E-07	2820	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 7
Total sediment mass = 3904.21 g
Total runoff volume = 1.187 m^3
Total phosphorus mass = 75.609 g
Total DP mass = 2.234 g

Table E-33. Field data of event B072006V2 (site: B, plot: V2, date: 07/20/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
120	8.333E-06	1500	6.495E-06	0.021	1.392E-04	2.402	1.906									
180	5.000E-06	1560	5.317E-05	0.066	3.490E-03	3.401	1.885									
240	3.333E-06	1620	1.147E-04	0.099	1.134E-02	4.159	1.878									
300	1.667E-06	1680	3.698E-04	0.184	6.815E-02	6.117	1.867								5.83	0.027
360	8.333E-06	1740	4.649E-04	0.208	9.674E-02	6.665	1.864									
420	1.833E-05	1800	1.010E-03	0.314	3.176E-01	9.109	1.857									
480	2.000E-05	1860	1.549E-03	0.395	6.117E-01	10.958	1.853									
540	2.167E-05	1920	1.586E-03	0.400	6.342E-01	11.072	1.853								5.49	0.016
600	1.000E-05	1980	1.412E-03	0.376	5.308E-01	10.521	1.854									
660	6.667E-06	2040	1.170E-03	0.340	3.982E-01	9.699	1.856									
720	3.333E-06	2100	9.341E-04	0.302	2.818E-01	8.815	1.858									
780	3.333E-06	2160	6.903E-04	0.257	1.773E-01	7.784	1.861									
840	1.667E-06	2220	5.337E-04	0.224	1.195E-01	7.029	1.863	20.03	2.05	3.68	77.12	15.63	1.53	0	5.58	0.023
900	1.667E-06	2280	3.125E-04	0.168	5.265E-02	5.755	1.868									
960	1.667E-06	2340	2.112E-04	0.137	2.887E-02	5.027	1.872									
1020	1.667E-06	2400	1.487E-04	0.113	1.687E-02	4.494	1.875								5.65	0.018
1080	1.667E-06	2460	8.976E-05	0.087	7.784E-03	3.883	1.880									
1140	5.000E-06	2520	5.528E-05	0.067	3.704E-03	3.432	1.885									
1200	8.333E-06	2580	3.241E-05	0.050	1.635E-03	3.055	1.890									
1260	1.167E-05	2640	2.284E-05	0.042	9.561E-04	2.861	1.893									
1320	1.167E-05	2700	1.826E-05	0.037	6.786E-04	2.755	1.896									
1380	8.333E-06	2760	1.411E-05	0.032	4.572E-04	2.647	1.898									
1440	1.333E-05	2820	7.892E-06	0.024	1.877E-04	2.454	1.904									
1500	1.833E-05	2880	3.866E-06	0.016	6.289E-05	2.287	1.911									
1560	1.833E-05	2940	4.224E-07	0.005	2.115E-06	2.049	1.932									
1620	1.333E-05	3000	0.000E+00	0.000	0.000E+00	0.000	0.000									
1680	1.500E-05															
1740	1.333E-05															
1800	1.333E-05															
1860	1.000E-05															
1920	1.000E-05															
1980	5.000E-06															
2040	5.000E-06															
2100	1.667E-06															
2160	3.333E-06															
2220	1.667E-06															
2280	1.667E-06															
2340	1.667E-06															
2460	8.333E-07															

Number of field samples = 6
Total sediment mass = 201.891 g
Total runoff volume = 0.649 m^3
Total phosphorus mass = 5.861 g
Total DP mass = 1.206 g

Table E-34. Field data of event B072006S3 (site: B, plot: S3, date: 07/20/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
540	1.815E-05	0.050	9.123E-04	2.878	1.342									
600	1.903E-04	0.515	9.797E-02	14.607	1.478									
660	5.011E-04	1.342	6.724E-01	33.310	1.538									
720	8.515E-04	2.269	1.932E+00	53.133	1.572									
780	8.033E-04	2.141	1.720E+00	50.458	1.568									
840	6.396E-04	1.709	1.093E+00	41.261	1.554									
900	4.704E-04	1.261	5.930E-01	31.526	1.534									
960	3.067E-04	0.826	2.532E-01	21.804	1.507								5.59	0.012
1020	1.932E-04	0.522	1.010E-01	14.790	1.479									
1080	1.062E-04	0.289	3.066E-02	9.147	1.443									
1140	5.969E-05	0.163	9.749E-03	5.963	1.409									
1200	3.919E-05	0.108	4.220E-03	4.486	1.385									
1260	3.791E-05	0.104	3.951E-03	4.392	1.383									
1320	3.688E-05	0.101	3.741E-03	4.316	1.381									
1380	1.665E-04	0.451	7.511E-02	13.091	1.470									
1440	5.036E-04	1.349	6.791E-01	33.455	1.538									
1500	7.827E-04	2.087	1.633E+00	49.306	1.567									
1560	1.641E-03	4.342	7.124E+00	95.451	1.615									
1620	2.407E-03	6.346	1.527E+01	134.794	1.641									
1680	2.626E-03	6.916	1.816E+01	145.797	1.647									
1740	2.436E-03	6.421	1.564E+01	136.243	1.642	205.4	0.42	1.56	16.22	6.02	37.89	37.88	5.54	0.024
1800	2.287E-03	6.032	1.379E+01	128.705	1.637									
1860	1.798E-03	4.753	8.546E+00	103.628	1.621									
1920	1.454E-03	3.851	5.598E+00	85.620	1.607									
1980	1.105E-03	2.937	3.245E+00	67.008	1.589									
2040	6.175E-04	1.650	1.019E+00	40.001	1.551								5.73	0.034
2100	5.376E-04	1.439	7.734E-01	35.422	1.542									
2160	3.392E-04	0.912	3.094E-01	23.765	1.513									
2220	2.414E-04	0.651	1.572E-01	17.803	1.492									
2280	1.851E-04	0.501	9.270E-02	14.276	1.476									
2340	1.283E-04	0.348	4.468E-02	10.612	1.454									
2400	7.128E-05	0.195	1.388E-02	6.775	1.419								5.85	0.020
2460	3.421E-05	0.094	3.220E-03	4.116	1.377									
2520	2.381E-05	0.066	1.565E-03	3.324	1.357									
2580	1.925E-05	0.053	1.025E-03	2.965	1.345									
2640	1.469E-05	0.041	5.988E-04	2.596	1.330								5.73	0.024
2700	1.255E-05	0.035	4.379E-04	2.418	1.321									
2760	1.027E-05	0.029	2.939E-04	2.224	1.310									
2820	7.992E-06	0.022	1.784E-04	2.023	1.297									
2880	2.579E-06	0.007	1.878E-05	1.496	1.238									

Number of field samples = 13
Total sediment mass = 5922.05 g
Total runoff volume = 1.422 m^3
Total phosphorus mass = 129.083 g
Total DP mass = 2.270 g

Table E-35. Field data of event B072006V3 (site: B, plot: V3, date: 07/20/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
540	6.097E-06	0.024	1.483E-04	2.175	1.602									
600	8.734E-06	0.028	2.444E-04	2.269	1.611									
660	8.959E-06	0.028	2.532E-04	2.277	1.612									
720	7.430E-06	0.026	1.952E-04	2.225	1.607									
780	5.466E-06	0.023	1.274E-04	2.148	1.599									
840	3.678E-06	0.020	7.344E-05	2.060	1.589									
900	2.703E-06	0.018	4.786E-05	1.999	1.581									
960	5.410E-06	0.023	1.256E-04	2.145	1.599									
1020	7.045E-05	0.063	4.450E-03	3.146	1.666									
1080	7.246E-05	0.064	4.628E-03	3.163	1.667	24.56	1.68	3.23	68.85	24.28	1.97	0	5.86	0.025
1140	4.998E-05	0.055	2.761E-03	2.952	1.657									
1200	2.874E-05	0.045	1.280E-03	2.687	1.642									
1260	2.437E-05	0.042	1.018E-03	2.618	1.638									
1320	3.026E-05	0.045	1.375E-03	2.710	1.644									
1380	2.499E-05	0.042	1.054E-03	2.629	1.639									
1440	2.519E-05	0.042	1.065E-03	2.632	1.639									
1500	2.634E-05	0.043	1.134E-03	2.650	1.640									
1560	5.288E-05	0.056	2.986E-03	2.983	1.658									
1620	4.148E-04	0.126	5.231E-02	4.661	1.714									
1680	6.696E-04	0.152	1.018E-01	5.277	1.728									
1740	9.729E-04	0.176	1.711E-01	5.842	1.738	18.43	2.26	4.32	78.96	13.2	1.27	0	5.84	0.034
1800	1.184E-03	0.190	2.248E-01	6.173	1.744									
1860	1.310E-03	0.197	2.586E-01	6.352	1.746									
1920	1.396E-03	0.202	2.827E-01	6.470	1.748									
1980	1.328E-03	0.199	2.637E-01	6.378	1.747									
2040	1.284E-03	0.196	2.515E-01	6.316	1.746									
2100	1.173E-03	0.189	2.219E-01	6.156	1.743								5.73	0.023
2160	1.059E-03	0.182	1.925E-01	5.982	1.740									
2220	8.203E-04	0.165	1.350E-01	5.574	1.733									
2280	6.307E-04	0.148	9.365E-02	5.193	1.726									
2340	4.408E-04	0.129	5.693E-02	4.733	1.716								5.93	0.013
2400	3.484E-04	0.118	4.105E-02	4.463	1.710									
2460	2.554E-04	0.104	2.665E-02	4.141	1.701									
2520	1.983E-04	0.095	1.875E-02	3.906	1.694									
2580	1.401E-04	0.083	1.157E-02	3.618	1.685									
2640	1.452E-04	0.084	1.216E-02	3.646	1.686									
2700	1.128E-04	0.076	8.561E-03	3.456	1.679									
2760	8.233E-05	0.067	5.526E-03	3.243	1.670									
2820	5.280E-05	0.056	2.980E-03	2.982	1.658									
2880	2.773E-05	0.044	1.217E-03	2.672	1.641									
2940	1.838E-05	0.037	6.873E-04	2.509	1.630									
3000	1.183E-05	0.031	3.728E-04	2.360	1.619									
3060	6.315E-06	0.025	1.557E-04	2.183	1.603									
3120	2.072E-06	0.016	3.307E-05	1.951	1.574									
3180	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 7
Total sediment mass = 147.545 g
Total runoff volume = 0.872 m^3
Total phosphorus mass = 4.954 g
Total DP mass = 1.511 g

Table E-36. Field data of event B072006V1 (site: B, plot: V1, date: 07/20/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
480	0.000E+00	0.0000	0.000E+00	0.000	0.000									
540	3.191E-05	0.0508	2.941E-02	3.085	1.915									
600	3.185E-05	0.0550	3.877E-02	3.177	1.911									
660	3.183E-05	0.0563	4.196E-02	3.205	1.910									
720	3.185E-05	0.0550	3.870E-02	3.176	1.911									
780	3.187E-05	0.0534	3.496E-02	3.142	1.912									
840	3.190E-05	0.0518	3.133E-02	3.105	1.914									
900	3.192E-05	0.0506	2.894E-02	3.080	1.915									
960	3.174E-05	0.0623	5.994E-02	3.339	1.905									
1020	3.109E-05	0.1392	9.983E-01	5.069	1.865									
1080	3.108E-05	0.1409	1.040E+00	5.106	1.865									
1140	3.118E-05	0.1236	6.586E-01	4.716	1.871									
1200	3.133E-05	0.1030	3.477E-01	4.250	1.880								5.83	0.024
1260	3.144E-05	0.0904	2.202E-01	3.966	1.886									
1320	3.146E-05	0.0879	1.996E-01	3.910	1.888									
1380	3.144E-05	0.0902	2.183E-01	3.961	1.886								5.73	0.024
1440	3.143E-05	0.0913	2.284E-01	3.988	1.886									
1500	3.141E-05	0.0935	2.477E-01	4.036	1.885									
1560	3.117E-05	0.1266	7.154E-01	4.783	1.870									
1620	3.065E-05	0.2416	6.870E+00	7.398	1.839									
1680	3.046E-05	0.3057	1.566E+01	8.863	1.828									
1740	3.036E-05	0.3466	2.429E+01	9.797	1.822									
1800	3.030E-05	0.3718	3.104E+01	10.373	1.818								5.53	0.023
1860	3.028E-05	0.3849	3.505E+01	10.674	1.817									
1920	3.026E-05	0.3954	3.853E+01	10.915	1.815									
1980	3.028E-05	0.3839	3.475E+01	10.652	1.817	20.21	2.23	4.23	74.52	17.94	1.08	0	5.94	0.018
2040	3.029E-05	0.3774	3.273E+01	10.503	1.818									
2100	3.033E-05	0.3610	2.800E+01	10.126	1.820									
2160	3.037E-05	0.3430	2.342E+01	9.715	1.822									
2220	3.046E-05	0.3059	1.568E+01	8.866	1.828									
2280	3.057E-05	0.2672	9.770E+00	7.982	1.834									
2340	3.074E-05	0.2139	4.485E+00	6.766	1.845									
2400	3.087E-05	0.1816	2.530E+00	6.031	1.852									
2460	3.099E-05	0.1573	1.530E+00	5.479	1.859									
2520	3.097E-05	0.1614	1.673E+00	5.571	1.858									
2580	3.096E-05	0.1631	1.739E+00	5.612	1.858	26.77	1.74	3.38	61.2	31.23	2.44	0	5.82	0.014
2640	3.102E-05	0.1510	1.328E+00	5.337	1.861									
2700	3.114E-05	0.1310	8.066E-01	4.883	1.868									
2760	3.124E-05	0.1160	5.277E-01	4.544	1.874									
2820	3.138E-05	0.0973	2.849E-01	4.122	1.883									
2880	3.145E-05	0.0888	2.070E-01	3.931	1.887									
2940	3.154E-05	0.0802	1.447E-01	3.737	1.892									
3000	3.172E-05	0.0645	6.765E-02	3.387	1.903									
3060	3.204E-05	0.0435	1.702E-02	2.923	1.923									
3120	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples = 7
Total sediment mass = 18978.28 g
Total runoff volume = 0.0803 m^3
Total phosphorus mass = 0.4582 g
Total DP mass = 0.1501 g

Table E-37. Field data of event B072806S2 (site: B, plot: S2, date: 07/20/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	240	0.000E+00	0.000	0.000E+00	0.000	0.000									
120	3.333E-06	300	1.650E-05	0.179	2.953E-03	4.931	1.123									
240	6.667E-06	360	7.843E-04	2.753	2.159E+00	60.969	1.178									
360	2.583E-05	420	7.892E-04	2.765	2.182E+00	61.231	1.178								5.73	0.023
480	1.750E-05	480	8.707E-04	2.964	2.580E+00	65.593	1.179									
600	2.167E-05	540	1.123E-03	3.548	3.983E+00	78.398	1.183									
720	1.000E-05	600	1.663E-03	4.686	7.794E+00	103.388	1.189									
840	1.750E-05	660	7.733E-04	2.725	2.107E+00	60.369	1.178									
960	1.250E-05	720	3.758E-04	1.635	6.146E-01	36.550	1.167									
1080	1.167E-05	780	4.430E-04	1.837	8.139E-01	40.954	1.170									
1200	8.333E-06	840	6.897E-04	2.513	1.733E+00	55.727	1.176	235.5	2.68	4.24	15.1	5.3	25.8	46.87	5.83	0.023
1320	6.667E-06	900	6.923E-04	2.520	1.745E+00	55.877	1.176									
1440	5.833E-06	960	4.758E-04	1.933	9.196E-01	43.036	1.171									
1560	3.333E-06	1020	2.785E-04	1.323	3.684E-01	29.737	1.163									
1680	4.167E-06	1080	1.965E-04	1.034	2.032E-01	23.444	1.158									
1800	2.500E-06	1140	1.410E-04	0.817	1.152E-01	18.741	1.153									
1920	2.500E-06	1200	9.127E-05	0.601	5.482E-02	14.044	1.147									
2040	1.667E-06	1260	6.684E-05	0.482	3.220E-02	11.470	1.143									
2160	1.667E-06	1320	4.885E-05	0.386	1.885E-02	9.396	1.138									
2280	1.667E-06	1380	4.085E-05	0.340	1.389E-02	8.406	1.136									
2520	8.333E-07	1440	3.419E-05	0.300	1.025E-02	7.537	1.133									
2760	8.333E-07	1500	3.177E-05	0.285	9.043E-03	7.209	1.132									
2880	0.000E+00	1560	2.778E-05	0.259	7.191E-03	6.653	1.130									
		1620	2.650E-05	0.250	6.634E-03	6.469	1.130									
		1680	2.479E-05	0.239	5.920E-03	6.220	1.129	374.4	1.3	2.25	2.2	0.83	15.58	77.84	5.73	0.021
		1740	2.379E-05	0.232	5.519E-03	6.073	1.128									
		1800	2.251E-05	0.223	5.021E-03	5.880	1.127									
		1860	2.137E-05	0.215	4.594E-03	5.707	1.127									
		1920	1.952E-05	0.202	3.935E-03	5.419	1.125									
		1980	1.881E-05	0.196	3.693E-03	5.306	1.125									
		2040	1.852E-05	0.194	3.598E-03	5.260	1.125									
		2100	1.738E-05	0.186	3.229E-03	5.076	1.124									
		2160	1.710E-05	0.184	3.139E-03	5.030	1.124									
		2220	1.610E-05	0.176	2.833E-03	4.865	1.123									
		2280	1.524E-05	0.169	2.581E-03	4.722	1.122									
		2340	7.694E-06	0.104	8.028E-04	3.323	1.113									
		2400	7.267E-06	0.100	7.282E-04	3.234	1.112									
		2460	6.270E-06	0.090	5.659E-04	3.020	1.110									
		2520	5.557E-06	0.083	4.606E-04	2.861	1.108									
		2580	5.130E-06	0.078	4.018E-04	2.763	1.107									
		2640	4.703E-06	0.074	3.463E-04	2.662	1.106									
		2700	4.275E-06	0.069	2.943E-04	2.558	1.105									
		2760	3.848E-06	0.064	2.459E-04	2.452	1.103									
		2820	3.421E-06	0.059	2.011E-04	2.342	1.102									
		2880	2.993E-06	0.053	1.601E-04	2.227	1.100									
		2940	2.566E-06	0.048	1.231E-04	2.108	1.098									

Table E-37. Continued.

