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Stormwater Performance Monitoring in the Los Alamos/Pueblo Watershed During 2010

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Responsible project manager:

Steve Veenis	Steve Veenis	Project Manager	Environmental Programs	2.24.11
Printed Name	Signature	Title	Organization	Date

Responsible LANS representative:

Michael J. Graham	MJ Graham	Associate Director	Environmental Programs	24/Feb/11
Printed Name	Signature	Title	Organization	Date

Responsible DOE representative:

George J. Rael		Manager	DOE-LASO	2-28-2011
Printed Name	Signature	Title	Organization	Date

EXECUTIVE SUMMARY

This first annual monitoring report provides a summary of analytical monitoring, discharge measurements, and precipitation associated with stormwater collected from the Los Alamos and Pueblo (LA/P) Watershed from May 2010 through October 2010. Monitoring objectives are to collect data for evaluating the effect of watershed mitigations installed in the LA/P Watershed. Watershed mitigations being evaluated include DP Canyon grade-control structure and associated wetlands; Pueblo Canyon cross-vane structures, wing ditch, willow planting, wetlands, and grade-control structure; Los Alamos Canyon low-head weir; and the stormwater retention basins and associated willow planting below the Solid Waste Management Unit (SWMU) 01-001(f) drainage in Los Alamos Canyon. These mitigations have been implemented with the overall goal of working in concert with each other to minimize the potentially erosive nature of stormwater runoff, to enhance deposition of sediment, and to reduce or eliminate access of contaminated sediments to flood erosion.

Gage and sampling locations are situated within the LA/P Watershed to monitor the hydrology and sediment transport along the length of the watershed, including stations that bound the mitigations. However, the topography, geology, geomorphology, and meteorology of the watershed are quite complex, thus monitoring runoff and precipitation is also complex and challenging. Stage height, which is then converted to discharge using rating curves developed for each individual gage, is monitored at 5-minute intervals at a series of gages using shaft-encoder float sensors, self-contained bubbler pressure sensors, and ultrasonic probe sensors. Precipitation data are collected across the Los Alamos National Laboratory by means of five meteorological towers and an extended rain gage network. Sampling for analyte suites specific to each gage is conducted using ISCO 3700 portable automated samplers configured to initiate sampling routines when a preset stage height is recorded at the data logger or with a liquid level actuator. Sampling equipment and the extended rain gage network are shut down in the winter months (December through March) and reactivated in the spring. In addition, three grab samples were collected at the outlets of two constructed retention basins and wetlands below the SWMU 01-001(f) drainage on July 26.

Throughout the LA/P Watershed, frequency of discharge and suspended sediment concentrations are positively correlated with the impermeable area draining to each gage, indicating that the larger the impermeable area, the more frequently it flows and the greater the sediment yield. For all of the canyons and all measured storm events (with the exception of August 15), the flood bore moves from upstream to downstream with increasing or decreasing peak discharges. Because of the extremely localized precipitation, travel times and peak discharge increases/decreases vary substantially, and there is little to no relationship between peak discharge magnitudes, travel times between stations, or peak discharge increases/decreases. In Acid and Pueblo canyons, the upper watersheds have as many large increases in peak discharge as large decreases. Downstream the large decreases far outweigh the increases until the final stretch of the watershed, gage stations E060.1 to E109.9, where peak discharge increases in three of four events (100% average increase), most likely as a result of runoff from Guaje Canyon. Also, between E055, E056, and E059 to E060.1, which have flow paths that traverse the Pueblo Canyon Watershed mitigations, the peak discharge decreases for 34 of 35 events (97% average decrease); the only increase occurs during the very large August 16 storm.

In DP Canyon, the upper channel (E038 to E039.1) traverses the DP Canyon Watershed mitigations, and the peak discharge decreases in 26 of 32 events (72% average decrease); from E039.1 to E040, there are many more decreases in peak discharge than increases. In addition, the DP Canyon mitigations reduced runoff volume by 0.8 acre feet on both July 9 and 30, the two storm events when sampling was conducted upstream and downstream of the mitigations. In Los Alamos Canyon, the peak discharge increases in the upper watershed (E026 to E030) for all 9 events (81% average increase), most likely due

to additional runoff from the drainage area associated with E030 and the difference in percent impermeable area draining to the two stations (30% at E030 compared with 2% at E026). From E030 to E042.1, the peak discharge increases in 9 of 11 events (75% average increase); however, from E040 to E042.1, the peak discharge decreases in 15 of 18 events (78% average decrease). Also, the peak discharges are generally much higher at E040 than at E030 and are assumed to be due to the larger percent of total, or nested, impermeable area draining to E040 (50%) compared with E030 (7%). The LA Canyon low-head weir is located between E042.1 and E050.1, through which the peak discharge decreases for all 10 storm events (77% average decrease). For storm events, the flow is reduced completely (100% average decrease). In the final stretch of the LA Canyon Watershed, E050.1 to E109.9, the peak discharge increases for 2 storm events (59% average increase, most likely from Guaje Canyon) and decreases for 2 storm events (84% average decrease, assumed to be infiltration). Overall, the Pueblo Canyon mitigations, DP Canyon mitigations, and LA Canyon low-head weir reduced peak discharges, thus reducing the erosive force of the stream.

At gage stations E042.1 and E060.1, not at E109.9, positive linear correlations exist between discharge and suspended sediment concentrations at different time lags for each measured storm event (sediment lagging behind discharge). However, a stronger, more precise linear relationship exists between sediment yield and runoff volume across the LA/P Watershed. Comparing precipitation with discharge, the discharge lags the precipitation, and when there are several rainfall pulses, there are consequential peaks in the hydrograph. Suspended sediment is much less predictable with no definitive trend between concentration magnitude, peak discharge, or time to peak. Regarding the watershed mitigations, two storm events (July 9 and 30 were sampled up and downstream of the DP Canyon Watershed mitigations. On July 9, these mitigations reduced the suspended sediment concentrations by 46% and 40% relative percent difference (RPD), and on July 30, the first sample showed increased concentrations (29%) and the last sample showed decreased concentrations (16%). Overall, suspended sediment concentrations were reduced by the DP Canyon and Pueblo Canyon mitigations (no samples were collected downstream of the LA Canyon low-head weir).

Filtered and unfiltered results were obtained from all inorganic chemical analyses and radionuclide analyses at E109.9; filtered/unfiltered pairs were obtained twice for each nuclide and 33 times for each inorganic chemical. For the target analyte list metals, less than one-half of unfiltered results are detected for mercury, selenium, and thallium; silver, cadmium, and chromium are largely reduced to below detection limits in the filtered results. There was a five-fold reduction in detected, filtered analytical results for aluminum, barium, beryllium, copper, iron, manganese, nickel, lead, uranium, vanadium, and zinc. There was a two- to five-fold reduction in detected, filtered analytical results for arsenic, calcium, cobalt, magnesium, and potassium. Analytical results for samples collected at the retention basins and wetland below the SWMU 01-001(f) drainage show total polychlorinated biphenyls (PCBs) collected at the terminus of the wetland are almost 30 times less concentrated than total PCBs collected in the upper retention basin, suspended sediment is reduced 2 times in the same samples, and lead is reduced almost 5 times. Analyte concentrations, including suspended sediment, generally show a poor correlation to instantaneous discharge. However, suspended sediment concentrations can be used as a predictor of many inorganic chemicals and radionuclides in unfiltered samples due to the strong linear relationship between the two. In contrast, plutonium-239/240 and total PCBs are not linearly correlated to suspended sediment concentrations across the LA/P Watershed or at a single gage station.

The mitigations implemented in the Los Alamos and Pueblo canyons Watershed are relatively new features that, in some cases, are expected to take at least one runoff season to begin to show representative performance. Some positive effects of the mitigations, including reductions of peak discharge, sediment deposition, and contaminant transport, were observed during this monitoring year and will be reevaluated during sampling that will occur during 2011. However, the nature and location of storms in 2010 did not result in a comprehensive contaminant data set for assessment of the effects of the mitigations on contaminant concentrations within a storm or between storms to determine a sense of long-term performance expectations for the mitigations. Ongoing monitoring in 2011 is expected to enhance the data set and will advance the conceptual model for these relationships and further enable performance assessment of the mitigations.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by Los Alamos National Security, LLC. The Laboratory is located in north-central New Mexico approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 7200 to 7800 ft above mean sea level.

This first annual monitoring report provides a summary of analytical monitoring, discharge measurements, and precipitation associated with stormwater collected from the Los Alamos and Pueblo (LA/P) Watershed from May 2010 through October 2010. This annual monitoring report is being prepared pursuant to the New Mexico Environment Department- (NMED-) issued approval with modification of January 11, 2010, (NMED 2010, 108444) for the “Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project” (LANL 2009, 107457) . This monitoring plan was generated to support the NMED approved “Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” [IMWP] (LANL 2008, 101714) and the “Supplemental Interim Measures Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” [SIMWP] (LANL 2008, 105716).

Monitoring objectives are to collect data to allow the evaluation of the effect of watershed mitigations implemented in the LA/P Watershed. The discussion of flow and analytical results for suspended sediment and constituent concentrations is focused to evaluate overall watershed performance with specific emphasis on effects of the mitigations implemented per the “Interim Measures Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” (LANL 2008, 101714) and “Supplemental Interim Measures Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” (LANL 2008, 105716).

The NMED approval with modification dated January 11, 2010, also directed the Laboratory to monitor stormwater from a location directly below the spillway from the lower retention basin below the Solid Waste Management Unit (SWMU) 01-001(f) drainage.

The watershed addressed in the monitoring report is potentially contaminated with both hazardous and radioactive components. Corrective actions at the Laboratory are subject to a Compliance Order on Consent (the Consent Order). Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to the NMED in accordance with DOE policy.

Watershed mitigations being evaluated include DP Canyon grade-control structure and associated wetlands; Pueblo Canyon cross-vane structures, wing ditch, willow planting, wetlands, and grade-control structure; Los Alamos Canyon low-head weir; and the stormwater retention basins and associated willow planting below the SWMU 01-001(f) drainage in Los Alamos Canyon.

1.1 Project Goals

The mitigations implemented under the IMWP and SIMWP have been implemented with the overall goal of working in concert with each other to minimize the potentially erosive nature of stormwater runoff to enhance deposition of sediment and to reduce or eliminate access of contaminated sediments to flood erosion. Figure 1.0-1 shows the locations of the mitigations and the gages. In the Pueblo Watershed, the central focus of the mitigations is to maintain a physically, hydrologically, and biologically functioning wetland that can work to reduce peak flows and trap suspended solids due to the presence of thick wetland vegetation. Stabilization and enhancement of the wetland was accomplished with installation of a grade-control structure that is designed to inhibit headcutting at the terminus of the wetland and to promote establishment of additional riparian or wetland vegetation beyond the current terminus of the wetland. Mitigations in upper portions of Pueblo Canyon above the wetland are designed primarily to reduce the flood peaks and enhance channel/floodplain interaction before floods reach the wetland. Gages and monitoring locations are situated within the watershed to monitor the overall hydrology and sediment transport along the length of the watershed, including stations that bound the wetland.

In DP and Los Alamos canyons, mitigations focused on stabilizing and potentially partially burying a wet meadow reach (DP-2) in DP Canyon that is a source of contaminants that are entrained in common floods that originate from a portion of the Los Alamos townsite. A grade-control structure was installed at the terminus of reach DP-2 with a height that may encourage natural channel aggradation, thus inhibiting access to contaminated channel banks during floods. Stabilization and aggradation in reach DP-2 should also encourage spreading of floodwaters, thus reducing peak discharge due to transmission loss within the reach. Lower flood peaks should reduce the erosion of downcanyon contaminants in floodplains. Mitigations in lower Los Alamos Canyon several kilometers below the DP confluence involved removal of accumulated sediment behind the low-head weir and enhancing residence time of floodwaters to enable settling of suspended solids that may have contamination.

Additional mitigations were implemented in Los Alamos Canyon under a separate administrative requirement (NMED 2009, 105858) to address PCB contamination associated with SWMU 01-001(f). The mitigation actions at that location involved removal of contaminated sediment from a steep mesa slope and construction of retention basins at the bottom of the slope to promote settling of potentially contaminated sediments in runoff from the mesa slope.

This report presents data in the context of performance of these mitigations by evaluating the various metrics for performance, including flow (peak discharge and total discharge) and analytical results for sediment and constituent concentrations to evaluate overall watershed performance. The nature of precipitation events that generate floods is also evaluated as an integral part of the analysis.

2.0 FLOW, PRECIPITATION, AND SAMPLING IN THE LA/P WATERSHED

Measurements of discharge and surface-water sampling are conducted at 13 gages in LA/P canyons. Gages located at five concrete, trapezoidal, supercritical-flow flumes are designated Los Alamos above the Rio Grande (E109.9), Los Alamos below low-head weir (E050.1), Pueblo below grade-control structure (E060.1), DP below grade-control structure (E039.1), and Los Alamos above low-head weir (E042.1). Eight other gages complete the monitoring network in the LA/P Watershed are designated as Pueblo above Acid (E055), South Fork of Acid Canyon (E055.5), Acid above Pueblo (E056), Los Alamos below Ice Rink (E026), Los Alamos above DP Canyon (E030), DP above Technical Area 21 (E038), Pueblo above the wastewater treatment plant (E059), and DP above Los Alamos Canyon (E040). Figure 1.0-1 shows the locations of these gages and watershed mitigations within the Laboratory’s property boundary.

Stage height is monitored at 5-minute intervals in the LA/P Watershed at gages identified above. Sutron 8210 and 9210 data loggers store each recorded stage-height measurement as it is made. Discharge is computed for each 5-minute stage measurement using rating curves for each individual gage. Shaft-encoder float sensors installed in stilling wells are used to measure water levels at E026, E030, E039.1, E042.1, E050.1, E059, E060.1, and E109.9. Self-contained bubbler pressure sensors (Sutron Accubar) are used to measure water levels at E038, E055, E055.5, and E056 and provide backup sensing at

E109.9, E050.1, and E060.1. An ultrasonic probe sensor (Siemens Miltronics “The Probe”) is used to measure water levels at E040. During 2010, approximately 1,000,000 individual stage measurements were recorded at the 13 gage stations monitored within the LA/P Watershed.

Stormwater programs at the Laboratory use precipitation data collected at the Laboratory’s meteorological towers that are reported on the LANL Weather Machine. In addition, a seasonal, extended rain gage network is deployed during the months of April through November to coincide with stormwater monitoring periods. Using a geographic information system, stormwater monitoring stations are assigned to an individual rain gage using the method of Thiessen polygons. The use of the extended rain gage network allows the stormwater projects to optimize field team response to only those areas where precipitation likely resulted in runoff or exceeded a preestablished trigger amount that allows for more accurate association of rainfall to discharge at a gage. Rain gages, meteorological towers, and the drainage area for each discharge gage associated with the LA/P Watershed are presented in Figure 2.0-1.

Sampling is conducted using ISCO 3700 portable automated samplers. At E042.1, E050.1, E059, E060.1, and E109.9 two ISCO samplers are installed. At the start of the monitoring year, samplers at these gages were configured to initiate sampling routines using a liquid level actuator set at a height above the channel floor estimated to correspond to storm discharge of 5 or 10 cfs. During the year, these samplers were reconfigured to initiate sampling routines simultaneously when a preset stage height corresponding to discharge of 5 or 10 cfs was recorded at the data logger. One sampler is configured with a 24-bottle carousel to monitor primarily sediment, and the second sampler is configured with a 12-bottle carousel to monitor inorganic and organic chemicals and radionuclides. A single sampler configured with a 12-bottle carousel and liquid level actuator is installed at the other locations in the LA/P Watershed to monitor suspended sediment, inorganic and organic chemicals, and radionuclides. The liquid level actuator is set at a height above the channel floor approximating storm discharge of 5 or 10 cfs.

Sampling equipment at gages in LA/P Watershed and the extended rain gage network are shut down in the winter months and reactivated in the spring. During the 2010 sampling season, activated gages and sampling equipment at E042.1, E050.1, E060.1, and E109.9 were inspected at least weekly. Gaging and sampling equipment at the other LA/P Watershed gages were inspected at least biweekly.

2.1 Sampling at the Retention Basins in the Former LA-SMA-2 Drainage

Three grab samples were collected at the outlets of two constructed basins and wetlands below the SWMU 01-001(f) drainage on July 26. The basins were filled during precipitation on July 22, and remained full during subsequent smaller rains on July 23, 24, and 25. Discharge measurements were not collected from these constructed features.

Grab sampling locations were identified as CO101040, southeast corner of the upper retention basin near the culvert intake; CO101039, northeast corner of the lower retention basin near the culvert intake; and CO101038, above the culvert at terminus of the wetland below the lower retention basin. Sampling locations and stormwater control features at the retention basins below the SWMU 01-001(f) drainage are identified in Figure 2.1-1.

2.2 Sampling at the Gage Stations in the LA/P Watershed

During the monitoring year, 38 storm events were sampled and analyzed for inorganic and organic chemicals and radionuclides from the 13 gage station in the LA/P Watershed. Maximum daily discharge at all gages where flow exceeded 5 cfs at E050.1, E060.1, and E109.9, or 10 cfs at the other gages is presented in Table 2.2-1.

Because actuators are placed in stream channels at heights approximating discharges of 5 or 10 cfs, samples were collected even though flows did not meet the 10 cfs sampling threshold from discharge at: E039.1 of 6 cfs on July 9; E030 of 7 cfs on July 22, 8 cfs on August 15, and 7 cfs on August 23; E042.1 of 6 cfs on July 31; and E055 of 9 cfs on August 15. Sampling was initiated at E109.9 on September 22 at flow of less than 1 cfs; many samples were collected before discharge exceeded 5 cfs. Sampling was initiated during early June in the LA/P Watershed, thus discharges recorded in May were not sampled.

E038: Samples were collected from five storm events at E038 during the year. A sampler malfunction at E038 on June 30 was not corrected until the subsequent inspection on July 8. As a result, the E038 sampler was inoperative during discharges of 13 cfs on July 2 and 38 cfs on July 3. The sampler at E038 collected stormwater on July 22 and samples were retrieved during the following inspection on July 30. As a result, the sampler was full and did not collect during discharge of 42 cfs on July 25. The sampler at E038 collected stormwater on July 30 and samples were retrieved during the following inspection on August 6. As a result, the sampler was full and did not collect during discharges of 29 cfs on August 4 and 186 cfs on August 5. A sampler malfunction at E038 on August 15 was not corrected until the subsequent inspection on August 27. As a result, the sampler was inoperative during discharges of 156 cfs on August 15, 202 cfs on August 16, and 160 cfs on August 23. The samples at E038 collected on August 9, September 8, and September 22 were discarded because four samples had been collected during prior storm events and discharges of 63, 47, and 86 cfs, respectively, were less than the discharge of 112 cfs collected on July 22. These samples were not submitted for suspended sediment analyses. The sampler at E038 collected stormwater on October 2 from discharge that did not reach 10 cfs and samples were retrieved and discarded during the following inspection on October 13. Thus, the sampler was full and did not collect during the discharge of 25 cfs on October 5. The sampler at E038 collected stormwater on October 20 and samples were retrieved and submitted for suspended sediment analyses during the following inspection on October 26; therefore, the sampler was full and did not collect during the discharge of 25 cfs on October 21.

E039.1: Samples were collected from five storm events at E039.1 during the year. E039.1 sampling occurred on July 21; however, no discharge was recorded to occur during the day of sample collection and the water collected is of unknown origin. As a result, there is no hydrograph associated with samples collected at E039.1 on July 21. The sampler at E039.1 collected stormwater on July 21 and samples were retrieved during the following inspection on July 29. As a result, the sampler was full and did not collect during discharge of 16 cfs on July 25. The sampler at E039.1 collected stormwater on July 30 and samples were retrieved during the following inspection on August 11. As a result, the E039.1 sampler was full and did not collect during discharge of 276 cfs on August 5 and 16 cfs on August 9. The E039.1 sampler collected stormwater on August 15 and samples were retrieved during the following inspection on August 18. As a result, the sampler was full and did not collect during the discharge of 315 cfs on August 16. No water was collected during the August 23 discharge of 151 cfs at E039.1 because of a sampler malfunction. The sample collected on September 22 at E039.1 was discarded because four samples had been collected during prior storm events and flow of 107 cfs was less than flow of 197 cfs collected on August 15. These samples were not submitted for suspended sediment analyses. The sample collected on October 21 was submitted for suspended sediment analyses.

E040: Samples were collected from four storm events at E040 during the year. The sampler at E040 collected stormwater on July 30 and samples were retrieved during the following inspection on August 9. As a result, the E040 sampler was full and did not collect during discharge of 20 cfs on July 31 and 209 cfs on August 5. The flow of 10 cfs did not trigger the sampler on August 9. The sampler at E040 collected stormwater on August 15 and samples were retrieved during the following inspection on August 23. As a result, the E040 sampler was full and did not collect during discharge of 263 cfs on August 16. The sample collected on September 22 at E040 was discarded because four samples had been collected during previous storm events and flow of 2 cfs, collected because the actuator was set too low in the channel, was less than flow of 86 cfs recorded on August 15 and discharges were less than the 10 cfs trigger.

E026: The sampler at E026 did not collect a sample during the monitoring year. No flows at this gage exceeded 10 cfs.

E030: The sampler at E030 collected water four times during the monitoring year from discharges of less than 10 cfs because the actuator was set too low in the channel. The sampler at E030 collected stormwater on August 15 and samples were retrieved during the following inspection on August 23. As a result, the E030 sampler was full and did not collect during discharge of 30 cfs on August 16.

E042.1: Samples were collected from five storm events at E042.1 during the year. The sampler at E042.1 collected stormwater on July 22 and samples were retrieved during the following inspection on July 27. As a result, the E042.1 sampler was full and did not collect during discharge of 11 cfs on July 25. Discharge of 6 cfs collected on July 31 was collected because the actuator was set too low in the channel. Discharge on August 16 of 99 cfs was larger than any of the previous four discharges where samples were collected and, as a result, this fifth sample was collected. The samples collected on August 23 from flow of 19 cfs and on September 22 from flow of 18 cfs at E042.1 were discarded because five samples had been collected during previous storm events and flows were less than 99 cfs recorded on August 16.

E050.1: At E050.1 the samplers were not configured to collect stormwater until August 30, which caused three discharges exceeding 5 cfs to be missed. No other discharges exceeding 5 cfs occurred after August 30.

E109.9: Samples were collected from three storm events at E109.9 during the year. The sampler at E109.9 collected stormwater on August 15 and samples were retrieved during the following inspection on August 18. As a result, the E109.9 sampler was full and did not collect during discharge of 243 cfs on August 16. The gage was damaged on August 16 and was still inoperative on August 23. Discharge of 779 cfs on August 23 was estimated from a survey performed on the high-water mark observed during subsequent inspections.

E055.5: Samples were collected from four storm events at E055.5 during the year. The sampler at E055.5 collected stormwater on July 22 and samples were retrieved during the following inspection on July 28. As a result, the E055.5 sampler was full and did not collect during discharge of 31 cfs on July 25. The sampler at E055.5 collected stormwater on August 15 and samples were retrieved during the following inspection on August 20. As a result, the E055.5 sampler was full and did not collect during discharge of 69 cfs on August 16. Discharge of 12 cfs on September 22 did not trigger the sampler, thus a sample was not collected.

E056: Samples were collected from three storm events at E056 during the year. A sampler malfunction at E056 on July 14 was not corrected until the subsequent inspection on July 26. As a result, the E056 sampler was inoperative on July 22, July 24, and July 25 when flows with maximum discharge of 61 cfs, 11 cfs, and 55 cfs, respectively, occurred. The sampler at E056 collected stormwater on August 15 and samples were retrieved during the following inspection on September 1. As a result, the sampler was full and did not collect during discharges of 255 cfs on August 16, 38 cfs on August 17, and 94 cfs on August 23. Discharges of 13 cfs on October 20 and 21 cfs on October 21 did not trigger the sampler, thus samples were not collected.

E055: Samples were collected from three storm events at E055 during the year. The sampler at E055 collected stormwater on August 15 from a flow of 9 cfs and samples were retrieved during the following inspection on September 1. As a result, the E055 sampler was full and did not collect during discharge of 41 cfs on August 16 and 14 cfs on August 23.

E059: Samples were collected from one storm event at E059 during the year. The sampler at E059 collected stormwater on August 5 and samples were retrieved during the following inspection on August 16. As a result, the E059 sampler was full and did not collect during discharge of 49 cfs on August 15. Discharge was not recorded on August 5 during sample collection. Flow was estimated to reach 134 cfs; however, there is no hydrograph associated with samples collected at E059 on August 5. A sampler malfunction at E059 on August 16 was not corrected until the subsequent inspection on August 30. As a result, the E059 sampler was inoperative during discharges of 250 cfs on August 16 at 15:50 and 46 cfs on August 23.

E060.1: At E060.1 one flow exceeded 5 cfs during the field season; discharge of 132 cfs occurred on August 16 and was sampled.

2.3 Samples Collected in the LA/P Watershed

Sample suites vary according to monitoring groups and are based on key indicator constituents for a given portion of the watershed. Analyses were conducted from stormwater collected at gage locations as shown in Table 2.3-1. In cases where insufficient water was collected to perform all planned analyses, analyses were prioritized in the order presented in this table. Up to 22 suspended sediment analyses at the lower watershed gages were collected from a single ISCO sampler containing a 24-bottle carousel. Suspended sediment analyses at all other gages were collected from the first and last sample in an ISCO sampler containing a 12-bottle carousel. Target analyte list (TAL) metals were analyzed in filtered and unfiltered samples at all locations. Radionuclides were analyzed in filtered and unfiltered samples at E109.9. All other analyses were conducted from unfiltered samples. Sample collection times were recorded for each individual sample bottle filled, which allowed more precise estimation of discharge and suspended sediment at the time of sample collection.

Analyses were conducted using the analytical methods shown in Table 2.3-2. Detection limits are given for comparison purposes, but are affected by sample-specific factors that are not known fully until after sample analysis is complete.

The full list of samples collected at each gage station, sample IDs assigned, and analyses requested are given in Table 2.3-3. Hydrographs showing changes in discharge at each gage from each storm event resulting in sample collection were prepared. These hydrographs are overlaid with precipitation measured at associated rain gages and sediment concentrations and are presented in Appendix A.

Discharges from stormwater in the ephemeral channels of the Pajarito Plateau are characterized by rapidly increasing flow and then a gradually declining recessional tail. In order to characterize the transport of indicator constituents during storm events, these indicator constituents can be analyzed from multiple samples collected during the period of flow. In order to capture the point of stormwater discharge where maximum transport of constituents occurs, sampling is initiated near the peak of discharge, which typically occurs approximately 10 minutes following the start of the flood. At the lower watershed gages, sampling for suspended sediment is initiated at the start of flow and continues for 30 minutes at a high frequency to characterize the rapidly changing conditions of the early flood. After 30 minutes, flood energy has typically dissipated and conditions in the water column change more slowly. As a result, stormwater conditions can be characterized with a decreased sampling frequency.

At E026, E030, E038, E039.1, E040, E055.5, E055, and E056, sampling was triggered at a single sampler containing a 12-bottle carousel by discharges approximating 10 cfs. A liquid level actuator placed in the stream channel at a height estimated to correspond to a 10 cfs discharge was used to trigger sampling. Automated samplers initiated filling sample bottles 10 minutes following each triggering discharge. Sample bottles were filled sequentially without a delay between bottles. Sampling was generally complete 22 minutes following detection of a triggering discharge and 12 minutes following initiation of sampling. Table 2.3-4 shows the sampling sequence for these gages.

At E042.1, E050.1, E059, and E060.1, sampling was triggered at two samplers at each gage by discharges approximating 5 cfs or 10 cfs. At the start of the monitoring year, samplers at these gages were configured to initiate sampling routines using a liquid level actuator set at a height above the channel floor estimated to correspond to storm discharge of 5 or 10 cfs. During the year, these samplers were reconfigured to initiate sampling routines simultaneously when a preset stage height corresponding to a discharge of 5 or 10 cfs was recorded at the data logger. One sampler was fitted with a 12-bottle carousel and a second sampler was fitted with a 24-bottle carousel. Automated samplers initiated filling sample bottles in the 24-carousel sampler immediately following the triggering discharge. Automated samplers initiated filling sample bottles in the 12-carousel sampler 10 minutes following triggering discharge. In the sampler fitted with a 24-bottle carousel, a delay of 3 minutes was programmed to lapse between filling each of the first 11 bottles. Remaining bottles in the 24-carousel sampler were filled with a 20-minute delay between each bottle. In the sampler fitted with a 12-bottle carousel, after an initial 10-minute delay the first six sample bottles were filled with no delay between each sample bottle. The six remaining bottles were filled in pairs with a delay of 45 minutes between each pair. All bottles in the 24-bottle carousel were filled within 290 minutes from initiation of sampling. All bottles in the 12-bottle carousel were filled within 152 minutes from initiation of sampling. Table 2.3-5 shows the sampling sequence for these gages.

At E109.9, sampling was triggered at two samplers by discharges exceeding 5 cfs. At the start of the monitoring year, samplers at E109.9 were configured to initiate sampling routines using a liquid level actuator set at a height above the channel floor estimated to correspond to storm discharge of 5 or 10 cfs. During the year, these samplers were reconfigured to initiate sampling routines simultaneously when a preset stage height corresponding to 5 cfs was recorded at the data logger. Automated samplers initiated filling sample bottles in the 24-carousel sampler immediately following triggering discharge. Automated samplers initiated filling sample bottles in the 12-carousel sampler 10 minutes following triggering discharge. In the sampler fitted with a 24-bottle carousel, a delay of 2 minutes was programmed to lapse between filling each of the first 16 bottles. Remaining bottles in the 24-carousel sampler were filled with a 20-minute delay between each bottle. In the sampler fitted with a 12-bottle carousel, after an initial 10-minute delay, the first six sample bottles were filled with no delay between each sample bottle. The six remaining bottles were filled in pairs with a delay of 45 minutes between each pair. All bottles in the 24-bottle carousel were filled in 190 minutes from initiation of sampling. All bottles in the 12-bottle carousel were filled within 152 minutes from initiation of sampling. Table 2.3-6 shows the sampling protocol for this gage.

2.4 Damage and Repairs

Control structures in the Los Alamos and Pueblo canyons Watershed were damaged by storms occurring on August 15, 16, and 23, 2010. Damage assessments were prepared as part of the “Interim Assessment to Report Storm Damage to Sediment Control Structures and Monitoring Stations in Los Alamos and Pueblo Canyons” (LANL 2010, 111125). The DP Canyon grade-control structure was not damaged during storms in 2010, but additions to the structure were installed and completed on December 22, 2010.

Repairs were completed at the Pueblo Canyon grade-control structure on December 16, 2010. The 75-ft long x 3-ft wide x 5-ft deep trench that eroded on the upstream face of the structure was repaired by excavating a 5-ft wide trench down to a minimum of 1 ft below the existing bottom of the gabions, installing filter fabric at the bottom of the trench and along the face of the structure, and refilling and compacting the trench with clean fill. Erosion on the upstream southwest corner of the gabion structure was repaired by filling the scoured area with riprap. The 30-ft long x 4-ft wide x 5-ft deep eroded portion of stream bank directly downstream of the structure was repaired by regrading the downstream surfaces and installing riprap on the new surface.

Three Pueblo Canyon cross-vane structures were extensively damaged. Final recommendation will be presented in the May 2011 annual geomorphic conditions report based on full analysis of available data.

Repairs to the gage at E109.9 were completed on November 5, 2010. Damaged wire-enclosed riprap downstream of E109.9 was replaced with a gabion mattress and torn geotextile was replaced. Wire-enclosed riprap upstream of the flume was repaired by filling voids with rock, flattening bulges in the riprap, and inspecting and restoring wire lacing and connections as necessary. Large loose boulders upstream and downstream of the flume were removed.

The stilling well and flume at E109.9 were silted and the bubbler was damaged during storms on August 15–16. The flume and stilling well were cleared of approximately 1.5 ft of silt and coarse sand on August 18. The stilling well was again silted with approximately 3 in. of silt and sand during the storm on August 23, partially blocking the lowest intake. The stilling well remained partially silted and could not be completely cleared during inspections on August 31;, September 8, 15, 23, and 28; October 6, 20, and 25; November 1, 8, 15, 22, and 29; and December 15, 2010 and January 5 and 11, 2011. Gage measurements were able to be recorded during this period. Attempts were made to completely clear the stilling well on August 24, November 22, December 3, and December 15. The stilling well was completely cleared on January 19, 2011. The bubbler was reassembled during October, but was disassembled again during repair of the riprap downstream of the flume in early November. The bubbler was reinstalled on November 12.

3.0 WATERSHED HYDROLOGY

The topography, geology, geomorphology, and meteorology of LA/P Watershed are quite complex, including finger mesas, slot-like canyons, and large elevation gradients; alluvium, volcanic tuff, pumice, and basalt; ephemeral streams, constantly evolving stream networks (both laterally and vertically), and sediment-laden stream discharge; heavy winter snowfall that creates spring snowmelt, intense summer monsoonal rainfall, and occasional late summer to fall tropical storm activity. Consequently, monitoring of the LA/P Watershed runoff is also complex and challenging.

3.1 Drainage Areas and Impermeable Surfaces

Drainage areas unique to each gage station (Figure 2.0-1) were developed using the ArcHydro Data Model in ArcGIS. Model inputs were developed using an elevation grid created from 4-ft light detecting and ranging (LIDAR) images, a digital elevation model from 2000, surface-water drainage culverts from Los Alamos National Laboratory and Los Alamos County, and manual site-specific controls based on field assessments. Each drainage area defines the area that drains to the particular gage station from either the next upstream gage station or the headwaters of the watershed as determined by the model inputs.

The impermeable surface area was derived from the urban-sparse-bare rock land cover type within the taxonomic-level classification system developed in the Land Cover Map for the Eastern Jemez Region (McKown et al. 2003, 087150). The specific grid data set selected to provide the land cover type was the quarter-hectare smoothed taxonomic level. Within each gage station drainage area, the urban-sparse-bare rock land cover type was spatially queried for total acreage based upon the number of 50 ft x 50 ft grid cells that fell within the drainage boundary. This total area was then divided by the total area of the entire drainage area to derive the percent impermeable surface area. The following assumptions were made in the determination of the percent impermeable surface area: (1) the only available land cover data was from 2002–2003, therefore newer impermeable surfaces may not be captured; and (2) urban-sparse-bare rock grid cells that may have overlapped two drainage areas were spatially queried based upon where the center of the cell resided rather than the exact amount of each cell that fell within each drainage area.

A significant factor in the frequency of discharge at each gage is the ratio of permeable to impermeable surface area discharging to the gage. The gage at E109.9 measures discharge from a drainage area encompassing 15,800 acres, but E055.5 drains 52.7 acres. Yet, E055.5, with 81% impermeable surface area, recorded discharge greater than 5 cfs eight times and E109.9, with 8% impermeable surface area, recorded discharge greater than 5 cfs four times during this same time period. Flow occurred every day throughout the LA/P Watershed. Measurable discharge was recorded at: E038 with 88% impermeable surface area; E039.1, just below E038, with 29% impermeable surface area; and E056 with 70% impermeable surface area.

It is insightful to examine suspended sediment concentration statistics (Figure 3.1-1) for each station with respect to the drainage area (Figure 3.1-2) because the correlation between the two is quite high (Table 3.1-1). In general, these positive correlations signify that the larger the drainage area, the greater the concentration of suspended sediments in the runoff, as one would expect. However, the impermeable surface area is more highly correlated to suspended sediment than the permeable or total drainage area, suggesting that the amount of sediment in the runoff is strongly related to the impermeable surface area contributing to a station. Converting permeable surfaces to impermeable surfaces can increase the peak and shorten the duration of a hydrograph (Weng 2001, 111760; Huang et al. 2008, 111755), thereby creating a conduit for sediment to reach the stream and increasing suspended sediments measured at a gage.

3.2 Water and Sediment Transmission

Figure 3.2-1 is a flow diagram of the LA/P canyons, displaying each gage station and the location of watershed mitigations. For the storm events that were sampled, Figure 3.2-2 displays the hydrographs for each canyon from upstream to downstream; thus, it is useful to consider the progression of the gage stations downstream while examining the hydrographs. Tables 3.2-1 through 3.2-4 provide a summary of the flood bore transmission downstream for each canyon, including travel time of flood bore from the upstream to the downstream station, peak discharges of the flood bore at the station, and the percent reduction in peak discharge between the stations for every storm event in 2010. The flood bore is defined as the leading edge of the storm hydrograph as it transmits downcanyon and peak discharge is the maximum flow rate measured during a flood. In Acid and Pueblo canyons, transmission was computed between E055 and E056 to E060.1 because E059 was not fully operable until August 15. Focus was placed on peak discharge because it is related to stream power, and in ephemeral streams in semiarid climates, the greater the stream power, the greater the erosive force, hence the greater the sediment transport ((Bagnold 1977, 111753; Graf 1983, 111754; Lane et al. 1994, 111757). Also note that the peak discharges in Tables 3.2-1 through 3.2-4 are conceptually different than those in Table 2.2-1 due to temporal resolution; that is, Table 2.2-1 shows daily peak discharges (midnight to midnight) and Tables 3.2-1 through 3.2-4 show peak discharges for a particular storm event.

For all of the canyons, the flood bore moves from upstream to downstream, increasing or decreasing in power by means of alluvial groundwater and tributary contributions and/or channel and hillslope infiltration. The only exception in 2010 was in Acid and Pueblo canyons during the large storm events on August 15 when the intensity of the precipitation prevented the flood bore from reaching the downstream station before the runoff from the downstream station's own watershed. Because of the extremely localized precipitation in Los Alamos and the surrounding canyons and mountains, travel times and peak discharge increases/decreases vary substantially (Tables 3.2-1 through 3.2-4). Also, there is little to no relationship between peak discharge magnitudes, travel times between stations, or peak discharge increases/decreases. However, a summary of the peak discharge increases and decreases (Tables 3.2-5 and 3.2-6) between stations provides insight into the stream network.

In the upper watershed (E055.5 to E056 and E055 to E059) of Acid and Pueblo canyons, there are as many large increases in peak discharge as there are large decreases, signifying that the location of the precipitation has a considerable impact on the flow in the headwaters, as one might expect. Downstream the large decreases far outweigh the increases until the final stretch of the watershed, E060.1 to E109.9. In this stretch, peak discharge increases in three of four events (100% average increase), most likely due to the contribution of runoff from Guaje Canyon (a non-Laboratory subwatershed of E109.9 that is currently not monitored). Also note that between E055, E056, and E059 to E060.1, which have flow paths that traverse the Pueblo Canyon Watershed mitigations, the peak discharge decreases for 34 of 35 events (E055 to E060.1, 69% increase), the only increase occurring during the very large August 16 storm when the grade-control structure failed.

In DP Canyon, the upper channel (E038 to E039.1) traverses the DP Canyon Watershed mitigations. The fact that the peak discharge decreases in 26 of 32 events (72% average decrease) indicates that the mitigations are reducing the stream's erosive force and thus are performing well. From E039.1 to E040, there are many more decreases in peak discharge than increases, indicating further reduction in the erosive force. In Los Alamos Canyon, the peak discharge increases in the upper watershed (E026 to E030) for all 9 events (81% average increase), most likely due to additional runoff from the drainage area associated with E030 and the difference in percent of impermeable area draining to the two stations (30% at E030 in contrast to 2% at E026). As one progresses down LA Canyon, the confluence of E030 and E040 is located just downstream of the gage stations, with E042.1 at the bottom of the canyon just above the LA Canyon low-head weir. From E030 to E042.1, the peak discharge increases in 9 of 11 events (75% average increase); however, from E040 to E042.1, the peak discharge decreases in 15 of 18 events (78% average decrease). Also, the peak discharges are generally much higher at E040 than at E030. This pattern is assumed to be due to the larger percent of total, or nested, impermeable area draining to E040 (50%) in contrast to E030 (7%).

The LA Canyon low-head weir is located between E042.1 and E050.1, through which the peak discharge decreases for the entire 10 storm events (77% average decrease). For six storm events, the flow is reduced completely (100% average decrease). The erosive force is reduced, thus the watershed mitigation is performing well. In the final stretch of the Los Alamos Canyon Watershed E050.1 to E109.9, the peak discharge increases for two storm events (59% average increase, most likely from Guaje Canyon), and decreases for two storm events (84% average decrease, assumed to be infiltration).

Figure 3.2-3 shows the hydrograph and sedigraph for each station that was sampled throughout a storm event. Table 3.2-7 shows the linear correlations between the discharge and suspended sediment for these stations and storm events for different time lags (suspended sediment lagging behind discharge). On August 15 at E109.9, initially high suspended sediment concentrations were produced from flows of 20 cfs and were less possibly related to loading of sediment in the channel by bank collapse and burrowing. First storms of the year might also be expected to produce higher suspended sediment concentrations. Stations E042.1 and E060.1 have high positive correlations at varying time lags (0 to 20 minutes), but E109.9 is less so. Figure 3.2-4 displays the linear relationship between sediment yield and runoff volume for the stations where suspended sediment was measured throughout the storm event; Table 3.2-8 contains the values displayed in Figure 3.2-4. Although suspended sediment and instantaneous discharge are not always highly correlated as a result of localized precipitation, sediment availability, or antecedent conditions, the linear relationship between sediment yield and runoff volume for a watershed is well established (Onodera et al. 1993, 111759; Nichols 2006, 111758; Mingguo et al. 2007, 111756).

The runoff volume for each storm was computed as follows

$$V = \sum_{i=0}^{n} Q(t_i)(t_{i+1} - t_i) \quad , \qquad \textbf{Equation 3.2-1}$$

where n = the number of instantaneous discharge measurements taken throughout the storm event,

t = the time, i, at which an instantaneous discharge measurement is taken, and

$Q(t_i)$ = the discharge (ft^3/s) at time t_i.

The mass of sediment for each storm event was computed by

$$M = \sum_{j=0}^{n} Q(t_j)(t_{j+1} - t_j)\,SSC(t_j) \quad , \qquad \textbf{Equation 3.2-2}$$

where n = the number of suspended sediment samples taken throughout the storm event,

t_j = the time, j, at which an suspended sediment sample is taken,

$Q(t_j)$ = the discharge (ft^3/s) at time t_j interpolated from the instantaneous discharge measurements taken at time t_i, and

$SSC(t_j)$ = the suspended sediment concentration (mg/L) at time t_j (conversion between liters and cubic feet is required).

In Appendix A, hydrographs, precipitation, and suspended sediment are displayed for each date and station that samples were collected. The precipitation shown is associated with the precipitation-station-based Thiessen polygons that overlay the watershed area, thus are theoretically contributing to the discharge measured at the station. As expected, the discharge lags the precipitation, and when there are several pulses in the hyetograph, there are consequential peaks in the hydrograph. Suspended sediment is much less predictable with no definitive trend between concentration magnitude, peak discharge, or time to peak.

3.3 Impact and Efficiency of Watershed Mitigations

Grade-control structures are constructed to reduce erosive flood energy and to cause upstream aggradation to fill existing stream channels, bury existing floodplain deposits, and support wetland health. As a consequence of the aggradation they promote and the wetlands they support, grade-control structures should reduce sediment transported during flood events. Cross-vane structures are constructed to decrease flood peaks to reduce the erosive force of the rising floodwaters before floods entering downstream wetlands. Cross-vane structures may also enhance deposition of sediment. Wing ditches divert floodwater from the main channel into adjacent floodplains to decrease surface water flow velocities. Willow planting is done to aid in surface stabilization, flow reduction, and sediment accumulation.

DP Canyon during 2010: Sampling conducted in DP Canyon on July 9 and July 30 was performed above (E038) and below (E039.1) the watershed mitigations. Analyses performed from samples collected during these storms allow direct evaluation of the DP Canyon Watershed mitigations. Sampling was conducted from similar portions of each storm. A 45-minute delay occurred between initiation of sampling and the maximum discharge at E038 and E039.1 on July 9. On July 30, a 29-minute delay occurred between initiation of sampling at E038 and E039.1, and a 35-minute delay occurred between maximum discharges from the two gages. Samples collected for suspended sediment analyses initiate and conclude sample collection at E038 and E039.1. Between these two stations for these two storms, the average relative percent difference (RPD) is 34% decreasing (three of the four samples) and 29% increasing (one of the four samples).

Decreasing stormwater velocity allows for infiltration to be increased. Increasing infiltration reduces the distance that a storm surge travels in the stream channel and decreases the distance that inorganic and organic chemicals and radionuclides entrained in the water column travel. Increasing infiltration reduces peak storm discharge (see Figure 3.3-2), but also decreases the total volume of stormwater volume passing the gage station. A reduction in runoff volume and suspended sediment concentrations was observed related to watershed mitigations between E038 and E039.1 on July 9 and July 30. On July 9, total runoff volume was reduced from 1.1 acre feet at E038 to 0.3 acre feet at E039.1. Not counting runoff unique to the E039.1 drainage area, 0.8 acre feet of stormwater was absorbed between the two gage stations. On July 30, total runoff volume was reduced from 3.2 acre feet at E038 to 2.4 acre feet at E039.1. Again, not counting runoff unique to the E039.1 drainage area, 0.8 acre feet infiltrated between the two gage stations.

In addition to examining coinciding sampling events, watershed mitigation performance can be assessed by examining overall statistics for 2010. Figure 3-3.1 displays box and whisker plots for E038 and E039.1 for both suspended sediment concentrations and peak discharge. These plots show that the DP Canyon Watershed mitigations are reducing the suspended sediment concentrations and peak discharge (i.e., erosive force), thus are performing well.

Los Alamos Canyon during 2010: No sampling was performed in Los Alamos Canyon above (E059) and below (E060.1) the watershed mitigations for the same storm. Therefore, overall statistics for 2010 must be used to assess performance. Figure 3.3-1 displays box and whisker plots for E059 and E060.1 for both suspended sediment concentrations and peak discharge. As can be seen in these plots, the Los Alamos Canyon Watershed mitigations are reducing the suspended sediment concentrations and peak discharge (i.e., erosive force), thus are performing well.

4.0 ANALYTICAL RESULTS

Appendix B contains all analytical results obtained from stormwater runoff samples collected in Los Alamos and Pueblo canyons during 2010.

As explained in the work plan for implementing the control structures addressed by this monitoring report, the structures were installed as part of an interim measure under section VII.B of the Consent Order (LANL 2008, 101714) to mitigate transport of contaminated sediments in the Los Alamos and Pueblo canyons Watershed. The analytical results from monitoring are presented and evaluated within this context. The control structures were not installed with the objective of reducing concentrations of waterborne contaminants to specific levels, and the analytical results are not compared with water quality standards or other criteria for that purpose or to evaluate compliance with regulatory requirements. For this report, monitoring results are compared with water quality standards for the purpose of narrowing the list of specific constituents for conceptual model discussions in this report and to provide a basis for potential future revisions to the analytical suites. The New Mexico Water Quality Control Commission (NMWQCC) Standards for Interstate and Intrastate Surface Waters (New Mexico Administrative Code 20.6.4) establish surface water standards for New Mexico. The NMWQCC classifies all surface water within the Laboratory boundary with segment-specific designated uses. The LA/P stream segments are classified as ephemeral or intermittent, with designated uses of limited aquatic life, livestock watering, wildlife habitat, and secondary contact. Some of the standards are for total concentrations, which are compared with data from unfiltered surface water samples. Other standards are for dissolved concentrations, which are compared with data from filtered samples. Table 4.0-1 presents the NMWQCC standards that were used as numeric values for comparison with monitoring results for the purposes stated above. Table 4.0-2 presents the comparison of detected analytical results with these comparison values.

When chemicals and radionuclides have comparison values for multiple designated uses, the smallest value is selected for comparison with analytical results. Analytical constituents consistently detected above these values include gross alpha and total PCBs. Other radionuclides consistently detected, but without comparison values, include plutonium-239/240, cesium-137, uranium-234, uranium-235/236, uranium-238, and strontium-90.

4.1 Data Exceptions

Suspended sediment concentrations measured from stormwater samples collected at E042.1 on August 16 are not representative of field conditions. During this particular event, the maximum discharge corresponds to the smallest sediment concentrations, and sediment concentrations fluctuate in ways unlike those observed in samples collected from other sampling events. The suspended sediment associated with the samples collected at E042.1 on August 16 cannot be used for evaluation of watershed mitigation performance.

Sampling at E039.1 occurred on July 21. However, no discharge and no precipitation were recorded to occur during the day of sample collection. Water collected is of unknown origin. There is no hydrograph associated with samples collected at E039.1 on July 21. Analytical results are not representative of stormwater, thus cannot be used for evaluation of watershed mitigation performance.

Sampling at E059 occurred on August 5 before the gage was fully prepared to collect stage-height measurements. Therefore, discharge from this day is estimated and there is no measured hydrograph associated with this storm.

Sampling at E109.9 occurred on August 23 at a time when stage-height measurements from the encoder were invalid because of silting and the damaged bubbler from the August 16 storm. As a result, peak discharge was estimated from the high water mark left by the storm. There is not a usable hydrograph associated with this storm.

4.2 Filtered and Unfiltered Results

Filtered and unfiltered results were obtained from all inorganic chemical analyses and from radionuclide analyses at E109.9. Comparisons of filtered and unfiltered radionuclide results are presented in Table 4.2-1. Filtered and unfiltered pairs were obtained two times for each nuclide. Comparisons of filtered and unfiltered inorganic chemical results are presented in Table 4.2-2. Filtered and unfiltered pairs were obtained 33 times for each inorganic chemical. Organic chemicals were not analyzed from filtered samples.

For the TAL metals, less than one-half of unfiltered results are detected for mercury, selenium, and thallium. Silver, cadmium, and chromium are largely reduced to below detection limits in the filtered result. Because of the high frequency of nondetected results, these TAL metals are excluded from subsequent unfiltered/filtered comparisons.

The RPD of each detected pair helps to show the influence of filtration on analytical results. A five-fold reduction from the unfiltered to filtered analytical result corresponds to a 133% RPD. A two-fold reduction from the unfiltered to filtered analytical result corresponds to a 66% RPD. Aluminum, barium, beryllium, copper, iron, manganese, nickel, lead, uranium, vanadium, and zinc express an average RPD greater than 133% in detected, filtered analytical results. Arsenic, calcium, cobalt, magnesium, and potassium expressed average RPDs greater than 66%, but less than or equal to 133% in detected, filtered analytical results. The average of detected boron, sodium, and antimony filtered results expressed RPDs less than 66%.

4.3 Sediment Transport

Discharge was calculated from stage height using a rating curve, which is the relationship between discharge in cubic feet per second and height of the water in feet, developed for each individual gage. Stage height was measured at 5-minute intervals, logged continuously during each sampled storm event. Suspended sediment was measured up to 22 times at E042.1, E050.1, E059, and E060.1 during the first 290 minutes of each storm. Suspended sediment was measured up to 18 times at E109.9 during the first 190 minutes of each storm. At other gages, suspended sediment was measured immediately before and following sampling for inorganic and organic chemicals and radionuclides.

Suspended sediment and instantaneous discharge estimates are calculated for each analytical result using a linear relationship between the two corresponding analytically-determined suspended sediment concentrations or the two corresponding discharge measurements, as follows

$$y = mx+b \quad , \qquad \textbf{Equation 4.3-1}$$

where y = the calculated concentration of suspended sediment or discharge at the time of sample collection,

m = the slope of the line,

x = the time differential in minutes between suspended sediment sample collection or discharge measurements, and

b = the concentration of analytically-determined sediment before sample analyses or corresponding discharge measurements.

The slope m is determined by dividing the difference in sediment concentrations between samples collected before and following analytical sample collection by the difference in minutes between the sample collection times of the samples collected immediately before and following analytical sample collection.

Using this equation, concentrations of suspended sediment and instantaneous discharge are calculated for each sample collected. The calculated suspended sediment concentrations are presented in Table 4.3-1.

4.4 Relationships between Discharge, Suspended Sediment, and Contaminant Concentrations

The quality of relationships between calculated suspended sediment concentrations, calculated instantaneous discharge, and analytical results obtained provide insight into performance of watershed mitigation installed in the LA/P Watershed and the usefulness of future monitoring strategies.

Analyte concentrations, including suspended sediment, generally show a poor correlation to instantaneous discharge. The relationship of calculated, instantaneous discharge to suspended sediment at all LA/P gages during 2010 is displayed in Figure 4.4-1. Across the watershed, instantaneous discharge is poorly correlated to suspended sediment concentrations. Instead, instantaneous sediment transport is more accurately related to the particle sizes of sediment being transported in the water column; transport velocity of suspended load as affected by stream grade, channel obstructions, and other factors; settling velocity of particles; and channel bed sheer stress due to grain resistance as impacted by recent soil disturbances, wetland condition, channel erosion and channel composition among other factors (Scott 2006, 111789). These conditions can vary between gages in the same channel and between storms at the same gage.

Suspended sediment concentrations can be used as a predictor of many inorganic chemicals and radionuclides in unfiltered samples. Uranium-238 expresses a strong linear relationship to sediment concentration in the LA/P Watershed as displayed in Figure 4.4-2.

Sixteen frequently detected inorganic chemicals and radionuclides were selected to show the relationship between instantaneous discharge and corresponding analyte concentration (Figure 4.4-3). These 16 chemicals and radionuclides were evaluated to show the relationship between suspended sediment concentrations and corresponding analyte concentration (Figure 4.4-4). All correlations between instantaneous discharge and analyte concentrations are negative. The correlations between suspended sediment concentrations and unfiltered detected results are considerably stronger. Results obtained from E109.9 on August 15 and September 22 can be identified as outliers but are retained in both sets of figures for comparison.

In contrast, plutonium-239/240 and total PCBs across the LA/P Watershed are not linearly correlated to suspended sediment concentrations as shown in Figure 4.4-5. The lack of correlation results from a spatial distribution of this radionuclide and class of organic chemicals across the LA/P Watershed.

However, even at a single gaging station, the relationships between plutonium-239/240 and total PCBs to suspended sediment concentrations are not consistent. The relationships of these constituents measured at E042.1 during storm events sampled this year are shown in Figure 4.4-6. At this single station, equations describing the relationship between suspended sediment and plutonium-239/240 or total PCBs have very poor correlation. This lack of a single equation indicates that plutonium-239/240 and total PCBs are not homogeneously distributed through sediments reaching E042.1 during storm events. Because of the paucity of samples collected, correlations cannot be determined for plutonium-239/240 and total PCBs in Pueblo Canyon this year.

Because suspended sediment concentrations vary widely, it is useful to normalize inorganic chemical and radionuclide concentrations to sediment concentrations in which a correlation exists between suspended sediment and an analyte across the LA/P Watershed. After normalization, inorganic chemicals are converted to milligrams per kilogram units of measure and can be compared with canyon sediment background values (LANL 1998, 059730). Table 4.4-1 presents the results of this normalization and comparison of inorganic chemicals from aluminum through iron, Table 4.4-2 presents normalized results for lead through zinc. Table 4.4-3 presents normalized results for radionuclides.

Analytical results for samples collected at the retention basins and wetland below the SWMU 01-001(f) drainage are presented in Table 4.4-4. Total PCBs collected at the terminus of the wetland are almost 30 times less concentrated than total PCBs collected in the upper retention basin. Suspended sediment is reduced two times in the same samples. Lead is reduced almost five times. Interestingly, total and isotopic uranium show concentration increases as water passes through the retention basins to the wetland.

5.0 CONCLUSIONS

The mitigations implemented in the Los Alamos and Pueblo canyons Watershed are relatively new features that in some cases are expected to take at least one runoff season to begin to show representative performance. Some positive effects of the mitigations, including reductions of peak discharge, sediment deposition, and contaminant transport, were observed during this monitoring year and will be reevaluated during sampling that will occur during 2011. However, the nature and location of storms in 2010 did not result in a comprehensive contaminant data set for assessment of the effects of the mitigations on contaminant concentrations within a storm or between storms to determine a sense of long-term performance expectations for the mitigations.

Long-term assessment of overall watershed and mitigations performance will be greatly enabled through establishment of key relations between flow, suspended solids concentrations, and contaminant concentrations. The 2010 data set provided some insights into these critical relationships. For example, the 2010 data set indicates that inorganic and organic chemicals and radionuclides show generally poor correlations to suspended sediment concentrations for legacy constituents measured across the watershed, and also poor correlations at individual gages. Stronger correlations are observed between suspended sediment concentrations and naturally occurring constituents in sediment. Although instantaneous maximum discharge and suspended sediment concentrations are not well correlated, total runoff volume and total sediment yield for each storm are strongly correlated.

Ongoing monitoring in 2011 is expected to enhance the data set and will advance the conceptual model for these relationships and further enable performance assessment of the mitigations.

6.0 REFERENCES AND MAP DATA SOURCES

6.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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6.2 Map Data Sources

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Summer/Winter rain gage locations and networks; Los Alamos National Laboratory, Environmental Programs; Unpublished 2010 project data, Project 10-0027.

Gage stations; Los Alamos National Laboratory, Environmental Programs; Unpublished 2011 project data, Project 11-0002; locations based on WQDB data pull from January 5, 2011.

Gage drainage areas; Los Alamos National Laboratory, Environmental Programs; Unpublished 2011 project data, Project 11-0002; areas developed using the ArcHydro data model.

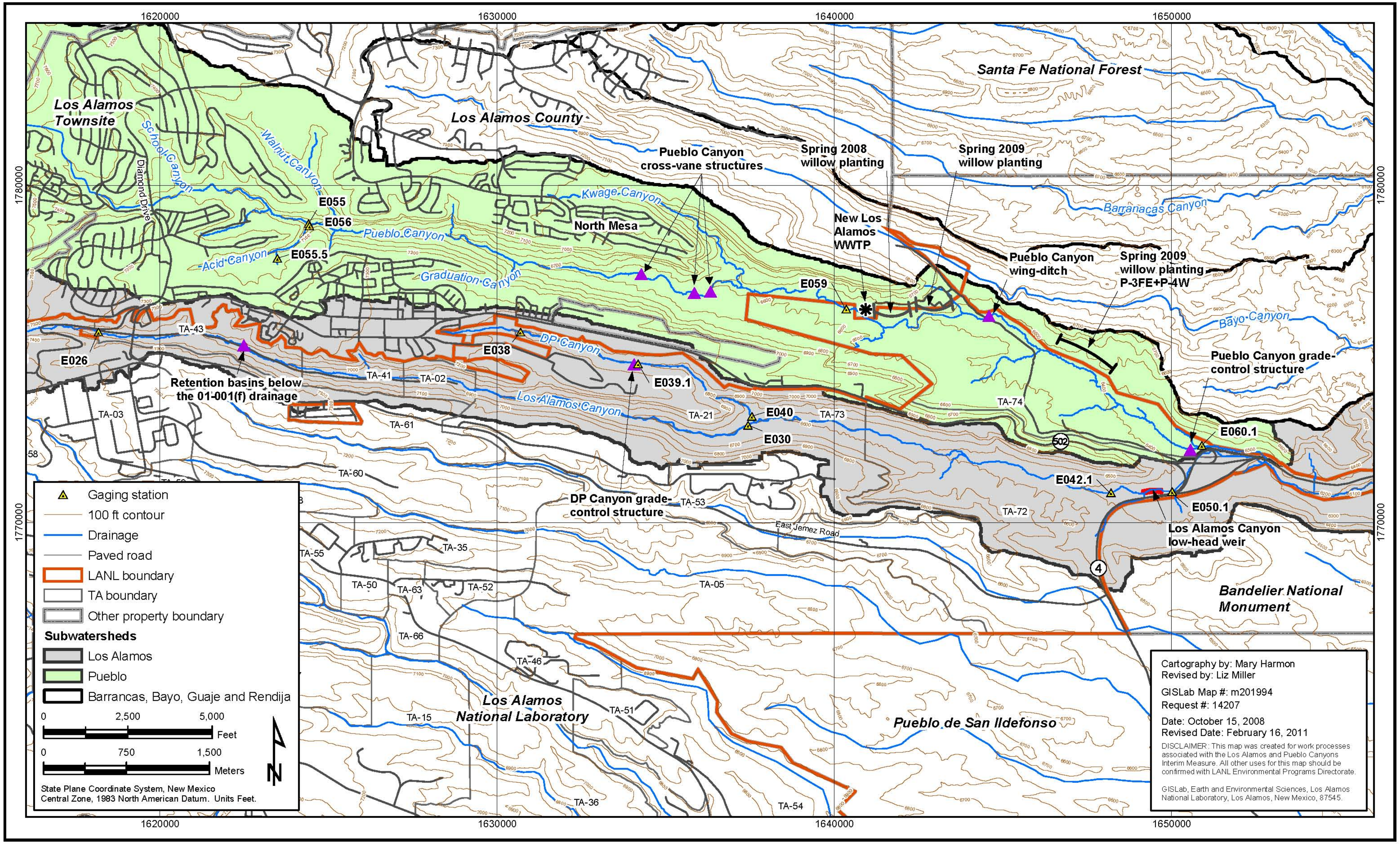


Figure 1.0-1 Los Alamos and Pueblo canyons showing monitoring locations and stormwater mitigation features

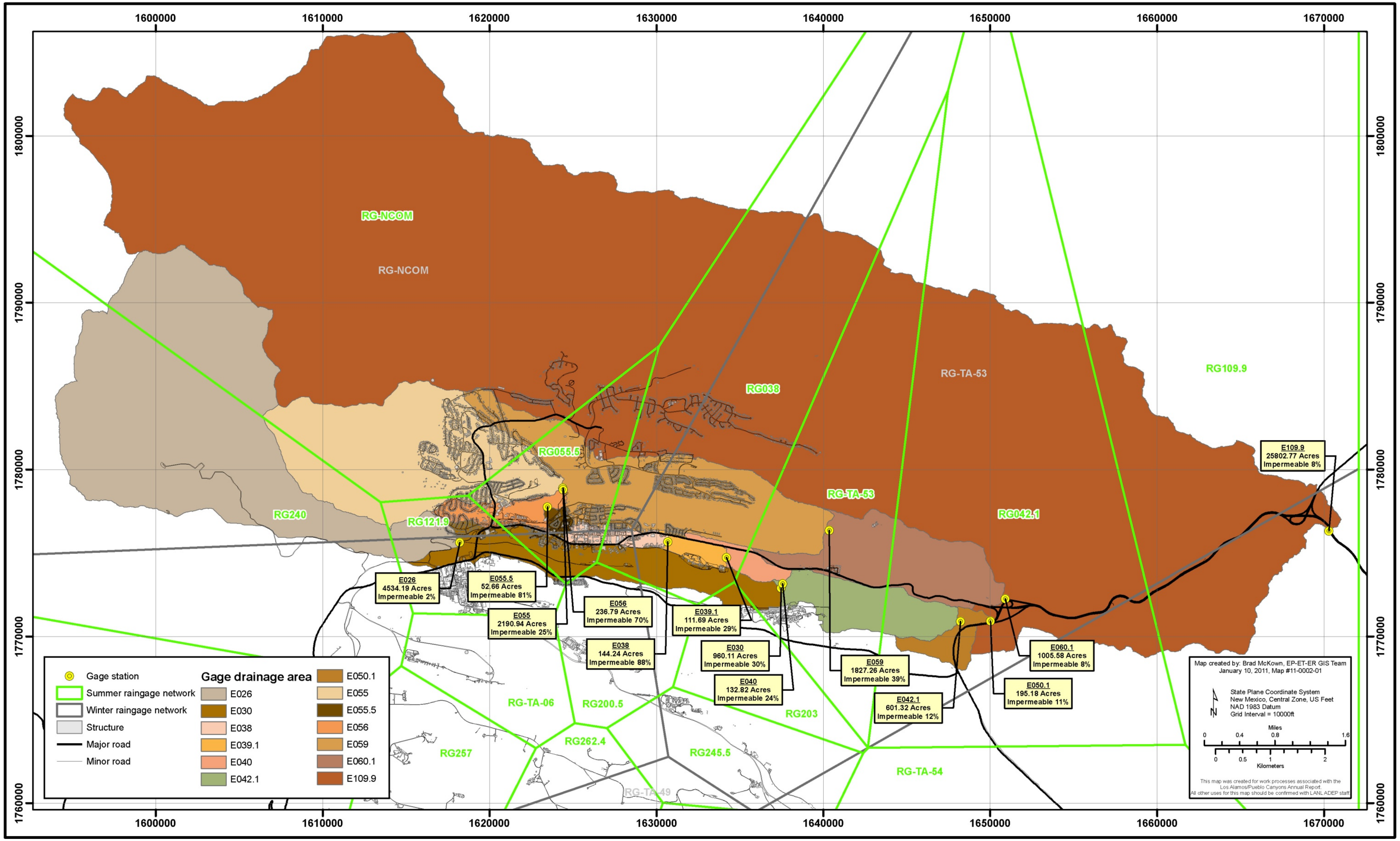
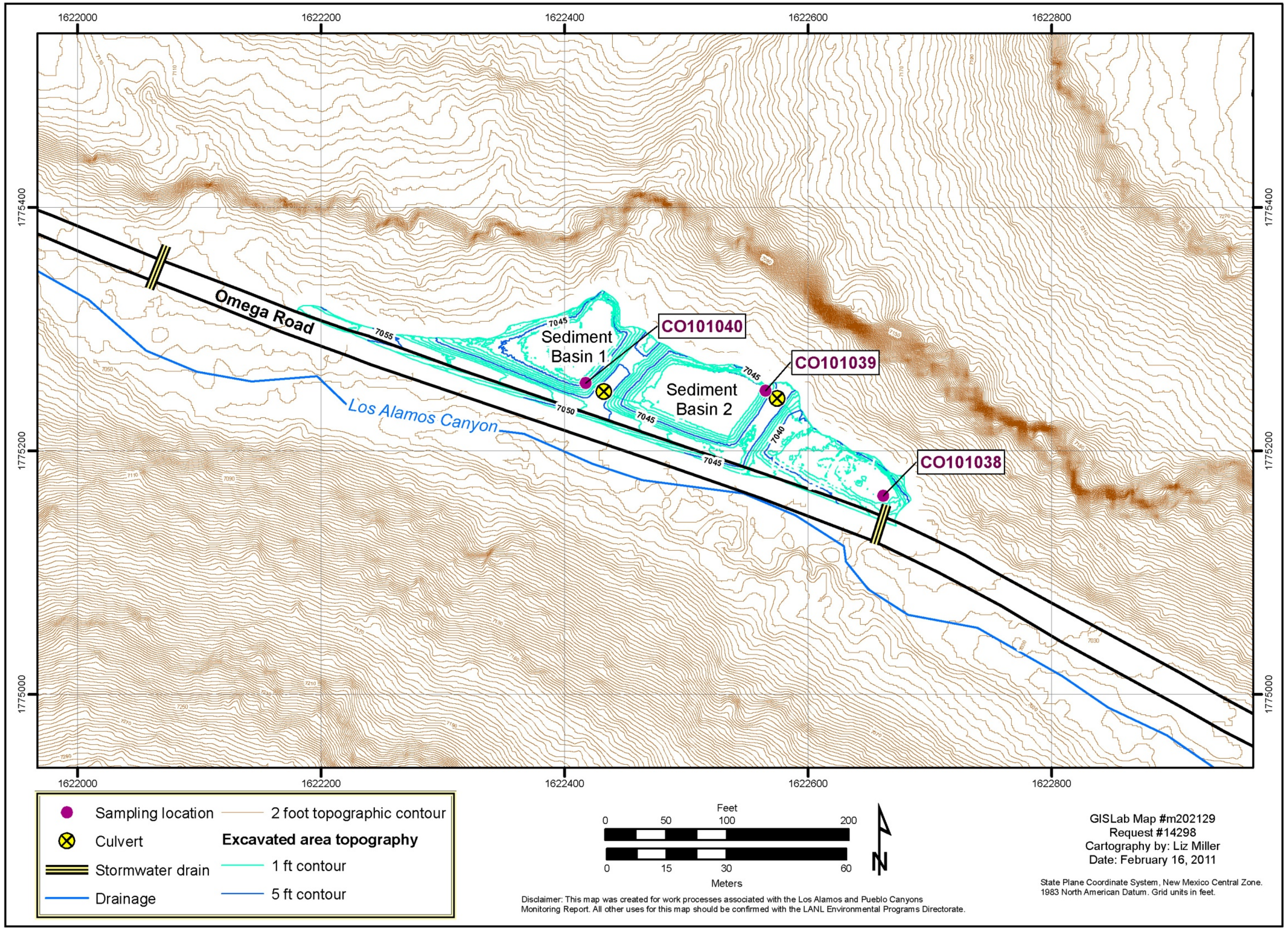


Figure 2.0-1 Los Alamos and Pueblo canyons drainage areas for each gage and associated rain gages



GISLab Map #m202129
Request #14298
Cartography by: Liz Miller
Date: February 16, 2011

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum. Grid units in feet.

Disclaimer: This map was created for work processes associated with the Los Alamos and Pueblo Canyons Monitoring Report. All other uses for this map should be confirmed with the LANL Environmental Programs Directorate.