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
		3000	2.138E-06	0.042	9.015E-05	1.982	1.095									
		3060	1.711E-06	0.036	6.160E-05	1.849	1.092									
		3120	1.284E-06	0.029	3.771E-05	1.705	1.088									
		3180	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 8
Total sediment mass = 1651.34 g
Total runoff volume = 0.597 m^3
Total phosphorus mass = 36.603 g
Total DP mass = 0.702 g

Table E-38. Field data of event B072806V2 (site: B, plot: V2, date: 07/28/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
120	0.000E+00	0.000	0.000E+00	0.000	0.000									
180	9.599E-06	0.009	8.293E-05	1.686	1.516									
240	1.270E-05	0.011	1.340E-04	1.729	1.517									
300	2.659E-05	0.018	4.748E-04	1.896	1.522									
360	3.416E-05	0.021	7.293E-04	1.977	1.523									
420	3.258E-05	0.021	6.722E-04	1.961	1.523									
480	3.448E-05	0.021	7.410E-04	1.980	1.523								5.74	0.013
540	3.848E-05	0.023	8.940E-04	2.022	1.524									
600	3.626E-05	0.022	8.075E-04	1.999	1.524									
660	4.487E-05	0.026	1.163E-03	2.085	1.525									
720	3.442E-04	0.111	3.810E-02	4.239	1.538									
780	2.936E-04	0.099	2.902E-02	3.926	1.537									
840	1.884E-04	0.072	1.357E-02	3.230	1.534									
900	1.163E-04	0.051	5.946E-03	2.700	1.531								5.86	0.025
960	9.986E-05	0.046	4.577E-03	2.569	1.530									
1020	2.572E-04	0.090	2.313E-02	3.692	1.536									
1080	2.190E-04	0.080	1.756E-02	3.440	1.535	24.30	1.52	4.17	63.14	14.26	8.18	8.73	5.85	0.018
1140	1.623E-04	0.065	1.052E-02	3.045	1.533									
1200	1.096E-04	0.049	5.370E-03	2.647	1.530									
1260	7.664E-05	0.038	2.909E-03	2.375	1.528									
1320	5.399E-05	0.030	1.597E-03	2.172	1.526								5.65	0.019
1380	3.686E-05	0.023	8.307E-04	2.005	1.524									
1440	2.759E-05	0.018	5.059E-04	1.907	1.522									
1500	2.208E-05	0.016	3.454E-04	1.845	1.521									
1560	1.873E-05	0.014	2.605E-04	1.805	1.520									
1620	1.752E-05	0.013	2.323E-04	1.790	1.519									
1680	1.657E-05	0.013	2.113E-04	1.779	1.519									
1740	1.576E-05	0.012	1.939E-04	1.768	1.519									
1800	1.473E-05	0.012	1.728E-04	1.755	1.518									
1860	1.412E-05	0.011	1.606E-04	1.747	1.518									
1920	1.368E-05	0.011	1.521E-04	1.742	1.518									
1980	1.319E-05	0.011	1.429E-04	1.735	1.518									
2040	1.287E-05	0.011	1.370E-04	1.731	1.517									
2100	1.244E-05	0.010	1.292E-04	1.725	1.517									
2160	1.201E-05	0.010	1.217E-04	1.719	1.517									
2220	1.148E-05	0.010	1.126E-04	1.712	1.517									
2280	1.117E-05	0.010	1.075E-04	1.708	1.517									
2340	1.075E-05	0.009	1.007E-04	1.702	1.516									
2400	1.014E-05	0.009	9.112E-05	1.694	1.516									
2460	9.697E-06	0.009	8.438E-05	1.687	1.516									
2520	9.140E-06	0.008	7.625E-05	1.679	1.515									
2580	8.903E-06	0.008	7.290E-05	1.676	1.515									
2640	8.458E-06	0.008	6.677E-05	1.669	1.515									
2700	7.525E-06	0.007	5.466E-05	1.655	1.514									
2760	6.593E-06	0.007	4.358E-05	1.641	1.513									

Table E-38. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
2820	5.660E-06	0.006	3.357E-05	1.626	1.512									
2880	4.728E-06	0.005	2.466E-05	1.610	1.511									
2940	3.795E-06	0.004	1.693E-05	1.593	1.510									
3000	2.230E-06	0.003	6.808E-06	1.562	1.507									
3060	1.262E-06	0.002	2.570E-06	1.539	1.503									
3120	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 9.750 g
Total runoff volume = 0.153 m^3
Total phosphorus mass = 0.465 g
Total DP mass = 0.234 g

Table E-39. Field data of event B072806S3 (site: B, plot: S3, date: 07/28/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
240	0.000E+00	0.000	0.000E+00	0.000	0.000									
300	1.312E-05	0.162	2.130E-03	4.864	1.221									
360	9.465E-04	2.740	2.593E+00	63.857	1.209									
420	9.667E-04	2.778	2.685E+00	64.673	1.209									
480	1.094E-03	3.014	3.295E+00	69.653	1.209									
540	1.463E-03	3.653	5.346E+00	83.001	1.208									
600	1.648E-03	3.952	6.514E+00	89.166	1.208								6.02	0.025
660	1.016E-03	2.871	2.917E+00	66.639	1.209									
720	5.673E-04	1.954	1.108E+00	46.929	1.211									
780	7.415E-04	2.332	1.729E+00	55.133	1.210									
840	8.160E-04	2.484	2.027E+00	58.403	1.210									
900	8.170E-04	2.486	2.031E+00	58.446	1.210								6.10	0.018
960	6.563E-04	2.151	1.412E+00	51.230	1.210									
1020	4.935E-04	1.782	8.793E-01	43.152	1.211									
1080	3.697E-04	1.472	5.443E-01	36.265	1.212									
1140	3.148E-04	1.324	4.169E-01	32.925	1.212									
1200	2.955E-04	1.270	3.752E-01	31.693	1.212									
1260	2.372E-04	1.098	2.605E-01	27.764	1.213									
1320	2.180E-04	1.039	2.264E-01	26.391	1.213									
1380	2.103E-04	1.014	2.134E-01	25.829	1.213									
1440	1.745E-04	0.897	1.565E-01	23.083	1.214									
1500	1.710E-04	0.885	1.513E-01	22.803	1.214	298.8	1.3	1.95	1.84	1.26	28.49	65.17	6.12	0.023
1560	1.688E-04	0.877	1.481E-01	22.629	1.214									
1620	1.672E-04	0.872	1.457E-01	22.494	1.214									
1680	1.493E-04	0.809	1.208E-01	21.018	1.214									
1740	1.482E-04	0.805	1.193E-01	20.919	1.214									
1800	1.478E-04	0.804	1.188E-01	20.891	1.214									
1860	1.467E-04	0.799	1.173E-01	20.791	1.214									
1920	1.463E-04	0.798	1.168E-01	20.763	1.214								5.97	0.027
1980	1.280E-04	0.731	9.353E-02	19.156	1.215									
2040	1.275E-04	0.729	9.293E-02	19.111	1.215									
2100	1.183E-04	0.694	8.210E-02	18.272	1.215									
2160	8.261E-05	0.547	4.520E-02	14.718	1.216									
2220	8.172E-05	0.543	4.440E-02	14.622	1.216									
2280	8.150E-05	0.542	4.420E-02	14.598	1.216									
2340	7.994E-05	0.535	4.281E-02	14.430	1.216									
2400	7.883E-05	0.531	4.182E-02	14.309	1.216									
2460	7.683E-05	0.522	4.008E-02	14.090	1.216								5.92	0.040
2520	4.352E-05	0.358	1.559E-02	10.007	1.218									
2580	4.241E-05	0.352	1.494E-02	9.853	1.218									
2640	3.634E-05	0.318	1.156E-02	8.979	1.218									
2700	3.449E-05	0.307	1.060E-02	8.701	1.218									
2760	2.665E-05	0.259	6.910E-03	7.451	1.219									
2820	1.882E-05	0.206	3.876E-03	6.043	1.220									
2880	1.554E-05	0.182	2.821E-03	5.386	1.221									

Table E-39. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
2940	1.227E-05	0.155	1.904E-03	4.670	1.221									
3000	8.989E-06	0.126	1.137E-03	3.874	1.222									
3060	5.713E-06	0.094	5.354E-04	2.949	1.223									
3120	4.431E-06	0.079	3.511E-04	2.531	1.224									
3180	2.935E-06	0.060	1.772E-04	1.975	1.225									
3240	1.420E-06	0.037	5.309E-05	1.276	1.227									
3300	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 7

Total sediment mass = 2182.04 g

Total runoff volume = 0.925 m^3

Total phosphorus mass = 51.060 g

Total DP mass = 1.119 g

Table E-40. Field data of event B072806V3 (site: B, plot: V3, date: 07/28/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
120	3.296E-08	0.000	1.143E-07	0.000	0.000									
180	1.088E-05	0.040	4.363E-04	2.571	1.547									
240	1.401E-05	0.045	6.250E-04	2.696	1.551									
300	2.801E-05	0.060	1.674E-03	3.118	1.560									
360	3.564E-05	0.066	2.358E-03	3.297	1.564									
420	3.404E-05	0.065	2.209E-03	3.262	1.563									
480	3.596E-05	0.066	2.388E-03	3.304	1.564									
540	5.515E-05	0.080	4.387E-03	3.674	1.570									
600	5.679E-05	0.081	4.573E-03	3.702	1.570								5.78	0.021
660	1.615E-04	0.125	2.022E-02	4.976	1.585									
720	3.742E-04	0.178	6.677E-02	6.521	1.597									
780	3.303E-04	0.169	5.591E-02	6.254	1.595									
840	2.493E-04	0.150	3.747E-02	5.703	1.591									
900	1.861E-04	0.133	2.474E-02	5.199	1.587									
960	2.287E-04	0.145	3.316E-02	5.547	1.590									
1020	3.286E-04	0.169	5.550E-02	6.243	1.595	25.52	1.5	4.39	59.66	18.71	13.13	2.61	6.03	0.018
1080	2.761E-04	0.157	4.333E-02	5.895	1.593									
1140	2.455E-04	0.149	3.666E-02	5.675	1.591									
1200	1.802E-04	0.131	2.363E-02	5.147	1.587									
1260	1.133E-04	0.108	1.221E-02	4.477	1.580									
1320	8.965E-05	0.098	8.753E-03	4.188	1.577								6.06	0.021
1380	9.330E-05	0.099	9.264E-03	4.235	1.577									
1440	8.064E-05	0.093	7.528E-03	4.066	1.575									
1500	7.310E-05	0.090	6.549E-03	3.959	1.574									
1560	6.852E-05	0.087	5.973E-03	3.890	1.573									
1620	6.687E-05	0.086	5.769E-03	3.865	1.573									
1680	8.269E-05	0.094	7.802E-03	4.094	1.576									
1740	8.159E-05	0.094	7.655E-03	4.079	1.575									
1800	7.955E-05	0.093	7.384E-03	4.051	1.575									
1860	7.566E-05	0.091	6.877E-03	3.996	1.574									
1920	7.177E-05	0.089	6.380E-03	3.939	1.574								6.16	0.018
1980	6.789E-05	0.087	5.894E-03	3.880	1.573									
2040	6.400E-05	0.085	5.420E-03	3.820	1.572									
2100	5.821E-05	0.081	4.736E-03	3.726	1.571									
2160	5.242E-05	0.078	4.081E-03	3.627	1.569									
2220	4.150E-05	0.071	2.927E-03	3.421	1.566									
2280	3.728E-05	0.067	2.513E-03	3.333	1.564									
2340	4.051E-05	0.070	2.829E-03	3.400	1.565									
2400	2.768E-05	0.059	1.646E-03	3.110	1.560									
2460	2.122E-05	0.053	1.128E-03	2.933	1.556									
2520	1.476E-05	0.046	6.734E-04	2.724	1.551									
2580	8.308E-06	0.036	2.973E-04	2.451	1.543									
2640	6.477E-06	0.032	2.086E-04	2.353	1.540									
2700	4.646E-06	0.028	1.301E-04	2.237	1.535									
2760	4.790E-07	0.011	5.141E-06	1.760	1.504									
2820	2.000E-07	0.007	1.485E-06	1.666	1.492									
2880	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 7
Total sediment mass = 32.440 g
Total runoff volume = 0.255 m^3
Total phosphorus mass = 1.286 g
Total DP mass = 0.404 g

Table E-41. Field data of event B072806V1 (site: B, plot: V1, date: 07/28/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
180	5.280E-06	0.0000	2.063E-04	1.424	0.000									
240	8.611E-06	0.0470	4.050E-04	1.690	3.000									
300	1.923E-05	0.0638	1.226E-03	2.239	2.707									
360	2.604E-05	0.0715	1.862E-03	2.490	2.604									
420	2.533E-05	0.0708	1.792E-03	2.466	2.613									
480	2.519E-05	0.0706	1.779E-03	2.461	2.615									
540	2.574E-05	0.0712	1.833E-03	2.480	2.608									
600	6.611E-04	0.2435	1.610E-01	7.728	1.721									
660	8.948E-04	0.2731	2.444E-01	8.593	1.656								6.03	0.023
720	1.078E-03	0.2931	3.160E-01	9.172	1.617									
780	8.926E-04	0.2728	2.436E-01	8.585	1.656									
840	6.446E-04	0.2412	1.555E-01	7.660	1.727									
900	5.709E-04	0.2303	1.315E-01	7.341	1.754									
960	8.168E-04	0.2638	2.155E-01	8.322	1.675									
1020	7.876E-04	0.2602	2.049E-01	8.217	1.683	19.50	1.8	4.76	72.89	13.43	7.02	0.1	6.20	0.016
1080	7.016E-04	0.2491	1.747E-01	7.891	1.708									
1140	5.277E-04	0.2236	1.180E-01	7.142	1.772									
1200	4.007E-04	0.2014	8.071E-02	6.485	1.835								6.12	0.023
1260	3.476E-04	0.1909	6.635E-02	6.170	1.869									
1320	3.130E-04	0.1834	5.741E-02	5.948	1.894									
1380	2.915E-04	0.1786	5.206E-02	5.802	1.911									
1440	2.317E-04	0.1637	3.792E-02	5.353	1.968									
1500	1.773E-04	0.1479	2.623E-02	4.875	2.037								6.03	0.024
1560	1.427E-04	0.1362	1.944E-02	4.518	2.094									
1620	1.053E-04	0.1214	1.278E-02	4.061	2.177									
1680	5.292E-05	0.0936	4.952E-03	3.192	2.378									
1740	2.927E-05	0.0748	2.188E-03	2.594	2.565									
1800	1.780E-05	0.0619	1.102E-03	2.179	2.734									
1860	1.615E-05	0.0597	9.643E-04	2.107	2.768									
1920	1.425E-05	0.0569	8.109E-04	2.016	2.813									
1980	1.234E-05	0.0539	6.652E-04	1.917	2.865									
2040	1.043E-05	0.0506	5.278E-04	1.808	2.927									
2100	8.527E-06	0.0469	3.996E-04	1.684	3.004									
2160	6.621E-06	0.0426	2.819E-04	1.541	3.103									
2220	4.714E-06	0.0374	1.765E-04	1.369	3.241									
2280	2.807E-06	0.0308	8.636E-05	1.141	3.463									
2340	9.005E-07	0.0200	1.801E-05	0.766	4.005									
2400	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 140.35 g
Total runoff volume = 0.5939 m^3
Total phosphorus mass = 4.4561 g
Total DP mass = 1.0490 g

Table E-42. Field data of event B090606S2 (site: B, plot: S2, date: 09/06/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	180	0.000E+00	0.000	0.000E+00	0.000	0.000									
60	1.167E-05	240	6.001E-05	0.000	1.434E-02	0.000	0.000									
120	1.000E-05	300	1.367E-04	0.488	6.665E-02	13.418	1.360									
180	1.667E-05	360	3.995E-04	1.236	4.937E-01	31.129	1.423									
240	1.833E-05	420	1.245E-03	3.310	4.120E+00	78.711	1.493									
300	2.333E-05	480	2.000E-03	4.991	9.982E+00	116.535	1.523									
360	2.333E-05	540	2.232E-03	5.489	1.225E+01	127.641	1.530								5.84	0.021
420	2.500E-05	600	1.937E-03	4.854	9.400E+00	113.464	1.521									
480	2.500E-05	660	1.623E-03	4.165	6.762E+00	98.020	1.510									
540	2.333E-05	720	8.638E-04	2.411	2.083E+00	58.263	1.470									
600	1.667E-05	780	2.905E-04	0.937	2.723E-01	24.129	1.404	330.5	1.14	2.56	5.25	2.6	22.74	65.72	6.12	0.021
660	1.333E-05	840	6.973E-05	0.272	1.897E-02	8.170	1.322									
720	3.333E-06	900	3.291E-05	0.142	4.671E-03	4.924	1.281									
780	1.667E-06	960	2.422E-05	0.109	2.635E-03	4.080	1.264								6.09	0.018
840	1.667E-06	1020	2.080E-05	0.095	1.984E-03	3.734	1.256									
900	1.667E-06	1080	1.938E-05	0.090	1.738E-03	3.587	1.252									
960	1.667E-06	1140	1.795E-05	0.084	1.507E-03	3.438	1.248									
1020	0.000E+00	1200	1.667E-05	0.079	1.312E-03	3.302	1.244									
		1260	1.567E-05	0.075	1.169E-03	3.194	1.241									
		1320	1.468E-05	0.070	1.034E-03	3.086	1.238									
		1380	1.083E-05	0.054	5.864E-04	2.653	1.222									
		1440	6.982E-06	0.037	2.585E-04	2.189	1.200									
		1500	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 2728.776 g
Total runoff volume = 0.662 m^3
Total phosphorus mass = 64.057 g
Total DP mass = 0.988 g

Table E-43. Field data of event B090606V2 (site: B, plot: V2, date: 09/06/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
60	0.000E+00	0.000	0.000E+00	0.000	0.000									
120	5.690E-06	0.000	1.719E-04	0.000	0.000									
180	1.874E-05	0.046	8.658E-04	2.965	1.594									
240	2.492E-05	0.051	1.274E-03	3.116	1.611									
300	3.258E-05	0.056	1.832E-03	3.269	1.627									
360	3.613E-05	0.058	2.108E-03	3.331	1.634									
420	3.847E-05	0.060	2.296E-03	3.370	1.638									
480	4.285E-05	0.062	2.657E-03	3.438	1.644									
540	4.257E-05	0.062	2.634E-03	3.434	1.644									
600	1.047E-03	0.194	2.026E-01	6.919	1.855	8.53	7.94	15.24	75	1.82	0	0	6.12	0.023
660	1.265E-03	0.207	2.618E-01	7.253	1.868									
720	9.187E-04	0.185	1.697E-01	6.699	1.846									
780	6.377E-04	0.162	1.034E-01	6.132	1.820									
840	3.309E-04	0.128	4.250E-02	5.260	1.776								6.02	0.012
900	1.539E-04	0.098	1.504E-02	4.443	1.725									
960	5.574E-05	0.068	3.796E-03	3.615	1.661									
1020	2.586E-05	0.052	1.339E-03	3.136	1.613									
1080	1.700E-05	0.045	7.586E-04	2.917	1.588								5.98	0.020
1140	1.302E-05	0.041	5.284E-04	2.791	1.572									
1200	1.021E-05	0.037	3.800E-04	2.684	1.558									
1260	8.917E-06	0.035	3.162E-04	2.627	1.550									
1320	8.235E-06	0.034	2.838E-04	2.595	1.545									
1380	7.275E-06	0.033	2.399E-04	2.547	1.538									
1440	6.134E-06	0.031	1.903E-04	2.482	1.528									
1500	5.062E-06	0.029	1.467E-04	2.414	1.517									
1560	5.591E-06	0.030	1.679E-04	2.449	1.523									
1620	2.905E-06	0.024	6.907E-05	2.234	1.486									
1680	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4

Total sediment mass = 49.027 g

Total runoff volume = 0.286 m^3

Total phosphorus mass = 1.812 g

Total DP mass = 0.520 g

Table E-44. Field data of event B090606S3 (site: B, plot: S3, date: 09/06/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
180	0.000E+00	0.000	0.000E+00	0.000	0.000									
240	6.206E-05	0.000	1.548E-02	0.000	0.000									
300	9.906E-05	0.371	3.676E-02	11.195	1.199									
360	4.144E-04	1.251	5.184E-01	33.096	1.246									
420	9.305E-04	2.486	2.313E+00	62.582	1.273									
480	1.466E-03	3.658	5.363E+00	89.893	1.289	292.8	0.14	0.65	1.13	0.93	30.06	67.08	6.12	0.034
540	1.694E-03	4.134	7.001E+00	100.864	1.294									
600	1.407E-03	3.531	4.968E+00	86.976	1.287								6.20	0.038
660	1.278E-03	3.256	4.162E+00	80.580	1.284									
720	5.778E-04	1.659	9.585E-01	42.943	1.257									
780	2.012E-04	0.677	1.363E-01	18.966	1.222									
840	1.025E-04	0.382	3.918E-02	11.480	1.200									
900	3.480E-05	0.153	5.311E-03	5.450	1.165									
960	2.804E-05	0.127	3.564E-03	4.757	1.159									
1020	2.363E-05	0.110	2.598E-03	4.286	1.153								6.01	0.027
1080	2.005E-05	0.096	1.917E-03	3.890	1.148									
1140	1.771E-05	0.086	1.523E-03	3.624	1.144									
1200	1.564E-05	0.077	1.211E-03	3.383	1.141									
1260	1.289E-05	0.066	8.461E-04	3.052	1.135									
1320	1.192E-05	0.061	7.327E-04	2.932	1.132									
1380	1.082E-05	0.057	6.123E-04	2.793	1.129									
1440	1.027E-05	0.054	5.559E-04	2.723	1.128									
1500	8.613E-06	0.047	4.017E-04	2.506	1.122									
1560	7.786E-06	0.043	3.334E-04	2.394	1.119									
1620	6.684E-06	0.038	2.514E-04	2.241	1.115									
1680	5.581E-06	0.032	1.801E-04	2.083	1.109									
1740	4.479E-06	0.027	1.199E-04	1.918	1.103									
1800	3.928E-06	0.024	9.405E-05	1.831	1.099									
1860	0.000E+00	0.000	0.000E+00	0.000	0.000									
1920	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 1531.94 g
Total runoff volume = 0.507 m^3
Total phosphorus mass = 37.903 g
Total DP mass = 0.642 g

Table E-45. Field data of event B090606V3 (site: B, plot: V3, date: 09/06/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
240	0.000E+00	0.000	0.000E+00	0.000	0.000									
300	5.338E-06	0.000	2.042E-04	0.000	0.000									
360	1.475E-05	0.079	1.162E-03	3.160	1.473									
420	1.566E-05	0.082	1.287E-03	3.230	1.487									
480	1.988E-05	0.097	1.935E-03	3.532	1.547									
540	2.148E-05	0.103	2.209E-03	3.638	1.567									
600	2.246E-05	0.106	2.385E-03	3.701	1.579									
660	2.134E-05	0.102	2.186E-03	3.629	1.565									
720	1.779E-05	0.090	1.600E-03	3.387	1.519	19.87	1.72	5.35	66.05	12.03	11.63	3.23	5.860	0.023
780	1.218E-05	0.069	8.377E-04	2.947	1.427									
840	1.128E-05	0.065	7.340E-04	2.866	1.409									
900	1.106E-05	0.064	7.103E-04	2.846	1.404									
960	9.483E-06	0.058	5.457E-04	2.694	1.369									
1020	9.443E-06	0.057	5.418E-04	2.690	1.368								6.020	0.032
1080	9.390E-06	0.057	5.366E-04	2.685	1.367									
1140	8.022E-06	0.051	4.099E-04	2.541	1.332									
1200	8.155E-06	0.052	4.215E-04	2.556	1.335									
1260	5.365E-06	0.038	2.059E-04	2.217	1.246									
1320	4.076E-06	0.032	1.287E-04	2.026	1.191									
1380	2.628E-06	0.023	6.076E-05	1.765	1.107									
1440	2.346E-06	0.021	5.005E-05	1.705	1.087									
1500	1.952E-06	0.019	3.653E-05	1.613	1.054									
1560	1.351E-06	0.014	1.948E-05	1.449	0.992									
1620	9.532E-07	0.011	1.072E-05	1.314	0.936									
1680	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 2
Total sediment mass = 1.093 g
Total runoff volume = 0.014 m^3
Total phosphorus mass = 0.043 g
Total DP mass = 0.020 g

Table E-46. Field data of event B090606V1 (site: B, plot: V1, date: 09/06/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
240	0.000E+00	0.0000	0.000E+00	0.000	0.000									
300	7.177E-06	0.0105	7.508E-05	1.752	1.515									
360	1.149E-05	0.0139	1.592E-04	1.854	1.536									
420	1.629E-05	0.0171	2.781E-04	1.947	1.553									
480	2.229E-05	0.0206	4.588E-04	2.047	1.567									
540	2.336E-05	0.0212	4.945E-04	2.064	1.570									
600	1.365E-03	0.2402	3.279E-01	7.974	1.775	11.43	3.96	7.79	71.29	8.19	8.78	0	6.01	0.021
660	1.587E-03	0.2628	4.170E-01	8.591	1.783									
720	1.470E-03	0.2511	3.691E-01	8.271	1.779									
780	1.175E-03	0.2197	2.581E-01	7.415	1.767									
840	7.732E-04	0.1711	1.323E-01	6.098	1.744									
900	5.478E-04	0.1393	7.630E-02	5.240	1.726								6.20	0.032
960	3.366E-04	0.1041	3.505E-02	4.297	1.701									
1020	1.400E-04	0.0617	8.633E-03	3.161	1.657									
1080	5.179E-05	0.0341	1.764E-03	2.418	1.608									
1140	3.102E-05	0.0251	7.776E-04	2.172	1.583								6.11	0.028
1200	2.423E-05	0.0216	5.240E-04	2.077	1.571									
1260	1.973E-05	0.0191	3.776E-04	2.006	1.562									
1320	1.641E-05	0.0171	2.811E-04	1.949	1.553									
1380	1.503E-05	0.0163	2.444E-04	1.924	1.549									
1440	1.429E-05	0.0158	2.255E-04	1.910	1.546									
1500	1.407E-05	0.0156	2.199E-04	1.906	1.546									
1560	1.396E-05	0.0156	2.171E-04	1.904	1.545									
1620	1.362E-05	0.0153	2.089E-04	1.897	1.544									
1680	1.362E-05	0.0153	2.089E-04	1.897	1.544									
1740	1.345E-05	0.0152	2.048E-04	1.894	1.544									
1800	1.319E-05	0.0150	1.984E-04	1.889	1.543									
1860	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples = 4
Total sediment mass = 97.8853 g
Total runoff volume = 0.4638 m^3
Total phosphorus mass = 3.3327 g
Total DP mass = 0.8139 g

Table E-47. Field data of event B090906S2 (site: B, plot: S2, date: 09/09/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	600	0.000E+00	0.000	0.000E+00	0.000	0.000									
60	3.333E-06	660	2.650E-05	0.031	8.125E-04	2.035	1.270									
120	1.000E-05	720	7.752E-05	0.099	7.656E-03	3.797	1.355									
180	3.333E-06	780	2.363E-04	0.333	7.860E-02	9.597	1.448									
240	1.667E-06	840	2.039E-04	0.283	5.774E-02	8.382	1.436									
300	1.667E-06	900	4.892E-04	0.735	3.595E-01	19.406	1.513									
480	3.333E-06	960	6.944E-04	1.077	7.476E-01	27.677	1.545									
540	1.667E-06	1020	1.289E-03	2.113	2.725E+00	52.625	1.604									
600	3.333E-06	1080	1.579E-03	2.635	4.160E+00	65.130	1.624									
660	1.667E-06	1140	1.459E-03	2.418	3.528E+00	59.933	1.616									
720	1.500E-05	1200	1.067E-03	1.719	1.833E+00	43.149	1.586									
780	1.667E-05	1260	1.476E-03	2.448	3.613E+00	60.655	1.617									
840	1.000E-05	1320	2.295E-03	3.961	9.093E+00	96.840	1.660									
900	1.167E-05	1380	2.703E-03	4.734	1.280E+01	115.252	1.677									
960	1.000E-05	1440	2.839E-03	4.994	1.418E+01	121.464	1.682									
1020	1.833E-05	1500	2.195E-03	3.774	8.285E+00	92.361	1.656									
1080	2.000E-05	1560	1.894E-03	3.213	6.085E+00	78.957	1.641									
1140	1.833E-05	1620	1.898E-03	3.221	6.115E+00	79.158	1.642									
1200	1.333E-05	1680	2.094E-03	3.584	7.505E+00	87.831	1.651	232.1	5.08	5.62	12.99	4.58	25.71	46.02	6.02	0.023
1260	1.333E-05	1740	2.302E-03	3.973	9.143E+00	97.112	1.661									
1320	2.333E-05	1800	2.773E-03	4.867	1.349E+01	118.424	1.679									
1380	2.333E-05	1860	2.436E-03	4.227	1.030E+01	103.178	1.666									
1440	2.500E-05	1920	1.895E-03	3.215	6.095E+00	79.024	1.641									
1500	2.000E-05	1980	2.376E-03	4.113	9.771E+00	100.448	1.664									
1560	1.833E-05	2040	2.127E-03	3.646	7.756E+00	89.316	1.653									
1620	1.833E-05	2100	1.103E-03	1.783	1.966E+00	44.686	1.589									
1680	2.167E-05	2160	8.061E-04	1.267	1.021E+00	32.262	1.559								6.08	0.022
1740	2.167E-05	2220	8.788E-04	1.392	1.223E+00	35.276	1.567									
1800	2.167E-05	2280	1.173E-03	1.906	2.235E+00	47.644	1.595									
1860	2.333E-05	2340	4.559E-04	0.681	3.103E-01	18.088	1.507									
1920	2.000E-05	2400	3.314E-04	0.481	1.593E-01	13.222	1.478									
1980	2.333E-05	2460	4.921E-04	0.740	3.641E-01	19.523	1.514									
2040	2.500E-05	2520	3.835E-04	0.564	2.162E-01	15.244	1.491									
2100	2.167E-05	2580	2.687E-04	0.383	1.028E-01	10.821	1.460									
2160	1.000E-05	2640	2.622E-04	0.373	9.766E-02	10.574	1.457									
2220	1.833E-05	2700	2.558E-04	0.363	9.279E-02	10.334	1.455									
2280	1.667E-05	2760	2.877E-04	0.412	1.186E-01	11.545	1.466									
2340	1.833E-05	2820	6.508E-04	1.003	6.529E-01	25.903	1.539									
2400	1.000E-05	2880	1.065E-03	1.716	1.828E+00	43.085	1.586									
2460	1.333E-05	2940	8.742E-04	1.384	1.210E+00	35.087	1.567									
2520	1.167E-05	3000	8.076E-04	1.269	1.025E+00	32.325	1.559									
2580	1.000E-05	3060	4.570E-04	0.682	3.119E-01	18.130	1.507									
2640	8.333E-06	3120	6.721E-04	1.039	6.984E-01	26.769	1.542									
2700	8.333E-06	3180	1.042E-03	1.676	1.747E+00	42.127	1.584									
2760	1.000E-05	3240	6.476E-04	0.998	6.461E-01	25.771	1.539									
2820	1.167E-05	3300	4.194E-04	0.622	2.607E-01	16.650	1.499									

Table E-47. Continued.