Figure 2.1-1 **Watershed mitigations and sampling locations at the retention basins and wetland below the SWMU 01-001(f) drainage**

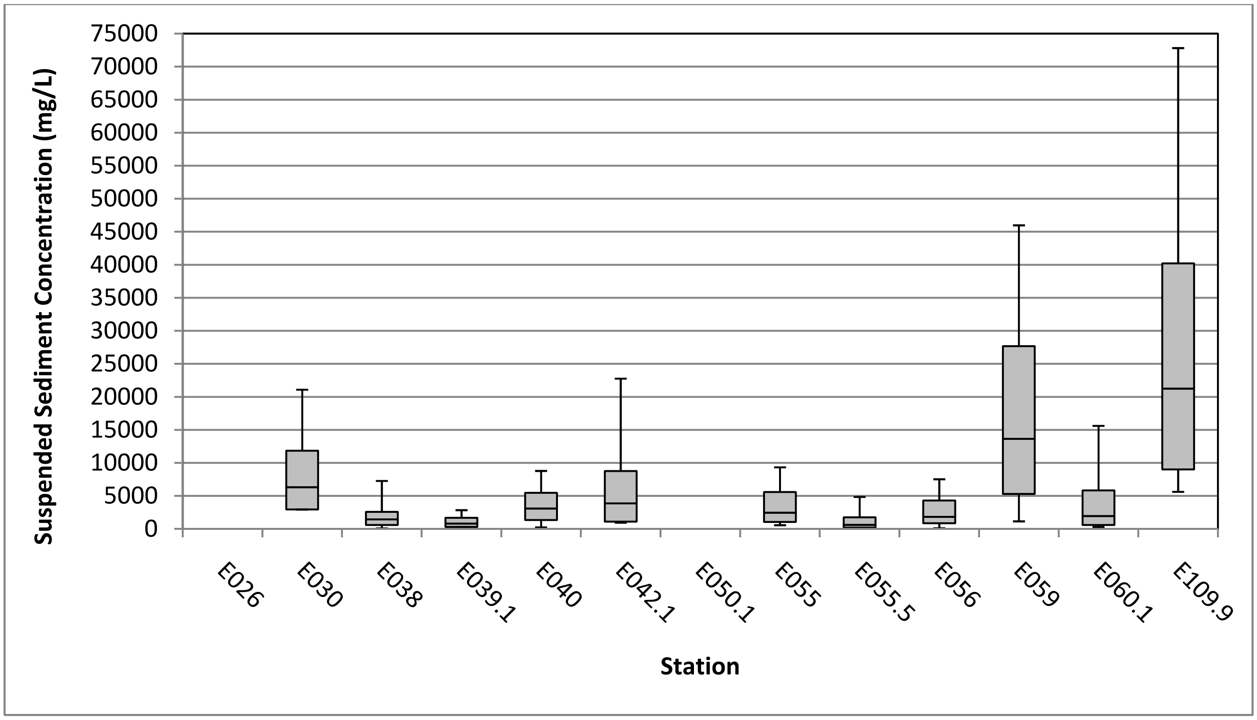


Figure 3.1-1 Box and whisker plot of suspended sediment concentrations for each station (no suspended sediment samples were collected at E026 or E050.1)

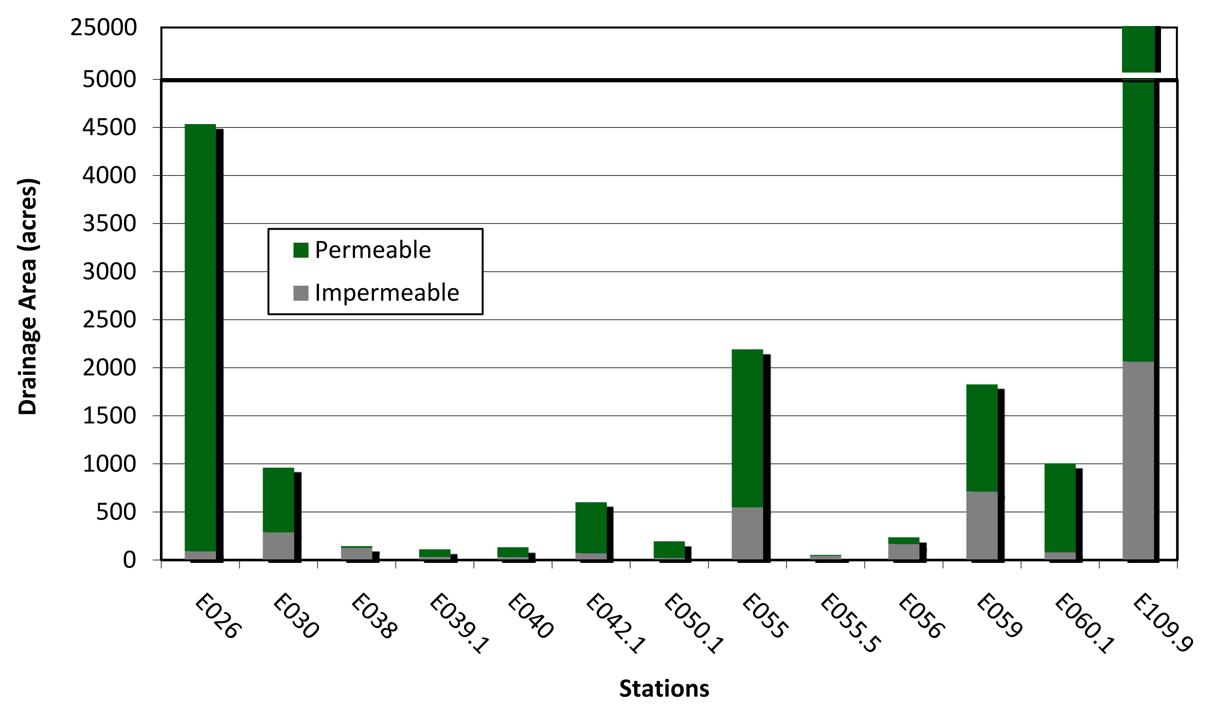


Figure 3.1-2 Unique drainage area and fraction of permeable/impermeable area for each station

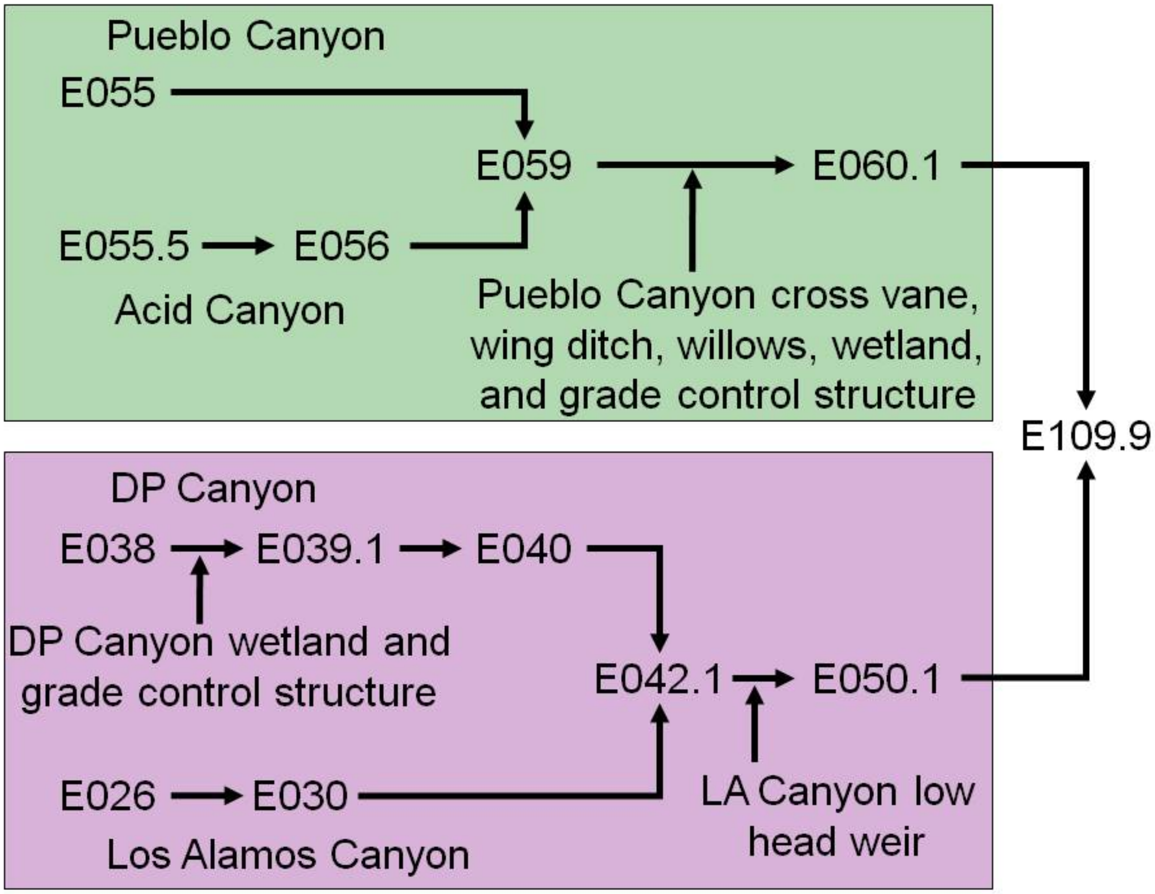


Figure 3.2-1 Flow diagram of gage stations and watershed mitigations in Los Alamos/DP and Pueblo/Acid canyons

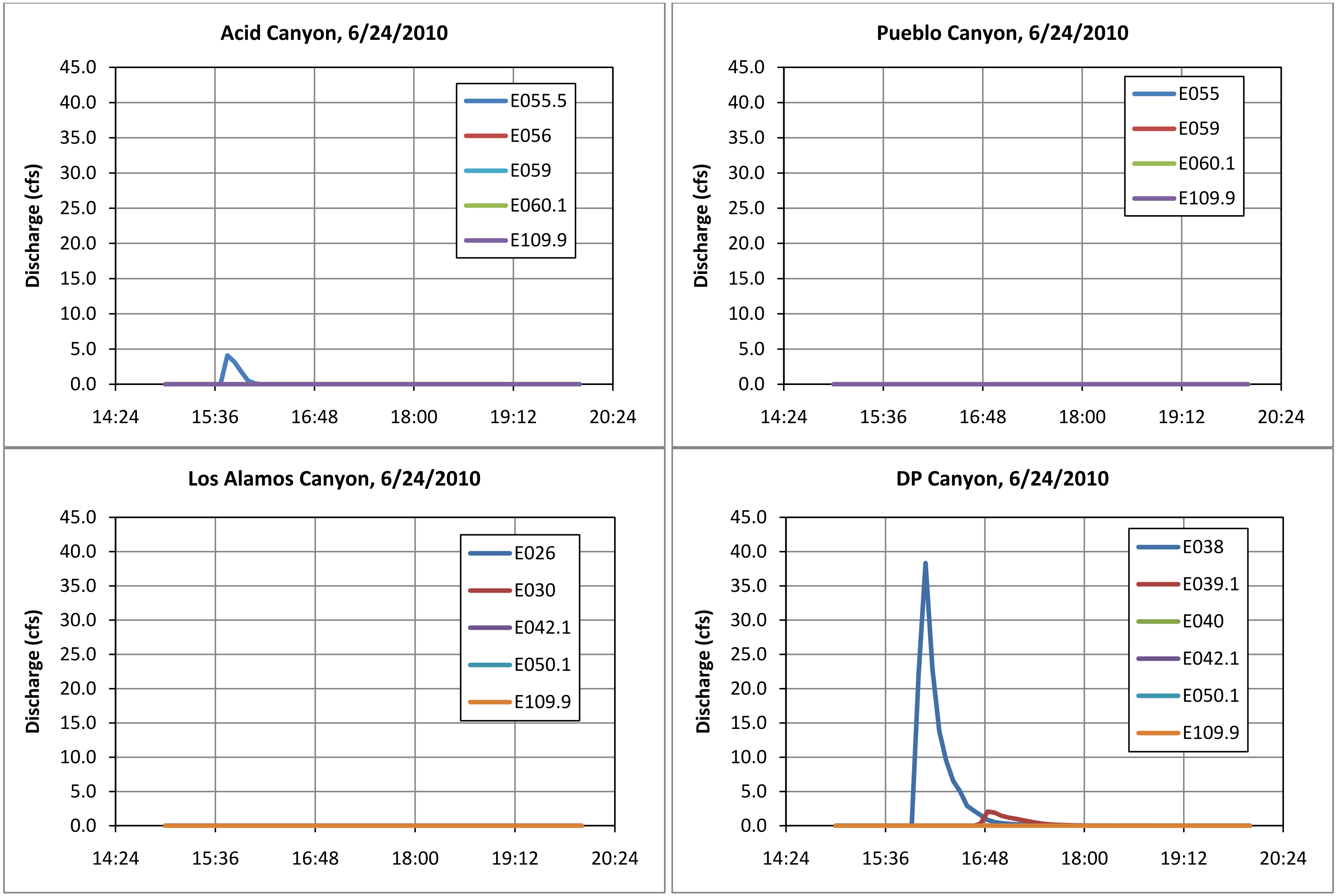


Figure 3.2-2 Hydrographs during each sampling event for each canyon from upstream to downstream reaches

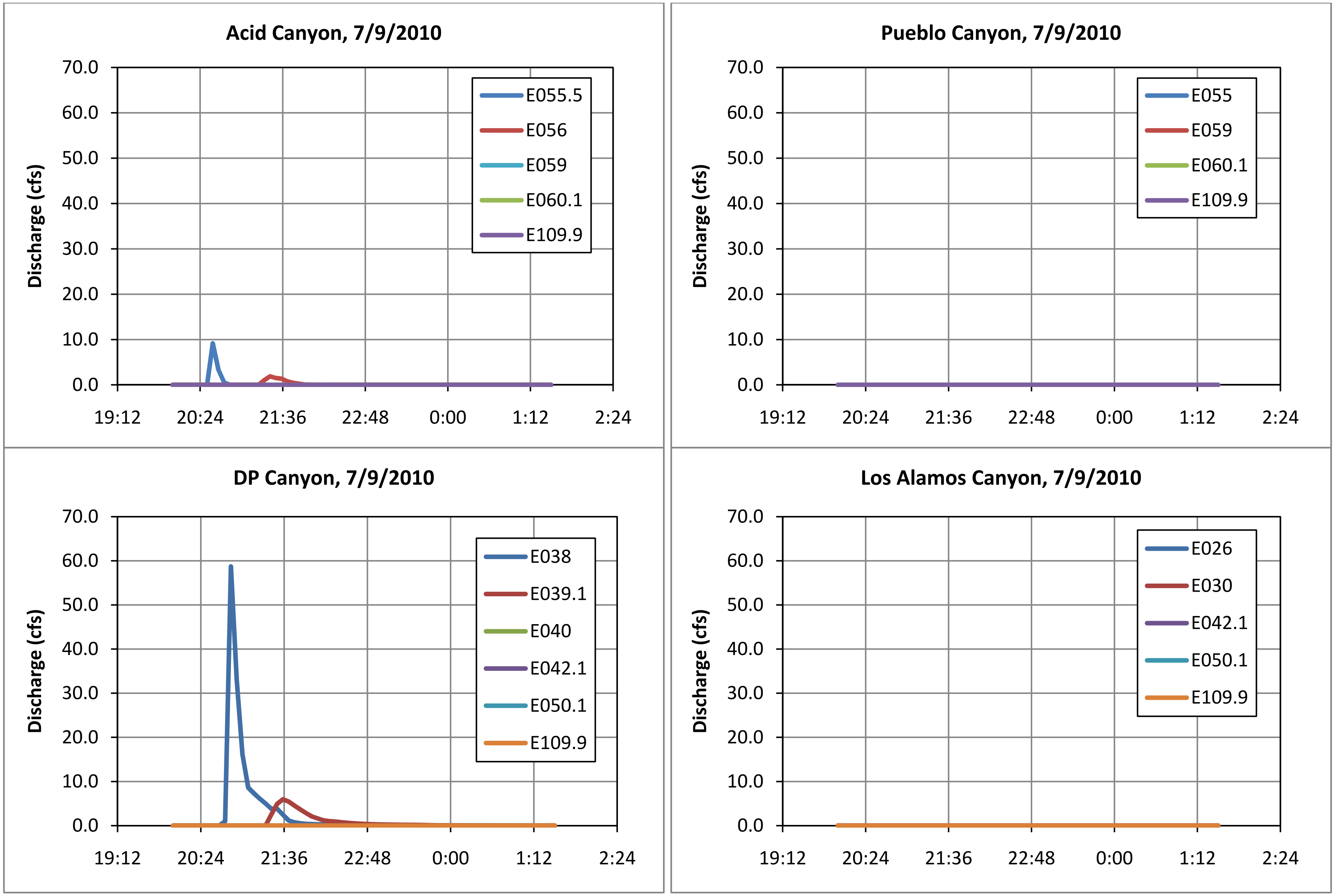


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**

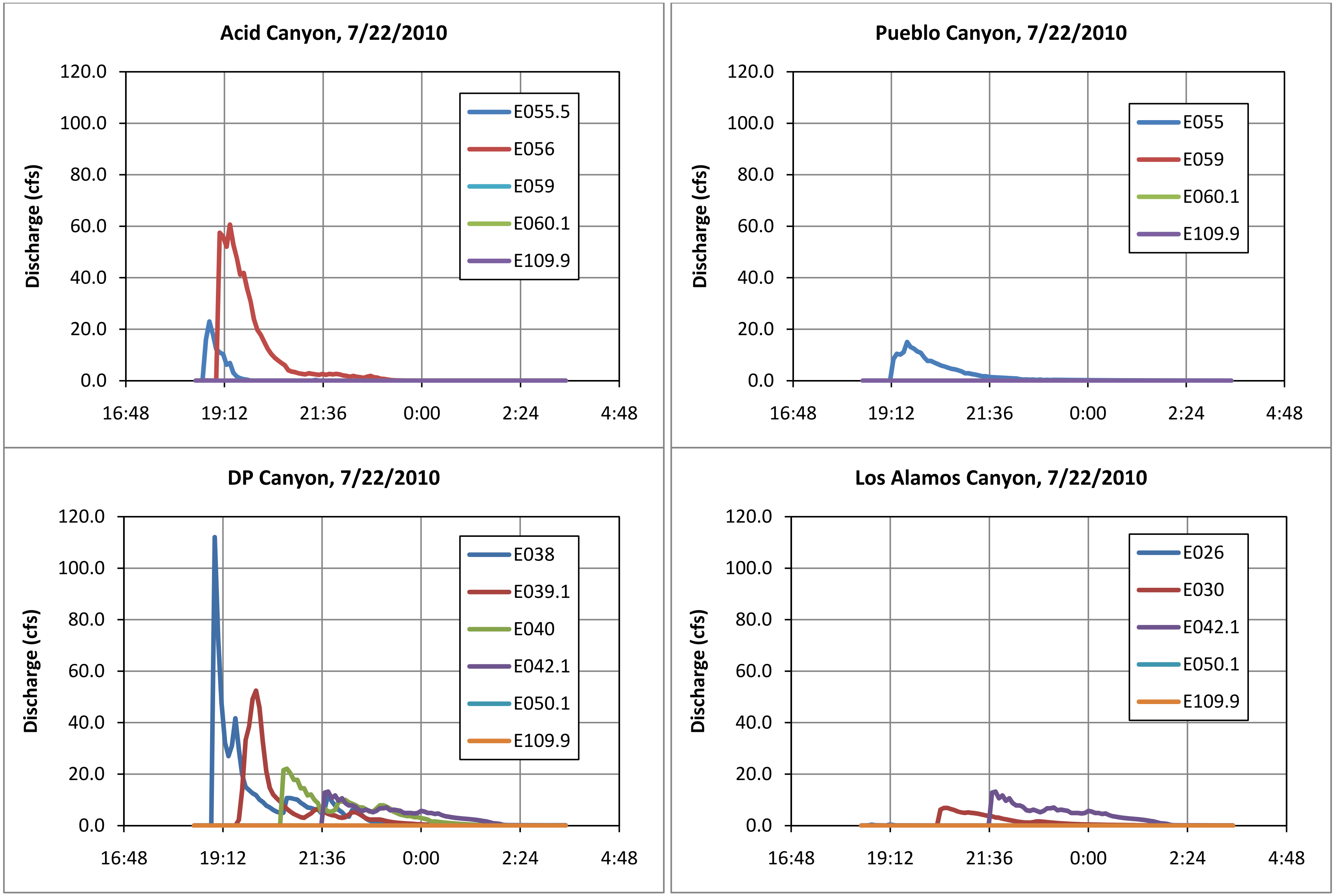
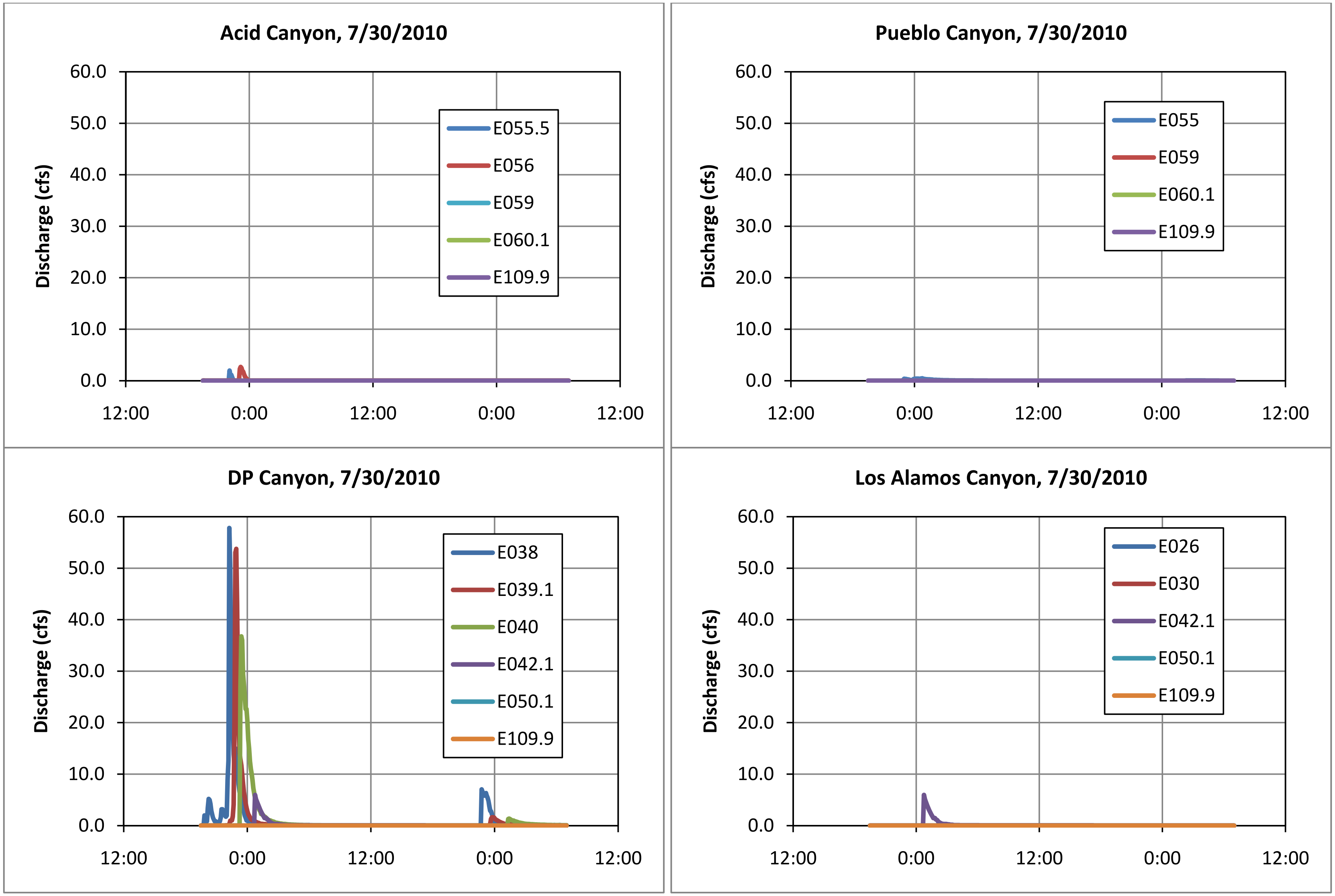


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**



Acid Canyon, 7/30/2010

Pueblo Canyon, 7/30/2010

DP Canyon, 7/30/2010

Los Alamos Canyon, 7/30/2010

Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**

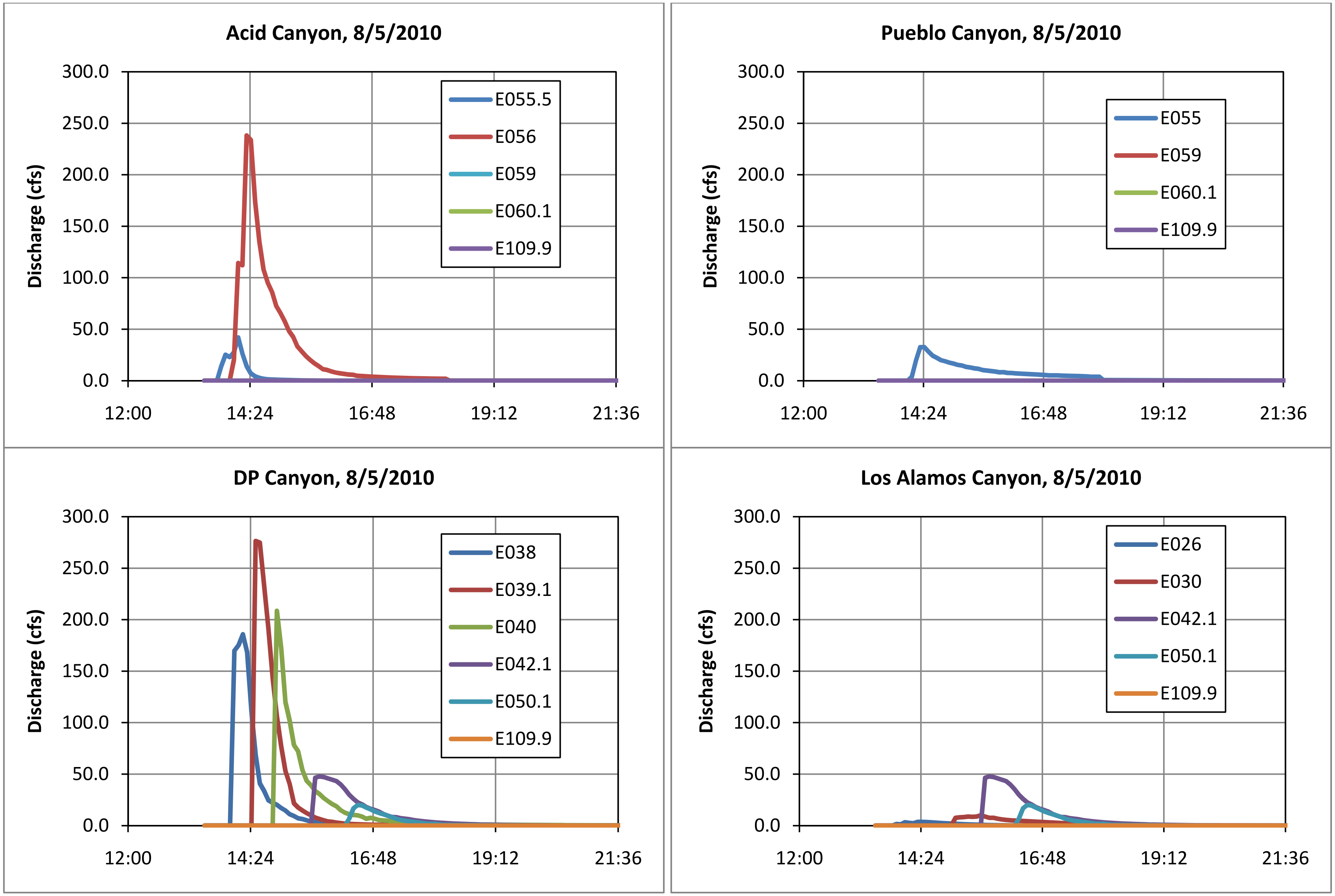


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**

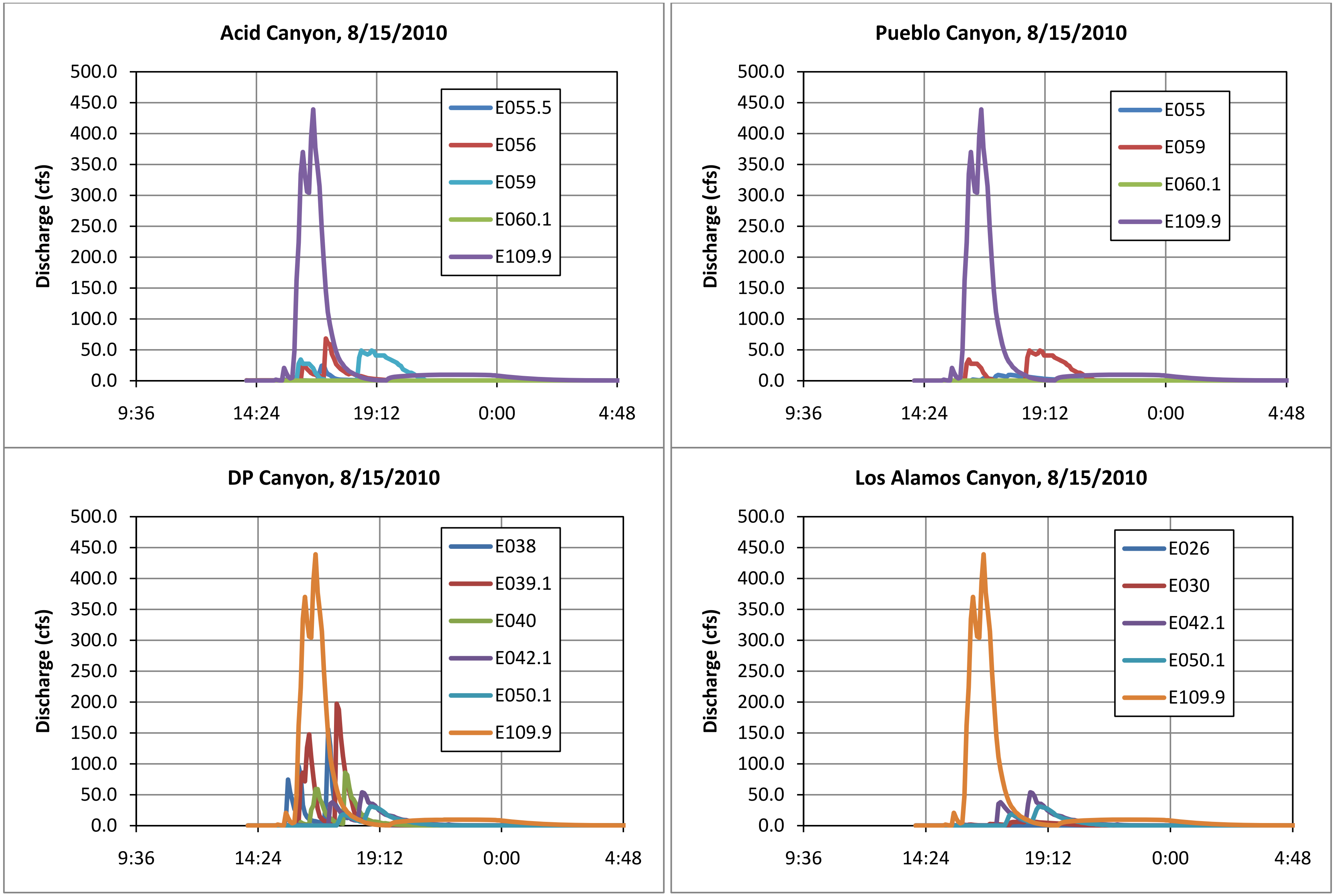


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**

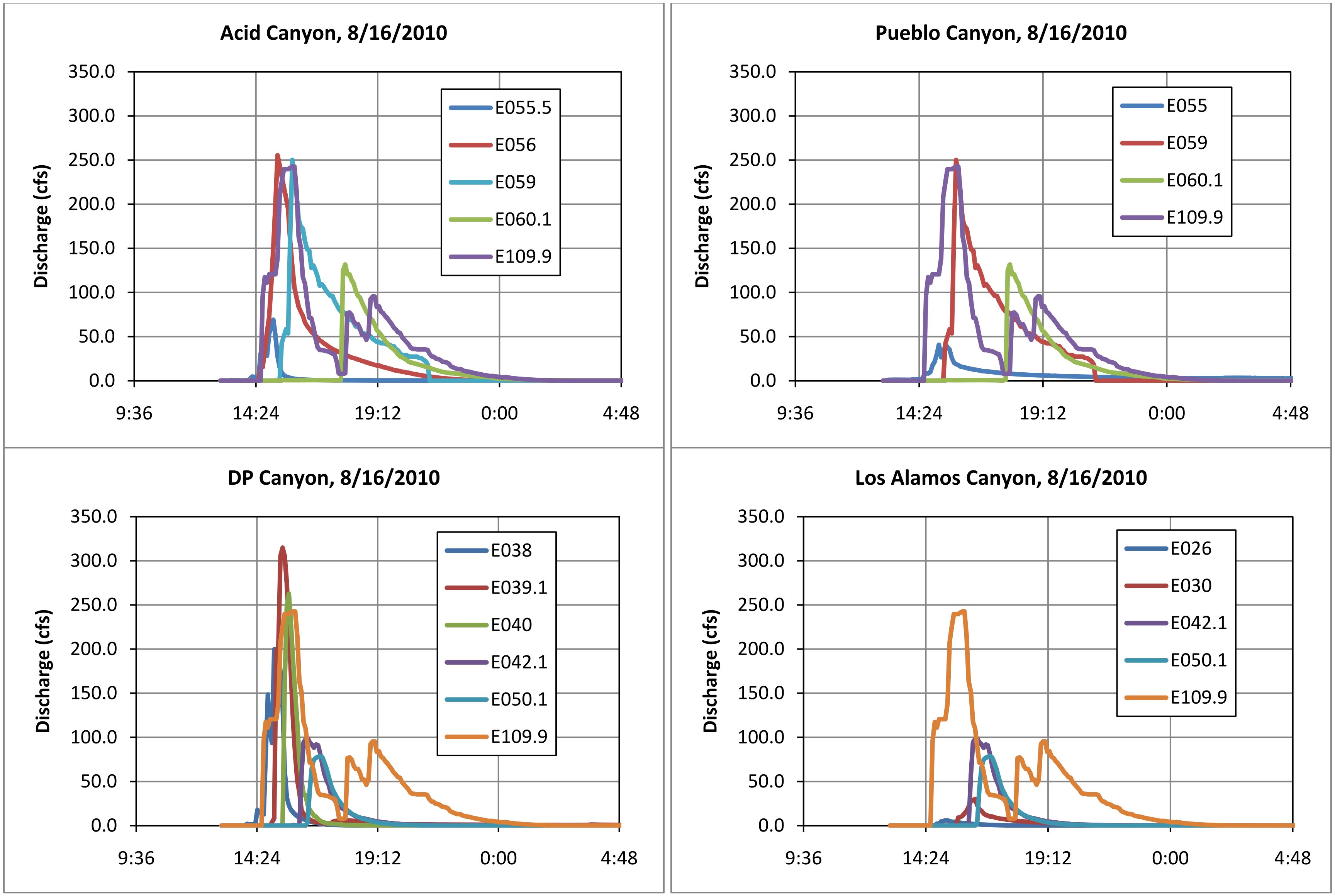
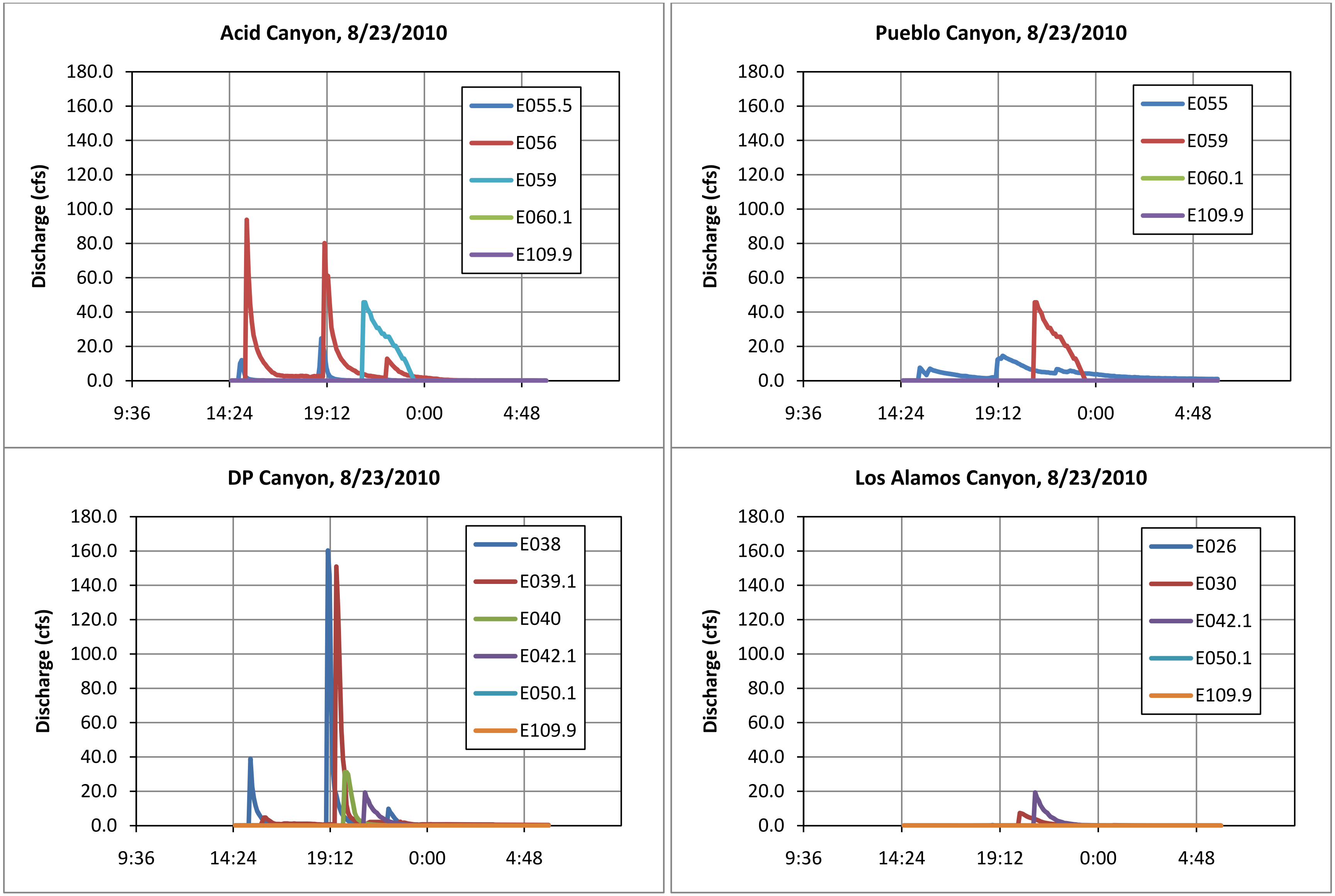


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**



Note: E109.9 was not functioning on August 23.

Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**

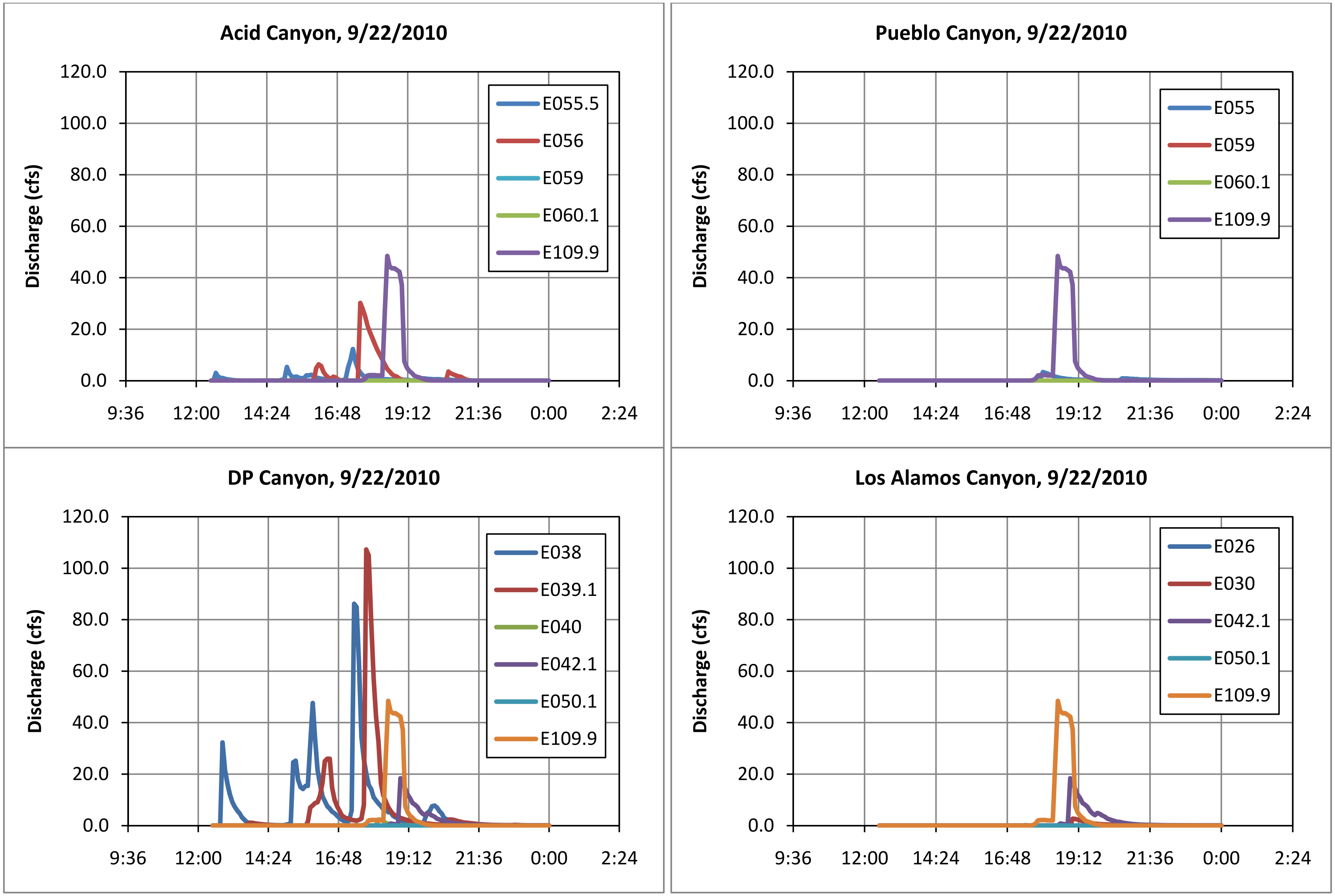


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**

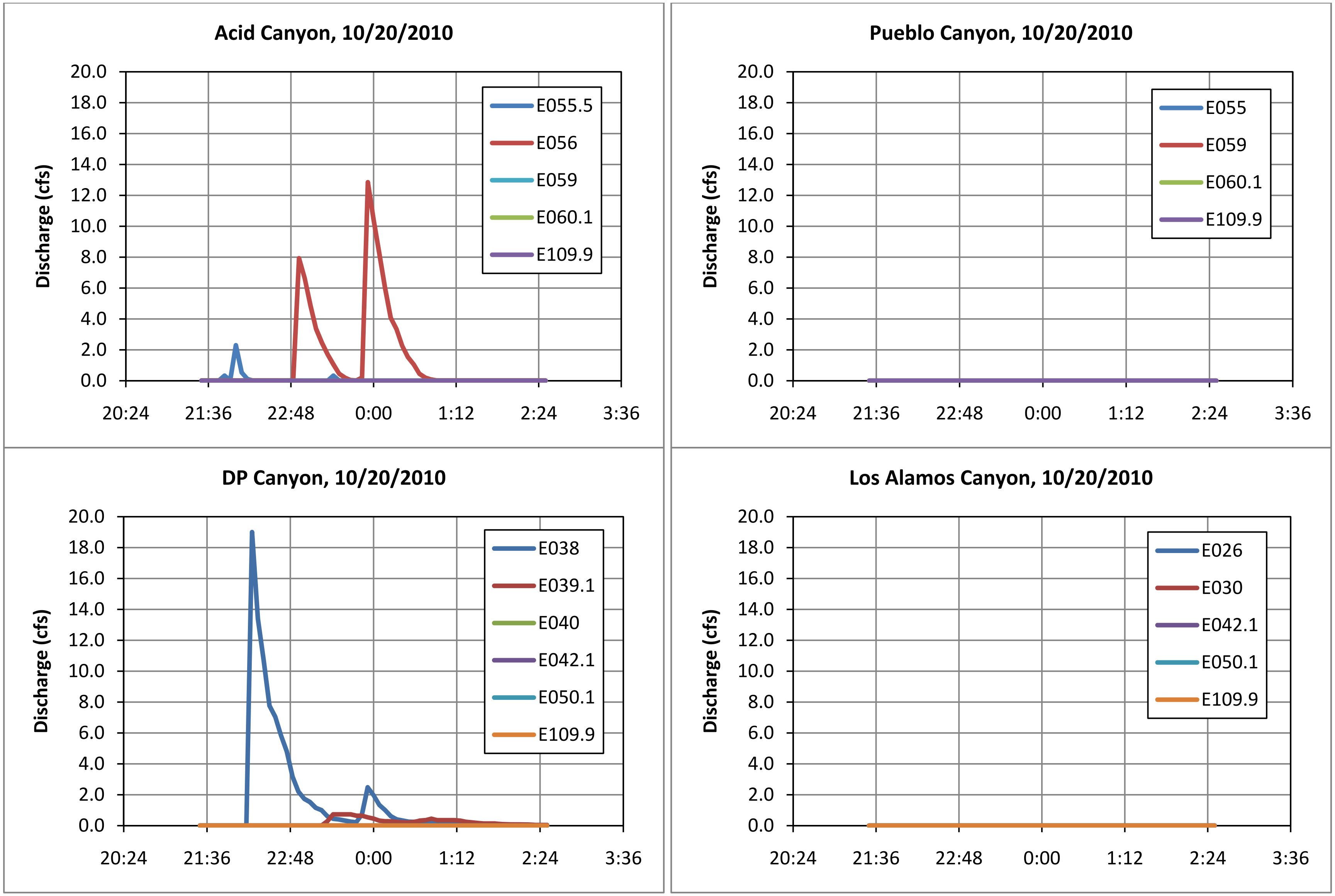


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**

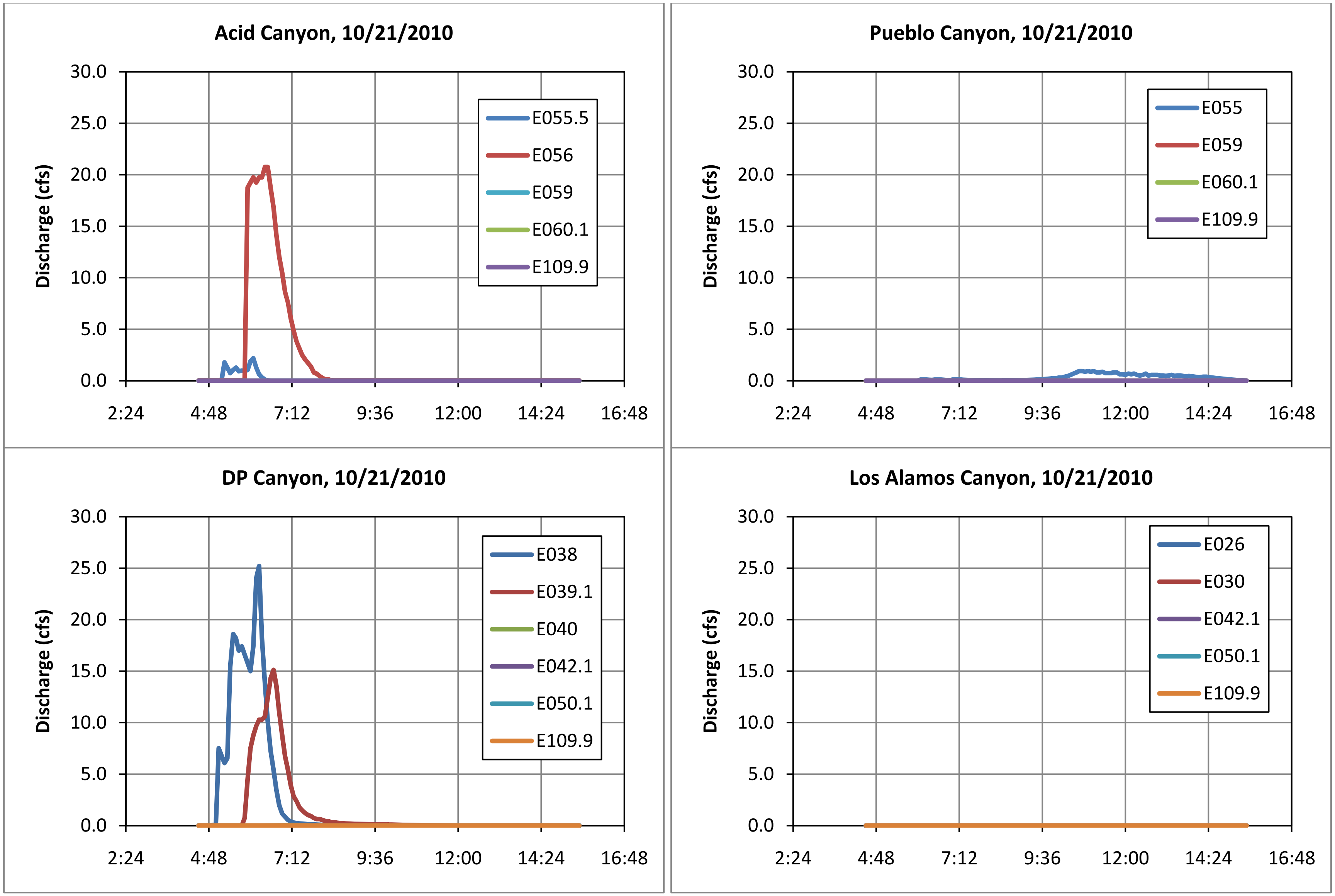
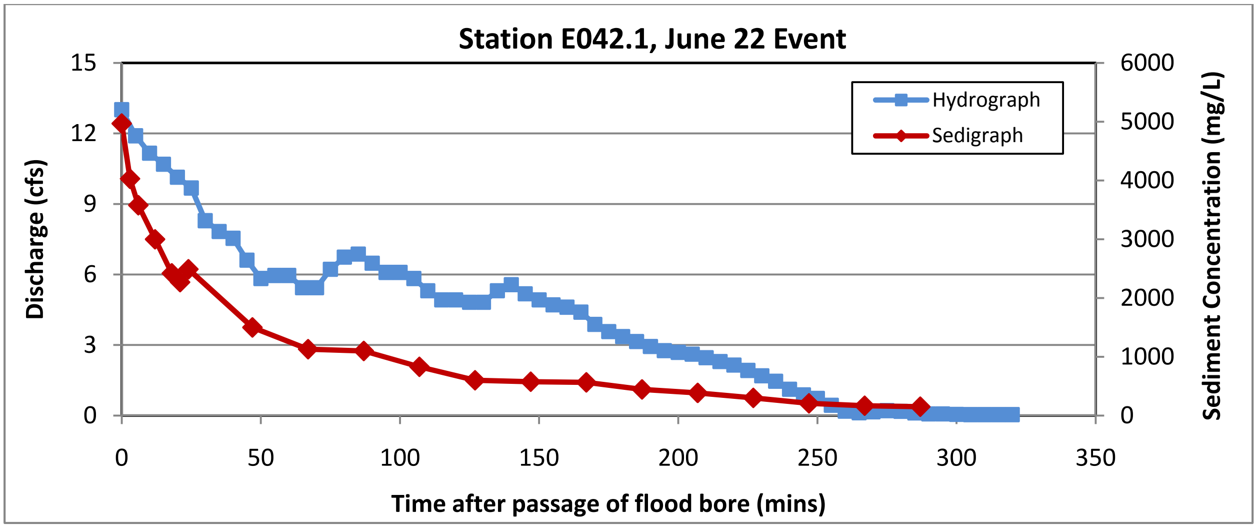
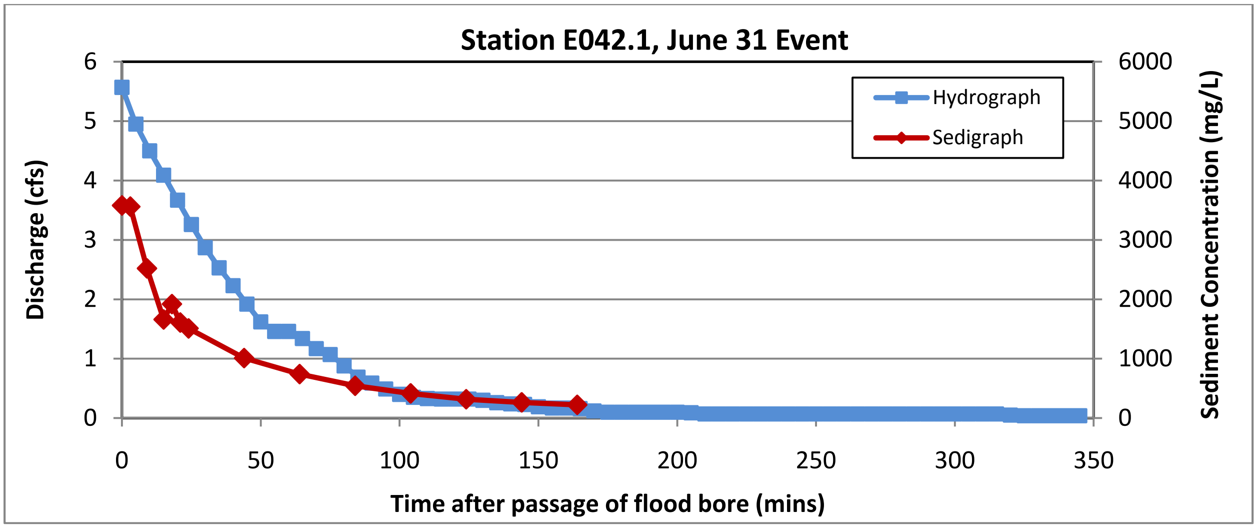


Figure 3.2-2 (continued) **Hydrographs during each sampling event for each canyon from upstream to downstream reaches**





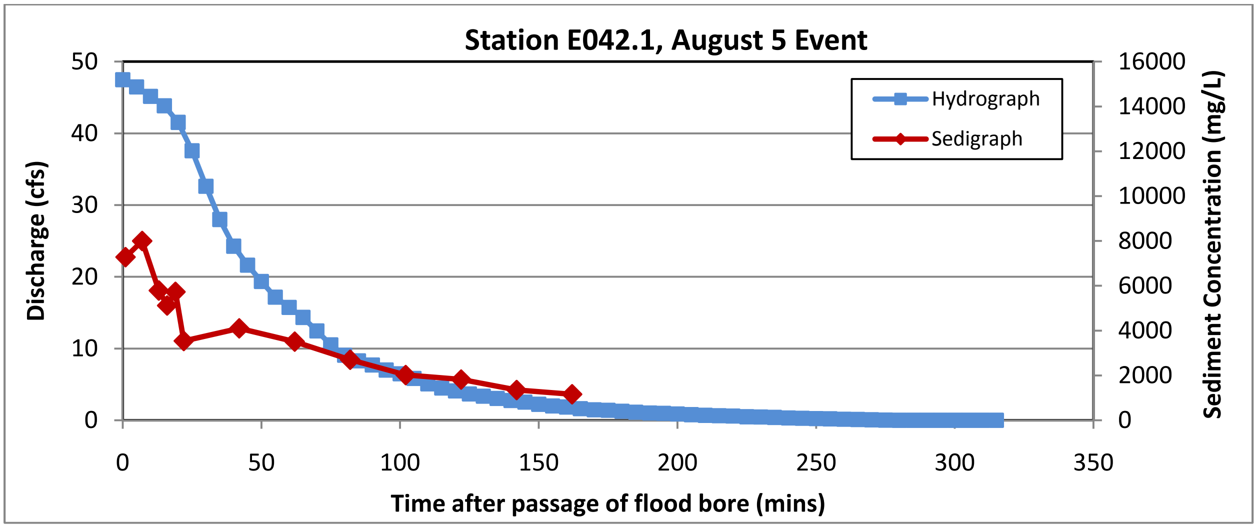
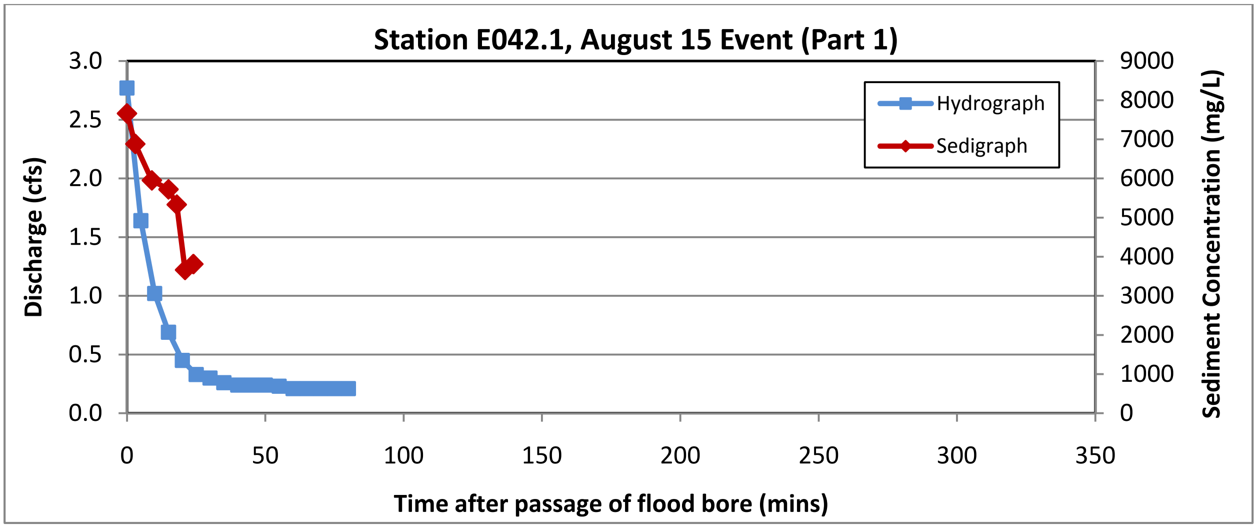
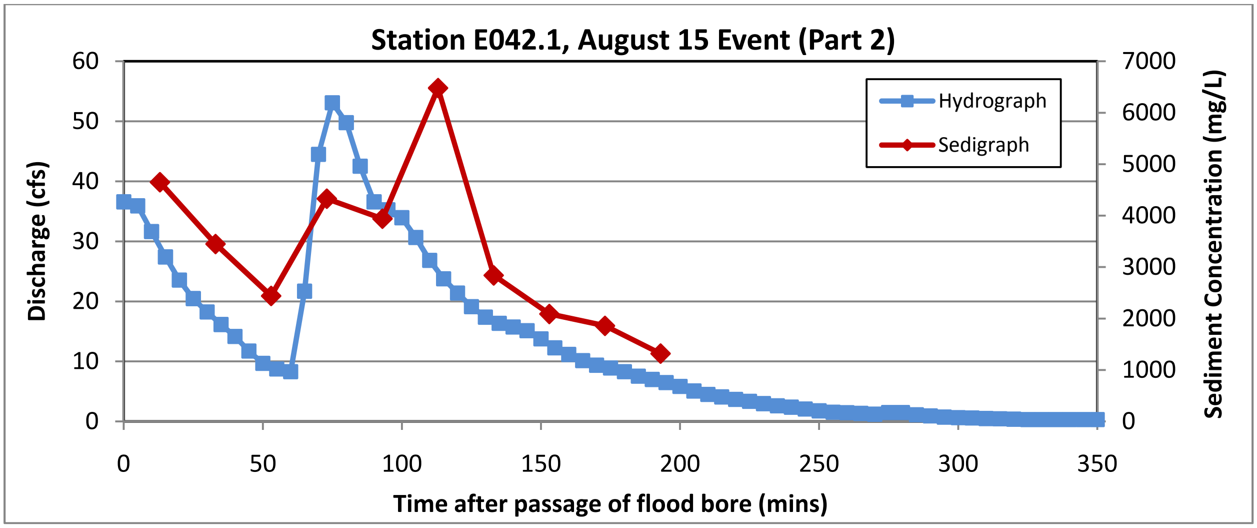


Figure 3.2-3 **Discharge and suspended sediment concentration for each station sampled throughout the storm event**





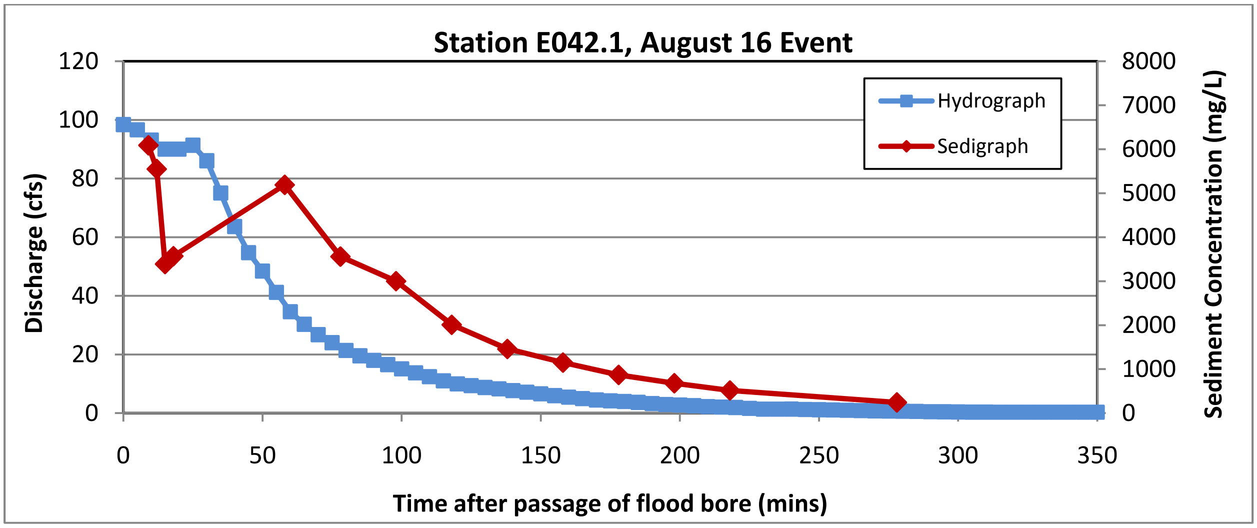
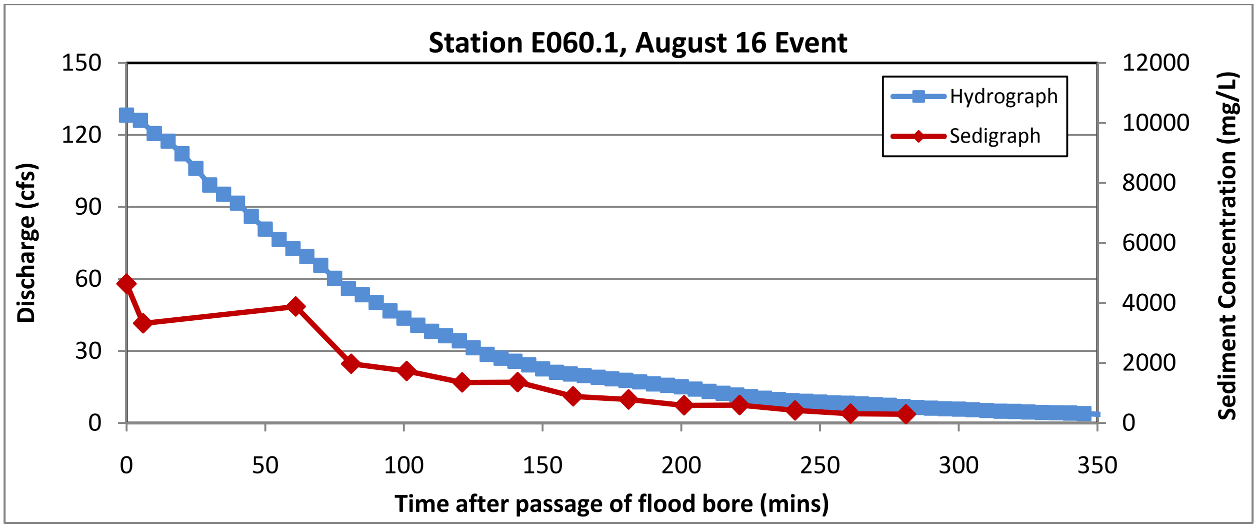
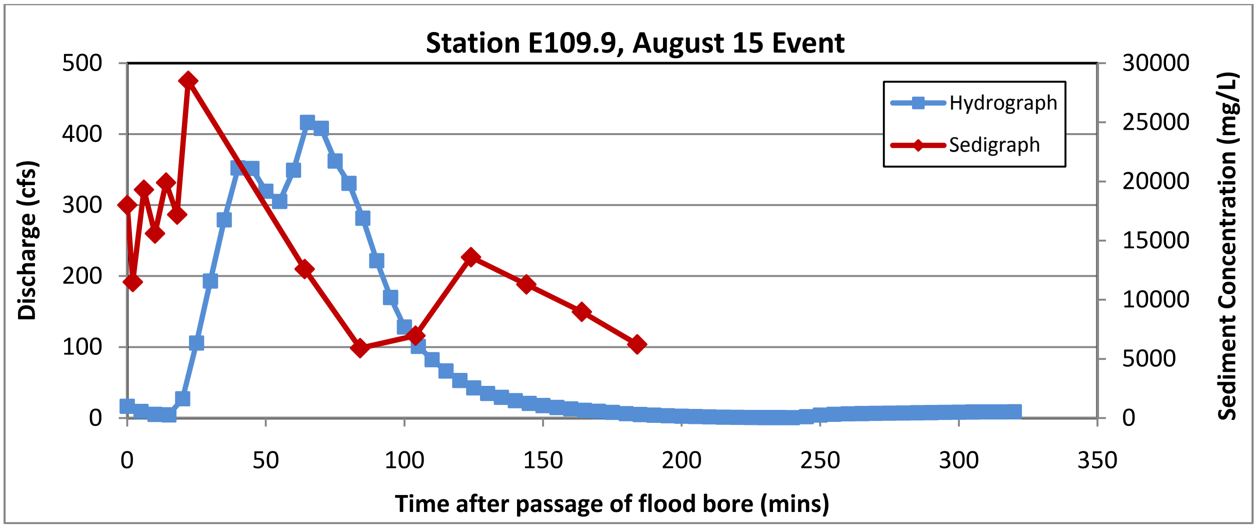


Figure 3.2-3 (continued) **Discharge and suspended sediment concentration for each station sampled throughout the storm event**





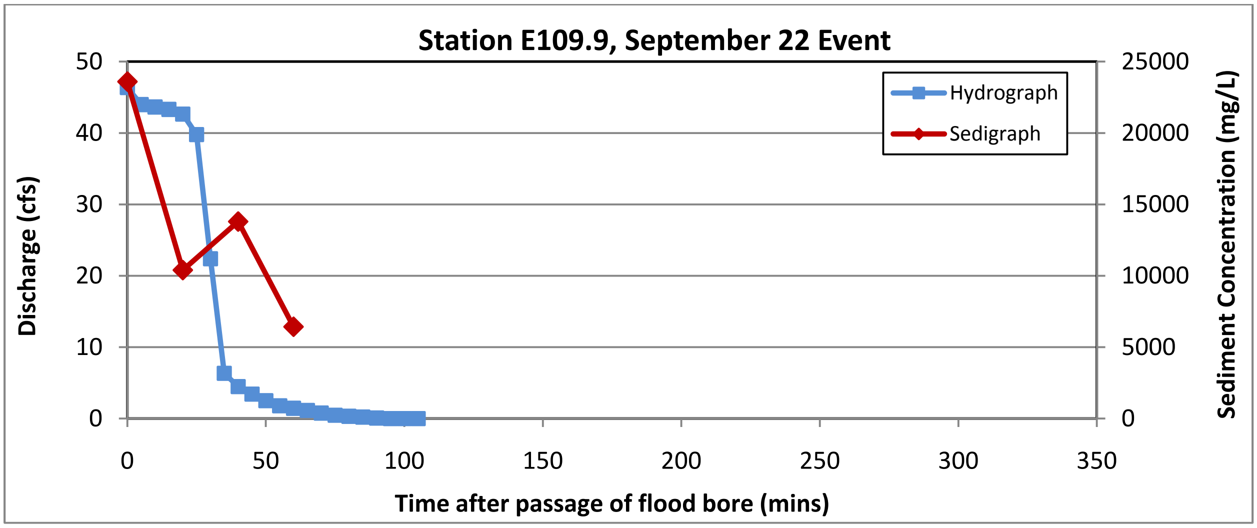


Figure 3.2-3 (continued) **Discharge and suspended sediment concentration for each station sampled throughout the storm event**

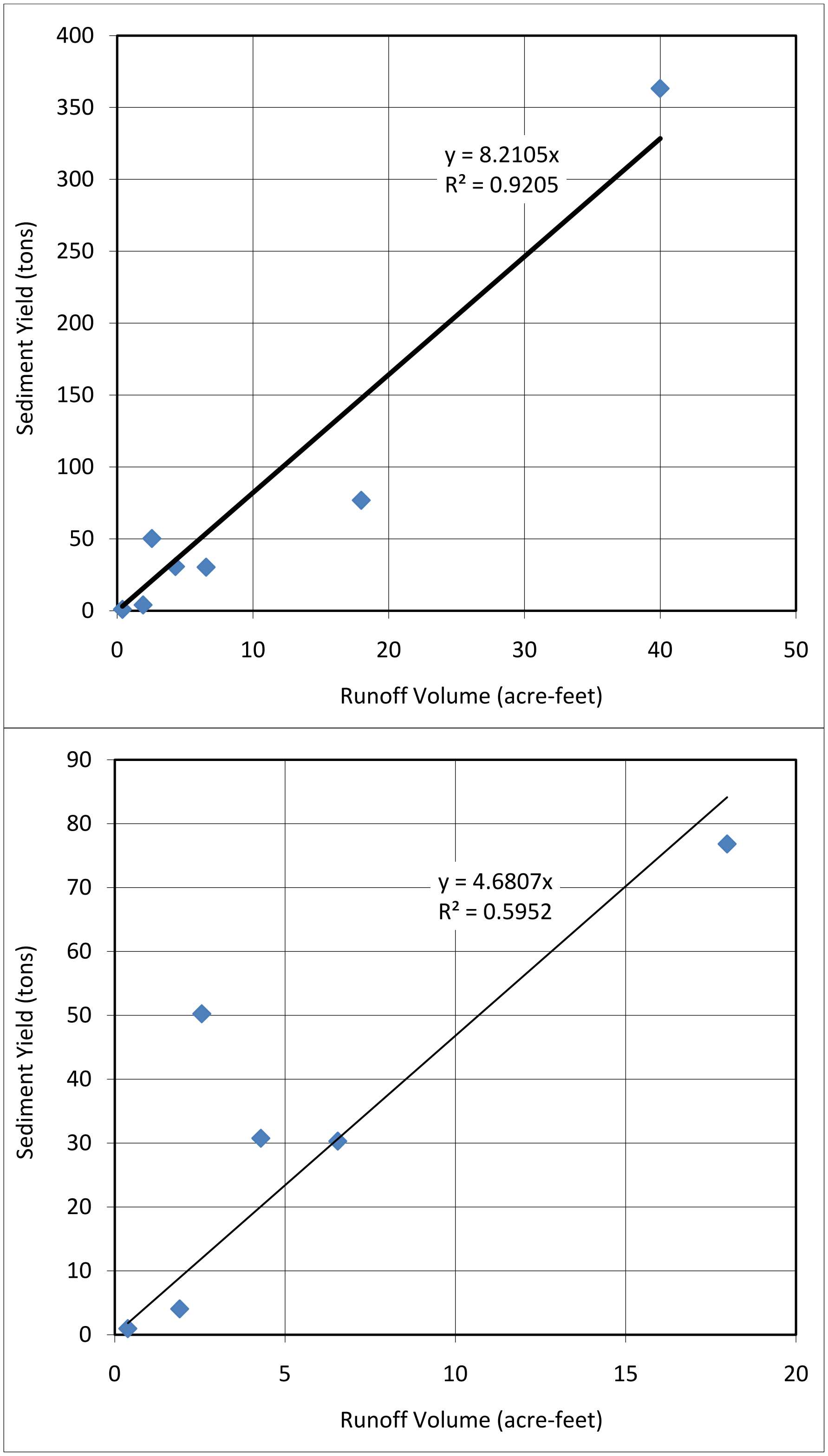


Figure 3.2-4 **Relationship between sediment yield and runoff volume with (top) and without (bottom) August 16 storm at E109.9**

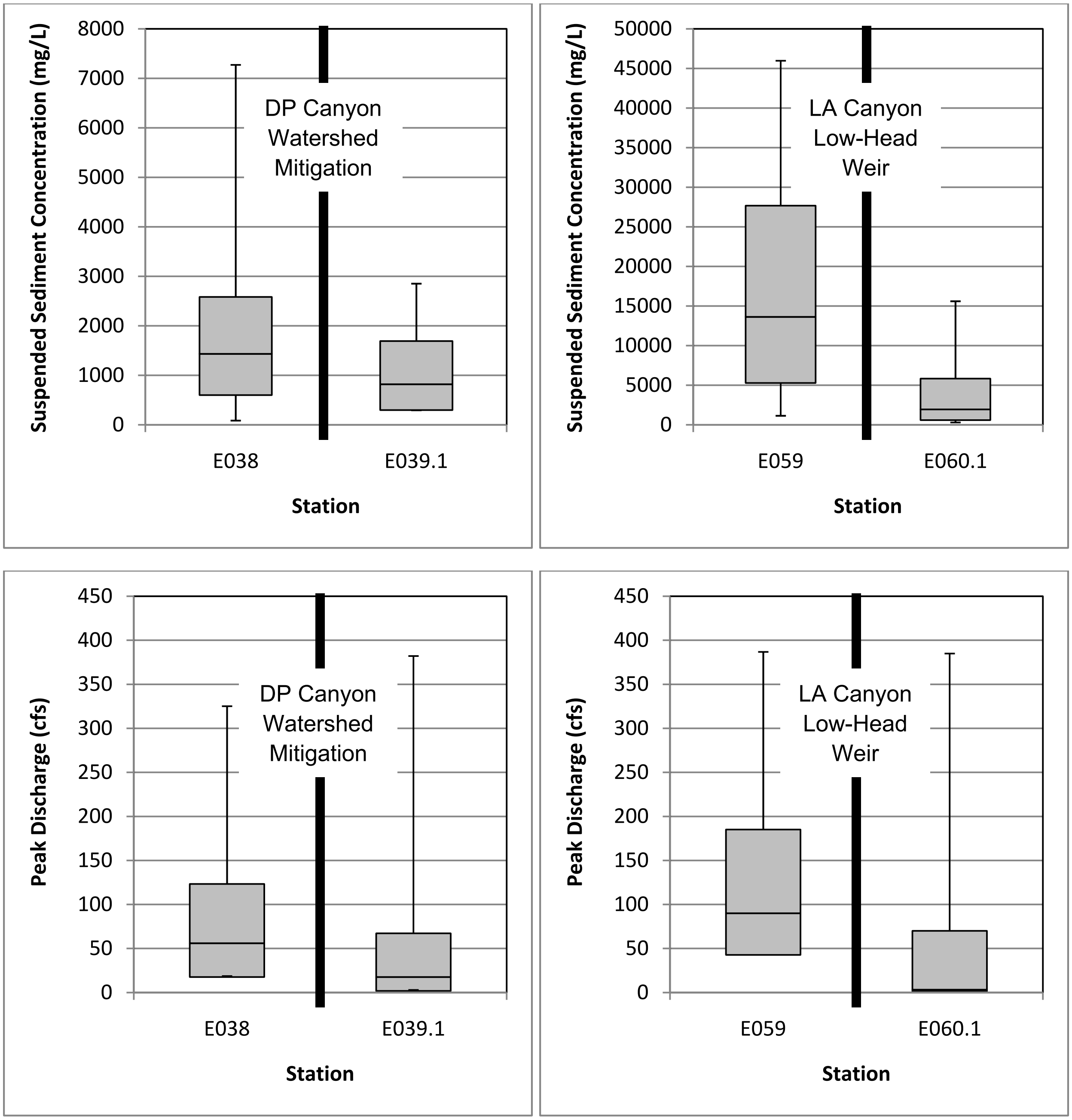


Figure 3.3-1 **Box and whisker plot of suspended sediment concentrations (top) and peak discharge (bottom) upstream and downstream of the DP Canyon Watershed mitigation (left) and Los Alamos Canyon low-head weir (right)**

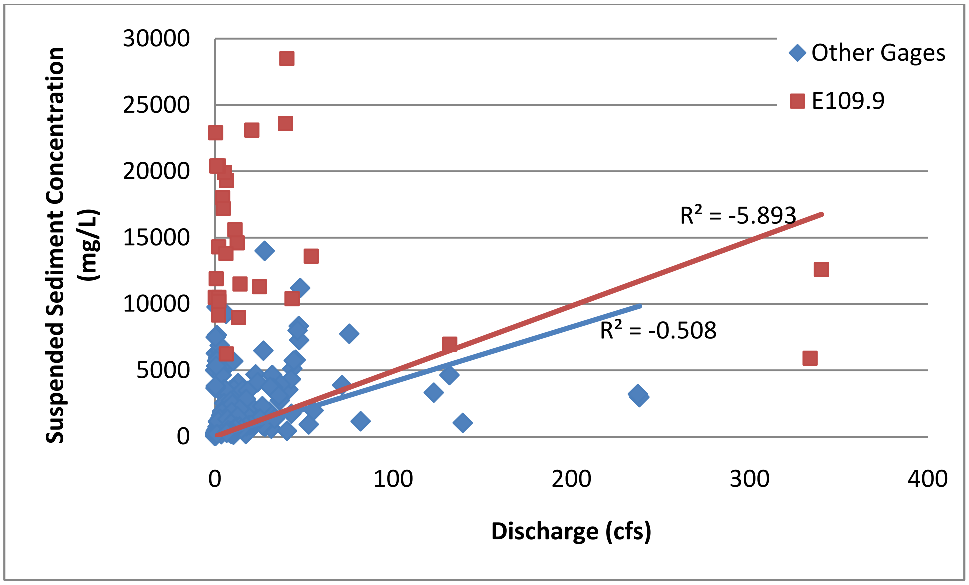


Figure 4.4-1 Relationship of suspended sediment to discharge within the LA/P Watershed

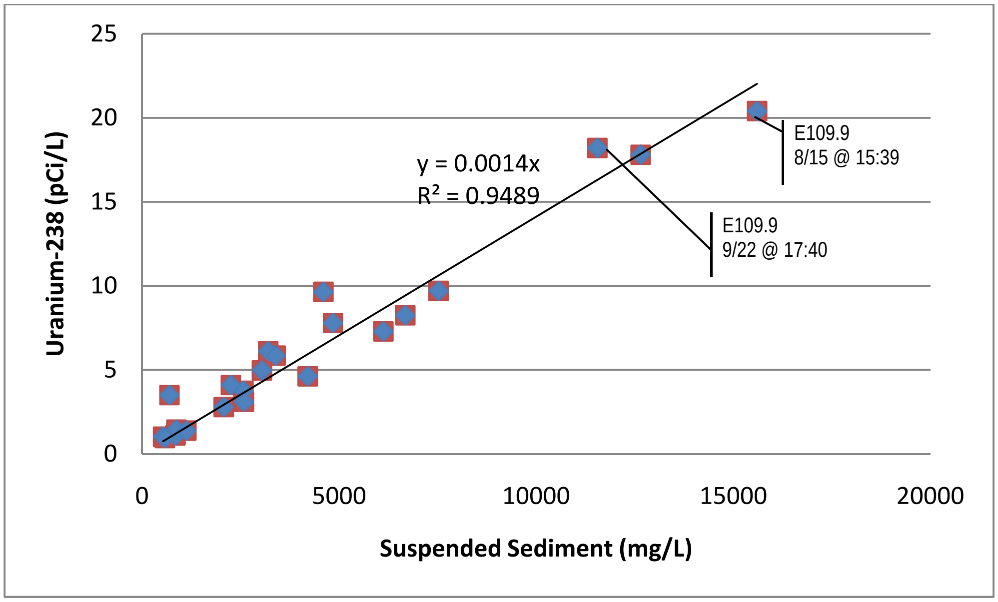


Figure 4.4-2 Relationship of uranium-238 to suspended sediment within the LA/P Watershed

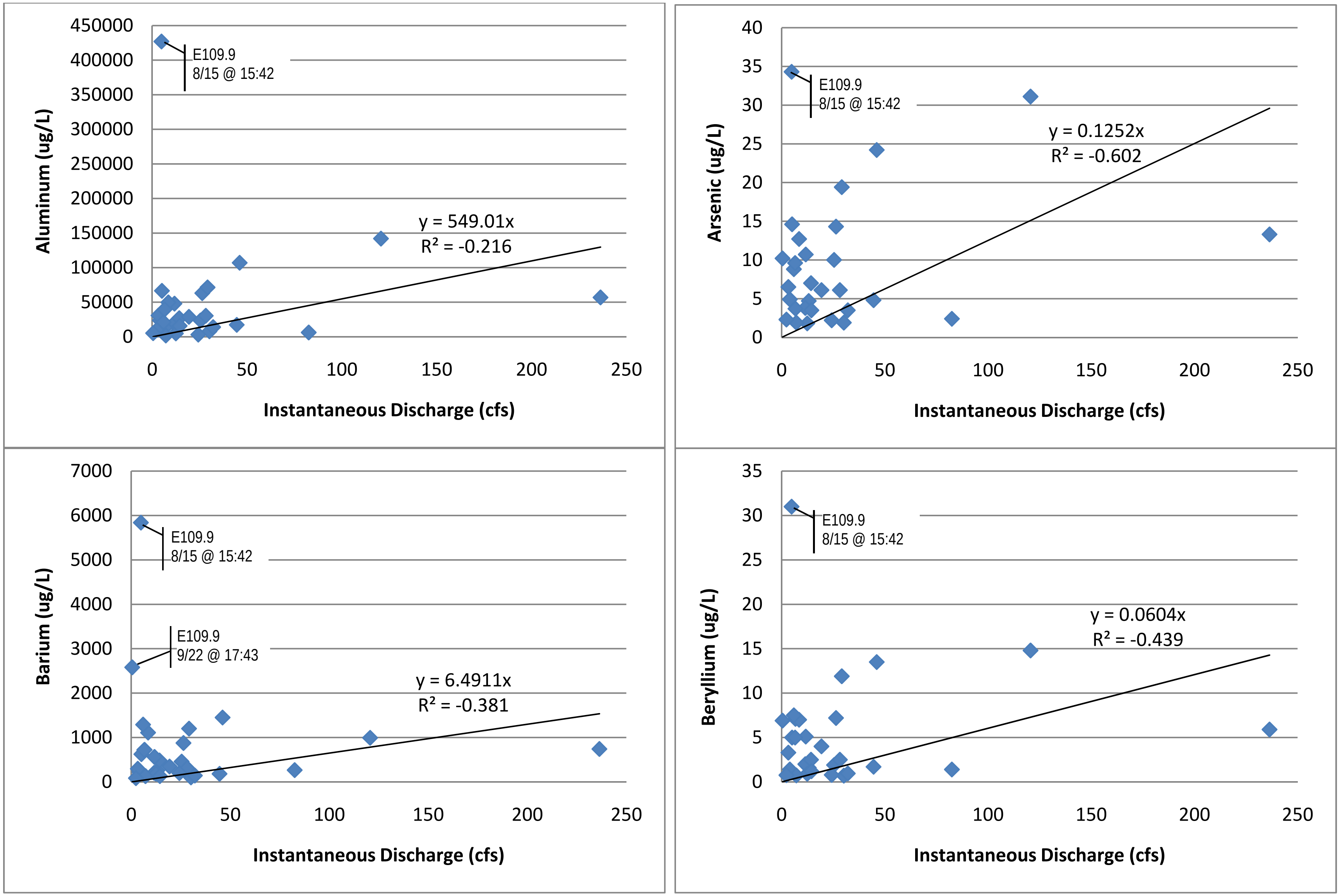


Figure 4.4-3 **Relationship of instantaneous discharge to detected constituents in stormwater within the LA/P Watershed**

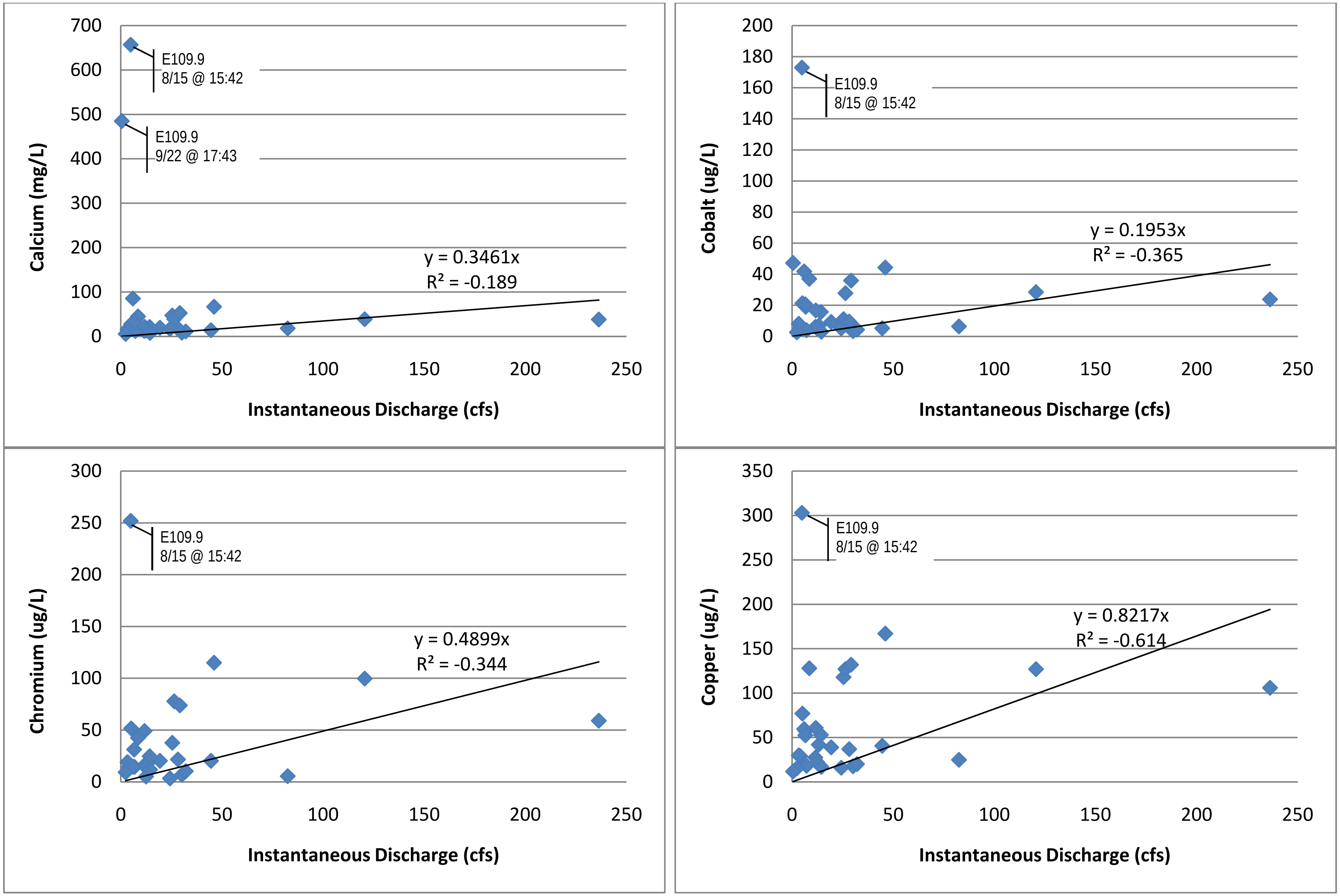


Figure 4.4-3 (continued) **Relationship of instantaneous discharge to detected constituents in stormwater within the LA/P Watershed**

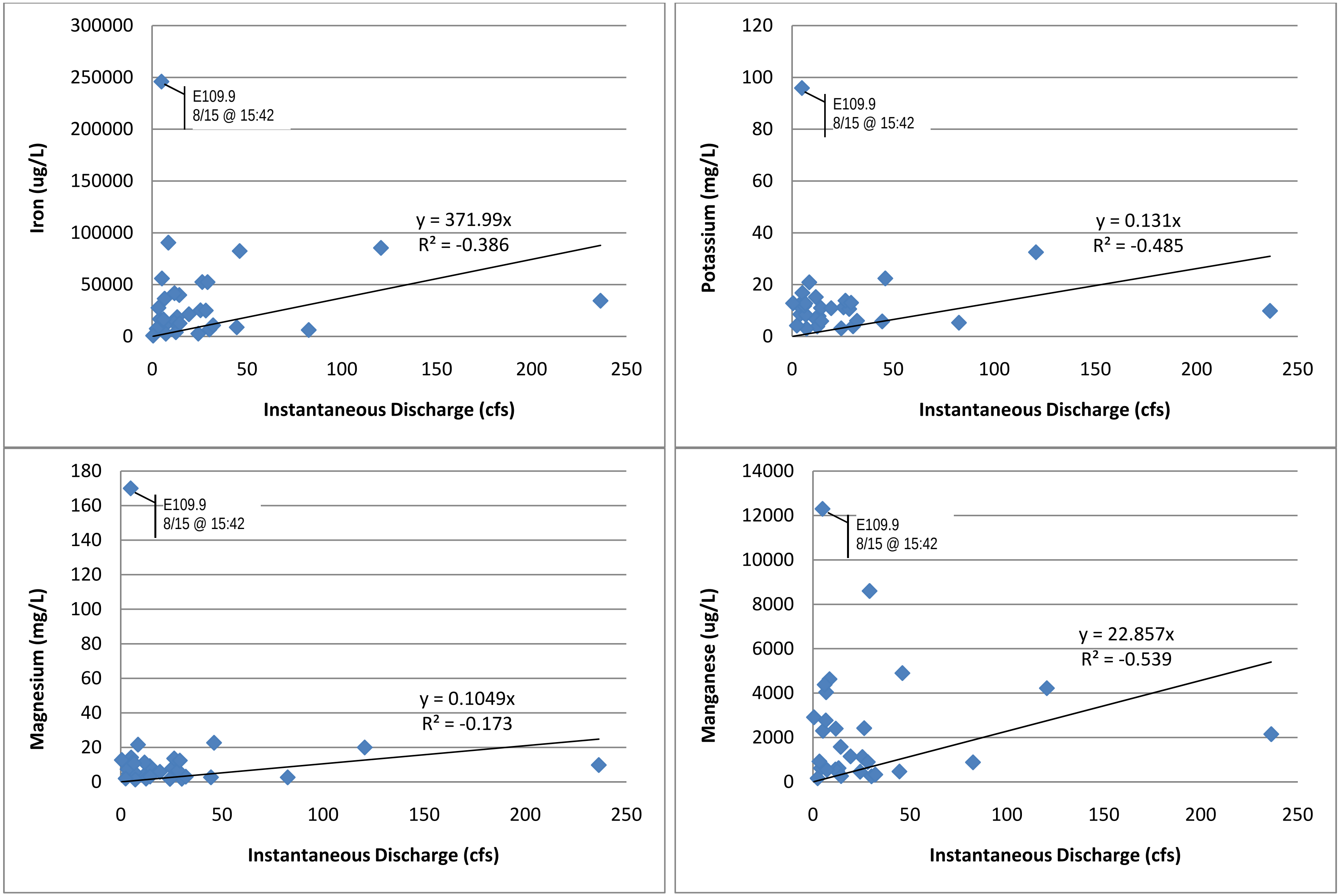


Figure 4.4-3 (continued) **Relationship of instantaneous discharge to detected constituents in stormwater within the LA/P Watershed**

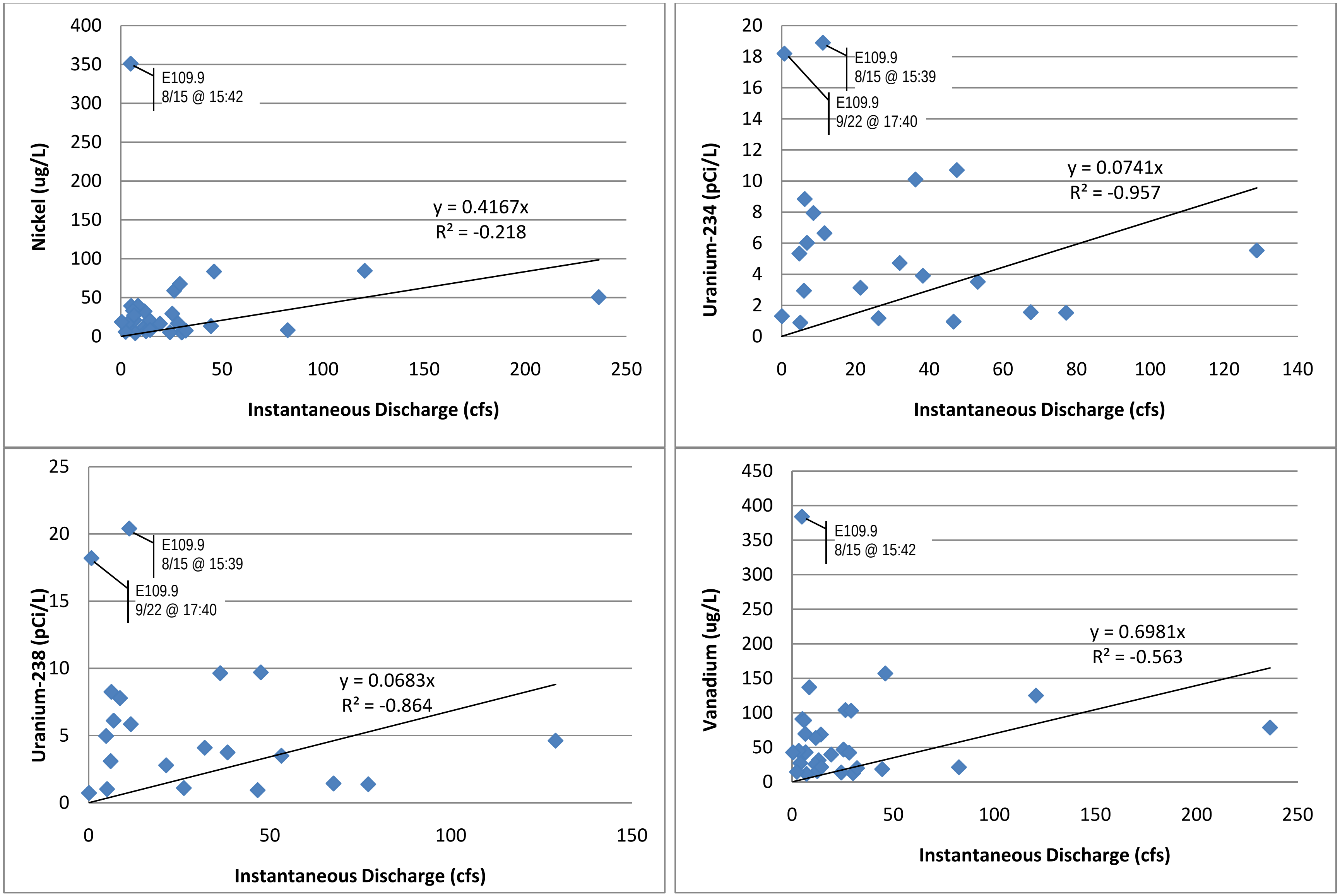


Figure 4.4-3 (continued) **Relationship of instantaneous discharge to detected constituents in stormwater within the LA/P Watershed**

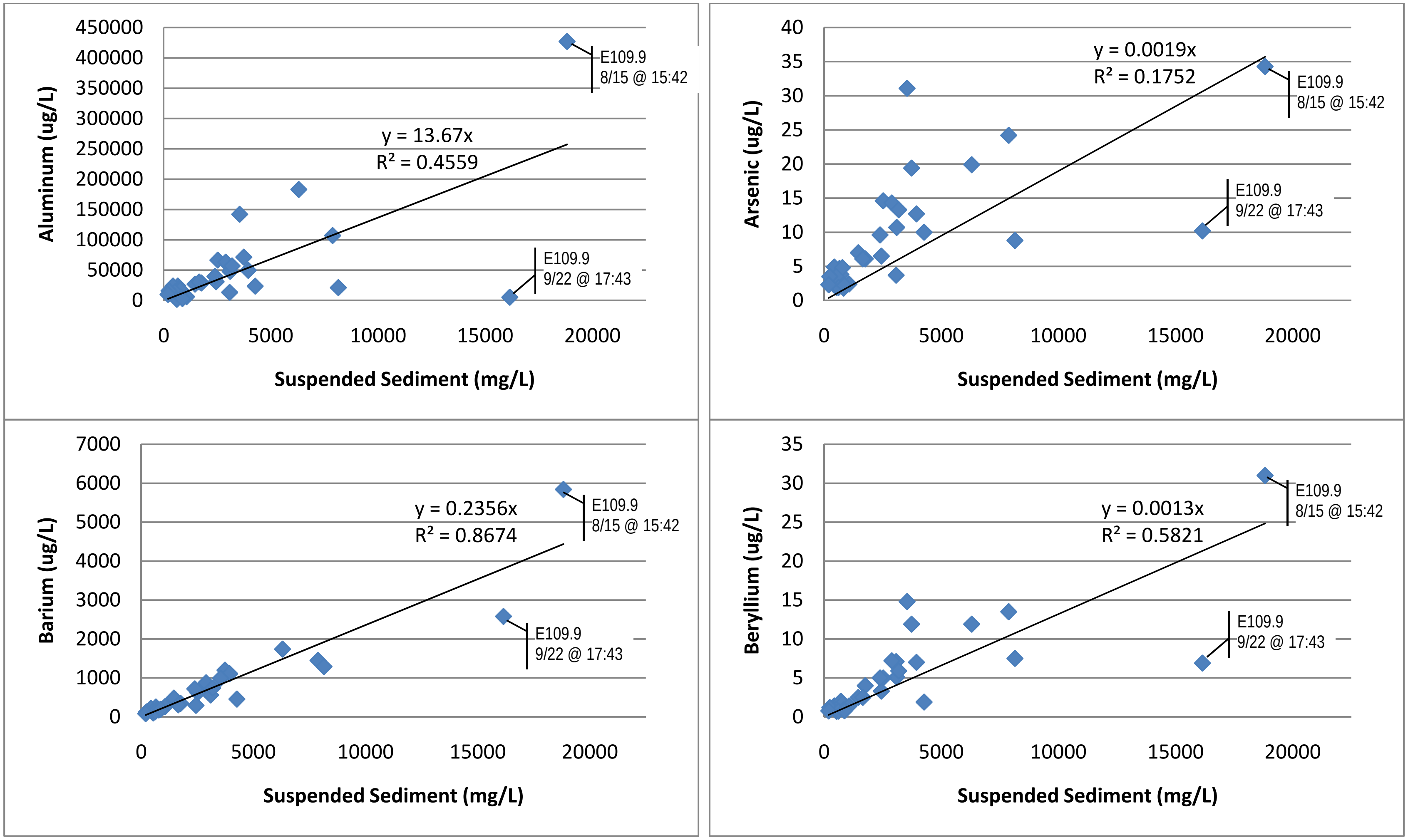


Figure 4.4-4 **Relationship of suspended sediment to other constituents in stormwater within the LA/P Watershed**

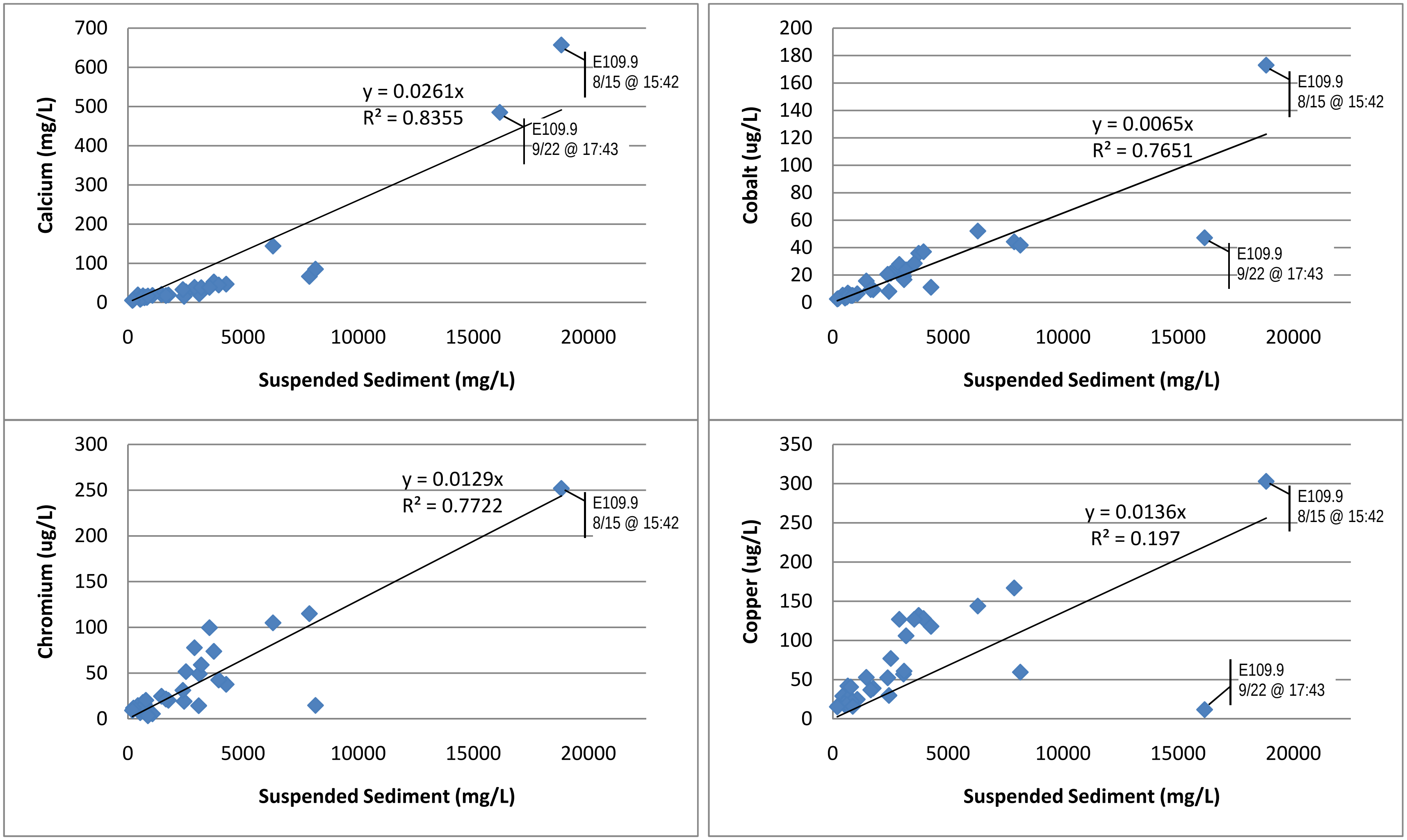


Figure 4.4-4 (continued) **Relationship of suspended sediment to other constituents in stormwater within the LA/P Watershed**

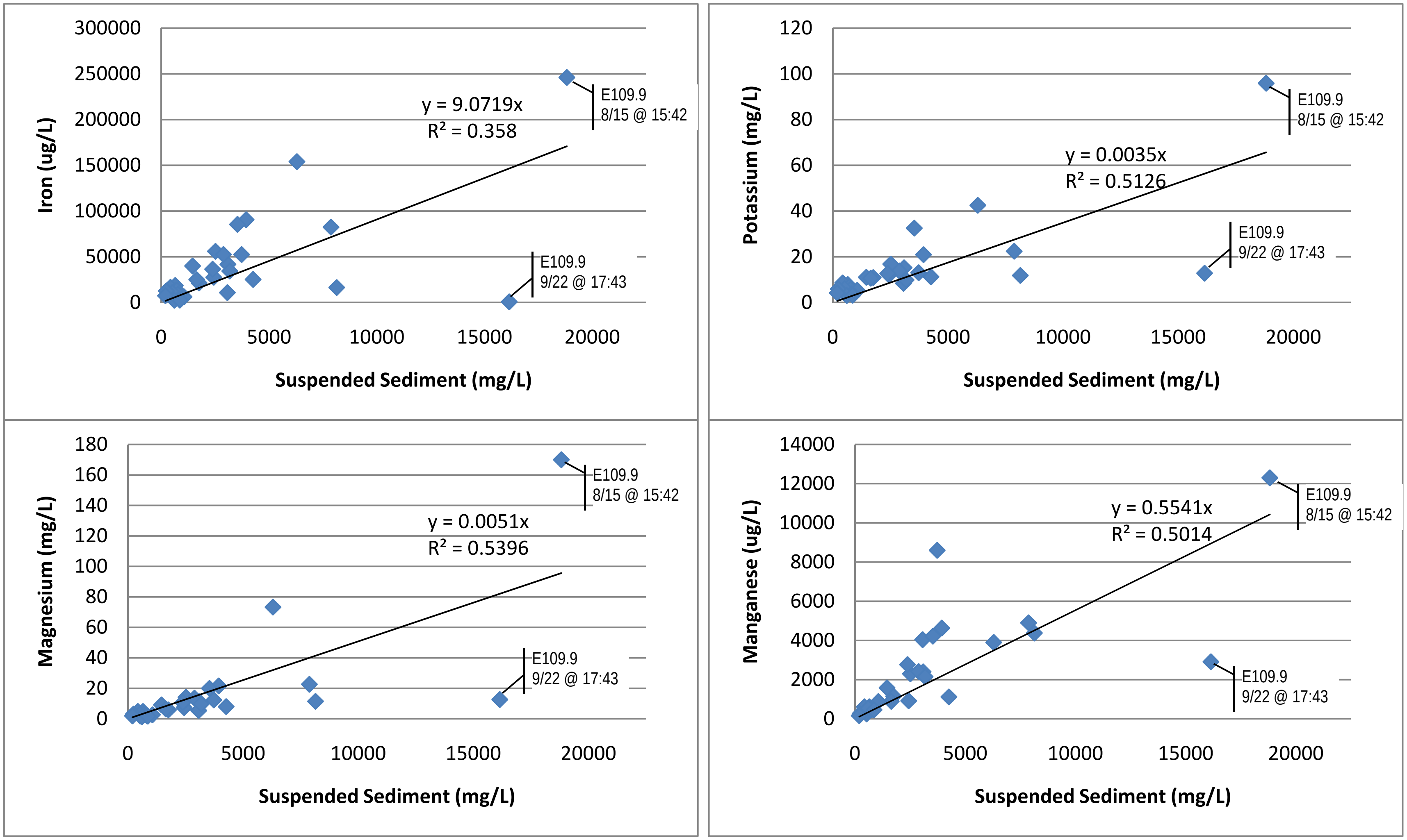


Figure 4.4-4 (continued) **Relationship of suspended sediment to other constituents in stormwater within the LA/P Watershed**

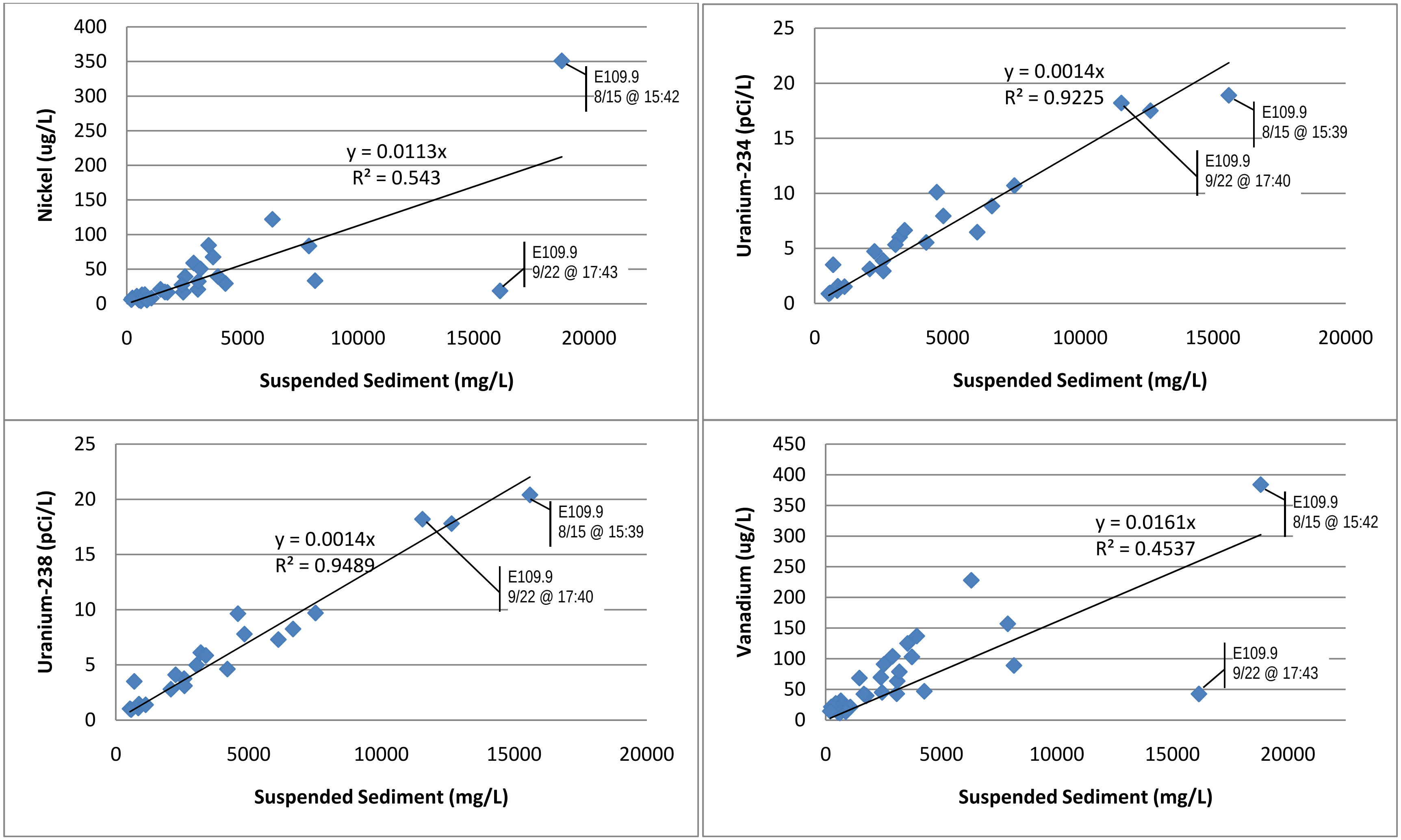


Figure 4.4-4 (continued) **Relationship of suspended sediment to other constituents in stormwater within the LA/P Watershed**