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
2880	1.333E-05	3360	5.585E-04	0.849	4.742E-01	22.174	1.525								6.13	0.032
2940	1.667E-05	3420	6.412E-04	0.987	6.329E-01	25.513	1.538									
3000	1.333E-05	3480	5.241E-04	0.792	4.153E-01	20.797	1.519									
3060	1.500E-05	3540	3.665E-04	0.537	1.967E-01	14.583	1.487									
3120	1.167E-05	3600	3.127E-04	0.451	1.412E-01	12.504	1.473									
3180	1.500E-05	3660	3.508E-04	0.512	1.794E-01	13.972	1.483									
3240	1.833E-05	3720	4.123E-04	0.610	2.515E-01	16.370	1.498									
3300	1.167E-05	3780	1.391E-03	2.295	3.192E+00	56.988	1.611									
3360	1.167E-05	3840	2.177E-03	3.740	8.142E+00	91.548	1.655									
3420	1.667E-05	3900	2.583E-03	4.506	1.164E+01	109.820	1.672									
3480	1.333E-05	3960	2.098E-03	3.592	7.539E+00	88.033	1.652									
3540	1.167E-05	4020	1.529E-03	2.544	3.889E+00	62.955	1.620									
3600	8.333E-06	4080	6.621E-04	1.022	6.768E-01	26.362	1.541									
3660	1.167E-05	4140	6.939E-04	1.076	7.466E-01	27.659	1.545									
3720	1.000E-05	4200	8.030E-04	1.261	1.013E+00	32.137	1.559									
3780	1.333E-05	4260	1.406E-03	2.322	3.265E+00	57.642	1.612								6.22	0.021
3840	1.833E-05	4320	1.397E-03	2.306	3.221E+00	57.250	1.612									
3900	1.833E-05	4380	3.314E-04	0.481	1.593E-01	13.222	1.478									
3960	2.000E-05	4440	2.712E-04	0.387	1.048E-01	10.918	1.460									
4020	1.333E-05	4500	2.389E-04	0.337	8.045E-02	9.696	1.449									
4080	1.333E-05	4560	2.145E-04	0.299	6.423E-02	8.780	1.440								6.01	0.030
4140	1.167E-05	4620	1.872E-04	0.258	4.832E-02	7.763	1.428									
4200	1.333E-05	4680	1.135E-04	0.150	1.697E-02	5.073	1.386									
4260	1.167E-05	4740	8.105E-05	0.104	8.402E-03	3.921	1.358									
4320	1.500E-05	4800	3.619E-05	0.043	1.558E-03	2.366	1.294									
4380	1.000E-05	4860	3.177E-05	0.037	1.187E-03	2.215	1.284									
4440	8.333E-06	4920	2.949E-05	0.034	1.016E-03	2.137	1.278									
4500	5.000E-06	4980	2.949E-05	0.034	1.016E-03	2.137	1.278									
4560	3.333E-06	5040	1.852E-05	0.021	3.844E-04	1.762	1.243									
4620	3.333E-06	5100	1.211E-05	0.013	1.582E-04	1.540	1.212									
4680	3.333E-06	5160	1.211E-05	0.013	1.582E-04	1.540	1.212									
4740	1.667E-06	5220	8.977E-06	0.009	8.462E-05	1.427	1.190									
4800	3.333E-06	5280	6.270E-06	0.000	0.000E+00	1.326	1.165									
4920	8.333E-07	5340	0.000E+00	0.000	0.000E+00	0.000	0.000									
5040	8.333E-07															
5160	8.333E-07															
5220	0.000E+00															

Number of field samples = 9

Total sediment mass = 12007.0 g

Total runoff volume = 4.277 m^3

Total phosphorus mass = 295.826 g

Total DP mass = 6.894 g

Table E-48. Field data of event B090906V2 (site: B, plot: V2, date: 09/09/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
960	0.000E+00	0.000	0.000E+00	0.000	0.000									
1020	3.250E-05	0.011	3.731E-04	2.002	1.488									
1080	9.041E-05	0.024	2.214E-03	2.474	1.541									
1140	7.887E-05	0.022	1.746E-03	2.395	1.534									
1200	5.620E-04	0.095	5.328E-02	4.346	1.640									
1260	8.333E-04	0.127	1.058E-01	5.067	1.662									
1320	7.500E-04	0.117	8.804E-02	4.858	1.656									
1380	1.297E-03	0.176	2.285E-01	6.094	1.687									
1440	2.233E-03	0.263	5.883E-01	7.768	1.719									
1500	2.100E-03	0.252	5.285E-01	7.551	1.715								5.98	0.021
1560	1.630E-03	0.209	3.400E-01	6.735	1.700									
1620	1.433E-03	0.190	2.717E-01	6.363	1.693									
1680	1.633E-03	0.209	3.413E-01	6.741	1.700									
1740	1.897E-03	0.233	4.429E-01	7.210	1.709									
1800	2.042E-03	0.246	5.033E-01	7.454	1.713									
1860	2.257E-03	0.265	5.991E-01	7.805	1.719									
1920	2.364E-03	0.275	6.496E-01	7.975	1.722									
1980	2.156E-03	0.257	5.532E-01	7.642	1.717									
2040	2.100E-03	0.252	5.285E-01	7.551	1.715									
2100	2.183E-03	0.259	5.656E-01	7.687	1.717	17.87	2.11	5.3	78.68	13.18	0.73	0	6.03	0.021
2160	1.668E-03	0.212	3.541E-01	6.805	1.702									
2220	1.162E-03	0.162	1.886E-01	5.813	1.681									
2280	1.067E-03	0.152	1.625E-01	5.608	1.676									
2340	9.500E-04	0.140	1.329E-01	5.344	1.669									
2400	8.500E-04	0.129	1.095E-01	5.107	1.663									
2460	7.190E-04	0.114	8.181E-02	4.778	1.654									
2520	5.744E-04	0.096	5.535E-02	4.382	1.641								6.01	0.021
2580	5.859E-04	0.098	5.729E-02	4.415	1.642									
2640	4.235E-04	0.077	3.255E-02	3.919	1.624									
2700	2.630E-04	0.054	1.421E-02	3.336	1.598									
2760	1.333E-04	0.033	4.355E-03	2.731	1.562									
2820	8.333E-05	0.023	1.922E-03	2.426	1.537									
2880	2.333E-04	0.049	1.153E-02	3.213	1.592									
2940	5.333E-04	0.091	4.864E-02	4.262	1.637									
3000	8.208E-04	0.126	1.030E-01	5.036	1.661									
3060	7.646E-04	0.119	9.106E-02	4.895	1.657								6.04	0.024
3120	6.833E-04	0.110	7.487E-02	4.684	1.651									
3180	4.833E-04	0.085	4.098E-02	4.110	1.631									
3240	7.500E-04	0.117	8.804E-02	4.858	1.656									
3300	8.333E-04	0.127	1.058E-01	5.067	1.662									
3360	7.504E-04	0.117	8.812E-02	4.859	1.656									
3420	3.667E-04	0.069	2.533E-02	3.726	1.616									
3480	4.667E-04	0.083	3.855E-02	4.058	1.630									
3540	4.000E-04	0.074	2.948E-02	3.840	1.621									
3600	3.667E-04	0.069	2.533E-02	3.726	1.616									
3660	2.833E-04	0.057	1.617E-02	3.417	1.602									

Table E-48. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3720	2.167E-04	0.047	1.014E-02	3.140	1.588									
3780	6.640E-04	0.107	7.122E-02	4.632	1.649									
3840	9.928E-04	0.144	1.434E-01	5.442	1.672									
3900	1.322E-03	0.179	2.360E-01	6.143	1.688									
3960	1.476E-03	0.194	2.862E-01	6.447	1.695									
4020	1.375E-03	0.184	2.530E-01	6.250	1.691									
4080	1.290E-03	0.175	2.262E-01	6.079	1.687								6.14	0.031
4140	1.073E-03	0.153	1.643E-01	5.622	1.676									
4200	9.000E-04	0.134	1.209E-01	5.227	1.666									
4260	7.667E-04	0.119	9.148E-02	4.900	1.657									
4320	9.275E-04	0.137	1.274E-01	5.292	1.668									
4380	8.636E-04	0.130	1.125E-01	5.140	1.664									
4440	6.333E-04	0.104	6.559E-02	4.548	1.647									
4500	5.616E-04	0.095	5.322E-02	4.345	1.640									
4560	3.275E-04	0.064	2.081E-02	3.585	1.610									
4620	2.482E-04	0.052	1.284E-02	3.275	1.595									
4680	2.039E-04	0.045	9.124E-03	3.083	1.584									
4740	1.464E-04	0.035	5.122E-03	2.802	1.567									
4800	1.241E-04	0.031	3.843E-03	2.680	1.558									
4860	6.667E-05	0.020	1.303E-03	2.306	1.525									
4920	5.500E-05	0.017	9.322E-04	2.213	1.515									
4980	4.333E-05	0.014	6.156E-04	2.110	1.503									
5040	3.167E-05	0.011	3.566E-04	1.993	1.487									
5100	2.000E-05	0.008	1.602E-04	1.851	1.464									
5160	8.333E-06	0.004	3.491E-05	1.653	1.421									
5220	5.000E-06	0.003	1.435E-05	1.569	1.397									
5280	3.333E-06	0.002	7.084E-06	1.514	1.378									
5340	5.000E-07	0.001	2.607E-07	1.337	1.291									
5400	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 7

Total sediment mass = 623.439 g

Total runoff volume = 3.494 m^3

Total phosphorus mass = 21.216 g

Total DP mass = 5.874 g

Table E-49. Field data of event B090906S3 (site: B, plot: S3, date: 09/09/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
660	0.000E+00	0.000	0.000E+00	0.000	0.000									
720	3.110E-05	0.135	4.210E-03	5.749	1.162									
780	3.747E-04	1.252	4.692E-01	34.658	1.442									
840	4.160E-04	1.375	5.720E-01	37.553	1.456									
900	6.185E-04	1.960	1.212E+00	50.994	1.507									
960	6.771E-04	2.125	1.439E+00	54.704	1.518								6.03	0.023
1020	1.148E-03	3.408	3.914E+00	82.560	1.590									
1080	1.376E-03	4.005	5.510E+00	95.092	1.615									
1140	1.338E-03	3.907	5.227E+00	93.035	1.611									
1200	1.012E-03	3.044	3.081E+00	74.797	1.572									
1260	1.235E-03	3.637	4.491E+00	87.378	1.600									
1320	2.014E-03	5.630	1.134E+01	128.234	1.669	247.9	7.56	6.99	15.16	4.23	16.43	49.63	6.02	0.023
1380	2.518E-03	6.876	1.731E+01	152.905	1.702									
1440	2.453E-03	6.717	1.648E+01	149.781	1.698									
1500	2.008E-03	5.615	1.127E+01	127.931	1.669									
1560	1.595E-03	4.572	7.295E+00	106.806	1.636									
1620	1.423E-03	4.127	5.872E+00	97.627	1.620									
1680	2.136E-03	5.936	1.268E+01	134.342	1.678									
1740	2.261E-03	6.244	1.411E+01	140.452	1.686									
1800	2.017E-03	5.638	1.137E+01	128.386	1.669									
1860	1.844E-03	5.204	9.596E+00	119.661	1.656									
1920	1.386E-03	4.033	5.591E+00	95.666	1.616									
1980	1.730E-03	4.916	8.507E+00	113.829	1.647								5.98	0.020
2040	2.044E-03	5.706	1.166E+01	129.749	1.671									
2100	6.015E-04	1.912	1.150E+00	49.908	1.503									
2160	7.803E-04	2.413	1.883E+00	61.075	1.537									
2220	8.515E-04	2.608	2.221E+00	65.370	1.549									
2280	1.145E-03	3.400	3.895E+00	82.390	1.589									
2340	5.227E-04	1.686	8.815E-01	44.774	1.485									
2400	4.682E-04	1.528	7.155E-01	41.127	1.471									
2460	3.448E-04	1.163	4.010E-01	32.526	1.432								6.04	0.025
2520	4.061E-04	1.346	5.464E-01	36.863	1.453									
2580	3.288E-04	1.114	3.663E-01	31.363	1.426									
2640	1.937E-04	0.694	1.344E-01	21.011	1.362									
2700	1.012E-04	0.389	3.930E-02	13.010	1.287									
2760	1.768E-04	0.640	1.132E-01	19.630	1.351									
2820	3.891E-04	1.295	5.040E-01	35.675	1.447									
2880	8.870E-04	2.705	2.400E+00	67.481	1.554									
2940	1.045E-03	3.132	3.272E+00	76.670	1.577									
3000	7.811E-04	2.415	1.886E+00	61.121	1.537									
3060	3.621E-04	1.215	4.399E-01	33.765	1.438									
3120	7.555E-04	2.344	1.771E+00	59.557	1.533								6.02	0.029
3180	8.385E-04	2.573	2.157E+00	64.590	1.547									
3240	9.667E-04	2.922	2.824E+00	72.163	1.566									
3300	6.576E-04	2.070	1.361E+00	53.475	1.515									
3360	7.697E-04	2.383	1.834E+00	60.428	1.535									

Table E-49. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3420	6.712E-04	2.109	1.415E+00	54.333	1.517									
3480	6.515E-04	2.053	1.338E+00	53.092	1.513									
3540	4.682E-04	1.528	7.155E-01	41.127	1.471									
3600	2.818E-04	0.971	2.736E-01	27.889	1.407									
3660	3.621E-04	1.215	4.399E-01	33.765	1.438									
3720	1.044E-03	3.130	3.267E+00	76.627	1.577									
3780	1.309E-03	3.831	5.016E+00	91.464	1.608									
3840	2.083E-03	5.804	1.209E+01	131.712	1.674									
3900	1.902E-03	5.351	1.018E+01	122.618	1.661									
3960	1.326E-03	3.876	5.142E+00	92.407	1.610									
4020	9.045E-04	2.753	2.490E+00	68.520	1.557									
4080	6.500E-04	2.049	1.332E+00	52.997	1.513								6.20	0.021
4140	6.742E-04	2.117	1.428E+00	54.523	1.518									
4200	6.968E-04	2.180	1.519E+00	55.935	1.522									
4260	1.348E-03	3.934	5.305E+00	93.612	1.612									
4320	1.335E-03	3.899	5.204E+00	92.870	1.611									
4380	6.333E-04	2.002	1.268E+00	51.940	1.510									
4440	4.156E-04	1.374	5.710E-01	37.526	1.455									
4500	3.650E-04	1.223	4.465E-01	33.970	1.439									
4560	2.870E-04	0.987	2.831E-01	28.276	1.409									
4620	2.338E-04	0.821	1.920E-01	24.209	1.385									
4680	2.021E-04	0.721	1.458E-01	21.696	1.367									
4740	8.394E-05	0.329	2.760E-02	11.371	1.267									
4800	7.409E-05	0.294	2.179E-02	10.403	1.253									
4860	6.318E-05	0.255	1.612E-02	9.297	1.236									
4920	5.470E-05	0.224	1.226E-02	8.408	1.221									
4980	4.394E-05	0.184	8.100E-03	7.235	1.198									
5040	3.091E-05	0.135	4.161E-03	5.726	1.162									
5100	2.636E-05	0.117	3.078E-03	5.167	1.146									
5160	2.167E-05	0.098	2.123E-03	4.567	1.126									
5220	1.697E-05	0.079	1.337E-03	3.935	1.103									
5280	1.348E-05	0.064	8.648E-04	3.440	1.081									
5340	1.242E-05	0.060	7.405E-04	3.284	1.073									
5400	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 11
Total sediment mass = 15597.704 g
Total runoff volume = 3.919 m^3
Total phosphorus mass = 366.735 g
Total DP mass = 6.254 g

Table E-50. Field data of event B090906V3 (site: B, plot: V3, date: 09/09/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
780	1.063E-08	0.000	0.000E+00	0.000	0.000									
840	3.066E-06	0.319	9.784E-04	4.229	1.880									
900	1.045E-05	0.104	1.082E-03	4.511	1.819									
960	1.076E-05	0.371	3.990E-03	4.518	1.817									
1020	1.160E-05	0.685	7.944E-03	4.537	1.814									
1080	1.266E-05	0.575	7.274E-03	4.559	1.809									
1140	3.949E-05	0.185	7.316E-03	4.875	1.755									
1200	7.198E-05	0.131	9.396E-03	5.061	1.726									
1260	6.667E-05	0.173	1.154E-02	5.037	1.730									
1320	6.700E-05	0.205	1.373E-02	5.038	1.730								5.85	0.0123
1380	8.333E-05	0.250	2.081E-02	5.109	1.720									
1440	9.967E-05	0.652	6.501E-02	5.169	1.711									
1500	1.160E-04	3.102	3.598E-01	5.221	1.704									
1560	1.667E-04	1.954	3.256E-01	5.348	1.688									
1620	4.500E-04	0.622	2.800E-01	5.730	1.643									
1680	2.000E-03	0.136	2.719E-01	6.402	1.578									
1740	1.833E-03	0.127	2.325E-01	6.359	1.582									
1800	1.567E-03	0.171	2.674E-01	6.283	1.589									
1860	1.367E-03	0.283	3.874E-01	6.218	1.595									
1920	1.544E-03	0.220	3.392E-01	6.276	1.589									
1980	2.133E-03	0.154	3.290E-01	6.433	1.575									
2040	1.900E-03	0.159	3.020E-01	6.376	1.580									
2100	1.850E-03	0.038	7.057E-02	6.363	1.582	18.57	1.95	5.04	78.3	13.37	1.34	0	5.93	0.021
2160	1.717E-03	0.051	8.756E-02	6.327	1.585									
2220	1.417E-03	0.054	7.618E-02	6.235	1.593									
2280	1.567E-03	0.030	4.724E-02	6.283	1.589									
2340	1.067E-03	0.035	3.706E-02	6.103	1.605									
2400	8.833E-04	0.036	3.213E-02	6.018	1.613									
2460	7.167E-04	0.036	2.565E-02	5.927	1.623									
2520	5.667E-04	0.037	2.081E-02	5.826	1.633									
2580	4.833E-04	0.041	2.000E-02	5.760	1.640									
2640	5.833E-04	0.028	1.611E-02	5.838	1.632								6.02	0.032
2700	5.167E-04	0.022	1.158E-02	5.787	1.637									
2760	3.406E-04	0.029	1.000E-02	5.618	1.655									
2820	2.757E-04	0.026	7.274E-03	5.536	1.665									
2880	2.434E-04	0.048	1.158E-02	5.488	1.671									
2940	2.000E-04	0.092	1.844E-02	5.415	1.679									
3000	1.667E-04	0.154	2.565E-02	5.348	1.688									
3060	1.333E-04	0.296	3.952E-02	5.269	1.698									
3120	1.000E-04	0.515	5.149E-02	5.170	1.711									
3180	6.667E-05	0.373	2.486E-02	5.037	1.730								6.09	0.023
3240	1.000E-04	0.153	1.525E-02	5.170	1.711									
3300	1.500E-04	0.076	1.140E-02	5.311	1.693									
3360	2.000E-04	0.080	1.595E-02	5.415	1.679									
3420	4.167E-04	0.043	1.810E-02	5.699	1.647									

Table E-50. Continued.

Time (s)	Q (m³/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
3540	5.167E-04	0.034	1.734E-02	5.787	1.637									
3600	4.167E-04	0.045	1.868E-02	5.699	1.647									
3660	6.564E-04	0.023	1.487E-02	5.889	1.626									
3720	4.833E-04	0.095	4.608E-02	5.760	1.640									
3780	5.000E-04	0.082	4.084E-02	5.774	1.638									
3840	4.667E-04	0.165	7.704E-02	5.745	1.641									
3900	3.500E-04	0.509	1.781E-01	5.629	1.654									
3960	3.333E-04	0.616	2.052E-01	5.610	1.656	14.16	4.16	3.79	77.44	14.61	0	0	6.10	0.031
4020	3.000E-04	0.524	1.572E-01	5.569	1.661									
4080	5.218E-04	0.218	1.137E-01	5.791	1.637									
4140	1.083E-03	0.094	1.016E-01	6.111	1.605									
4200	1.467E-03	0.077	1.123E-01	6.252	1.591									
4260	1.333E-03	0.064	8.590E-02	6.207	1.596									
4320	1.167E-03	0.062	7.262E-02	6.145	1.601									
4380	1.017E-03	0.058	5.904E-02	6.082	1.607									
4440	9.667E-04	0.048	4.604E-02	6.059	1.610									
4500	7.500E-04	0.075	5.605E-02	5.946	1.621									
4560	6.000E-04	0.069	4.158E-02	5.850	1.630									
4620	5.167E-04	0.045	2.316E-02	5.787	1.637									
4680	6.000E-04	0.027	1.624E-02	5.850	1.630									
4740	8.500E-04	0.015	1.306E-02	6.001	1.615									
4800	7.167E-04	0.014	1.031E-02	5.927	1.623									
4860	5.333E-04	0.014	7.466E-03	5.801	1.636									
4920	2.667E-04	0.016	4.176E-03	5.523	1.666									
4980	1.343E-04	0.025	3.408E-03	5.271	1.698									
5040	1.111E-04	0.021	2.339E-03	5.206	1.706									
5100	9.036E-05	0.030	2.714E-03	5.136	1.716									
5160	6.819E-05	0.010	6.719E-04	5.044	1.729									
5220	4.603E-05	0.011	5.000E-04	4.921	1.747									
5280	4.603E-05	0.007	3.000E-04	4.921	1.747									
5340	3.144E-05	0.000	0.000E+00	0.000	0.000									

Number of field samples = 8
Total sediment mass = 329.037 g
Total runoff volume = 2.690 m^3
Total phosphorus mass = 16.288 g
Total DP mass = 4.332 g

Table E-51. Field data of event B090906V1 (site: B, plot: V1, date: 09/09/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
120	0.000E+00	0.0000	0.000E+00	0.000	0.000									
180	7.013E-06	0.0163	1.121E-04	1.996	1.449									
240	6.932E-06	0.0158	1.094E-04	1.992	1.448									
300	6.816E-06	0.0145	9.905E-05	1.987	1.447									
360	6.376E-06	0.0147	9.375E-05	1.967	1.443									
420	6.144E-06	0.0154	9.454E-05	1.956	1.440									
480	6.178E-06	0.0162	9.985E-05	1.958	1.440									
540	6.410E-06	0.0163	1.044E-04	1.969	1.443									
600	6.608E-06	0.0157	1.036E-04	1.978	1.445									
660	6.573E-06	0.0207	1.363E-04	1.976	1.445									
720	7.907E-06	0.0226	1.785E-04	2.034	1.457									
780	9.484E-06	0.0207	1.959E-04	2.094	1.470									
840	1.010E-05	0.0204	2.060E-04	2.116	1.474									
900	1.045E-05	0.0205	2.138E-04	2.128	1.477									
960	1.071E-05	0.0220	2.358E-04	2.137	1.479									
1020	1.144E-05	0.0231	2.647E-04	2.161	1.483									
1080	1.237E-05	4.5554	5.636E-02	2.190	1.489									
1140	4.602E-04	0.3038	1.398E-01	5.180	1.768									
1200	8.494E-04	0.2022	1.717E-01	6.282	1.820								5.98	0.023
1260	9.757E-04	0.1979	1.931E-01	6.573	1.832									
1320	1.056E-03	0.1868	1.972E-01	6.747	1.839									
1380	1.071E-03	0.2095	2.245E-01	6.779	1.840									
1440	1.169E-03	0.2447	2.860E-01	6.979	1.848									
1500	1.376E-03	0.2315	3.187E-01	7.374	1.862									
1560	1.481E-03	0.2156	3.193E-01	7.559	1.869									
1620	1.483E-03	0.2228	3.304E-01	7.562	1.869									
1680	1.517E-03	0.2293	3.478E-01	7.622	1.871									
1740	1.571E-03	0.2251	3.535E-01	7.713	1.874									
1800	1.588E-03	0.2318	3.681E-01	7.742	1.875									
1860	1.632E-03	0.2529	4.127E-01	7.815	1.877									
1920	1.763E-03	0.2559	4.512E-01	8.026	1.884	23.93	1.18	3.3	56.54	5.33	17.85	15.81	6.02	0.025
1980	1.872E-03	0.2543	4.760E-01	8.195	1.890									
2040	1.941E-03	0.2636	5.115E-01	8.299	1.893									
2100	2.037E-03	0.2460	5.012E-01	8.441	1.897									
2160	2.010E-03	0.2438	4.900E-01	8.400	1.896									
2220	1.979E-03	0.2313	4.577E-01	8.355	1.895									
2280	1.890E-03	0.2301	4.348E-01	8.222	1.890									
2340	1.826E-03	0.2140	3.907E-01	8.125	1.887									
2400	1.699E-03	0.2066	3.509E-01	7.924	1.881									
2460	1.580E-03	0.2015	3.184E-01	7.729	1.874									
2520	1.480E-03	0.1766	2.613E-01	7.557	1.869									
2580	1.295E-03	0.1775	2.299E-01	7.223	1.857									
2640	1.188E-03	0.1720	2.043E-01	7.017	1.849									
2700	1.097E-03	0.1699	1.864E-01	6.833	1.842									
2760	1.031E-03	0.1503	1.550E-01	6.694	1.837	21.17	1.7	3.28	59.77	6.97	16.21	12.07	6.09	0.032
2820	9.106E-04	0.1407	1.281E-01	6.426	1.826									
2880	8.006E-04	0.1761	1.410E-01	6.163	1.815									
2940	8.542E-04	0.2149	1.836E-01	6.293	1.820									
3000	1.021E-03	0.2101	2.145E-01	6.671	1.836									
3060	1.133E-03	0.2060	2.335E-01	6.907	1.845									

Table E-51. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45um (%)	0.45-2um (%)	2-37um (%)	37-100um (%)	100-250um (%)	>250um (%)	pH	EC (S/m)
3180	1.233E-03	0.1970	2.429E-01	7.105	1.853									
3240	1.233E-03	0.2018	2.488E-01	7.105	1.853									
3300	1.253E-03	0.2049	2.568E-01	7.143	1.854									
3360	1.280E-03	0.2037	2.607E-01	7.194	1.856									
3420	1.293E-03	0.2023	2.616E-01	7.220	1.857									
3480	1.296E-03	0.2038	2.642E-01	7.225	1.857								6.02	0.028
3540	1.305E-03	0.1826	2.382E-01	7.241	1.857									
3600	1.217E-03	0.1825	2.220E-01	7.073	1.851									
3660	1.160E-03	0.1851	2.147E-01	6.962	1.847									
3720	1.134E-03	0.1790	2.030E-01	6.909	1.845									
3780	1.092E-03	0.1914	2.091E-01	6.823	1.842									
3840	1.114E-03	0.2041	2.275E-01	6.868	1.844									
3900	1.179E-03	0.2039	2.404E-01	7.000	1.849									
3960	1.224E-03	0.2109	2.582E-01	7.088	1.852									
4020	1.285E-03	0.1981	2.545E-01	7.204	1.856									
4080	1.272E-03	0.2083	2.650E-01	7.180	1.855									
4140	1.308E-03	0.2201	2.878E-01	7.247	1.858									
4200	1.382E-03	0.1920	2.653E-01	7.384	1.863								6.09	0.031
4260	1.309E-03	0.2054	2.688E-01	7.248	1.858									
4320	1.320E-03	0.1999	2.639E-01	7.270	1.859									
4380	1.304E-03	0.1898	2.474E-01	7.240	1.857									
4440	1.248E-03	0.1842	2.299E-01	7.134	1.854									
4500	1.188E-03	0.1656	1.967E-01	7.017	1.849									
4560	1.069E-03	0.1461	1.562E-01	6.775	1.840									
4620	9.154E-04	0.1253	1.147E-01	6.437	1.826									
4680	7.432E-04	0.1040	7.732E-02	6.017	1.808									
4740	5.696E-04	0.0886	5.049E-02	5.532	1.786									
4800	4.273E-04	0.0789	3.370E-02	5.065	1.762									
4860	3.253E-04	0.0690	2.245E-02	4.670	1.739									
4920	2.474E-04	0.0545	1.349E-02	4.317	1.716									
4980	1.754E-04	0.0534	9.368E-03	3.926	1.689								6.02	0.028
5040	1.372E-04	0.0436	5.977E-03	3.678	1.669									
5100	1.013E-04	0.0456	4.623E-03	3.404	1.645									
5160	8.519E-05	0.0373	3.176E-03	3.263	1.632									
5220	6.612E-05	0.0355	2.346E-03	3.072	1.612									
5280	5.391E-05	0.0349	1.884E-03	2.932	1.597									
5340	4.649E-05	0.0355	1.649E-03	2.837	1.585									
5400	4.250E-05	0.0354	1.504E-03	2.782	1.579									
5460	3.994E-05	0.0292	1.167E-03	2.745	1.574									
5520	3.367E-05	0.0099	3.341E-04	2.648	1.561									
5580	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples	7	
Total sediment mass =	984.7368	g
Total runoff volume =	4.8407	m^3
Total phosphorus mass =	35.1225	g
Total DP mass =	8.9820	g

Table E-52. Field data of event B090906V4 (site: B, plot: V4, date: 09/09/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1020	0.000E+00	0.0000	0.000E+00	0.000	0.000									
1080	3.278E-05	0.0164	5.381E-04	3.408	1.793									
1140	4.705E-05	0.0207	9.752E-04	3.642	1.769									
1200	1.096E-04	0.0358	3.921E-03	4.367	1.712									
1260	1.592E-04	0.0456	7.258E-03	4.785	1.688									
1320	2.161E-04	0.0555	1.200E-02	5.180	1.668									
1380	2.812E-04	0.0658	1.851E-02	5.566	1.652									
1440	6.437E-04	0.1124	7.237E-02	7.107	1.600									
1500	7.510E-04	0.1242	9.329E-02	7.458	1.591									
1560	7.009E-04	0.1188	8.326E-02	7.298	1.595									
1620	5.996E-04	0.1074	6.439E-02	6.952	1.605									
1680	5.955E-04	0.1069	6.367E-02	6.938	1.605								5.86	0.023
1740	8.186E-04	0.1313	1.075E-01	7.665	1.585									
1800	1.150E-03	0.1636	1.881E-01	8.559	1.565									
1860	1.268E-03	0.1742	2.209E-01	8.840	1.559									
1920	1.497E-03	0.1940	2.905E-01	9.347	1.549									
1980	1.523E-03	0.1962	2.988E-01	9.401	1.548									
2040	1.563E-03	0.1995	3.117E-01	9.483	1.547									
2100	1.419E-03	0.1874	2.660E-01	9.180	1.552									
2160	1.282E-03	0.1755	2.250E-01	8.873	1.558								6.02	0.022
2220	9.244E-04	0.1421	1.313E-01	7.970	1.578									
2280	7.805E-04	0.1273	9.939E-02	7.550	1.588									
2340	6.976E-04	0.1184	8.261E-02	7.287	1.595									
2400	7.576E-04	0.1249	9.463E-02	7.479	1.590									
2460	6.496E-04	0.1131	7.347E-02	7.127	1.600									
2520	4.854E-04	0.0937	4.547E-02	6.519	1.618									
2580	4.008E-04	0.0828	3.317E-02	6.159	1.629									
2640	3.818E-04	0.0802	3.063E-02	6.072	1.632									
2700	3.226E-04	0.0719	2.320E-02	5.785	1.643									
2760	2.660E-04	0.0635	1.690E-02	5.481	1.655									
2820	2.099E-04	0.0545	1.144E-02	5.140	1.670									
2880	1.913E-04	0.0513	9.816E-03	5.016	1.676									
2940	2.771E-04	0.0652	1.806E-02	5.543	1.653									
3000	5.814E-04	0.1053	6.121E-02	6.887	1.606									
3060	7.381E-04	0.1228	9.065E-02	7.418	1.592									
3120	8.667E-04	0.1363	1.181E-01	7.806	1.582									
3180	8.397E-04	0.1335	1.121E-01	7.728	1.584									
3240	8.885E-04	0.1385	1.230E-01	7.869	1.581									
3300	9.936E-04	0.1488	1.479E-01	8.159	1.574	17.23	1.96	3.68	79.37	14.97	0.01	0	6.20	0.034
3360	1.041E-03	0.1534	1.597E-01	8.284	1.571									
3420	9.077E-04	0.1404	1.274E-01	7.923	1.579									
3480	9.615E-04	0.1457	1.401E-01	8.072	1.576									
3540	9.923E-04	0.1487	1.476E-01	8.155	1.574									
3600	9.167E-04	0.1413	1.295E-01	7.949	1.579									
3660	7.747E-04	0.1267	9.819E-02	7.532	1.589									