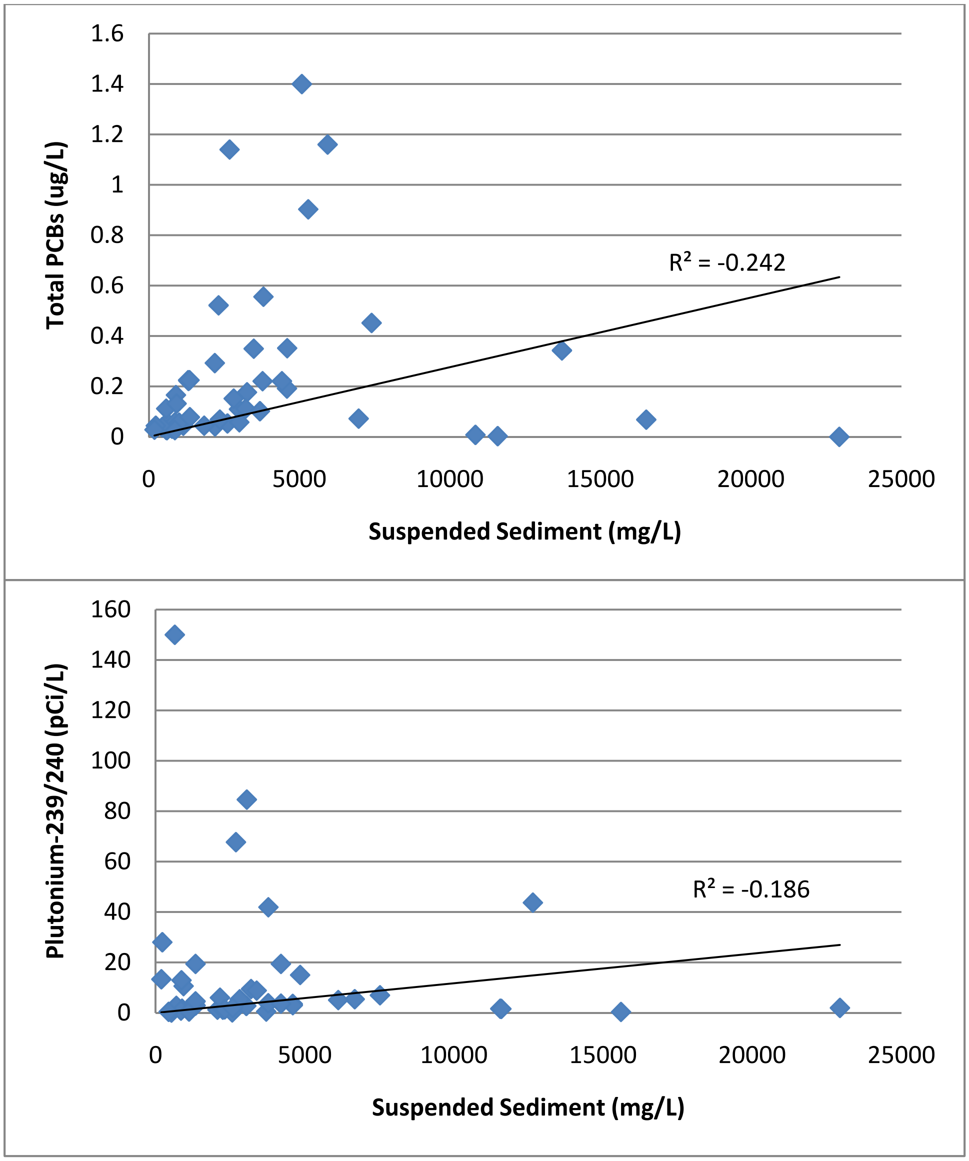


Figure 4.4-5 **Relationship of suspended sediment to plutonium-239/240 and total PCBs within the LA/P Watershed**

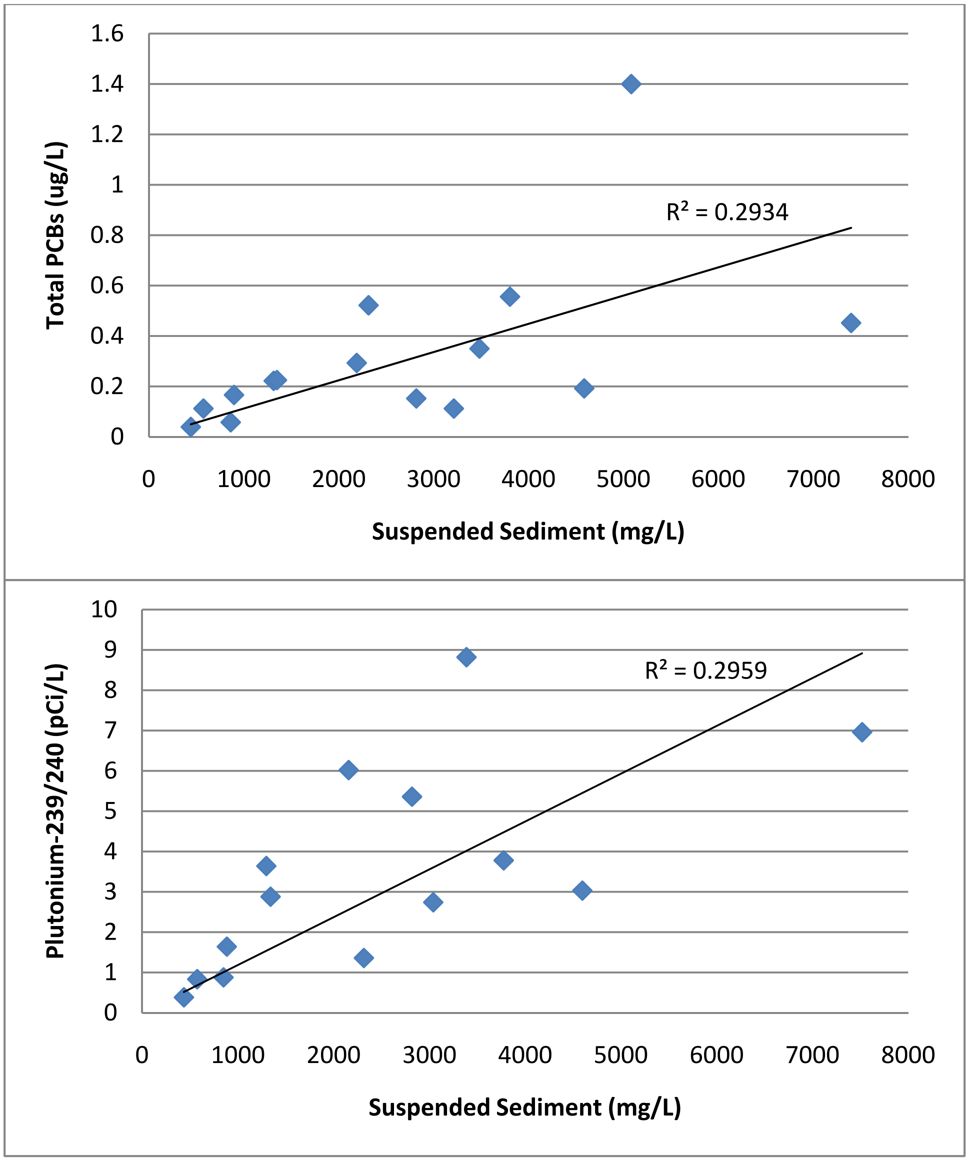


Figure 4.4-6 Relationship of plutonium-239/240 and total PCBs to suspended sediment at E042.1

Table 2.2-1
Maximum Discharge and Sampling in the LA/P Watershed

Date	LA Canyon Discharge (cfs)								Pueblo Canyon Discharge (cfs)				
	DP Canyon			LA Canyon					Acid Canyon		Pueblo Canyon		
	E038	**E039.1**	**E040**	**E026**	**E030**	**E042.1**	**E050.1**	**E109.9**	**E055.5**	**E056**	**E055**	**E059**	**E060.1**
05/14/10	74 NS[a]	23 NS	12 NS	2 NS	3 NS	3 NS	na[b]	<1 NS	3 NS	10 NS	4 NS	na	0
05/15/10	32 NS	41 NS	33 NS	2 NS	5 NS	14 NS	na	<1 NS	2 NS	11 NS	5 NS	na	0
06/24/10	38 S[c]	2 NS	0[d]	0	0	0	na	0	4 NS	<1 NS	0	na	0
07/02/10	13 NS	<1 NS	0	0	0	0	na	0	0	<1 NS	0	na	0
07/03/10	38 NS	4 NS	0	0	0	0	na	0	3 NS	<1 NS	0	na	0
07/09/10	59 S	6 S	0	0	0	0	na	0	9 NS	2 NS	0	na	0
07/22/10	112 S	52 S[e]	22 S	<1 NS	7 S	13 S	0	0	23 S	61 NS	15 S	na	0
07/24/10	8 NS	1 NS	<1 NS	0	0	0	0	0	0	11 NS	5 NS	na	0
07/25/10	42 NS	16 NS	5 NS	1 NS	8 NS	11 NS	0	0	31 NS	55 NS	8 NS	na	0
07/30/10	58 S	54 S	37 S	0	0	0	0	0	2 NS	3 NS	<1 NS	na	0
07/31/10	7 NS	3 NS	20 NS	0	0	6 S	0	0	0	<1 NS	<1 NS	na	0
08/04/10	29 NS	<1 NS	0	0	0	0	0	0	1 NS	<1 NS	0	na	0
08/05/10	186 NS	276 NS	209 NS	4 NS	10 S	48 S	20 NS	0	42 S	238 S	33 S	134[f] S	0
08/09/10	63 NS	16 NS	10 NS	0	0	0	0	0	4 NS	<1 NS	1 NS	na	0
08/15/10	156 NS	197 S	86 S	<1 NS	8 S	54 S	31 NS	439 S	25 S	68 S	9 S	49 NS	1 NS
08/16/10	202 NS	315 NS	263 NS	6 NS	30 NS	99 S	79 NS	243 NS	69 NS	255 NS	41 NS	250 NS	132 S
08/17/10	1 NS	1 NS	<1 NS	0	0	<1 NS	0	4 NS	<1 NS	38 NS	3 NS	0	2 NS
08/23/10	160 NS	151 NS	31 S	<1 NS	7 S	19 NS	0	779[f] S	25 S	94 NS	14 NS	46 NS	0
09/08/10	47 NS	2 NS	0	0	0	0	0	0	1 NS	<1 NS	0	0	0
09/22/10	86 NS	107 NS	2 NS	0	3 NS	18 NS	0	48 S	12 NS	30 S	3 NS	0	0
10/05/10	25 NS	3 NS	0	0	0	0	0	0	2 NS	<1 NS	0	0	0
10/20/10	19 S	1 NS	0	0	0	0	0	0	2 NS	13 NS	0	0	0
10/21/10	25 NS	15. S	<1 NS	0	0	0	0	0	2 NS	21 NS	1 NS	0	0

[a] NS = Sample was not collected on day with discharge. Cell is highlighted in yellow.

[b] na = Not available. Cell is highlighted in grey.

[c] S = Sample was collected on day with discharge. Cell is highlighted in green.

[d] Zero discharge occurred. Cell is highlighted in orange.

[e] Sample collection at E039.1 is recorded to have occurred on July 21— a day without flow at any gaging station or precipitation at any rain gage.

[f] Flow is estimated.

Table 2.3-1
Locations and Analytical Suites for Stormwater Samples

Monitoring Group	Locations	Analytical Suite
Upper Los Alamos Canyon	E038, E039.1, E040, E026, E030	Suspended sediment, PCBs (by method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, isotopic uranium, strontium-90, dioxins and furans, TAL metals, hardness, gross alpha, suspended sediment
Upper Pueblo Canyon	E055, E055.5, E056	Suspended sediment, PCBs (by method 1668A), isotopic plutonium, dioxins and furans, TAL metals, hardness, gross alpha, suspended sediment
Lower watershed	E042.1, E050.1, E059, E060.1, E109.9	PCBs (by method 1668A), isotopic plutonium, gamma spectroscopy radionuclides, isotopic uranium, americium-241 (by alpha spectroscopy), strontium-90, dioxins and furans, TAL metals, hardness, gross alpha, gross beta, radium-226/radium-228, suspended sediment
Retention basins and wetland below the SWMU 01-001(f) drainage	CO101038, CO101039, CO101040	Suspended sediment, TAL metals, hardness, PCBs (by method 1668A), isotopic uranium, total organic carbon, gross alpha, gross beta

Table 2.3-2
Analytical Requirements for Stormwater Samples

Analytical Suite	Method	Detection Limit	Upper Los Alamos Canyon	Upper Pueblo Canyon	Lower Watershed	Retention Basins and Wetland below the SWMU 01-001(f) Drainage
PCBs	EPA:1668A	25 pg/L	√[a]	√	√	√
Isotopic plutonium	HASL-300	0.5 pCi/L	√	√	√	—[b]
Gamma spectroscopy radionuclides	EPA:901.1	3 pCi/L (cesium-137)	√	—	√	—
Isotopic uranium	HASL-300	0.5 pCi/L	√	—	√	√
Americium-241	HASL-300	0.5 pCi/L	—	—	√	—
Strontium-90	EPA:905.0	0.5 pCi/L	√	—	√	—
TAL metals	EPA:200.7/200.8/245.2	Variable	√	√	√	√
Dioxins and furans	EPA:1613B	1.0 pg/L	√	√	√	—
Gross alpha	EPA:900	3 pCi/L	√	√	√	√
Gross beta	EPA:900	1 pCi/L	—	—	√	√
Radium-226/radium-228	EPA:903.1/EPA:904	0.5/0.5 pCi/L	—	—	√	—
Suspended sediment	EPA:160.2	10 mg/L	√	√	√	—
Total organic carbon	SW-846:9060	0.5 mg/L	—	—	—	√

[a] Monitoring required.

[b] Monitoring not requested.

Table 2.3-3
Summary of Samples Collected and Analyses Requested

Station	Collection Date	Field Prep	Americium-241	Dioxins and Furans	Gamma Spectroscopy	Gross Alpha	Hardness	Isotopic Plutonium	Isotopic Radium	Isotopic Uranium	Metals	PCB Congeners	Strontium-90	Suspended Sediment
E030	7/22/10	F	—[a]	—	—	—	X[b]	—	—	—	X	—	—	—
E030	7/22/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E030	8/5/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E030	8/5/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E030	8/15/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E030	8/15/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E030	8/23/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E030	8/23/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E038	6/24/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E038	6/24/10	UF	—	X	X	—	X	X	—	X	X	X	X	X
E038	7/9/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E038	7/9/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E038	7/22/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E038	7/22/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E038	7/30/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E038	7/30/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E038	10/20/10	UF	—	—	—	—	—	—	—	—	—	—	—	X
E039.1	7/9/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E039.1	7/9/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E039.1	7/21/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E039.1	7/21/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E039.1	7/30/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E039.1	7/30/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E039.1	8/15/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E039.1	8/15/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E039.1	10/21/10	UF	—	—	—	—	—	—	—	—	—	—	—	X
E040	7/22/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E040	7/22/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E040	7/30/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E040	7/30/10	UF	—	X	X	X	X	X	—	X	X	X	X	X
E040	8/15/10	F	—	—	—	—	X	—	—	—	X	—	—	—

Table 2.3-3 (continued)

Station	Collection Date	Field Prep	Americium-241	Dioxins and Furans	Gamma Spectroscopy	Gross Alpha	Hardness	Isotopic Plutonium	Isotopic Radium	Isotopic Uranium	Metals	PCB Congeners	Strontium-90	Suspended Sediment
E040	8/15/10	UF	—	—	—	X	X	—	—	—	X	—	—	X
E040	8/23/10	UF	—	—	—	X	—	—	—	—	—	X	—	X
E042.1	7/22/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E042.1	7/22/10	UF	X	X	X	X	X	X	X	X	X	X	X	X
E042.1	7/23/10	UF	—	—	X	—	—	X	—	—	—	X	—	X
E042.1	7/31/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E042.1	7/31/10	UF	X	X	X	—	X	X	X	X	X	X	X	X
E042.1	8/5/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E042.1	8/5/10	UF	X	X	X	X	X	X	X	X	X	X	X	X
E042.1	8/15/10	UF	X	X	X	—	—	X	X	X	—	X	X	X
E042.1	8/16/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E042.1	8/16/10	UF	X	X	X	—	X	X	X	X	X	X	X	X
E055	7/22/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E055	7/22/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E055	8/5/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E055	8/5/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E055	8/15/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E055	8/15/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E055.5	7/22/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E055.5	7/22/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E055.5	8/5/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E055.5	8/5/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E055.5	8/15/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E055.5	8/15/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E055.5	8/23/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E055.5	8/23/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E056	8/5/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E056	8/5/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E056	8/15/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E056	8/15/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E056	9/22/10	F	—	—	—	—	X	—	—	—	X	—	—	—

Table 2.3-3 (continued)

Station	Collection Date	Field Prep	Americium-241	Dioxins and Furans	Gamma Spectroscopy	Gross Alpha	Hardness	Isotopic Plutonium	Isotopic Radium	Isotopic Uranium	Metals	PCB Congeners	Strontium-90	Suspended Sediment
E056	9/22/10	UF	—	X	—	X	X	X	—	—	X	X	—	X
E059	8/5/10	UF	X	X	X	—	—	X	X	X	—	X	X	X
E060.1	8/16/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E060.1	8/16/10	UF	X	X	X	—	X	X	X	X	X	X	X	X
E109.9	8/15/10	F	X	—	X	X	X	X	X	X	X	—	X	—
E109.9	8/15/10	UF	X	X	X	X	X	X	X	X	X	X	X	X
E109.9	8/23/10	F	—	—	—	—	X	—	—	—	X	—	—	—
E109.9	8/23/10	UF	X	—	X	X	X	X	X	X	X	—	X	X
E109.9	9/22/10	F	X	—	X	—	X	X	X	X	X	—	X	—
E109.9	9/22/10	UF	X	X	X	—	X	X	X	X	X	X	X	X

[a] — = Analysis was not requested or results were not returned.

[b] X = Analysis was performed.

Table 2.3-4
Sampling Sequence for Collection of Stormwater Samples at Upper Watershed Gages

Sample Bottle	E026, E030, E038, E039.1 & E040		E055, E055.5, & E056	
	Start Time (min) 12-Bottle ISCO	Analytical Suites	Start Time (min) 12-Bottle ISCO	Analytical Suites
1	10	Suspended sediment	10	Suspended sediment
2	11	PCB congener	11	PCB congener
3	12	PCB congener	12	PCB congener
4	13	Gamma spectroscopy; isotopic plutonium, and isotopic uranium	13	Isotopic plutonium
5	14	Strontium-90	14	Dioxins and furans
6	15	Dioxins and furans	15	Dioxins and furans
7	16	Dioxins and furans	16	TAL metals
8	17	TAL metals	17	Gross α
9	18	Gross α	18	Suspended sediment
10	19	Suspended sediment	19	Extra bottle
11	20	Extra bottle	20	Extra bottle
12	21	Extra bottle	21	Extra bottle

Table 2.3-5
Sampling Sequence for Collection of Stormwater Samples at Lower Watershed Gages

Sample Bottle	E042.1, E050.1, E059, & E060.1			
	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO
1	10	PCB congener	0	Suspended sediment
2	11	Gamma spectroscopy; isotopic plutonium, americium-241, and isotopic uranium	3	Suspended sediment
3	12	Strontium-90	6	Suspended sediment
4	13	Dioxins and furans	9	Suspended sediment
5	14	TAL metals	12	Radium-226
6	15	Gross-α and gross-β	15	Suspended sediment
7	60	PCB congener	18	Radium-228
8	61	Gamma spectroscopy; isotopic plutonium	21	Suspended sediment
9	105	PCB congener	24	Suspended sediment
10	106	Gamma spectroscopy; isotopic plutonium	27	Suspended sediment
11	150	PCB congener	30	Suspended sediment
12	151	Gamma spectroscopy and isotopic plutonium	50	Suspended sediment
13	n/a*	n/a	70	Suspended sediment
14	n/a	n/a	90	Suspended sediment
15	n/a	n/a	110	Suspended sediment
16	n/a	n/a	130	Suspended sediment
17	n/a	n/a	150	Suspended sediment
18	n/a	n/a	170	Suspended sediment
19	n/a	n/a	190	Suspended sediment
20	n/a	n/a	210	Suspended sediment
21	n/a	n/a	230	Suspended sediment
22	n/a	n/a	250	Suspended sediment
23	n/a	n/a	270	Suspended sediment
24	n/a	n/a	290	Suspended sediment

*n/a = Not applicable.

Table 2.3-6
Sampling Sequence for Collection of Stormwater Samples at E109.9

Sample Bottle	E109.9			
	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO
1	10	PCB congener	0	Suspended sediment
2	11	Gamma spectroscopy; isotopic plutonium, americium-241, and isotopic uranium	2	Suspended sediment
3	12	Strontium-90	4	Suspended sediment
4	13	Dioxins and furans	6	Suspended sediment
5	14	TAL metals	8	Suspended sediment
6	15	Gross-α and gross-β	10	Gamma spectroscopy; isotopic plutonium, americium-241, and isotopic uranium
7	60	PCB congener	12	Suspended sediment
8	61	Gamma spectroscopy and isotopic plutonium	14	Strontium-90
9	105	PCB congener	16	Suspended sediment
10	106	Gamma spectroscopy and isotopic plutonium	18	Radium-226
11	150	PCB congener	20	Suspended sediment
12	151	Gamma spectroscopy and isotopic plutonium	22	Radium-228
13	n/a*	n/a	24	Suspended sediment
14	n/a	n/a	26	Radium-226
15	n/a	n/a	28	Suspended sediment
16	n/a	n/a	30	Radium-228
17	n/a	n/a	50	Suspended sediment
18	n/a	n/a	70	Suspended sediment
19	n/a	n/a	90	Suspended sediment
20	n/a	n/a	110	Suspended sediment
21	n/a	n/a	130	Suspended sediment
22	n/a	n/a	150	Suspended sediment
23	n/a	n/a	170	Suspended sediment
24	n/a	n/a	190	Suspended sediment

*n/a = Not applicable.

Table 3.1-1
Correlation Matrix between Drainage Area and Suspended Sediment Concentration Statistics

Surface Type	Lower Quartile	Maximum	Median	Minimum	Upper Quartile
Total	0.86	0.85	0.83	0.55	0.81
Impermeable	0.94	0.87	0.91	0.71	0.90
Permeable	0.86	0.84	0.82	0.53	0.80

Table 3.2-1

Travel Time of Flood Bore, Peak Discharges, Increase or Decrease in Peak Discharge, and Percent Increase/Decrease in Peak Discharge from Upstream to Downstream Stations for All 2010 Storm Events in Acid Canyon

Date	Travel Time from E055.5 to E056 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E056 to E059 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E056 to E060.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E060.1 to E109.9 (min)	Peaks (cfs)		+/–[a]	%
		E055.5	E056				E056	E059				E056	E060.1				E060.1	E109.9		
5/14	30	2	10	+	77	—[b]	10	na[c]	—	—	—	10	0	–	100	—	0	0	N	N
5/15	15	3	11	+	69	—	11	na	—	—	—	11	0	–	100	—	0	0	N	N
6/24	—	4	0	–	100	—	0	na	—	—	—	0	0	N	N	—	0	0	N	N
7/02	—	0	0	N	N	—	0	na	—	—	—	0	0	N	N	—	0	0	N	N
7/03	—	3	0	–	100	—	0	na	—	—	—	0	0	N	N	—	0	0	N	N
7/09	50	9	2	–	79	—	2	na	—	—	—	2	0	-	100	—	0	0	N	N
7/22	25	18	61	+	70	—	61	na	—	—	—	61	0	-	100	—	0	0	N	N
7/24	—	0	11	+	100	—	11	na	—	—	—	11	0	-	100	—	0	0	N	N
7/25	20	31	55	+	44	—	55	na	—	—	—	55	0	-	100	—	0	0	N	N
7/26	—	0	0	N	N	—	0	na	—	—	—	0	0	N	N	—	0	0	N	N
7/30	65	2	3	+	26	—	3	na	—	—	—	3	0	–	100	—	0	0	N	N
7/31	—	0	0	N	N	—	0	na	—	—	—	0	0	N	N	—	0	0	N	N
8/1	—	0	0	N	N	—	0	na	—	—	—	0	0	N	N	—	0	0	N	N
8/4	60	1	0	–	38	—	0	na	—	—	—	0	0	–	100	—	0	0	N	N
8/5	10	42	238	+	82	—	238	na	—	—	—	238	0	–	100	—	0	0	N	N
8/6	—	0	0	N	N	—	0	na	—	—	—	0	0	N	N	—	0	0	N	N
8/9	80	2	0	–	70	—	0	na	—	—	—	0	0	–	100	—	0	0	N	N
8/15	20	5	28	+	82	-5	28	34	N	N	-20	28	1	N	N	45	1	439	+	100
	5	25	68	+	63	85	68	49	–	28	—	68	0	–	100	—	0	10	+	100
8/16	10	69	255	+	73	40	255	233	–	9	160	255	132	–	48	65	132	95	–	28
8/17	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N

Table 3.2-1 (continued)

Date	Travel Time from E055.5 to E056 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E056 to E059 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E056 to E060.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E060.1 to E109.9 (min)	Peaks (cfs) 9		+/–[a]	%
		E055.5	E056				E056	E059				E056	E060.1				E060.1	E109.9		
8/23	15	12	94	+	87	—	94	0	–	100	—	94	0	–	100	—	0	0	N	N
	10	25	80	+	69	115	80	46	–	43	—	80	0	–	100	—	0	0	N	N
9/08	—	1	0	–	100	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
9/22	15	12	30	+	59	—	30	0	–	100	—	30	0	–	100	—	0	48	+	100
10/05	—	2	0	–	100	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
10/20	55	2	8	+	71	—	8	0	–	100	—	8	0	–	100	—	0	0	N	N
	30	0	13	+	97	—	13	0	–	100	—	13	0	–	100	—	0	0	N	N
10/21	50	2	20	+	91	—	20	0	–	100	—	20	0	–	100	—	0	0	N	N
	20	2	21	+	89	—	21	0	–	100	—	21	0	–	100	—	0	0	N	N
Min	5	1	2	—	26	40	2	34	—	9	160	2	1	—	48	45	1	48	—	100
Mean	31	9	34	—	77	80	34	27	—	76	160	34	5	—	97	45	0	17	—	100
Max	80	69	255	—	100	115	255	233	—	100	160	255	132	—	100	45	1	439	—	100

[a] + = Increase, – = decrease, N = no change in peak discharges.

[b] — = Result not obtained.

[c] na = Discharge not available. E059 began monitoring discharge on August 15.

Table 3.2-2
Travel Time of Flood Bore, Peak Discharges, Increase or Decrease in Peak Discharge, and Percent Increase/Decrease in Peak Discharge from Upstream to Downstream Stations for All 2010 Storm Events in Pueblo Canyon

Date	Travel Time from E055 to E059 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E055 to E060.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E059 to E060.1 (min)	Peaks (cfs)		+/–[a]	%
		E055	E059				E055	E060.1				E059	E060.1		
5/14	—[b]	0	na[c]	—	—	—	0	0	N	N[a]	—	na	0	—	—
5/15	—	0	na	—	—	—	0	0	N	N	—	na	0	—	—
6/24	—	0	na	—	—	—	0	0	N	N	—	na	0	—	—
7/02	—	0	na	—	—	—	0	0	N	N	—	na	0	—	—
7/03	—	0	na	—	—	—	0	0	N	N	—	na	0	—	—
7/09	—	0	na	—	—	—	0	0	N	N	—	na	0	—	—
7/22	—	15	na	—	—	—	15	0	–	100	—	na	0	—	—
7/24	—	5	na	—	—	—	5	0	–	100	—	na	0	—	—
7/25	—	8	na	—	—	—	8	0	–	100	—	na	0	—	—
7/26	—	0	na	—	—	—	0	0	N	N	—	na	0	—	—
7/30	—	0	na	—	—	—	0	0	–	100	—	na	0	—	—
7/31	—	0	na	—	—	—	0	0	–	100	—	na	0	—	—
8/1	—[a]	0	na[b]	—	—	—	0	0	N	N	—	na	0	—	—
8/4	—	0	na	—	—	—	0	0	–	100	—	na	0	—	—
8/5	—	33	na	—	—	—	33	0	–	100	—	na	0	—	—
8/6	—	0	na	—	—	—	0	0	N	N	—	na	0	—	—
8/9	—	1	na	—	—	—	1	0	–	100	—	na	0	—	—
8/15	-35	4	34	N	N	-50	4	1	N	N	-15	34	1	N	N
	45	9	49	+	81	—	9	0	–	100	—	49	0	–	100
8/16	30	41	233	+	82	150	41	132	+	69	120	233	132	–	44
8/17	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/23	—	8	0	–	100	—	8	0	–	100	—	0	0	N	N
	95	14	46	+	68	—	14	0	–	100	—	46	0	–	100

Table 3.2-2 (continued)

Date	Travel Time from E055 to E059 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E055 to E060.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E059 to E060.1 (min)	Peaks (cfs)		+/–[a]	%
		E055	E059				E055	E060.1				E059	E060.1		
9/08	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
9/22	—	3	0	–	100	—	3	0	–	100	—	0	0	N	N
10/05	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
10/20	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
10/21	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
Min	30	1	34	—	68	150	1	1	—	69	120	34	1	—	44
Mean	57	5	27	—	86	150	5	5	—	98	120	27	5	—	81
Max	95	41	233	—	100	150	41	132	—	100	120	233	132	—	100

[a] + = Increase, – = decrease, N = no change in peak discharges.

[b] — = Result not obtained.

[c] na = Discharge not available. E059 began monitoring discharge on August 15.

Table 3.2-3

Travel Time of Flood Bore, Peak Discharges, Increase or Decrease in Peak Discharge, and and Percent Increase/Decrease in Peak Discharge from Upstream to Downstream Stations for All 2010 Storm Events in DP Canyon

Date	Travel Time from E038 to E039.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E039.1 to E040 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E040 to E042.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E042.1 to E050.1 (min)	Peaks (cfs)		+/–[a]	%
		E038	E039.1				E039.1	E040				E040	E042.1				E042.1	E050.1		
5/14	55	74	23	–	69	75	23	4	–	84	—[b]	4	0	–	100	—	0	0	N	N
	35	31	21	–	32	40	21	12	–	43	—	12	0	–	100	—	0	0	N	N
5/15	35	34	30	–	11	30	30	26	–	13	—	26	0	–	100	—	0	0	N	N
	30	32	41	+	23	20	41	33	–	20	—	33	0	–	100	—	0	0	N	N
6/24	45	38	2	–	95	—	2	0	–	100	—	0	0	N	N	—	0	0	N	N
7/02	60	13	0	–	97	—	0	0	–	100	—	0	0	N	N	—	0	0	N	N
7/03	45	38	4	–	90	—	4	0	–	100	—	0	0	N	N	—	0	0	N	N
	70	5	0	–	95	—	0	0	–	100	—	0	0	N	N	—	0	0	N	N
7/09	45	59	6	–	90	—	6	0	–	100	—	0	0	N	N	—	0	0	N	N
7/22	60	112	52	–	53	45	52	22	–	58	60	22	13	–	40	—	13	0	–	100
7/24	50	8	1	–	86	—	1	0	–	100	—	0	0	N	N	—	0	0	N	N
7/25	65	5	1	–	90	—	1	0	–	100	—	0	0	N	N	—	0	0	N	N
	40	42	16	–	61	45	16	5	–	68	145	5	11	+	54	—	11	0	–	100
7/26	—	0	0	–	100	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
7/30	40	58	54	–	7	30	54	37	–	32	80	37	6	–	84	—	6	0	–	100
7/31	60	7	2	–	77	100	2	1	–	17	—	1	0	–	100	—	0	0	N	N
8/1	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/4	50	29	4	–	86	—	4	0	–	100	—	0	0	N	N	—	0	0	N	N
8/5	15	186	276	+	33	25	276	209	–	25	50	209	48	–	77	45	48	20	–	58
8/6	—	2	0	–	100	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N

Table 3.2-3 (continued)

Date	Travel Time from E038 to E039.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E039.1 to E040 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E040 to E042.1 (min)	Peaks (cfs)		+/–[a]	%	Travel Time from E042.1 to E050.1 (min)	Peaks (cfs)		+/–[a]	%
		E038	E039.1				E039.1	E040				E040	E042.1				E042.1	E050.1		
8/9	35	65	16	–	75	55	16	10	–	37	—	10	0	–	100	—	0	0	N	N
	50	5	1	–	84	90	1	1	–	24	—	1	0	–	100	—	0	0	N	N
8/15	25	96	148	+	35	15	148	59	–	60	40	59	38	–	36	25	38	18	–	52
	20	156	197	+	21	20	197	86	–	57	40	86	54	–	37	20	54	31	–	43
8/16	10	202	315	+	36	15	315	263	–	17	45	263	99	–	62	30	99	79	–	20
8/17	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/23	40	39	5	–	88	—	5	0	–	100	—	0	0	N	N	—	0	0	N	N
	25	160	151	–	6	25	151	31	–	79	60	31	19	–	38	—	19	0	–	100
9/08	55	47	2	–	96	—	2	0	–	100	—	0	0	N	N	—	0	0	N	N
9/22	30	48	26	–	45	25	26	0	–	100	35	0	0	+	43	—	0	0	–	100
	25	86	107	+	20	25	107	2	–	98	45	2	18	+	87	—	18	0	–	100
10/05	55	25	3	–	90	—	3	0	–	100	—	0	0	N	N	—	0	0	N	N
10/20	70	19	1	–	96	—	1	0	–	100	—	0	0	N	N	—	0	0	N	N
10/21	25	25	15	–	40	35	15	0	–	100	—	0	0	–	100	—	0	0	N	N
Min	10	2	1	—	2	15	1	1	—	13	35	1	6	—	36	20	6	18	—	20
Mean	42	51	45	—	63	40	45	24	—	71	60	24	9	—	75	30	9	4	—	77
Max	70	202	315	—	100	100	315	263	—	100	145	263	99	—	100	45	99	79	—	100

[a] + = Increase, – = decrease, N = no change in peak discharges.

[b] — = Result not obtained.

Table 3.2-4
Travel Time of Flood Bore, Peak Discharges, Increase or Decrease in Peak Discharge, and Percent Increase/Decrease in Peak Discharge from Upstream to Downstream Stations for All 2010 Storm Events in Los Alamos Canyon

Date	E026 E030	Peaks (cfs) E026	Peaks (cfs) E030	+/–[a]	%	E030 E042.1	Peaks (cfs) E030	Peaks (cfs) E042.1	+/–[a]	%	E042.1 E050.1	Peaks (cfs) E042.1	Peaks (cfs) E050.1	+/–[a]	%	E050.1 E109.9	Peaks (cfs) E050.1	Peaks (cfs) E109.9	+/–[a]	%
5/14	110	2	3	+	47	—[b]	3	0	–	100	—	0	0	N	N	—	0	0	N	N
	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
5/15	95	2	5	+	59	—	5	0	–	100	—	0	0	N	N	—	0	0	N	N
	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
6/24	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
7/02	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
7/03	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
7/09	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
7/22	100	0	7	+	98	75	7	13	+	48	—	13	0	-	100	—	0	0	N	N
7/24	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
7/25	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
	85	1	8	+	87	155	8	11	+	29	—	11	0	–	100	—	0	0	N	N
7/26	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
7/30	—	0	0	N	N	—	0	6	+	100	—	6	0	–	100	—	0	0	N	N
7/31	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/1	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/4	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/5	75	4	10	+	64	10	10	48	+	79	45	48	20	–	58	—	20	0	–	100
8/6	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/9	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/15	—	0	0	N	N	—	0	38	+	100	25	38	18	–	52	-65	18	439	N	N
	75	0	8	+	99	10	8	54	+	86	20	54	31	–	43	175	31	10	–	69

Table 3.2-4 (continued)

Date	E026 E030	Peaks (cfs)		+/–[a]	%	E030 E042.1	Peaks (cfs)		+/–[a]	%	E042.1 E050.1	Peaks (cfs)		+/–[a]	%	E050.1 E109.9	Peaks (cfs)		+/–[a]	%
		E026	E030				E030	E042.1				E042.1	E050.1				E050.1	E109.9		
8/16	70	6	30	+	81	5	30	99	+	69	30	99	79	-	20	125	79	95	+	17
8/17	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
8/23	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
	80	0	7	+	96	45	7	19	+	62	—	19	0	–	100	—	0	0	N	N
9/08	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
9/22	—	0	0	N	N	—	0	0	+	100	—	0	0	–	100	—	0	48	+	100
	—	0	3	+	100	-5	3	18	N	N	—	18	0	–	100	—	0	0	N	N
10/05	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
10/20	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
10/21	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N	—	0	0	N	N
Min	70	1	3	—	47	5	3	6	—	29	20	6	18	—	20	125	18	10	—	17
Mean	86	0	2	—	81	50	2	9	—	79	30	9	4	—	77	150	4	5	—	71
Max	110	6	30	—	100	155	30	99	—	100	45	99	79	—	100	175	79	95	—	100

[a] + = Increase, – = decrease, N = no change in peak discharges.

[b] — = Result not obtained.