Table E-52. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3720	6.706E-04	0.1154	7.742E-02	7.198	1.598									
3780	6.726E-04	0.1157	7.779E-02	7.204	1.597									
3840	8.167E-04	0.1311	1.071E-01	7.659	1.586									
3900	1.215E-03	0.1695	2.061E-01	8.717	1.562									
3960	1.273E-03	0.1747	2.224E-01	8.852	1.559								6.13	0.032
4020	1.376E-03	0.1837	2.527E-01	9.084	1.554									
4080	1.313E-03	0.1782	2.340E-01	8.943	1.557									
4140	1.176E-03	0.1659	1.951E-01	8.621	1.564									
4200	1.068E-03	0.1559	1.665E-01	8.353	1.569									
4260	1.087E-03	0.1578	1.715E-01	8.402	1.568									
4320	1.067E-03	0.1558	1.662E-01	8.350	1.569								6.03	0.027
4380	9.564E-04	0.1452	1.389E-01	8.058	1.576									
4440	8.897E-04	0.1386	1.233E-01	7.873	1.580									
4500	6.577E-04	0.1140	7.498E-02	7.154	1.599									
4560	4.382E-04	0.0877	3.843E-02	6.323	1.624									
4620	2.710E-04	0.0643	1.742E-02	5.509	1.654									
4680	2.429E-04	0.0599	1.455E-02	5.346	1.661									
4740	2.262E-04	0.0572	1.293E-02	5.244	1.666									
4800	1.864E-04	0.0505	9.408E-03	4.982	1.678									
4860	1.723E-04	0.0480	8.265E-03	4.882	1.683									
4920	1.522E-04	0.0443	6.736E-03	4.730	1.691									
4980	1.320E-04	0.0404	5.332E-03	4.567	1.700									
5040	1.119E-04	0.0363	4.060E-03	4.388	1.711									
5100	1.020E-04	0.0342	3.486E-03	4.294	1.717									
5160	5.207E-05	0.0221	1.152E-03	3.715	1.762									
5220	4.648E-05	0.0206	9.559E-04	3.634	1.770									
5280	4.089E-05	0.0189	7.742E-04	3.547	1.778									
5340	2.524E-05	0.0139	3.498E-04	3.261	1.811									
5400	2.198E-05	0.0127	2.785E-04	3.190	1.821									
5460	1.872E-05	0.0114	2.138E-04	3.114	1.832									
5520	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples =	7	
Total sediment mass =	407.5519	g
Total runoff volume =	2.8790	m^3
Total phosphorus mass =	22.7113	g
Total DP mass =	4.5597	g

Table E-53. Field data of event B091006S2 (site: B, plot: S2, date: 09/10/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	900	0.000E+00	0.000	0.000E+00	0.000	0.000									
60	1.667E-06	960	1.111E-05	0.026	2.937E-04	2.033	1.410									
180	1.667E-06	1020	1.154E-05	0.027	3.163E-04	2.058	1.411									
240	1.667E-06	1080	1.268E-05	0.030	3.804E-04	2.126	1.414									
300	3.333E-06	1140	1.468E-05	0.035	5.065E-04	2.243	1.419									
360	3.333E-06	1200	2.939E-05	0.067	1.976E-03	3.098	1.443									
420	3.333E-06	1260	3.217E-05	0.073	2.359E-03	3.258	1.446									
480	3.333E-06	1320	4.086E-05	0.092	3.769E-03	3.757	1.455									
540	3.333E-06	1380	5.251E-05	0.117	6.163E-03	4.425	1.463									
600	5.000E-06	1440	5.484E-05	0.122	6.710E-03	4.559	1.465									
660	6.667E-06	1500	6.774E-05	0.150	1.015E-02	5.297	1.472									
720	6.667E-06	1560	7.518E-05	0.166	1.245E-02	5.723	1.476									
780	5.000E-06	1620	1.663E-04	0.355	5.904E-02	10.926	1.504								6.03	0.023
840	3.333E-06	1680	4.827E-04	0.988	4.767E-01	28.999	1.543									
900	3.333E-06	1740	7.513E-04	1.510	1.135E+00	44.361	1.560									
960	5.000E-06	1800	9.132E-04	1.821	1.663E+00	53.628	1.567									
1020	3.333E-06	1860	1.170E-03	2.311	2.704E+00	68.344	1.577									
1080	3.333E-06	1920	1.209E-03	2.385	2.884E+00	70.585	1.578									
1140	5.000E-06	1980	1.544E-03	3.015	4.655E+00	89.766	1.587									
1200	5.000E-06	2040	1.629E-03	3.175	5.171E+00	94.648	1.589	261.4	7.64	6.67	14.72	3.39	15.51	52.06	6.11	0.021
1260	6.667E-06	2100	1.821E-03	3.534	6.437E+00	105.700	1.593									
1320	5.000E-06	2160	1.628E-03	3.172	5.164E+00	94.580	1.589									
1380	8.333E-06	2220	1.584E-03	3.091	4.897E+00	92.086	1.588									
1440	1.667E-05	2280	1.229E-03	2.423	2.979E+00	71.743	1.578									
1500	1.333E-05	2340	8.916E-04	1.780	1.587E+00	52.391	1.566									
1560	1.667E-05	2400	4.668E-04	0.956	4.465E-01	28.091	1.542								6.21	0.031
1620	1.667E-05	2460	3.606E-04	0.746	2.691E-01	22.018	1.533									
1680	1.833E-05	2520	3.109E-04	0.647	2.013E-01	19.183	1.527									
1740	1.833E-05	2580	3.144E-04	0.654	2.058E-01	19.383	1.528									
1800	2.000E-05	2640	3.429E-04	0.711	2.439E-01	21.008	1.531									
1860	2.167E-05	2700	4.510E-04	0.925	4.174E-01	27.188	1.541									
1920	2.667E-05	2760	4.976E-04	1.017	5.059E-01	29.848	1.545									
1980	2.500E-05	2820	5.430E-04	1.106	6.004E-01	32.445	1.548									
2040	2.667E-05	2880	6.846E-04	1.381	9.456E-01	40.543	1.556									
2100	1.167E-05	2940	1.059E-03	2.099	2.222E+00	61.962	1.573									
2160	5.000E-06	3000	1.086E-03	2.152	2.338E+00	63.553	1.574									
2220	3.333E-06	3060	1.101E-03	2.179	2.399E+00	64.375	1.574								6.16	0.023
2280	3.333E-06	3120	1.080E-03	2.139	2.310E+00	63.168	1.573									
2340	3.333E-06	3180	9.982E-04	1.984	1.980E+00	58.497	1.571									
2400	6.667E-06	3240	8.925E-04	1.782	1.590E+00	52.442	1.566									
2460	5.000E-06	3300	8.634E-04	1.726	1.490E+00	50.775	1.565									
2520	5.000E-06	3360	9.651E-04	1.921	1.853E+00	56.598	1.569									
2580	5.000E-06	3420	8.732E-04	1.745	1.524E+00	51.339	1.565									
2640	8.333E-06	3480	6.676E-04	1.348	9.000E-01	39.569	1.555									
2700	1.167E-05	3540	5.278E-04	1.076	5.679E-01	31.574	1.547									
2760	1.167E-05	3600	4.283E-04	0.880	3.771E-01	25.889	1.539									

Table E-53. Continued.

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
2820	1.667E-05	3660	3.347E-04	0.695	2.325E-01	20.539	1.530									
2880	1.333E-05	3720	1.815E-04	0.386	7.004E-02	11.790	1.508									
2940	1.333E-05	3780	1.372E-04	0.295	4.049E-02	9.264	1.497								6.02	0.020
3000	8.333E-06	3840	8.109E-05	0.178	1.445E-02	6.061	1.479									
3060	8.333E-06	3900	8.293E-05	0.182	1.510E-02	6.166	1.479									
3120	1.667E-05	3960	7.236E-05	0.160	1.155E-02	5.561	1.475									
3180	1.167E-05	4020	6.273E-05	0.139	8.733E-03	5.011	1.470									
3240	8.333E-06	4080	6.606E-05	0.146	9.666E-03	5.201	1.471									
3300	6.667E-06	4140	5.940E-05	0.132	7.847E-03	4.820	1.468									
3360	5.000E-06	4200	4.629E-05	0.104	4.814E-03	4.069	1.459									
3420	5.000E-06	4260	2.233E-05	0.052	1.154E-03	2.690	1.434									
3480	3.333E-06	4320	1.076E-05	0.026	2.754E-04	2.012	1.409									
3540	1.667E-06	4380	0.000E+00	0.000	0.000E+00	0.000	0.000									
3600	1.667E-06															
3660	1.667E-06															
3720	0.000E+00															

Number of field samples = 6

Total sediment mass = 3819.574 g

Total runoff volume = 1.866 m^3

Total phosphorus mass = 113.234 g

Total DP mass = 2.921 g

Table E-54. Field data of event B091006V2 (site: B, plot: V2, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
960	0.000E+00	0.000	0.000E+00	0.000	0.000									
1020	3.533E-06	0.003	9.978E-06	1.547	1.447									
1080	6.843E-06	0.005	3.106E-05	1.652	1.499									
1140	7.317E-06	0.005	3.484E-05	1.665	1.504									
1200	7.929E-06	0.005	4.000E-05	1.680	1.511									
1260	8.263E-06	0.005	4.294E-05	1.687	1.514									
1320	8.402E-06	0.005	4.419E-05	1.691	1.515									
1380	8.555E-06	0.005	4.559E-05	1.694	1.517									
1440	8.750E-06	0.005	4.738E-05	1.699	1.519									
1500	8.750E-06	0.005	4.738E-05	1.699	1.519									
1560	8.750E-06	0.005	4.738E-05	1.699	1.519									
1620	8.945E-06	0.006	4.921E-05	1.703	1.521									
1680	1.646E-05	0.009	1.402E-04	1.842	1.571									
1740	2.050E-05	0.010	2.045E-04	1.902	1.590									
1800	3.907E-05	0.016	6.193E-04	2.120	1.646									
1860	5.010E-05	0.019	9.495E-04	2.225	1.668									
1920	2.199E-04	0.055	1.205E-02	3.258	1.805									
1980	3.926E-04	0.083	3.262E-02	3.977	1.862									
2040	4.923E-04	0.098	4.812E-02	4.334	1.885								6.02	0.023
2100	9.110E-04	0.152	1.385E-01	5.597	1.948									
2160	1.284E-03	0.195	2.497E-01	6.541	1.984									
2220	1.430E-03	0.210	3.006E-01	6.883	1.996								6.12	0.031
2280	1.221E-03	0.188	2.292E-01	6.391	1.979									
2340	1.058E-03	0.169	1.791E-01	5.984	1.964									
2400	9.565E-04	0.157	1.506E-01	5.719	1.953									
2460	6.662E-04	0.121	8.092E-02	4.895	1.916									
2520	4.818E-04	0.096	4.637E-02	4.298	1.883									
2580	3.412E-04	0.075	2.563E-02	3.779	1.848									
2640	2.315E-04	0.057	1.317E-02	3.313	1.810									
2700	1.790E-04	0.047	8.464E-03	3.057	1.785									
2760	1.687E-04	0.045	7.644E-03	3.004	1.780									
2820	1.703E-04	0.046	7.771E-03	3.012	1.781									
2880	2.013E-04	0.051	1.036E-02	3.169	1.797	7.39	3.15	2.36	94.49	0	0	0	5.98	0.021
2940	2.275E-04	0.056	1.277E-02	3.294	1.808									
3000	2.873E-04	0.066	1.907E-02	3.559	1.831									
3060	3.787E-04	0.081	3.066E-02	3.925	1.859									
3120	4.586E-04	0.093	4.259E-02	4.217	1.878									
3180	5.856E-04	0.111	6.483E-02	4.643	1.903									
3240	6.076E-04	0.114	6.908E-02	4.713	1.906								6.21	0.022
3300	6.403E-04	0.118	7.559E-02	4.815	1.912									
3360	6.114E-04	0.114	6.982E-02	4.725	1.907									
3420	5.535E-04	0.106	5.885E-02	4.539	1.897									
3480	5.321E-04	0.103	5.500E-02	4.468	1.893									
3540	3.220E-04	0.072	2.320E-02	3.703	1.843									
3600	2.472E-04	0.060	1.473E-02	3.384	1.817								6.15	0.032

Table E-54. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3660	1.971E-04	0.051	9.982E-03	3.148	1.795									
3720	1.770E-04	0.047	8.298E-03	3.047	1.784									
3780	1.512E-04	0.042	6.333E-03	2.909	1.769									
3840	1.192E-04	0.035	4.210E-03	2.724	1.747									
3900	1.007E-04	0.031	3.149E-03	2.607	1.731									
3960	6.370E-05	0.023	1.435E-03	2.340	1.689									
4020	4.569E-05	0.018	8.104E-04	2.184	1.659									
4080	3.588E-05	0.015	5.352E-04	2.087	1.638									
4140	1.974E-05	0.010	1.917E-04	1.891	1.586									
4200	1.846E-05	0.009	1.709E-04	1.873	1.581									
4260	1.055E-05	0.006	6.534E-05	1.737	1.534									
4320	8.900E-06	0.005	4.879E-05	1.702	1.520									
4380	5.350E-06	0.004	2.035E-05	1.610	1.479									
4440	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples =	5	
Total sediment mass =	126.885	g
Total runoff volume =	1.021	m^3
Total phosphorus mass =	5.019	g
Total DP mass =	1.942	g