Table 3.2-5
Summary of Peak Discharge Increases/Decreases in Acid and Pueblo Canyons

Summary	E055.5 to E056	E056 to E059	E056 to E060.1	E055 to E059	E055 to E060.1	E059 to E060.1	E060.1 to E109.9
No. of Increases	17	0	0	3	1	0	3
No. of Decreases	7	9	19	2	12	3	1
Mean Increase	74%	0%	0%	77%	69%	0	100%
Mean Decrease	84%	76%	97%	100%	100%	81%	28%

Table 3.2-6
Summary of Peak Discharge Increases/Decreases in DP and Los Alamos Canyons

Summary	E038 to E039.1	E039.1 to E040	E040 to E042.1	E026 to E030	E030 to E042.1	E042.1 to E050.1	E50.1 to E109.9
No. of Increases	6	0	3	9	9	0	2
No. of Decreases	26	30	15	0	2	10	2
Mean Increase	28%	0%	61%	81%	75%	0%	59%
Mean Decrease	72%	71%	78%	0%	100%	77%	84%

Table 3.2-7
Linear Correlations between Discharge and Suspended Sediment for Each Station Sampled throughout the Storm Event

Time Lag	E042.1						E060	E109.9	
	7/22	7/31	8/5	8/15 Part I	8/15 Part II	8/16	8/16	8/16	9/22
Q_t, SSC_t	0.82	0.73	0.71	0.90	0.67	0.56	0.42	-0.36	0.30
Q_t, SSC_{t-1}	0.91	0.89	0.83	-0.49	0.08	0.58	0.75	0.26	0.23
Q_t, SSC_{t-2}	0.93	0.94	0.84	-0.81	-0.16	0.55	0.93	0.34	-0.40
Q_t, SSC_{t-3}	0.95	0.94	0.86	-0.57	-0.08	0.44	0.96	0.26	-0.47
Q_t, SSC_{t-4}	0.95	0.95	0.88	-0.66	-0.26	0.24	0.95	0.12	-0.16
Q_t, SSC_{t-5}	0.94	0.97	0.88	-0.87	0.25	0.35	0.98	0.05	0.47

Note: Maximum positive correlations are highlighted.

Table 3.2-8
Sediment Yield and Runoff Volume for Each Station Sampled throughout the Storm Event

Station	Date	Sediment Yield (kg)	Runoff Volume (ft^3)	Sediment Yield (tons)	Runoff Volume (acre-feet)
E042.1	7/22	3666	83118	4.0	1.9
E042.1	7/31	863	16761	1.0	0.4
E042.1	8/5	27893	186936	30.7	4.3
E042.1	8/15	27490	285316	30.3	6.5
E060.1	8/16	69703	783166	76.8	18.0
E109.9	8/16	329509	1742127	363.2	40.0
E109.9	9/22	45576	111367	50.2	2.6

Table 4.0-1
NM Aquatic Acute, NM Human Health Persistent, NM Livestock Watering, and NM Wildlife Habitat Screening Levels

Analytical Suite[a]	Analyte Code	Analyte Name	Field Prep	NM Aqu Acute 2010 100 mg	NM HH Persistent 2010	NM Lvstk Wtr 2010	NM Wldlf Hab 2010
DIOX/FUR	1746-01-6	Tetrachlorodibenzodioxin[2,3,7,8-]	UF	n/a[b]	0.000000051	n/a	n/a
METALS	Al	Aluminum	F	3420	n/a	n/a	n/a
METALS	Sb	Antimony	F	n/a	640	n/a	n/a
METALS	As	Arsenic	F	340	9	200	n/a
METALS	B	Boron	F	n/a	n/a	5000	n/a
METALS	Cd	Cadmium	F	1.59	n/a	50	n/a
METALS	Cr	Chromium	F	n/a	n/a	1000	n/a
METALS	Cr(III)	Chromium(III)	F	570	n/a		n/a
METALS	Co	Cobalt	F	n/a	n/a	1000	n/a
METALS	Cu	Copper	F	13.4	n/a	500	n/a
METALS	Pb	Lead	F	64.6	n/a	100	n/a
METALS	Mn	Manganese	F	2990	n/a	n/a	n/a
METALS	Hg	Mercury	F	1.4	n/a	n/a	n/a
METALS	Hg	Mercury	UF	n/a	n/a	10	0.77
METALS	Ni	Nickel	F	468	4600	n/a	n/a
METALS	Se	Selenium	F	n/a	4200	50	n/a
METALS	Se	Selenium	UF	20	n/a	n/a	5
METALS	Ag	Silver	F	3.22	n/a	n/a	n/a
METALS	Tl	Thallium	F	n/a	0.47	n/a	n/a
METALS	V	Vanadium	F	n/a	n/a	100	n/a
METALS	Zn	Zinc	F	160	26000	25000	n/a
PCB_CONG	1336-36-3	Total PCB	UF	n/a	0.00064	n/a	0.014
RAD	GROSSA	Gross alpha	UF	n/a	n/a	15	n/a
RAD	Radium-226	Radium-226	UF	n/a	n/a	30	n/a
RAD	Radium-228	Radium-228	UF	n/a	n/a	30	n/a

[a] All units are microgram per liter except for RAD which are picocuries per liter.

[b] n/a = Not applicable.

Table 4.0-2
Summary of Maximum Detected Results above Screening Levels at Los Alamos and Pueblo canyons in Stormwater

Station Number	Collection Date	Aluminum	Antimony	Arsenic	Boron	Cadmium	Chromium	Cobalt	Copper	Gross alpha	Lead	Mercury	Nickel	Radium-226	Radium-226 and Radium-228	Radium-228	Selenium	Silver	2,3,7,8-Tetrachlorodibenzodioxin	Thallium	Total PCB	Vanadium	Zinc
Screening Level		**3420**	**640**	**9**	**5000**	**1.59**	**570**	**1000**	**13.4**	**15**	**64.6**	**0.77**	**468**	**30**	**30**	**30**	**5**	**3.22**	**0.000000051**	**0.47**	**0.00064**	**100**	**160**
E030	7/22/10	—*	—	—	—	—	—	—	—	65.8	—	—	—	—	—	—	—	—	—	—	0.177	—	—
E030	8/15/10	—	—	—	—	—	—	—	—	221	—	—	—	—	—	—	—	—	—	—	1.16	—	—
E030	8/23/10	—	—	—	—	—	—	—	—	110	—	—	—	—	—	—	—	—	—	—	1.14	—	—
E030	8/5/10	—	—	—	—	—	—	—	—	160	—	0.85	—	—	—	—	—	—	—	—	0.903	—	—
E038	6/24/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.11	—	—
E038	7/22/10	—	—	—	—	—	—	—	—	55.2	—	—	—	—	—	—	—	—	—	—	0.0451	—	—
E038	7/30/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0269	—	—
E038	7/9/10	—	—	—	—	—	—	—	—	24.9	—	—	—	—	—	—	—	—	—	—	0.0361	—	—
E039.1	7/21/10	—	—	—	—	—	—	—	—	16.4	—	—	—	—	—	—	—	—	—	—	—	—	246
E039.1	7/30/10	—	—	—	—	—	—	—	—	16.8	—	—	—	—	—	—	—	—	—	—	0.0323	—	—
E039.1	7/9/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0277	—	—
E039.1	8/15/10	—	—	—	—	—	—	—	—	28.4	—	—	—	—	—	—	—	—	—	—	0.0445	—	—
E040	7/22/10	—	—	—	—	—	—	—	—	36.9	—	—	—	—	—	—	—	—	—	—	0.0416	—	—
E040	7/30/10	—	—	—	—	—	—	—	—	57.6	—	—	—	—	—	—	—	—	—	—	0.0532	—	—
E040	8/15/10	—	—	—	—	—	—	—	—	97.3	—	—	—	—	—	—	—	—	—	—	—	—	—
E040	8/23/10	—	—	—	—	—	—	—	—	25.5	—	—	—	—	—	—	—	—	—	—	0.0444	—	—
E042.1	7/22/10	—	—	—	—	—	—	—	—	57.7	—	—	—	—	—	—	—	—	—	—	0.35	—	—
E042.1	7/23/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.112	—	—
E042.1	7/31/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.112	—	—

Table 4.0-2 (continued)

Station Number	Collection Date	Aluminum	Antimony	Arsenic	Boron	Cadmium	Chromium	Cobalt	Copper	Gross alpha	Lead	Mercury	Nickel	Radium-226	Radium-226 and Radium-228	Radium-228	Selenium	Silver	2,3,7,8-Tetrachlorodibenzodioxin	Thallium	Total PCB	Vanadium	Zinc
Screening Level		**3420**	**640**	**9**	**5000**	**1.59**	**570**	**1000**	**13.4**	**15**	**64.6**	**0.77**	**468**	**30**	**30**	**30**	**5**	**3.22**	**0.000000051**	**0.47**	**0.00064**	**100**	**160**
E042.1	8/15/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.39	—	—
E042.1	8/16/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.96	—	—
E042.1	8/5/10	—	—	—	—	—	—	—	—	86.6	—	—	—	—	—	—	—	—	—	—	0.556	—	—
E055	7/22/10	—	—	—	—	—	—	—	—	52.5	—	—	—	—	—	—	—	—	—	—	0.225	—	—
E055	8/15/10	—	—	—	—	—	—	—	—	17.3	—	—	—	—	—	—	—	—	—	—	0.132	—	—
E055	8/5/10	—	—	—	—	—	—	—	—	54.7	—	—	—	—	—	—	—	—	—	—	0.102	—	—
E055.5	7/22/10	—	—	—	—	—	—	—	—	83	—	—	—	—	—	—	—	—	—	—	0.0574	—	—
E055.5	8/15/10	—	—	—	—	—	—	—	—	36.9	—	—	—	—	—	—	—	—	—	—	0.0443	—	—
E055.5	8/23/10	—	—	—	—	—	—	—	—	31.1	—	—	—	—	—	—	—	—	—	—	0.0284	—	—
E055.5	8/5/10	—	—	—	—	—	—	—	—	192	—	1	—	—	—	—	—	—	—	—	0.0689	—	—
E056	8/15/10	—	—	—	—	—	—	—	—	23.9	—	—	—	—	—	—	—	—	—	—	0.0563	—	—
E056	8/5/10	—	—	—	—	—	—	—	—	190	—	—	—	—	—	—	—	—	—	—	0.0581	—	—
E056	9/22/10	—	—	—	—	—	—	—	—	15.6	—	—	—	—	—	—	—	—	—	—	0.0266	—	—
E059	8/5/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.352	—	—
E060.1	8/16/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.221	—	—
E109.9	8/15/10	—	—	—	—	—	—	—	—	455	—	—	—	—	—	—	—	—	—	—	0.0726	—	—
E109.9	8/23/10	—	—	29.3	—	—	—	—	—	109	—	—	—	—	—	—	—	—	—	—	—	—	—
E109.9	9/22/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0081	—	—

Note: All units are micrograms per liter except gross alpha and isotopic radium which are in picocurie per liter.

* — = Result is not detected above screening level.

Table 4.2-1
Comparison of Filtered with Unfiltered Radionuclide Results

Analyte	Unfiltered Sample ID	Unfiltered Collection Date/Time	Filtered Sample ID	Filtered Collection Date/Time	Unfiltered Result (pCi/L)	Filtered Result (pCi/L)	RPD
Am-241	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	<0.124	0.133	n/a*
Am-241	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	<0.0969	<0.00867	n/a
Co-60	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	<1.25	<2.22	n/a
Co-60	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	<1.34	<-1.28	n/a
Cs-137	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	<0.255	<1.53	n/a
Cs-137	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	<1.49	<0.556	n/a
GROSSA	WTLAP-10-18430	8/15/10 15:43	WTLAP-10-18426	8/15/10 15:43	455	3.3	197%
GROSSB	WTLAP-10-18430	8/15/10 15:43	WTLAP-10-18426	8/15/10 15:43	719	<1.41	199%
Pu-238	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	<0.0442	<0.0483	n/a
Pu-238	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	<-0.0273	<0	n/a
Pu-239/240	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	0.331	0.772	-80%
Pu-239/240	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	1.61	<0.0135	197%
Ra-226	WTLAP-10-18406	8/15/10 15:41	WTLAP-10-18402	8/15/10 15:49	9.3	17.7	-62%
Ra-226	WTLAP-10-18408	9/22/10 17:55	WTLAP-10-18404	9/22/10 18:03	8.06	0.474	178%
Ra-228	WTLAP-10-18406	8/15/10 15:41	WTLAP-10-18402	8/15/10 15:49	12	18.6	-43%
Ra-228	WTLAP-10-18408	9/22/10 17:55	WTLAP-10-18404	9/22/10 18:03	5.81	<0.687	157%
Sr-90	WTLAP-10-18344	8/15/10 15:40	WTLAP-10-18461	8/15/10 15:37	0.767	0.836	-8%
Sr-90	WTLAP-10-18346	9/22/10 17:41	WTLAP-10-18463	9/22/10 17:51	<0.288	<0.219	n/a
U-234	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	18.9	19.4	-3%
U-234	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	18.2	0.668	1.85
U-235/236	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	1.45	1.49	-0.03
U-235/236	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	0.83	<0.0245	188%
U-238	WTLAP-10-18296	8/15/10 15:39	WTLAP-10-18442	8/15/10 15:33	20.4	19.9	2%
U-238	WTLAP-10-18298	9/22/10 17:40	WTLAP-10-18444	9/22/10 17:39	18.2	0.516	188%

* n/a = Not applicable.

Table 4.2-2
Comparison of Filtered with Unfiltered Inorganic Chemical Results

Analyte	Total Count	Unfiltered	Filtered	Count with >5x reduction	Count with >2x reduction	Average RPD	RPD StdDev
Aluminum	33	Detect	Detect	29	32	175%	0.36
Arsenic	1	ND*	ND	0	0	0.00	0
Arsenic	25	Detect	ND	8	19	103%	0.49
Arsenic	7	Detect	Detect	3	6	118%	0.74
Boron	4	ND	ND	0	0	0.00	0.00
Boron	3	Detect	ND	0	0	40%	0.25
Boron	26	Detect	Detect	0	3	41%	0.34
Barium	33	Detect	Detect	29	32	160%	0.35
Beryllium	1	ND	ND	0	0	0.00	0
Beryllium	21	Detect	ND	21	21	181%	0.17
Beryllium	11	Detect	Detect	10	11	179%	0.19
Calcium	33	Detect	Detect	3	17	79%	0.45
Cobalt	1	ND	ND	0	0	0.00	0
Cobalt	5	Detect	ND	4	5	137%	0.11
Cobalt	27	Detect	Detect	13	20	112%	0.63
Copper	1	ND	ND	0	0	-24%	0
Copper	3	Detect	ND	3	3	176%	0.04
Copper	29	Detect	Detect	26	29	165%	0.27
Iron	4	Detect	ND	4	4	196%	0.04
Iron	29	Detect	Detect	25	28	173%	0.37
Potassium	33	Detect	Detect	3	24	91%	0.41
Magnesium	33	Detect	Detect	21	31	133%	0.40
Manganese	1	Detect	ND	1	1	196%	0
Manganese	32	Detect	Detect	30	31	184%	0.36
Sodium	33	Detect	Detect	0	0	16%	0.12
Nickel	1	Detect	ND	1	1	181%	0
Nickel	32	Detect	Detect	27	31	160%	0.37
Lead	1	ND	ND	0	0	0.00	0
Lead	8	Detect	ND	8	8	195%	0.05
Lead	24	Detect	Detect	24	24	193%	0.08
Antimony	5	ND	ND	0	0	0.00	0.00
Antimony	1	ND	Detect	0	0	-117%	0
Antimony	3	Detect	ND	0	0	17%	0.10
Antimony	22	Detect	Detect	0	2	16%	0.32
Uranium	11	Detect	ND	11	11	184%	0.15
Uranium	22	Detect	Detect	20	21	166%	0.41
Vanadium	1	ND	ND	0	0	0.00	0
Vanadium	32	Detect	Detect	28	32	166%	0.26
Zinc	5	Detect	ND	5	5	194%	0.08
Zinc	28	Detect	Detect	26	27	173%	0.37

* ND = Not detected.

Table 4.3-1
Calculated Concentrations of Suspended Sediment
Determined for Each Sample Collected During 2010 in the LA/P Watershed

Station	Sample Collection Date and Time	Field Prep	Sample ID	Calculated Suspended Sediment Concentration (mg/L)
E030	7/22/10 8:34:00 PM	UF	WTLAP-10-18054	3200
E030	7/22/10 8:38:00 PM	UF	WTLAP-10-17936	3070
E030	8/5/10 3:16:00 PM	UF	WTLAP-10-18055	4840
E030	8/5/10 3:17:00 PM	UF	WTLAP-10-17989	4620
E030	8/5/10 3:20:00 PM	UF	WTLAP-10-17937	3940
E030	8/15/10 5:55:00 PM	UF	WTLAP-10-18056	6670
E030	8/15/10 5:56:00 PM	UF	WTLAP-10-17990	7040
E030	8/15/10 5:59:00 PM	UF	WTLAP-10-17938	8150
E030	7/22/10 8:34:00 PM	UF	WTLAP-10-18054	3200
E030	8/23/10 8:20:00 PM	UF	WTLAP-10-18057	2580
E030	8/23/10 8:24:00 PM	UF	WTLAP-10-17939	2390
E038	6/24/10 4:00:00 PM	UF	WTLAP-10-18046	2570
E038	6/24/10 4:04:00 PM	UF	WTLAP-10-17928	4270
E038	7/9/10 8:58:00 PM	UF	WTLAP-10-18047	845
E038	7/9/10 9:03:00 PM	UF	WTLAP-10-17929	654
E038	7/22/10 7:09:00 PM	UF	WTLAP-10-18048	868
E030	8/23/10 8:20:00 PM	UF	WTLAP-10-18057	2580
E038	7/22/10 7:14:00 PM	UF	WTLAP-10-17930	779
E038	7/30/10 10:24:00 PM	UF	WTLAP-10-18049	575
E038	7/30/10 10:25:00 PM	UF	WTLAP-10-17983	567
E038	7/30/10 10:29:00 PM	UF	WTLAP-10-17931	532
E039.1	7/9/10 9:43:00 PM	UF	WTLAP-10-18050	530
E039.1	7/9/10 9:44:00 PM	UF	WTLAP-10-17984	505
E039.1	7/9/10 9:47:00 PM	UF	WTLAP-10-17944	432
E039.1	7/30/10 10:54:00 PM	UF	WTLAP-10-18052	692
E039.1	7/30/10 10:56:00 PM	UF	WTLAP-10-17986	641
E039.1	7/30/10 11:01:00 PM	UF	WTLAP-10-17946	514
E039.1	8/15/10 4:12:00 PM	UF	WTLAP-10-18053	1120
E039.1	8/15/10 4:14:00 PM	UF	WTLAP-10-17987	1100
E039.1	8/15/10 4:19:00 PM	UF	WTLAP-10-17947	1060
E040	7/22/10 8:48:00 PM	UF	WTLAP-10-18042	2070
E040	7/22/10 8:49:00 PM	UF	WTLAP-10-17976	2010
E040	7/22/10 8:53:00 PM	UF	WTLAP-10-17920	1760
E040	7/30/10 11:32:00 PM	UF	WTLAP-10-18043	2250
E040	7/30/10 11:33:00 PM	UF	WTLAP-10-17977	2130

Table 4.3-1 (continued)

Station	Sample Collection Date and Time	Field Prep	Sample ID	Calculated Suspended Sediment Concentration (mg/L)
E040	7/30/10 11:37:00 PM	UF	WTLAP-10-17921	1650
E040	8/15/10 4:14:00 PM	UF	WTLAP-10-17922	2440
E042.1	7/22/10 9:47:00 PM	UF	WTLAP-10-18292	3390
E042.1	7/22/10 9:48:00 PM	UF	WTLAP-10-18340	3290
E042.1	7/22/10 9:48:00 PM	UF	WTLAP-10-18398	3290
E042.1	7/22/10 9:50:00 PM	UF	WTLAP-10-18374	3100
E042.1	7/22/10 10:37:00 PM	UF	WTLAP-10-18304	1300
E042.1	7/22/10 11:22:00 PM	UF	WTLAP-10-18316	884
E042.1	7/23/10 12:07:00 AM	UF	WTLAP-10-18328	574
E042.1	7/31/10 12:51:00 AM	UF	WTLAP-10-18293	3040
E042.1	7/31/10 12:51:00 AM	UF	WTLAP-10-18399	3040
E042.1	7/31/10 12:52:00 AM	UF	WTLAP-10-18341	2870
E042.1	7/31/10 12:54:00 AM	UF	WTLAP-10-18375	2520
E042.1	7/31/10 1:41:00 AM	UF	WTLAP-10-18305	849
E042.1	7/31/10 2:26:00 AM	UF	WTLAP-10-18317	435
E042.1	8/5/10 3:48:00 PM	UF	WTLAP-10-18294	7520
E042.1	8/5/10 3:49:00 PM	UF	WTLAP-10-18342	7640
E042.1	8/5/10 3:49:00 PM	UF	WTLAP-10-18400	7640
E042.1	8/5/10 3:51:00 PM	UF	WTLAP-10-18376	7880
E042.1	8/5/10 4:38:00 PM	UF	WTLAP-10-18306	3780
E042.1	8/5/10 5:23:00 PM	UF	WTLAP-10-18318	2160
E042.1	8/5/10 6:08:00 PM	UF	WTLAP-10-18330	1340
E042.1	8/15/10 3:50:00 PM	UF	WTLAP-10-18200	6410
E042.1	8/15/10 5:23:00 PM	UF	WTLAP-10-18130	4600
E042.1	8/15/10 5:24:00 PM	UF	WTLAP-10-18163	4610
E042.1	8/15/10 6:12:00 PM	UF	WTLAP-10-18143	2820
E042.1	8/15/10 7:42:00 PM	UF	WTLAP-10-18155	2310
E055	7/22/10 7:31:00 PM	UF	WTLAP-10-17623	1460
E055	8/5/10 2:23:00 PM	UF	WTLAP-10-17841	3710
E055	8/5/10 2:26:00 PM	UF	WTLAP-10-17624	3730
E055	8/15/10 5:30:00 PM	UF	WTLAP-10-17625	611
E055.5	7/22/10 6:58:00 PM	UF	WTLAP-10-17844	643
E055.5	7/22/10 7:02:00 PM	UF	WTLAP-10-17631	714
E055.5	8/5/10 2:07:00 PM	UF	WTLAP-10-17845	2690
E055.5	8/5/10 2:10:00 PM	UF	WTLAP-10-17632	2890
E055.5	8/15/10 5:11:00 PM	UF	WTLAP-10-17846	224
E055.5	8/15/10 5:14:00 PM	UF	WTLAP-10-17633	240

Table 4.3-1 (continued)

Station	Sample Collection Date and Time	Field Prep	Sample ID	Calculated Suspended Sediment Concentration (mg/L)
E055.5	8/23/10 3:10:00 PM	UF	WTLAP-10-17847	191
E055.5	8/23/10 3:13:00 PM	UF	WTLAP-10-17634	196
E056	8/5/10 2:18:00 PM	UF	WTLAP-10-17836	3060
E056	8/5/10 2:23:00 PM	UF	WTLAP-10-17615	3180
E056	8/15/10 4:27:00 PM	UF	WTLAP-10-17837	935
E056	8/15/10 4:30:00 PM	UF	WTLAP-10-17616	830
E056	9/22/10 5:46:00 PM	UF	WTLAP-10-17838	866
E056	9/22/10 5:49:00 PM	UF	WTLAP-10-17617	868
E059	8/5/10 3:26:00 PM	UF	WTLAP-10-25542	12600
E059	8/5/10 3:27:00 PM	UF	WTLAP-10-25536	11600
E059	8/5/10 3:27:00 PM	UF	WTLAP-10-25546	11600
E059	8/5/10 4:15:00 PM	UF	WTLAP-10-25564	4590
E060.1	8/16/10 5:52:00 PM	UF	WTLAP-10-18134	4200
E060.1	8/16/10 5:53:00 PM	UF	WTLAP-10-18167	3980
E060.1	8/16/10 5:55:00 PM	UF	WTLAP-10-18192	3540
E060.1	8/16/10 5:55:00 PM	UF	WTLAP-10-18208	3540
E060.1	8/16/10 6:41:00 PM	UF	WTLAP-10-18139	3780
E060.1	8/16/10 8:12:00 PM	UF	WTLAP-10-18159	1340
E109.9	8/15/10 3:39:00 PM	UF	WTLAP-10-18296	15600
E109.9	8/15/10 3:40:00 PM	UF	WTLAP-10-18344	16700
E109.9	8/15/10 3:41:00 PM	UF	WTLAP-10-18406	17800
E109.9	8/15/10 3:42:00 PM	UF	WTLAP-10-18382	18800
E109.9	8/23/10 3:34:00 PM	UF	WTLAP-10-18443	6120
E109.9	8/23/10 3:38:00 PM	UF	WTLAP-10-18462	5490
E109.9	8/23/10 3:42:00 PM	UF	WTLAP-10-18383	6300
E109.9	8/23/10 3:50:00 PM	UF	WTLAP-10-18403	13500
E109.9	9/22/10 5:40:00 PM	UF	WTLAP-10-18298	11500
E109.9	9/22/10 5:43:00 PM	UF	WTLAP-10-18384	16100
E109.9	9/22/10 5:55:00 PM	UF	WTLAP-10-18408	12400
E109.9	9/22/10 6:28:00 PM	UF	WTLAP-10-18310	22900
E109.9	9/22/10 7:13:00 PM	UF	WTLAP-10-18322	11600

Table 4.4-1
Concentrations of Detected Inorganic Chemicals Normalized to Suspended Sediment Concentrations (Aluminum through Iron)

Station Number	Sample Collection Date and Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Cobalt	Chromium	Copper	Iron
Canyon Sediment Background		**15400**[a]	**3.98**	**0.83**	**127**	**1.41**	**0.4**	**4.73**	**10.5**	**11.2**	**13800**
E030	7/22/10 20:38	4330	0.21	1.2	235	2.31	0.651	6.18	4.69	18.6	3520
E030	8/5/10 15:20	12600	0.24	3.22	282	1.78	0.736	9.39	10.8	32.5	23000
E030	8/15/10 17:59	2590	0.11	1.08	158	0.92	0.344	5.13	1.8	7.32	2010
E030	8/23/10 20:24	16600	0.31	4.02	302	2.09	0.587	8.63	13.1	22	15200
E038	6/24/10 16:04	5530	0.89	2.34	107	0.45	5.06	2.6	8.84	27.7	5910
E038	7/9/10 21:03	36400	2.6	7.19	390	2.45	4.28	10.6	27.4	64.3	28500
E038	7/22/10 19:14	22200	3.34	6.16	232	2.18	25.4	6.68	26.1	52.3	11300
E038	7/30/10 22:29	14800	1.32	3.57	188	1.32	0.545	6.2	12.8	33.3	12500
E039.1	7/9/10 21:47	55100	3.24	11.3	514	3.24	1.18	12.5	33.6	67.4	38700
E039.1	7/30/10 23:01	27200	1.58	6.81	278	1.85	0.622	8.36	20	39.1	20800
E039.1	8/15/10 16:19	5860	0.57	2.26	249	1.32	0.602	6.02	5.17	23.4	5800
E040	7/22/10 20:53	16400	0.57	3.47	198	2.28	0.473	5.3	11.6	22.2	12200
E040	7/30/10 23:37	18400	0.5	3.7	188	1.52	0.424	5.76	13.1	22.4	15200
E040	8/15/10 16:14	12600	0.25	2.66	121	1.35	0.451	3.32	7.83	12.3	11300
E042.1	7/22/10 21:50	15500	0.31	3.46	181	1.65	0.549	5.39	15.9	19.7	13500
E042.1	7/31/10 0:54	26400	0.48	5.79	248	1.98	0.794	8.45	20.5	30.6	22200
E042.1	8/5/10 15:51	13600	0.14	3.07	184	1.71	0.482	5.62	14.6	21.2	10500
E055	7/22/10 19:31	18500	0.56	4.8	331	1.72	1.1	10.8	16.9	36.4	27400
E055	8/5/10 14:26	19100	0.23	5.2	322	3.19	0.938	9.62	19.8	35.4	14000
E055	8/15/10 17:30	2960	—[b]	3.11	213	1.19	0.883	6.54	—	29.8	4090

Table 4.4-1 (continued)

Station Number	Sample Collection Date and Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Cobalt	Chromium	Copper	Iron
Canyon Sediment Background		**15400**	**3.98**	**0.83**	**127**	**1.41**	**0.4**	**4.73**	**10.5**	**11.2**	**13800**
E055.5	7/22/10 19:02	27000	0.91	5.32	287	2.8	1.08	8.54	22.1	38.5	19000
E055.5	8/5/10 14:10	21800	0.25	4.95	303	2.49	1.35	9.62	26.9	43.9	18200
E055.5	8/15/10 17:14	65800	—	14.6	541	5	1.92	12.1	49.1	70.8	52500
E055.5	8/23/10 15:13	50300	2.7	11.7	425	3.87	1.83	13.2	46.9	78.5	37800
E056	8/5/10 14:23	17900	0.2	4.18	233	1.85	1.07	7.47	18.5	33.3	10800
E056	8/15/10 16:30	5830	0.65	2.17	219	1.1	0.867	6.14	6.14	26.6	4830
E056	9/22/10 17:49	3640	—	2.53	228	0.91	0.645	5.99	3.8	18.4	3020
E060.1	8/16/10 17:55	40100	—	8.79	281	4.18	1.02	8.05	28.2	35.9	24100
E109.9	8/15/10 15:42	22700	—	1.82	310	1.65	0.244	9.19	13.4	16.1	13100
E109.9	8/23/10 15:42	29000	—	3.16	276	1.89	0.413	8.27	16.7	22.9	24400
E109.9	9/22/10 17:43	326	—	0.63	160	0.43	0.074	2.92	—	0.73	43.9

Note: All results are in milligrams per kilogram.

[*] — = Result is not detected.

Table 4.4-2
Concentrations of Detected Inorganic Chemicals Normalized to Suspended Sediment Concentrations (Lead through Zinc)

Station Number	Sample Collection Date and Time	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Uranium	Vanadium	Zinc
Canyon Sediment Background		**19.7**	**543**	**0.1**	**9.38**	**0.3**	**1**	**0.73**	**2.22**	**19.7**	**60.2**
E030	7/22/10 20:38	53.7	1310	—*	6.77	—	—	—	1.99	14	180
E030	8/5/10 15:20	73.3	1170	0.216	10	0.3	0.13	—	0.96	34.8	241
E030	8/15/10 17:59	19.9	538	—	4.09	—	—	0.038	0.95	10.9	63.2
E030	8/23/10 20:24	59.9	1160	—	11.4	0.46	0.16	0.272	3.18	29.2	177
E038	6/24/10 16:04	21.9	263	—	6.87	—	0.19	—	0.87	11	212
E038	7/9/10 21:03	79.7	946	—	19.7	—	0.4	—	2.45	48	727
E038	7/22/10 19:14	71.8	601	—	17.1	—	0.73	—	1.93	23.8	439
E038	7/30/10 22:29	44.7	472	—	9.58	—	—	—	1.35	23.7	293
E039.1	7/9/10 21:47	89.1	1430	—	25.2	—	0.46	—	2.78	63	785
E039.1	7/30/10 23:01	57.8	642	—	14.6	—	—	—	1.56	38.7	303
E039.1	8/15/10 16:19	55.2	829	—	7.61	—	—	—	1.5	19.9	229
E040	7/22/10 20:53	42.7	655	—	9.34	—	0.13	—	1.08	22.6	198
E040	7/30/10 23:37	44.6	542	—	10.2	—	0.19	0.285	1.03	25.7	177
E040	8/15/10 16:14	36.5	377	—	6.84	—	0.14	0.189	1.19	18.5	87.7
E042.1	7/22/10 21:50	43.3	775	—	10.4	—	0.18	—	1.71	20.5	159
E042.1	7/31/10 0:54	63.1	913	—	15.6	—	0.31	—	2.02	36.2	254
E042.1	8/5/10 15:51	53.7	622	0.09	10.6	0.46	0.17	0.228	1.8	19.9	137
E055	7/22/10 19:31	133	1080	—	14.3	—	0.4	—	1.92	47.1	331
E055	8/5/10 14:26	113	2300	0.161	18.1	0.94	0.4	0.322	2.41	27.6	244
E055	8/15/10 17:30	128	890	—	6.87	—	—	—	1.21	18.8	242
E055.5	7/22/10 19:02	137	782	—	16.2	—	0.53	—	3.36	36.1	535
E055.5	8/5/10 14:10	161	837	0.346	20.4	0.76	1.52	0.381	5.09	36	278

Table 4.4-2 (continued)

Station Number	Sample Collection Date and Time	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Uranium	Vanadium	Zinc
		19.7[a]	**543**	**0.1**	**9.38**	**0.3**	**1**	**0.73**	**2.22**	**19.7**	**60.2**
E055.5	8/15/10 17:14	202	1100	—	35	—	3.96	—	6.25	89.5	1210
E055.5	8/23/10 15:13	183	825	0.611	30.1	—	2.55	—	5.6	73.9	506
E056	8/5/10 14:23	102	675	—	15.9	0.66	0.6	0.239	2.61	24.7	218
E056	8/15/10 16:30	64.8	581	—	7.95	—	—	—	1.45	18.7	253
E056	9/22/10 17:49	47.6	526	—	6.1	—	—	—	1.38	15.7	190
E060.1	8/16/10 17:55	105	1190	—	23.9	0.9	2.01	0.791	3.42	35.3	184
E109.9	8/15/10 15:42	15.1	653	—	18.6	0.2	—	0.239	2.07	20.4	59
E109.9	8/23/10 15:42	19.4	619	—	19.4	—	0.12	0.27	1.7	36.2	79.8
E109.9	9/22/10 17:43	0.8	180	—	1.15	—	—	—	0.85	2.64	3.67

Note: All results are in milligrams per kilogram.

[*] — = Result is not detected.