Table E-55. Field data of event B091006S3 (site: B, plot: S3, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1140	0.000E+00	0.000	0.000E+00	0.000	0.000									
1200	8.917E-06	0.024	2.173E-04	1.990	1.449									
1260	1.242E-05	0.034	4.201E-04	2.213	1.458									
1320	1.592E-05	0.043	6.889E-04	2.434	1.464									
1380	1.942E-05	0.053	1.023E-03	2.655	1.469									
1440	4.050E-05	0.109	4.423E-03	3.978	1.489									
1500	5.867E-05	0.158	9.251E-03	5.117	1.499									
1560	2.051E-04	0.545	1.118E-01	14.320	1.533									
1620	2.637E-04	0.699	1.844E-01	18.017	1.540									
1680	6.200E-04	1.632	1.012E+00	40.597	1.564									
1740	7.417E-04	1.949	1.445E+00	48.336	1.570									
1800	8.550E-04	2.244	1.918E+00	55.553	1.574									
1860	8.867E-04	2.326	2.063E+00	57.572	1.575									
1920	1.318E-03	3.446	4.542E+00	85.117	1.586									
1980	1.355E-03	3.540	4.795E+00	87.450	1.587									
2040	1.582E-03	4.130	6.534E+00	102.023	1.591									
2100	1.782E-03	4.646	8.279E+00	114.826	1.595									
2160	1.514E-03	3.954	5.987E+00	97.671	1.590									
2220	1.168E-03	3.056	3.569E+00	75.515	1.582									
2280	1.018E-03	2.666	2.713E+00	65.916	1.579									
2340	8.342E-04	2.190	1.827E+00	54.226	1.573	217	5.11	6	12.71	4.37	29.73	42.08	6.24	0.018
2400	5.100E-04	1.345	6.858E-01	33.611	1.559									
2460	3.333E-04	0.882	2.941E-01	22.418	1.547									
2520	3.045E-04	0.807	2.456E-01	20.595	1.544									
2580	2.507E-04	0.665	1.668E-01	17.199	1.539									
2640	3.480E-04	0.921	3.203E-01	23.343	1.548									
2700	4.685E-04	1.236	5.792E-01	30.980	1.557									
2760	5.446E-04	1.435	7.815E-01	35.807	1.561									
2820	6.172E-04	1.624	1.003E+00	40.418	1.564									
2880	6.689E-04	1.759	1.177E+00	43.703	1.567									
2940	7.208E-04	1.894	1.365E+00	47.005	1.569									
3000	7.749E-04	2.035	1.577E+00	50.448	1.571									
3060	7.895E-04	2.073	1.637E+00	51.379	1.571									
3120	7.895E-04	2.073	1.637E+00	51.379	1.571									
3180	7.705E-04	2.024	1.559E+00	50.169	1.571									
3240	7.434E-04	1.953	1.452E+00	48.447	1.570									
3300	7.588E-04	1.993	1.513E+00	49.424	1.570									
3360	7.741E-04	2.033	1.574E+00	50.402	1.571									
3420	7.588E-04	1.993	1.513E+00	49.424	1.570									
3480	7.208E-04	1.894	1.365E+00	47.005	1.569									
3540	5.424E-04	1.429	7.752E-01	35.668	1.561									
3600	2.661E-04	0.706	1.877E-01	18.168	1.541									
3660	1.842E-04	0.490	9.028E-02	13.004	1.530									
3720	1.738E-04	0.463	8.044E-02	12.351	1.529									
3780	1.721E-04	0.458	7.883E-02	12.241	1.529									

Table E-55. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3840	1.572E-04	0.419	6.587E-02	11.306	1.526									
3900	1.424E-04	0.380	5.406E-02	10.372	1.523									
3960	1.275E-04	0.340	4.341E-02	9.438	1.520									
4020	1.127E-04	0.301	3.393E-02	8.505	1.517									
4080	9.783E-05	0.262	2.561E-02	7.573	1.513									
4140	8.298E-05	0.222	1.845E-02	6.641	1.508									
4200	6.813E-05	0.183	1.246E-02	5.710	1.503									
4260	5.847E-05	0.157	9.188E-03	5.104	1.499									
4320	5.138E-05	0.138	7.105E-03	4.660	1.495									
4380	3.397E-05	0.092	3.116E-03	3.569	1.484									
4440	1.731E-05	0.047	8.137E-04	2.522	1.466									
4500	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 6

Total sediment mass = 4015.63 g

Total runoff volume = 1.694 m^3

Total phosphorus mass = 99.583 g

Total DP mass = 2.660 g

Table E-56. Field data of event B091006V3 (site: B, plot: V3, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1620	0.000E+00	0.000	0.000E+00	0.000	0.000									
1680	2.050E-05	0.029	5.897E-04	1.970	1.419									
1740	3.567E-05	0.038	1.345E-03	2.195	1.443									
1800	5.700E-05	0.047	2.703E-03	2.443	1.463									
1860	1.330E-04	0.072	9.542E-03	3.079	1.502									
1920	1.920E-04	0.086	1.648E-02	3.457	1.518	27.57	2.06	2.04	61.89	23.53	10.16	0.31	5.94	0.023
1980	2.775E-04	0.103	2.852E-02	3.920	1.536									
2040	4.437E-04	0.129	5.735E-02	4.662	1.558									
2100	7.507E-04	0.167	1.255E-01	5.754	1.583									
2160	8.587E-04	0.178	1.533E-01	6.088	1.589									
2220	1.060E-03	0.198	2.096E-01	6.663	1.599									
2280	7.952E-04	0.172	1.367E-01	5.895	1.585									
2340	5.167E-04	0.139	7.195E-02	4.947	1.565									
2400	4.762E-04	0.134	6.372E-02	4.791	1.561									
2460	3.156E-04	0.109	3.455E-02	4.105	1.542								5.77	0.026
2520	2.120E-04	0.090	1.910E-02	3.573	1.523									
2580	1.777E-04	0.083	1.469E-02	3.371	1.515									
2640	1.536E-04	0.077	1.182E-02	3.218	1.508									
2700	1.707E-04	0.081	1.383E-02	3.328	1.513									
2760	2.170E-04	0.091	1.978E-02	3.601	1.524									
2820	2.810E-04	0.103	2.905E-02	3.937	1.536									
2880	3.309E-04	0.112	3.706E-02	4.176	1.544	27.95	1.77	3.7	56.65	21.08	15.81	1.00	5.93	0.023
2940	3.682E-04	0.118	4.344E-02	4.344	1.549									
3000	3.946E-04	0.122	4.817E-02	4.458	1.552									
3060	4.125E-04	0.125	5.146E-02	4.534	1.554									
3120	4.748E-04	0.134	6.345E-02	4.786	1.561									
3180	5.258E-04	0.140	7.385E-02	4.981	1.566									
3240	5.546E-04	0.144	7.995E-02	5.087	1.568									
3300	4.848E-04	0.135	6.543E-02	4.824	1.562									
3360	4.451E-04	0.129	5.763E-02	4.668	1.558									
3420	3.927E-04	0.122	4.782E-02	4.450	1.552									
3480	3.479E-04	0.115	3.993E-02	4.254	1.546								5.78	0.013
3540	2.974E-04	0.106	3.161E-02	4.018	1.539									
3600	2.464E-04	0.097	2.389E-02	3.761	1.530									
3660	1.954E-04	0.087	1.692E-02	3.477	1.519									
3720	1.551E-04	0.077	1.199E-02	3.228	1.509									
3780	1.108E-04	0.066	7.275E-03	2.917	1.493									
3840	8.251E-05	0.057	4.688E-03	2.686	1.480									
3900	5.975E-05	0.049	2.899E-03	2.471	1.465								5.94	0.020
3960	5.631E-05	0.047	2.654E-03	2.436	1.463									
4020	4.996E-05	0.044	2.222E-03	2.367	1.458									
4080	4.643E-05	0.043	1.992E-03	2.327	1.454									
4140	2.947E-05	0.034	1.012E-03	2.111	1.434									
4200	1.617E-05	0.026	4.141E-04	1.891	1.408									
4260	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 7
Total sediment mass = 104.150 g
Total runoff volume = 0.793 m^3
Total phosphorus mass = 3.758 g
Total DP mass = 1.233 g

Table E-57. Field data of event B091006V1 (site: B, plot: V1, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
660	0.000E+00	0.0000	0.000E+00	0.000	0.000									
720	8.124E-06	0.0074	6.047E-05	1.510	1.277									
780	8.889E-06	0.0079	7.025E-05	1.535	1.288									
840	8.750E-06	0.0078	6.843E-05	1.530	1.286									
900	9.140E-06	0.0080	7.357E-05	1.543	1.291									
960	8.945E-06	0.0079	7.098E-05	1.537	1.289									
1020	8.555E-06	0.0077	6.591E-05	1.524	1.283									
1080	8.458E-06	0.0076	6.466E-05	1.521	1.282									
1140	8.555E-06	0.0077	6.591E-05	1.524	1.283									
1200	8.695E-06	0.0078	6.770E-05	1.529	1.285									
1260	8.360E-06	0.0076	6.343E-05	1.518	1.280									
1320	8.458E-06	0.0076	6.466E-05	1.521	1.282									
1380	8.750E-06	0.0078	6.843E-05	1.530	1.286									
1440	8.945E-06	0.0079	7.098E-05	1.537	1.289									
1500	8.945E-06	0.0079	7.098E-05	1.537	1.289									
1560	9.140E-06	0.0080	7.357E-05	1.543	1.291									
1620	1.055E-05	0.0089	9.336E-05	1.584	1.310									
1680	5.060E-05	0.0251	1.270E-03	2.258	1.526									
1740	5.162E-05	0.0254	1.313E-03	2.270	1.529									
1800	5.265E-05	0.0258	1.357E-03	2.282	1.532									
1860	9.393E-05	0.0379	3.557E-03	2.698	1.621									
1920	3.265E-04	0.0867	2.830E-02	4.176	1.831									
1980	5.411E-04	0.1213	6.561E-02	5.138	1.923								6.03	0.016
2040	8.627E-04	0.1653	1.426E-01	6.315	2.013									
2100	9.722E-04	0.1790	1.740E-01	6.672	2.036									
2160	1.106E-03	0.1949	2.155E-01	7.085	2.062									
2220	1.338E-03	0.2213	2.961E-01	7.760	2.101									
2280	1.575E-03	0.2466	3.883E-01	8.399	2.135									
2340	1.762E-03	0.2657	4.682E-01	8.879	2.158								6.09	0.028
2400	1.681E-03	0.2575	4.329E-01	8.674	2.148									
2460	1.507E-03	0.2395	3.610E-01	8.221	2.126									
2520	1.153E-03	0.2005	2.312E-01	7.228	2.071									
2580	9.675E-04	0.1784	1.726E-01	6.657	2.036									
2640	8.016E-04	0.1574	1.262E-01	6.108	1.998									
2700	6.262E-04	0.1336	8.366E-02	5.473	1.951									
2760	4.849E-04	0.1127	5.466E-02	4.905	1.903									
2820	4.167E-04	0.1019	4.248E-02	4.606	1.875									
2880	4.186E-04	0.1022	4.279E-02	4.614	1.876									
2940	4.369E-04	0.1052	4.595E-02	4.696	1.884									
3000	4.865E-04	0.1130	5.496E-02	4.912	1.903									
3060	5.683E-04	0.1253	7.118E-02	5.247	1.933									
3120	6.532E-04	0.1374	8.975E-02	5.575	1.959									
3180	7.786E-04	0.1544	1.202E-01	6.028	1.993									
3240	8.627E-04	0.1653	1.426E-01	6.315	2.013	26.77	1.63	3.83	59.03	28.74	6.78	0	6.18	0.032
3300	9.595E-04	0.1774	1.702E-01	6.632	2.034									
3360	1.018E-03	0.1846	1.879E-01	6.817	2.046									

Table E-57. Continued.

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
3420	9.754E-04	0.1794	1.750E-01	6.682	2.037									
3480	8.960E-04	0.1695	1.519E-01	6.426	2.020									
3540	8.786E-04	0.1673	1.470E-01	6.368	2.016									
3600	8.754E-04	0.1669	1.461E-01	6.357	2.016									
3660	8.119E-04	0.1588	1.289E-01	6.143	2.001									
3720	6.905E-04	0.1426	9.844E-02	5.713	1.970									
3780	5.595E-04	0.1240	6.937E-02	5.212	1.930									
3840	4.452E-04	0.1065	4.742E-02	4.733	1.887									
3900	4.121E-04	0.1012	4.169E-02	4.585	1.873									
3960	3.083E-04	0.0834	2.573E-02	4.083	1.821									
4020	2.248E-04	0.0676	1.520E-02	3.622	1.765									
4080	1.925E-04	0.0610	1.174E-02	3.425	1.739								6.09	0.028
4140	1.368E-04	0.0486	6.647E-03	3.043	1.682									
4200	9.135E-05	0.0372	3.396E-03	2.675	1.617									
4260	5.370E-05	0.0261	1.402E-03	2.295	1.535									
4320	4.247E-05	0.0223	9.488E-04	2.156	1.500									
4380	1.842E-05	0.0128	2.361E-04	1.772	1.383									
4440	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples = 6

Total sediment mass = 317.3248 g

Total runoff volume = 1.8184 m^3

Total phosphorus mass = 11.8616 g

Total DP mass = 3.6580 g

Table E-58. Field data of event B091006V4 (site: B, plot: V4, date: 09/10/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
1860	0.000E+00	0.0000	0.000E+00	0.000	0.000									
1920	4.922E-05	0.0491	2.416E-03	2.808	1.430									
1980	7.567E-05	0.0577	4.366E-03	3.053	1.452									
2040	1.021E-04	0.0646	6.593E-03	3.245	1.468									
2100	3.429E-04	0.1017	3.488E-02	4.243	1.535									
2160	6.278E-04	0.1276	8.013E-02	4.912	1.569									
2220	9.208E-04	0.1474	1.357E-01	5.411	1.592									
2280	1.186E-03	0.1621	1.923E-01	5.778	1.606								6.03	0.027
2340	1.056E-03	0.1551	1.638E-01	5.605	1.600									
2400	5.290E-04	0.1197	6.332E-02	4.709	1.560									
2460	4.586E-04	0.1135	5.204E-02	4.548	1.551									
2520	3.421E-04	0.1016	3.476E-02	4.241	1.535									
2580	2.959E-04	0.0962	2.848E-02	4.099	1.527									
2640	2.547E-04	0.0910	2.317E-02	3.960	1.518									
2700	2.141E-04	0.0852	1.825E-02	3.807	1.509									
2760	1.845E-04	0.0806	1.488E-02	3.683	1.501									
2820	1.574E-04	0.0760	1.196E-02	3.557	1.492									
2880	1.753E-04	0.0791	1.387E-02	3.642	1.498	25.33	2.14	4.44	58.7	22.36	11.69	0.67	6.10	0.032
2940	2.885E-04	0.0953	2.751E-02	4.076	1.525									
3000	3.419E-04	0.1016	3.475E-02	4.240	1.535									
3060	4.177E-04	0.1095	4.576E-02	4.447	1.546									
3120	4.576E-04	0.1134	5.188E-02	4.546	1.551									
3180	5.243E-04	0.1193	6.256E-02	4.699	1.559									
3240	4.689E-04	0.1144	5.364E-02	4.573	1.553									
3300	4.099E-04	0.1088	4.458E-02	4.427	1.545									
3360	4.471E-04	0.1124	5.025E-02	4.520	1.550									
3420	5.159E-04	0.1186	6.117E-02	4.680	1.558								6.13	0.029
3480	4.239E-04	0.1101	4.669E-02	4.463	1.547									
3540	3.075E-04	0.0977	3.003E-02	4.136	1.529									
3600	2.469E-04	0.0899	2.220E-02	3.932	1.517									
3660	1.933E-04	0.0820	1.586E-02	3.722	1.503									
3720	1.491E-04	0.0744	1.109E-02	3.515	1.489									
3780	1.151E-04	0.0675	7.773E-03	3.327	1.475								6.00	0.021
3840	8.671E-05	0.0607	5.266E-03	3.138	1.460									
3900	7.614E-05	0.0578	4.403E-03	3.057	1.453									
3960	7.100E-05	0.0563	3.999E-03	3.014	1.449									
4020	6.659E-05	0.0550	3.662E-03	2.976	1.446									
4080	6.111E-05	0.0533	3.254E-03	2.927	1.441									
4140	5.564E-05	0.0514	2.860E-03	2.874	1.436									
4200	5.016E-05	0.0494	2.480E-03	2.818	1.431									
4260	4.468E-05	0.0473	2.116E-03	2.757	1.425									
4320	3.921E-05	0.0451	1.767E-03	2.691	1.418									
4380	3.153E-05	0.0415	1.310E-03	2.587	1.407									
4440	2.050E-05	0.0353	7.245E-04	2.400	1.385									
4500	1.203E-05	0.0289	3.482E-04	2.202	1.358									
4560	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples =	5	
Total sediment mass =	88.7276	g
Total runoff volume =	0.7737	m^3
Total phosphorus mass =	3.5120	g
Total DP mass =	1.1977	g

Table E-59. Field data of event B101206S2 (site: B, plot: S2, date: 10/12/06).

Time (s)	Rain (m/s)	Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
0	0.000E+00	480	0.000E+00	0.000	0.000E+00	0.000	0.000									
60	1.667E-06	540	2.701E-04	0.999	2.697E-01	26.879	1.274									
120	1.667E-06	600	5.948E-04	1.531	9.104E-01	39.286	1.287									
180	3.333E-06	660	3.662E-04	1.178	4.313E-01	31.096	1.279									
240	6.667E-06	720	8.572E-04	1.865	1.599E+00	46.910	1.293								5.83	0.017
300	8.333E-06	780	2.230E-03	3.127	6.973E+00	74.887	1.310									
360	1.333E-05	840	2.573E-03	3.379	8.695E+00	80.351	1.312									
420	1.500E-05	900	2.030E-03	2.972	6.033E+00	71.509	1.308									
480	1.667E-05	960	1.547E-03	2.566	3.968E+00	62.580	1.303	407.3	1.89	1.67	2.31	2.1	19.66	72.37	6.03	0.024
540	2.167E-05	1020	5.995E-04	1.537	9.215E-01	39.437	1.287									
600	1.500E-05	1080	1.892E-04	0.824	1.559E-01	22.700	1.268								6.10	0.025
660	1.333E-05	1140	5.018E-05	0.402	2.018E-02	12.283	1.246									
720	2.833E-05	1200	1.852E-05	0.235	4.345E-03	7.935	1.229									
780	3.333E-05	1260	1.596E-05	0.216	3.454E-03	7.451	1.227									
840	3.000E-05	1320	1.482E-05	0.208	3.081E-03	7.223	1.226								6.20	0.031
900	2.333E-05	1380	1.311E-05	0.195	2.551E-03	6.865	1.224									
960	2.167E-05	1440	9.546E-06	0.164	1.565E-03	6.033	1.219									
1020	1.500E-05	1500	8.977E-06	0.159	1.424E-03	5.886	1.218									
1080	1.167E-05	1560	8.549E-06	0.154	1.321E-03	5.773	1.217									
1140	5.000E-06	1620	7.552E-06	0.144	1.091E-03	5.497	1.215									
1200	3.333E-06	1680	6.697E-06	0.135	9.066E-04	5.245	1.213									
1260	1.667E-06	1740	6.982E-06	0.138	9.667E-04	5.331	1.214									
1380	3.333E-06	1800	6.127E-06	0.129	7.905E-04	5.068	1.211									
1440	5.000E-06	1860	5.415E-06	0.121	6.535E-04	4.835	1.210									
1500	1.667E-06	1920	4.703E-06	0.112	5.258E-04	4.586	1.207									
1620	1.667E-06	1980	4.560E-06	0.110	5.015E-04	4.534	1.207									
1920	1.667E-06	2040	4.133E-06	0.104	4.310E-04	4.373	1.205									
1980	0.000E+00	2100	2.024E-06	0.071	1.435E-04	3.411	1.194									
		2160	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples =	5	
Total sediment mass =	1800.06	g
Total runoff volume =	0.687	m^3
Total phosphorus mass =	43.642	g
Total DP mass =	0.894	g

Table E-60. Field data of event B101206V2 (site: B, plot: V2, date: 10/12/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
720	0.000E+00	0.000	0.000E+00	0.000	0.000									
780	3.490E-06	0.006	2.034E-05	1.386	1.247									
840	4.445E-06	0.007	2.969E-05	1.420	1.259									
900	5.143E-06	0.007	3.731E-05	1.442	1.266									
960	5.399E-06	0.007	4.026E-05	1.449	1.269									
1020	6.069E-06	0.008	4.835E-05	1.468	1.275									
1080	4.900E-05	0.026	1.271E-03	2.064	1.387									
1140	5.825E-04	0.105	6.122E-02	4.519	1.532								6.03	0.021
1200	1.863E-03	0.203	3.778E-01	7.601	1.606									
1260	1.688E-03	0.192	3.238E-01	7.251	1.599									
1320	1.255E-03	0.162	2.035E-01	6.311	1.580									
1380	8.368E-04	0.129	1.079E-01	5.265	1.555								6.12	0.027
1440	4.502E-04	0.091	4.090E-02	4.075	1.516									
1500	2.853E-04	0.070	2.003E-02	3.436	1.489	14.55	2.67	5.24	88.34	3.75	0	0	6.21	0.036
1560	1.288E-04	0.045	5.769E-03	2.651	1.442									
1620	4.734E-05	0.025	1.204E-03	2.048	1.385									
1680	1.914E-05	0.015	2.919E-04	1.721	1.335									
1740	1.230E-05	0.012	1.461E-04	1.607	1.312								6.13	0.028
1800	9.012E-06	0.010	8.977E-05	1.541	1.295									
1860	6.847E-06	0.009	5.839E-05	1.489	1.281									
1920	5.607E-06	0.008	4.272E-05	1.455	1.271									
1980	4.724E-06	0.007	3.266E-05	1.429	1.262									
2040	3.955E-06	0.006	2.473E-05	1.403	1.253									
2100	3.428E-06	0.006	1.977E-05	1.383	1.246									
2160	3.000E-06	0.005	1.605E-05	1.366	1.239									
2220	2.530E-06	0.005	1.229E-05	1.345	1.231									
2280	2.316E-06	0.005	1.071E-05	1.335	1.226									
2340	1.960E-06	0.004	8.245E-06	1.316	1.218									
2400	1.761E-06	0.004	6.970E-06	1.305	1.213									
2460	1.547E-06	0.004	5.692E-06	1.292	1.207									
2520	1.348E-06	0.003	4.586E-06	1.278	1.200									
2580	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 5

Total sediment mass = 68.664 g

Total runoff volume = 0.437 m^3

Total phosphorus mass = 2.692 g

Total DP mass = 0.686 g

Table E-61. Field data of event B101206S3 (site: B, plot: S3, date: 10/12/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
480	0.000E+00	0.000	0.000E+00	0.000	0.000									
540	1.114E-04	0.373	4.160E-02	10.529	1.389									
600	4.702E-04	0.975	4.584E-01	24.260	1.403								6.15	0.032
660	4.318E-04	0.921	3.978E-01	23.055	1.402									
720	5.788E-04	1.120	6.482E-01	27.497	1.405									
780	2.428E-03	2.912	7.071E+00	66.415	1.419									
840	2.502E-03	2.970	7.430E+00	67.658	1.420									
900	2.163E-03	2.696	5.832E+00	61.805	1.418									
960	1.557E-03	2.165	3.370E+00	50.389	1.415	394.9	1.81	1.7	2.41	2.04	20.11	71.93	5.94	0.028
1020	1.155E-03	1.775	2.050E+00	41.913	1.412									
1080	6.197E-04	1.172	7.262E-01	28.654	1.406									
1140	2.754E-04	0.683	1.880E-01	17.660	1.398								6.02	0.031
1200	1.056E-04	0.360	3.808E-02	10.225	1.388									
1260	2.976E-05	0.155	4.612E-03	5.321	1.376									
1320	2.342E-05	0.132	3.094E-03	4.761	1.373									
1380	1.832E-05	0.112	2.055E-03	4.268	1.371								6.18	0.034
1440	1.736E-05	0.108	1.878E-03	4.170	1.370									
1500	1.377E-05	0.093	1.277E-03	3.785	1.368									
1560	1.143E-05	0.082	9.363E-04	3.512	1.366									
1620	8.675E-06	0.068	5.912E-04	3.164	1.364									
1680	7.297E-06	0.061	4.431E-04	2.975	1.362									
1740	6.195E-06	0.054	3.373E-04	2.813	1.361									
1800	4.403E-06	0.043	1.910E-04	2.526	1.357									
1860	3.852E-06	0.040	1.528E-04	2.430	1.356									
1920	2.336E-06	0.028	6.640E-05	2.132	1.351									
1980	1.647E-06	0.023	3.709E-05	1.973	1.348									
2040	8.200E-07	0.014	1.160E-05	1.742	1.341									
2100	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 6

Total sediment mass = 1696.019 g

Total runoff volume = 0.753 m^3

Total phosphorus mass = 39.231 g

Total DP mass = 1.064 g

Table E-62. Field data of event B101206V3 (site: B, plot: V3, date: 10/12/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
720	0.000E+00	0.000	0.000E+00	0.000	0.000									
780	6.584E-06	0.045	2.956E-04	4.644	1.342									
840	5.497E-05	0.057	3.157E-03	4.537	1.418									
900	3.841E-04	0.072	2.764E-02	4.452	1.491								5.98	0.023
960	8.390E-04	0.079	6.609E-02	4.422	1.521									
1020	8.153E-04	0.079	6.402E-02	4.423	1.520									
1080	7.785E-04	0.078	6.080E-02	4.424	1.518									
1140	5.130E-04	0.074	3.817E-02	4.441	1.502								6.03	0.034
1200	3.350E-04	0.071	2.372E-02	4.458	1.485									
1260	2.259E-04	0.068	1.528E-02	4.474	1.470								6.10	0.290
1320	1.233E-04	0.063	7.777E-03	4.501	1.447									
1380	5.982E-05	0.058	3.469E-03	4.533	1.421									
1440	2.114E-05	0.051	1.087E-03	4.583	1.383									
1500	4.313E-06	0.043	1.844E-04	4.667	1.327	27.40	1.78	3.55	58.65	33.57	2.45	0	6.12	0.033
1560	1.695E-06	0.038	6.501E-05	4.719	1.296									
1620	1.158E-06	0.037	4.248E-05	4.742	1.283									
1680	8.131E-07	0.035	2.864E-05	4.763	1.272									
1740	7.166E-07	0.035	2.487E-05	4.770	1.267									
1800	6.339E-07	0.034	2.169E-05	4.778	1.263									
1860	5.926E-07	0.034	2.012E-05	4.782	1.261									
1920	5.926E-07	0.034	2.012E-05	4.782	1.261									
1980	4.961E-07	0.033	1.650E-05	4.793	1.255									
2040	3.721E-07	0.032	1.197E-05	4.811	1.246									
2100	4.548E-07	0.033	1.497E-05	4.798	1.253									
2160	4.548E-07	0.033	1.497E-05	4.798	1.253									
2220	4.134E-07	0.033	1.346E-05	4.804	1.250									
2280	4.134E-07	0.033	1.346E-05	4.804	1.250									
2340	0.000E+00	0.000	0.000E+00	0.000	0.000									

Number of field samples = 4

Total sediment mass = 18.720 g

Total runoff volume = 0.250 m^3

Total phosphorus mass = 1.111 g

Total DP mass = 0.376 g

Table E-63. Field data of event B101206V1 (site: B, plot: V1, date: 10/12/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (μm)	<0.45μm (%)	0.45-2μm (%)	2-37μm (%)	37-100μm (%)	100-250μm (%)	>250μm (%)	pH	EC (S/m)
360	0.000E+00	0.0000	0.000E+00	0.000	0.000									
420	5.248E-06	0.0096	5.055E-05	3.246	1.755									
480	6.960E-06	0.0116	8.062E-05	3.372	1.760									
540	8.310E-06	0.0130	1.081E-04	3.456	1.764									
600	9.980E-06	0.0147	1.463E-04	3.547	1.767									
660	9.771E-06	0.0145	1.413E-04	3.537	1.766									
720	1.116E-05	0.0158	1.761E-04	3.605	1.769									
780	1.331E-04	0.0797	1.061E-02	5.458	1.814								5.73	0.012
840	6.355E-04	0.2215	1.408E-01	7.458	1.843									
900	1.670E-03	0.4166	6.957E-01	9.196	1.861									
960	1.910E-03	0.4548	8.687E-01	9.476	1.863									
1020	1.767E-03	0.4322	7.636E-01	9.312	1.862	17.00	2.51	5.08	84.22	8.19	0	0	5.93	0.023
1080	1.567E-03	0.3996	6.260E-01	9.066	1.859									
1140	1.217E-03	0.3387	4.121E-01	8.575	1.855								6.02	0.028
1200	6.950E-04	0.2349	1.632E-01	7.600	1.844									
1260	3.689E-04	0.1553	5.728E-02	6.664	1.832									
1320	1.137E-04	0.0719	8.183E-03	5.300	1.811									
1380	2.848E-05	0.0291	8.286E-04	4.165	1.786									
1440	1.417E-05	0.0184	2.612E-04	3.735	1.773								5.84	0.023
1500	8.324E-06	0.0130	1.084E-04	3.457	1.764									
1560	5.401E-06	0.0098	5.301E-05	3.259	1.756									
1620	3.898E-06	0.0079	3.091E-05	3.123	1.750									
1680	3.174E-06	0.0069	2.201E-05	3.044	1.747									
1740	2.757E-06	0.0063	1.743E-05	2.992	1.744									
1800	2.270E-06	0.0056	1.264E-05	2.923	1.741									
1860	2.033E-06	0.0052	1.053E-05	2.886	1.739									
1920	1.796E-06	0.0048	8.585E-06	2.845	1.736									
1980	1.560E-06	0.0044	6.797E-06	2.800	1.734									
2040	1.281E-06	0.0038	4.910E-06	2.740	1.731									
2100	1.100E-06	0.0035	3.818E-06	2.696	1.728									
2160	1.100E-06	0.0035	3.818E-06	2.696	1.728									
2220	8.082E-07	0.0028	2.291E-06	2.611	1.723									
2280	6.412E-07	0.0024	1.563E-06	2.552	1.719									
2340	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples 5
Total sediment mass = 224.8942 g
Total runoff volume = 0.6124 m^3
Total phosphorus mass = 5.3263 g
Total DP mass = 1.1358 g

Table E-64. Field data of event B101206V4 (site: B, plot: V4, date: 10/12/06).

Time (s)	Q (m^3/s)	Sed. Conc (g/L)	Sed. Load (g/s)	TP (mg/L)	DP (mg/L)	dp (µm)	<0.45µm (%)	0.45-2µm (%)	2-37µm (%)	37-100µm (%)	100-250µm (%)	>250µm (%)	pH	EC (S/m)
360	0.000E+00	0.0000	0.000E+00	0.000	0.000									
420	1.045E-06	0.0246	2.568E-05	2.106	1.397									
480	1.306E-06	0.0260	3.401E-05	2.151	1.400									
540	2.037E-06	0.0292	5.940E-05	2.245	1.406									
600	1.899E-06	0.0286	5.440E-05	2.230	1.405									
660	1.169E-06	0.0253	2.957E-05	2.128	1.398									
720	3.332E-06	0.0331	1.102E-04	2.363	1.413									
780	7.053E-06	0.0401	2.825E-04	2.570	1.423									
840	8.467E-05	0.0756	6.400E-03	3.600	1.458								5.98	0.026
900	1.217E-03	0.1493	1.817E-01	5.682	1.497									
960	1.141E-03	0.1469	1.676E-01	5.614	1.496									
1020	7.003E-04	0.1297	9.082E-02	5.131	1.489									
1080	3.607E-04	0.1095	3.948E-02	4.562	1.479	10.08	3.61	7	87.23	2.17	0	0.00	6.03	0.028
1140	1.467E-04	0.0870	1.277E-02	3.926	1.466									
1200	5.228E-05	0.0668	3.494E-03	3.349	1.451								6.10	0.030
1260	2.309E-05	0.0542	1.252E-03	2.985	1.440									
1320	1.486E-05	0.0485	7.203E-04	2.817	1.433									
1380	6.154E-06	0.0387	2.381E-04	2.530	1.421									
1440	3.040E-06	0.0323	9.820E-05	2.340	1.411								6.09	0.027
1500	2.296E-06	0.0301	6.903E-05	2.273	1.407									
1560	1.662E-06	0.0277	4.601E-05	2.201	1.403									
1620	1.345E-06	0.0262	3.527E-05	2.156	1.400									
1680	1.166E-06	0.0253	2.948E-05	2.128	1.398									
1740	1.042E-06	0.0246	2.559E-05	2.106	1.397									
1800	8.211E-07	0.0231	1.899E-05	2.062	1.393									
1860	6.833E-07	0.0221	1.507E-05	2.029	1.391									
1920	6.419E-07	0.0217	1.394E-05	2.018	1.390									
1980	6.006E-07	0.0213	1.282E-05	2.007	1.389									
2040	5.041E-07	0.0204	1.029E-05	1.978	1.387									
2100	3.801E-07	0.0190	7.218E-06	1.933	1.383									
2160	3.387E-07	0.0184	6.247E-06	1.916	1.381									
2220	3.387E-07	0.0184	6.247E-06	1.916	1.381									
2280	1.596E-07	0.0152	2.428E-06	1.814	1.371									
2340	1.182E-07	0.0141	1.666E-06	1.778	1.367									
2400	0.000E+00	0.0000	0.000E+00	0.000	0.000									

Number of field samples = 5
Total sediment mass = 30.3295 g
Total runoff volume = 0.2267 m^3
Total phosphorus mass = 1.1885 g
Total DP mass = 0.3376 g

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