Table 4.4-3
Concentrations of Radionuclides Normalized to Suspended Sediment Concentrations

Station Number	Sample Collection Date and Time	Americium-241	Cesium-137	Potassium-40	Plutonium-238	Plutonium-239/240	Radium-226	Radium-228	Strontium-90	Uranium-234	Uranium-238
Canyon Sediment Background		**0.04**	**0.90**	**36.80**	**0.01**	**0.07**	**2.59**	**2.33**	**1.04**	**2.59**	**2.29**
E030	7/22/10 20:34	NA[a]	<[b]	<	0.0819	2.96	NA	NA	NA	1.88	1.91
E030	7/22/10 20:35	NA	NA	NA	NA	NA	NA	NA	<	NA	NA
E030	8/5/10 15:16	NA	<	58.4	0.0491	3.10	NA	NA	NA	1.64	1.61
E030	8/5/10 15:17	NA	NA	NA	NA	NA	NA	NA	0.147	NA	NA
E030	8/15/10 17:55	NA	<	26.1	0.0244	0.809	NA	NA	NA	1.32	1.24
E030	8/15/10 17:56	NA	NA	NA	NA	NA	NA	NA	0.180	NA	NA
E030	8/23/10 20:20	NA	<	NA	0.0159	0.736	NA	NA	NA	1.14	1.20
E030	8/23/10 20:21	NA	NA	NA	NA	NA	NA	NA	<	NA	NA
E038	6/24/10 16:00	NA	<	<	<	0.0588	NA	NA	NA	1.52	1.46
E038	6/24/10 16:03	NA	NA	NA	NA	NA	NA	NA	<	NA	NA
E038	7/9/10 20:58	NA	<	<	<	<	NA	NA	NA	1.38	1.30
E038	7/9/10 21:00	NA	NA	NA	NA	NA	NA	NA	<	NA	NA
E038	7/22/10 19:09	NA	<	<	<	<	NA	NA	NA	1.79	1.66
E038	7/22/10 19:10	NA	NA	NA	NA	NA	NA	NA	<	NA	NA
E038	7/30/10 22:24	NA	<	<	<	<	NA	NA	NA	1.65	1.64
E038	7/30/10 22:25	NA	NA	NA	NA	NA	NA	NA	2.70	NA	NA
E039.1	7/9/10 21:43	NA	<	<	<	0.173	NA	NA	NA	1.67	1.93
E039.1	7/9/10 21:44	NA	NA	NA	NA	NA	NA	NA	16.8	NA	NA
E039.1	7/30/10 22:54	NA	<	<	0.266	4.00	NA	NA	NA	5.07	5.06
E039.1	7/30/10 22:56	NA	NA	NA	NA	NA	NA	NA	5.44	NA	NA
E039.1	8/15/10 16:12	NA	<	<	0.0271	0.455	NA	NA	NA	1.36	1.23
E039.1	8/15/10 16:14	NA	NA	NA	NA	NA	NA	NA	3.68	NA	NA
E040	7/22/10 20:48	NA	6.57	<	0.0715	0.599	NA	NA	NA	1.51	1.35
E040	7/22/10 20:49	NA	NA	NA	NA	NA	NA	NA	7.07	NA	NA
E040	7/30/10 23:32	NA	5.73	<	0.0769	0.564	NA	NA	NA	2.10	1.82
E040	7/30/10 23:33	NA	NA	NA	NA	NA	NA	NA	8.12	NA	NA
E042.1	7/22/10 21:47	0.614	2.57	66.7	0.125	2.60	NA	NA	NA	1.96	1.73
E042.1	7/22/10 21:48	NA	NA	NA	NA	NA	NA	NA	1.47	NA	NA
E042.1	7/22/10 21:48	NA	NA	NA	NA	NA	0.891	1.27	NA	NA	NA
E042.1	7/22/10 22:37	NA	NA	<	0.141	2.81	NA	NA	NA	NA	NA
E042.1	7/22/10 23:22	NA	<	<	0.0956	1.86	NA	NA	NA	NA	NA
E042.1	7/23/10 0:07	NA	<	<	0.0870	1.45	NA	NA	NA	NA	NA
E042.1	7/31/10 0:51	0.855	3.91	<	0.0806	0.901	NA	NA	NA	1.75	1.63

Table 4.4-3 (continued)

Station Number	Sample Collection Date and Time	Americium-241	Cesium-137	Potassium-40	Plutonium-238	Plutonium-239/240	Radium-226	Radium-228	Strontium-90	Uranium-234	Uranium-238
Canyon Sediment Background		**0.04**	**0.90**	**36.80**	**0.01**	**0.07**	**2.59**	**2.33**	**1.04**	**2.59**	**2.29**
E042.1	7/31/10 0:51	NA	NA	NA	NA	NA	0.743	3.68	NA	NA	NA
E042.1	7/31/10 0:52	NA	NA	NA	NA	NA	NA	NA	2.32	NA	NA
E042.1	7/31/10 1:41	NA	<	<	0.124	1.03	NA	NA	NA	NA	NA
E042.1	7/31/10 2:26	NA	9.83	<	<	0.880	NA	NA	NA	NA	NA
E042.1	8/5/10 15:48	0.702	1.4	<	0.131	0.926	NA	NA	NA	1.42	1.29
E042.1	8/5/10 15:49	NA	NA	NA	NA	NA	NA	NA	3.80	NA	NA
E042.1	8/5/10 15:49	NA	NA	NA	NA	NA	0.628	1.10	NA	NA	NA
E042.1	8/5/10 16:38	NA	1.67	<	0.0665	1.00	NA	NA	NA	NA	NA
E042.1	8/5/10 17:23	NA	12.4	58.9	0.322	2.79	NA	NA	NA	NA	NA
E042.1	8/5/10 18:08	NA	6.79	<	0.108	2.15	NA	NA	NA	NA	NA
E042.1	8/15/10 15:50	NA	NA	NA	NA	NA	0.691	1.12	NA	NA	NA
E042.1	8/15/10 17:23	0.692	2.98	34.6	0.0729	0.659	NA	NA	NA	2.20	2.10
E042.1	8/15/10 17:24	NA	NA	NA	NA	NA	NA	NA	4.60	NA	NA
E042.1	8/15/10 18:12	NA	NA	<	0.0311	1.90	NA	NA	NA	NA	NA
E042.1	8/15/10 19:42	NA	<	NA	0.0413	0.587	NA	NA	NA	NA	NA
E055	7/22/10 19:28	NA	NA	NA	<	<	NA	NA	NA	NA	NA
E055	8/5/10 14:23	NA	NA	NA	<	0.137	NA	NA	NA	NA	NA
E055	8/15/10 17:27	NA	NA	NA	<	<	NA	NA	NA	NA	NA
E055.5	7/22/10 18:58	NA	NA	NA	0.597	233	NA	NA	NA	NA	NA
E055.5	8/5/10 14:07	NA	NA	NA	<	25.2	NA	NA	NA	NA	NA
E055.5	8/15/10 17:11	NA	NA	NA	0.440	125	NA	NA	NA	NA	NA
E055.5	8/23/10 15:10	NA	NA	NA	<	69.8	NA	NA	NA	NA	NA
E056	8/5/10 14:18	NA	NA	NA	<	27.7	NA	NA	NA	NA	NA
E056	8/15/10 16:27	NA	NA	NA	0.0752	11.3	NA	NA	NA	NA	NA
E056	9/22/10 17:46	NA	NA	NA	<	14.9	NA	NA	NA	NA	NA
E059	8/5/10 15:26	0.280	<	10.5	<	3.46	NA	NA	NA	1.38	1.41
E059	8/5/10 15:27	NA	NA	NA	NA	NA	0.757	0.680	NA	NA	NA
E059	8/5/10 15:27	NA	NA	NA	NA	NA	NA	NA	0.417	NA	NA
E059	8/5/10 16:15	NA	<	32.0	0.0538	0.766	NA	NA	NA	NA	NA
E060.1	8/16/10 17:52	0.552	<	<	<	4.62	NA	NA	NA	1.32	1.10
E060.1	8/16/10 17:53	NA	NA	NA	NA	NA	NA	NA	0.354	NA	NA
E060.1	8/16/10 17:55	NA	NA	NA	NA	NA	1.99	2.64	NA	NA	NA
E060.1	8/16/10 18:41	NA	<	<	<	11.1	NA	NA	NA	NA	NA
E060.1	8/16/10 20:12	NA	<	<	<	14.5	NA	NA	NA	NA	NA

Table 4.4-3 (continued)

Station Number	Sample Collection Date and Time	Americium-241	Cesium-137	Potassium-40	Plutonium-238	Plutonium-239/240	Radium-226	Radium-228	Strontium-90	Uranium-234	Uranium-238
Canyon Sediment Background		**0.04**	**0.90**	**36.80**	**0.01**	**0.07**	**2.59**	**2.33**	**1.04**	**2.59**	**2.29**
E109.9	8/15/10 15:39	<	<	17.2	<	0.0212	NA	NA	NA	1.21	1.31
E109.9	8/15/10 15:40	NA	NA	NA	NA	NA	NA	NA	0.046	NA	NA
E109.9	8/15/10 15:41	NA	NA	NA	NA	NA	0.524	0.676	NA	NA	NA
E109.9	8/23/10 15:34	4.66	<	23.2	<	0.824	NA	NA	NA	1.06	1.19
E109.9	8/23/10 15:38	NA	NA	NA	NA	NA	NA	NA	0.174	NA	NA
E109.9	8/23/10 15:50	NA	NA	NA	NA	NA	0.390	0.626	NA	NA	NA
E109.9	9/22/10 17:40	<	<	27.3	<	0.139	NA	NA	NA	1.58	1.58
E109.9	9/22/10 17:41	NA	NA	NA	NA	NA	NA	NA	<	NA	NA
E109.9	9/22/10 17:55	NA	NA	NA	NA	NA	0.650	0.469	NA	NA	NA
E109.9	9/22/10 18:28	NA	<	8.76	<	0.0850	NA	NA	NA	NA	NA
E109.9	9/22/10 19:13	NA	<	36.2	<	0.135	NA	NA	NA	NA	NA

Note: All results are in picocuries per gram.

[a] NA = Not analyzed.

[b] < = Sample was analyzed but radionuclide was not detected.

Table 4.4-4
Analytical Results from the Retention Basins and Wetland below the SWMU 01-001(f) Drainage Collected July 26, 2010

Sample Location	Analyte	Sample ID	Field Prep Code	Symbol Result	Result Unit of Measure
CO101040	Suspended sediment concentration	WTCAP-10-24689	UF	64.8	mg/L
CO101039	Suspended sediment concentration	WTCAP-10-24687	UF	16.2	mg/L
CO101038	Suspended sediment concentration	WTCAP-10-24681	UF	36.4	mg/L
CO101040	Calcium	WTCAP-10-24690	F	5.69	mg/L
CO101040	Calcium	WTCAP-10-24689	UF	6.06	mg/L
CO101039	Calcium	WTCAP-10-24688	F	31.6	mg/L
CO101039	Calcium	WTCAP-10-24687	UF	30.9	mg/L
CO101038	Calcium	WTCAP-10-24680	F	55.2	mg/L
CO101038	Calcium	WTCAP-10-24681	UF	54.7	mg/L
CO101040	Magnesium	WTCAP-10-24690	F	0.743	mg/L
CO101040	Magnesium	WTCAP-10-24689	UF	1.21	mg/L
CO101039	Magnesium	WTCAP-10-24688	F	5.34	mg/L
CO101039	Magnesium	WTCAP-10-24687	UF	5.48	mg/L
CO101038	Magnesium	WTCAP-10-24680	F	9.8	mg/L
CO101038	Magnesium	WTCAP-10-24681	UF	9.93	mg/L
CO101040	Potassium	WTCAP-10-24690	F	2.79	mg/L
CO101040	Potassium	WTCAP-10-24689	UF	3.55	mg/L
CO101039	Potassium	WTCAP-10-24688	F	5.53	mg/L
CO101039	Potassium	WTCAP-10-24687	UF	5.76	mg/L
CO101038	Potassium	WTCAP-10-24680	F	8.49	mg/L
CO101038	Potassium	WTCAP-10-24681	UF	8.59	mg/L
CO101040	Sodium	WTCAP-10-24690	F	7.73	mg/L
CO101040	Sodium	WTCAP-10-24689	UF	8.03	mg/L
CO101039	Sodium	WTCAP-10-24688	F	86.3	mg/L
CO101039	Sodium	WTCAP-10-24687	UF	84.7	mg/L
CO101038	Sodium	WTCAP-10-24680	F	151	mg/L
CO101038	Sodium	WTCAP-10-24681	UF	149	mg/L
CO101040	Hardness	WTCAP-10-24690	F	17.3	mg/L
CO101040	Hardness	WTCAP-10-24689	UF	20.1	mg/L
CO101039	Hardness	WTCAP-10-24688	F	101	mg/L
CO101039	Hardness	WTCAP-10-24687	UF	99.7	mg/L
CO101038	Hardness	WTCAP-10-24680	F	178	mg/L
CO101038	Hardness	WTCAP-10-24681	UF	178	mg/L
CO101040	Total organic carbon	WTCAP-10-24689	UF	9.73	mg/L
CO101039	Total organic carbon	WTCAP-10-24687	UF	9.37	mg/L

Table 4.4-4 (continued)

Sample Location	Analyte	Sample ID	Field Prep Code	Symbol Result	Result Unit of Measure
CO101038	Total organic carbon	WTCAP-10-24681	UF	10.1	mg/L
CO101040	Barium	WTCAP-10-24690	F	18.9	µg/L
CO101040	Barium	WTCAP-10-24689	UF	39	µg/L
CO101039	Barium	WTCAP-10-24688	F	57.5	µg/L
CO101039	Barium	WTCAP-10-24687	UF	67.2	µg/L
CO101038	Barium	WTCAP-10-24680	F	84.7	µg/L
CO101038	Barium	WTCAP-10-24681	UF	92.1	µg/L
CO101040	Boron	WTCAP-10-24690	F	<15	µg/L
CO101040	Boron	WTCAP-10-24689	UF	<15	µg/L
CO101039	Boron	WTCAP-10-24688	F	36.8	µg/L
CO101039	Boron	WTCAP-10-24687	UF	36.5	µg/L
CO101038	Boron	WTCAP-10-24680	F	56.3	µg/L
CO101038	Boron	WTCAP-10-24681	UF	56.2	µg/L
CO101040	Cobalt	WTCAP-10-24690	F	<2.9	µg/L
CO101040	Cobalt	WTCAP-10-24689	UF	<1	µg/L
CO101039	Cobalt	WTCAP-10-24688	F	<2.6	µg/L
CO101038	Cobalt	WTCAP-10-24680	F	<3.1	µg/L
CO101038	Cobalt	WTCAP-10-24681	UF	<1	µg/L
CO101040	Iron	WTCAP-10-24690	F	469	µg/L
CO101040	Iron	WTCAP-10-24689	UF	2520	µg/L
CO101039	Iron	WTCAP-10-24688	F	172	µg/L
CO101039	Iron	WTCAP-10-24687	UF	1470	µg/L
CO101038	Iron	WTCAP-10-24680	F	<102	µg/L
CO101038	Iron	WTCAP-10-24681	UF	1300	µg/L
CO101040	Manganese	WTCAP-10-24690	F	12.7	µg/L
CO101040	Manganese	WTCAP-10-24689	UF	61.5	µg/L
CO101039	Manganese	WTCAP-10-24688	F	23.8	µg/L
CO101039	Manganese	WTCAP-10-24687	UF	107	µg/L
CO101038	Manganese	WTCAP-10-24680	F	208	µg/L
CO101038	Manganese	WTCAP-10-24681	UF	289	µg/L
CO101040	Vanadium	WTCAP-10-24690	F	1.5	µg/L
CO101040	Vanadium	WTCAP-10-24689	UF	4.9	µg/L
CO101039	Vanadium	WTCAP-10-24688	F	5.2	µg/L
CO101039	Vanadium	WTCAP-10-24687	UF	7.6	µg/L
CO101038	Vanadium	WTCAP-10-24680	F	3.2	µg/L
CO101038	Vanadium	WTCAP-10-24681	UF	5.6	µg/L
CO101040	Zinc	WTCAP-10-24690	F	18.8	µg/L

Table 4.4-4 (continued)

Sample Location	Analyte	Sample ID	Field Prep Code	Symbol Result	Result Unit of Measure
CO101040	Zinc	WTCAP-10-24689	UF	48.3	µg/L
CO101039	Zinc	WTCAP-10-24688	F	5.4	µg/L
CO101039	Zinc	WTCAP-10-24687	UF	18	µg/L
CO101038	Zinc	WTCAP-10-24680	F	21	µg/L
CO101038	Zinc	WTCAP-10-24681	UF	36.9	µg/L
CO101040	Aluminum	WTCAP-10-24690	F	872	µg/L
CO101040	Aluminum	WTCAP-10-24689	UF	3970	µg/L
CO101039	Aluminum	WTCAP-10-24688	F	233	µg/L
CO101039	Aluminum	WTCAP-10-24687	UF	2260	µg/L
CO101038	Aluminum	WTCAP-10-24680	F	78.4	µg/L
CO101038	Aluminum	WTCAP-10-24681	UF	1410	µg/L
CO101040	Antimony	WTCAP-10-24690	F	1.5	µg/L
CO101040	Antimony	WTCAP-10-24689	UF	1.6	µg/L
CO101039	Antimony	WTCAP-10-24688	F	1.3	µg/L
CO101039	Antimony	WTCAP-10-24687	UF	1.1	µg/L
CO101038	Antimony	WTCAP-10-24680	F	0.83	µg/L
CO101038	Antimony	WTCAP-10-24681	UF	0.79	µg/L
CO101040	Arsenic	WTCAP-10-24690	F	<1.5	µg/L
CO101040	Arsenic	WTCAP-10-24689	UF	<1.5	µg/L
CO101039	Arsenic	WTCAP-10-24688	F	1.7	µg/L
CO101039	Arsenic	WTCAP-10-24687	UF	2.8	µg/L
CO101038	Arsenic	WTCAP-10-24680	F	<1.5	µg/L
CO101038	Arsenic	WTCAP-10-24681	UF	2.4	µg/L
CO101038	Antimony	WTCAP-10-24681	UF	0.79	µg/L
CO101040	Beryllium	WTCAP-10-24690	F	<0.1	µg/L
CO101040	Beryllium	WTCAP-10-24689	UF	0.29	µg/L
CO101039	Beryllium	WTCAP-10-24688	F	<0.1	µg/L
CO101039	Beryllium	WTCAP-10-24687	UF	0.14	µg/L
CO101038	Beryllium	WTCAP-10-24680	F	<0.1	µg/L
CO101038	Beryllium	WTCAP-10-24681	UF	0.11	µg/L
CO101040	Cadmium	WTCAP-10-24690	F	<0.11	µg/L
CO101040	Cadmium	WTCAP-10-24689	UF	0.11	µg/L
CO101039	Cadmium	WTCAP-10-24688	F	<0.11	µg/L
CO101039	Cadmium	WTCAP-10-24687	UF	<0.11	µg/L
CO101038	Cadmium	WTCAP-10-24680	F	<0.11	µg/L
CO101038	Cadmium	WTCAP-10-24681	UF	<0.11	µg/L
CO101040	Chromium	WTCAP-10-24690	F	<2.5	µg/L

Table 4.4-4 (continued)

Sample Location	Analyte	Sample ID	Field Prep Code	Symbol Result	Result Unit of Measure
CO101040	Chromium	WTCAP-10-24689	UF	3.2	µg/L
CO101039	Chromium	WTCAP-10-24688	F	<2.5	µg/L
CO101039	Chromium	WTCAP-10-24687	UF	<2.5	µg/L
CO101038	Chromium	WTCAP-10-24680	F	<2.5	µg/L
CO101038	Chromium	WTCAP-10-24681	UF	<2.5	µg/L
CO101040	Copper	WTCAP-10-24690	F	3.9	µg/L
CO101040	Copper	WTCAP-10-24689	UF	6.3	µg/L
CO101039	Copper	WTCAP-10-24688	F	3.4	µg/L
CO101039	Copper	WTCAP-10-24687	UF	5.4	µg/L
CO101038	Copper	WTCAP-10-24680	F	3.1	µg/L
CO101038	Copper	WTCAP-10-24681	UF	4.6	µg/L
CO101040	Lead	WTCAP-10-24690	F	0.96	µg/L
CO101040	Lead	WTCAP-10-24689	UF	7.6	µg/L
CO101039	Lead	WTCAP-10-24688	F	<0.5	µg/L
CO101039	Lead	WTCAP-10-24687	UF	2.5	µg/L
CO101038	Lead	WTCAP-10-24680	F	<0.5	µg/L
CO101038	Lead	WTCAP-10-24681	UF	1.6	µg/L
CO101040	Nickel	WTCAP-10-24690	F	1.4	µg/L
CO101040	Nickel	WTCAP-10-24689	UF	2.4	µg/L
CO101039	Nickel	WTCAP-10-24688	F	1.7	µg/L
CO101039	Nickel	WTCAP-10-24687	UF	2.3	µg/L
CO101038	Nickel	WTCAP-10-24680	F	2.4	µg/L
CO101040	Selenium	WTCAP-10-24690	F	<1	µg/L
CO101040	Selenium	WTCAP-10-24689	UF	<1	µg/L
CO101039	Selenium	WTCAP-10-24688	F	<1	µg/L
CO101039	Selenium	WTCAP-10-24687	UF	<1	µg/L
CO101038	Selenium	WTCAP-10-24680	F	<1	µg/L
CO101038	Selenium	WTCAP-10-24681	UF	<1	µg/L
CO101040	Silver	WTCAP-10-24690	F	<0.2	µg/L
CO101040	Silver	WTCAP-10-24689	UF	<0.2	µg/L
CO101039	Silver	WTCAP-10-24688	F	<0.2	µg/L
CO101039	Silver	WTCAP-10-24687	UF	<0.2	µg/L
CO101038	Silver	WTCAP-10-24680	F	<0.2	µg/L
CO101038	Silver	WTCAP-10-24681	UF	<0.2	µg/L
CO101040	Thallium	WTCAP-10-24690	F	<0.3	µg/L
CO101040	Thallium	WTCAP-10-24689	UF	<0.3	µg/L
CO101039	Thallium	WTCAP-10-24688	F	<0.3	µg/L

Table 4.4-4 (continued)

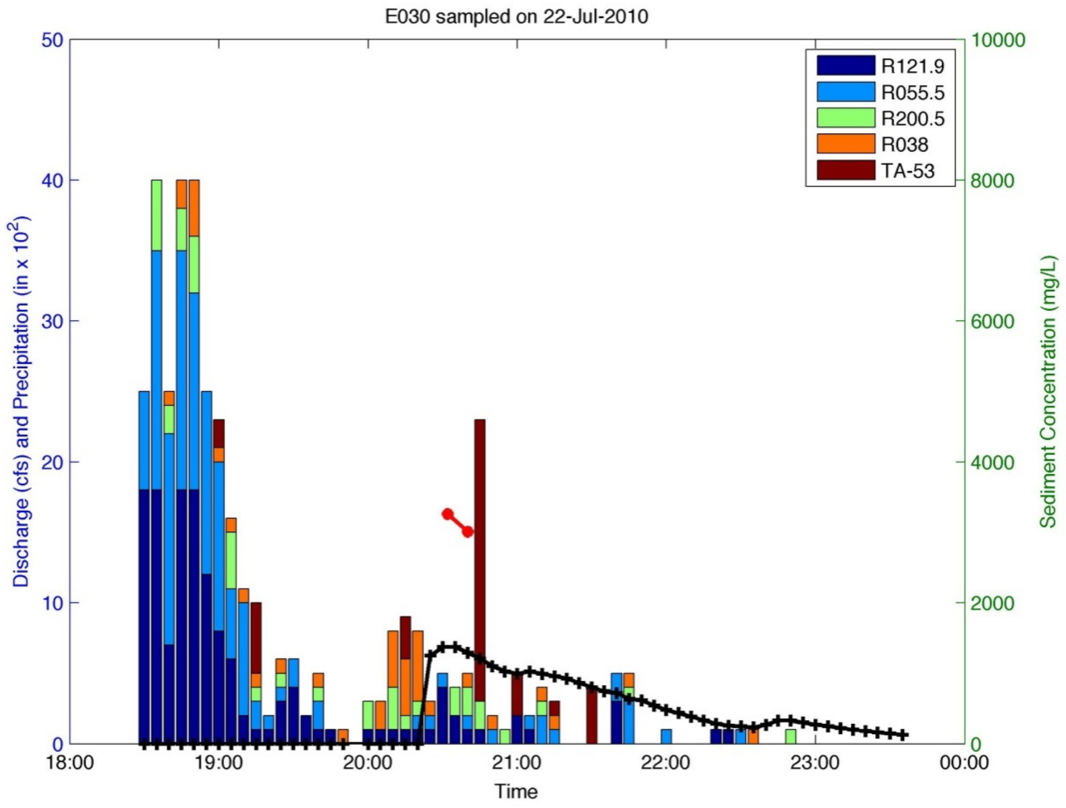
Sample Location	Analyte	Sample ID	Field Prep Code	Symbol Result	Result Unit of Measure
CO101039	Thallium	WTCAP-10-24687	UF	<0.3	µg/L
CO101038	Thallium	WTCAP-10-24680	F	<0.3	µg/L
CO101038	Thallium	WTCAP-10-24681	UF	<0.3	µg/L
CO101040	Uranium	WTCAP-10-24690	F	3.4	µg/L
CO101040	Uranium	WTCAP-10-24689	UF	9.8	µg/L
CO101039	Uranium	WTCAP-10-24688	F	9.5	µg/L
CO101039	Uranium	WTCAP-10-24687	UF	11.2	µg/L
CO101038	Uranium	WTCAP-10-24680	F	27.8	µg/L
CO101038	Uranium	WTCAP-10-24681	UF	30.1	µg/L
CO101040	Mercury	WTCAP-10-24690	F	<0.066	µg/L
CO101040	Mercury	WTCAP-10-24689	UF	<0.066	µg/L
CO101039	Mercury	WTCAP-10-24688	F	<0.066	µg/L
CO101039	Mercury	WTCAP-10-24687	UF	<0.066	µg/L
CO101038	Mercury	WTCAP-10-24680	F	<0.066	µg/L
CO101038	Mercury	WTCAP-10-24681	UF	< 0.066	µg/L
CO101040	Total PCB	WTCAP-10-24689	UF	15.1	µg/L
CO101039	Total PCB	WTCAP-10-24687	UF	1.01	µg/L
CO101038	Total PCB	WTCAP-10-24681	UF	0.545	µg/L
CO101040	Gross alpha	WTCAP-10-24689	UF	7.21	pCi/L
CO101039	Gross alpha	WTCAP-10-24687	UF	12.1	pCi/L
CO101038	Gross alpha	WTCAP-10-24681	UF	13.7	pCi/L
CO101040	Gross beta	WTCAP-10-24689	UF	5.97	pCi/L
CO101039	Gross beta	WTCAP-10-24687	UF	7.98	pCi/L
CO101038	Gross beta	WTCAP-10-24681	UF	17	pCi/L
CO101040	Uranium-234	WTCAP-10-24689	UF	2.69	pCi/L
CO101039	Uranium-234	WTCAP-10-24687	UF	3.72	pCi/L
CO101038	Uranium-234	WTCAP-10-24681	UF	10.1	pCi/L
CO101040	Uranium-235/236	WTCAP-10-24689	UF	0.167	pCi/L
CO101039	Uranium-235/236	WTCAP-10-24687	UF	0.237	pCi/L
CO101038	Uranium-235/236	WTCAP-10-24681	UF	0.673	pCi/L
CO101040	Uranium-238	WTCAP-10-24689	UF	3.07	pCi/L
CO101039	Uranium-238	WTCAP-10-24687	UF	3.24	pCi/L
CO101038	Uranium-238	WTCAP-10-24681	UF	9.48	pCi/L

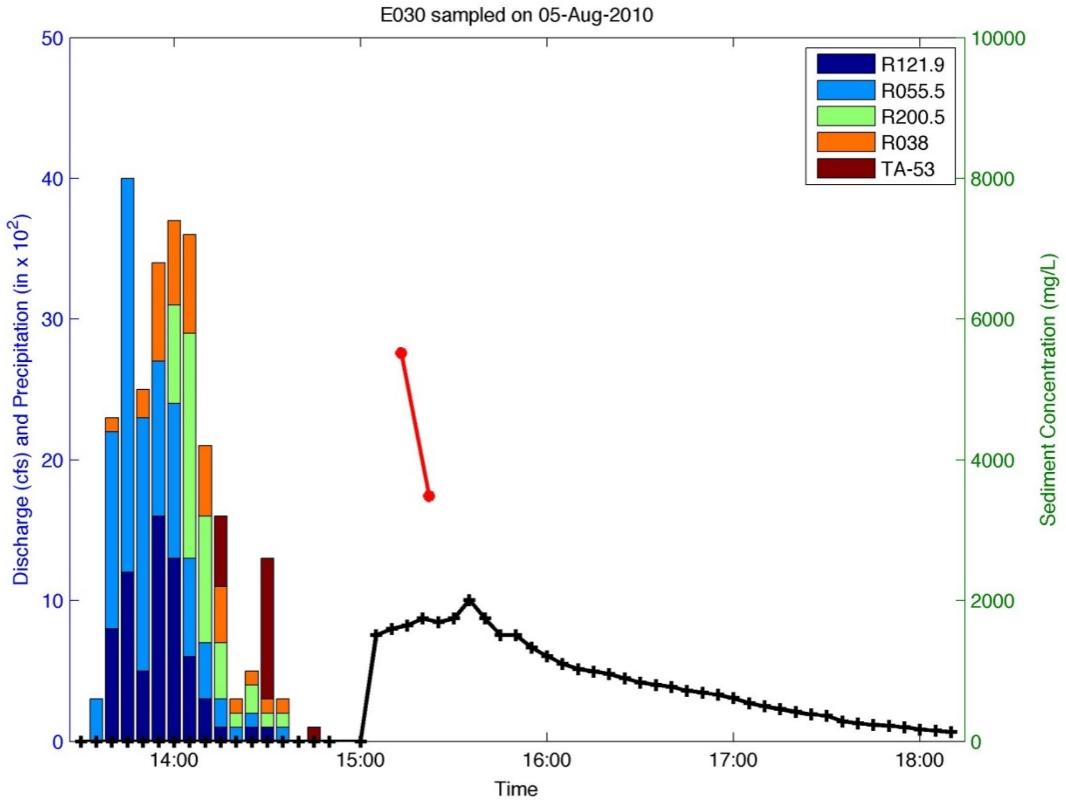
Appendix A

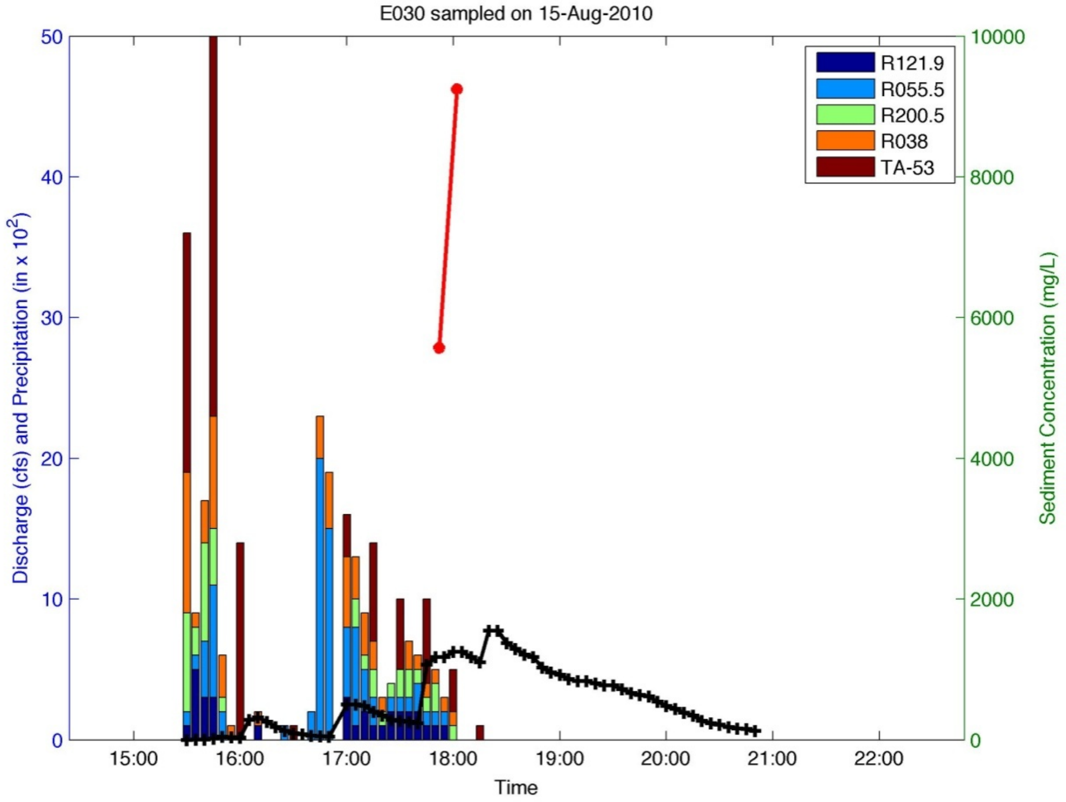
Hydrographs, Hyetographs, and Sedigraphs
for Samples Collected

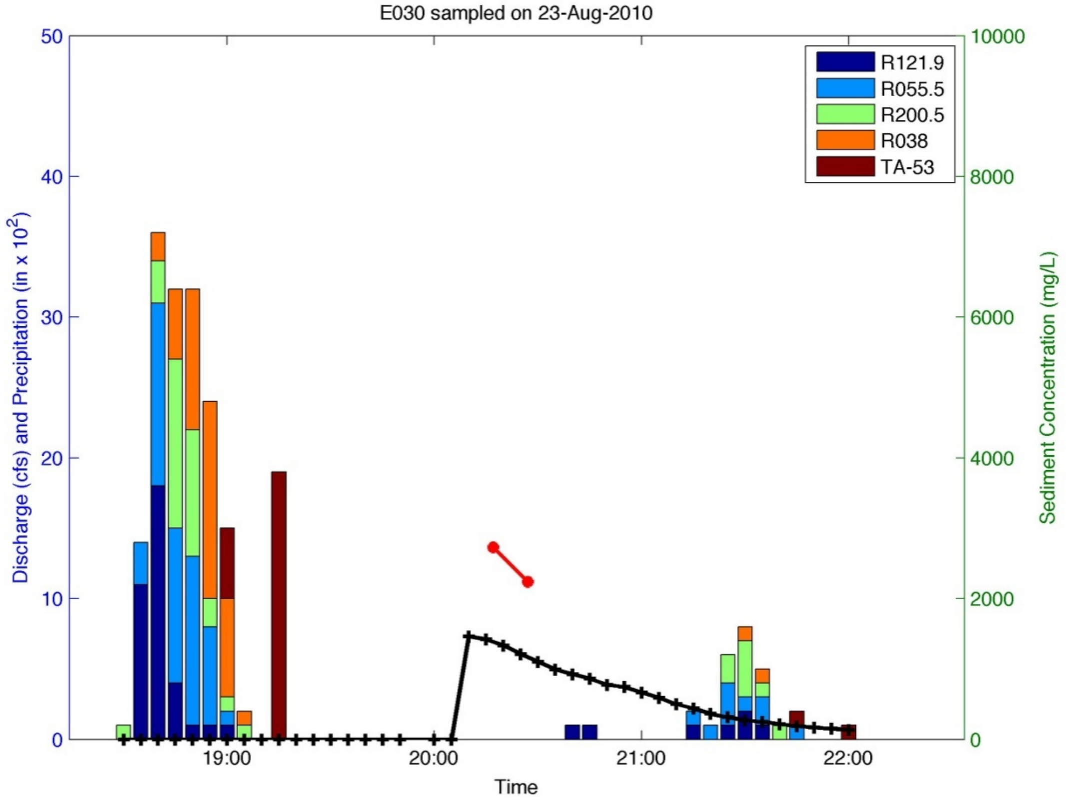
This appendix summarizes the relationships between precipitation, discharge, and sediment concentrations determined for each storm event sampled. Hydrographs at gages from each storm event resulting in sample collection are represented. These hydrographs are overlaid with precipitation measured at associated rain gages and sediment concentrations measured from samples collected during discharge.

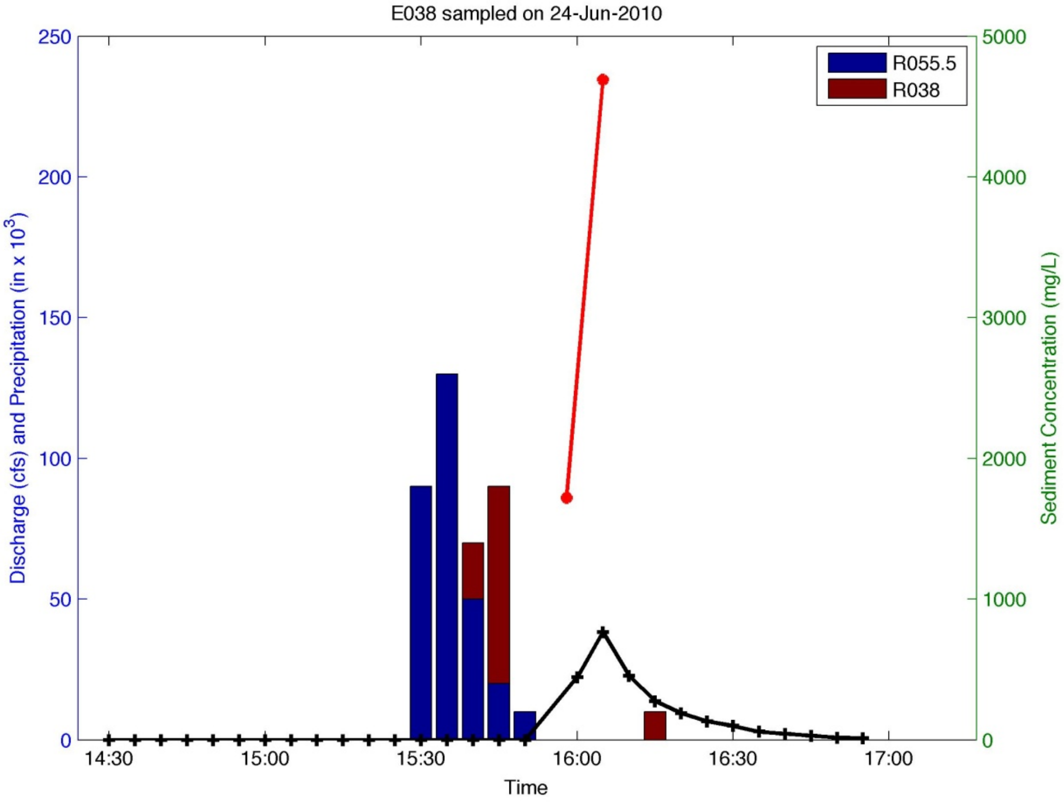
Hydrographs (**+**), hyetographs (assorted colors of stacked bars), and sedigraphs (●) for storm events during which sampling was performed are displayed.

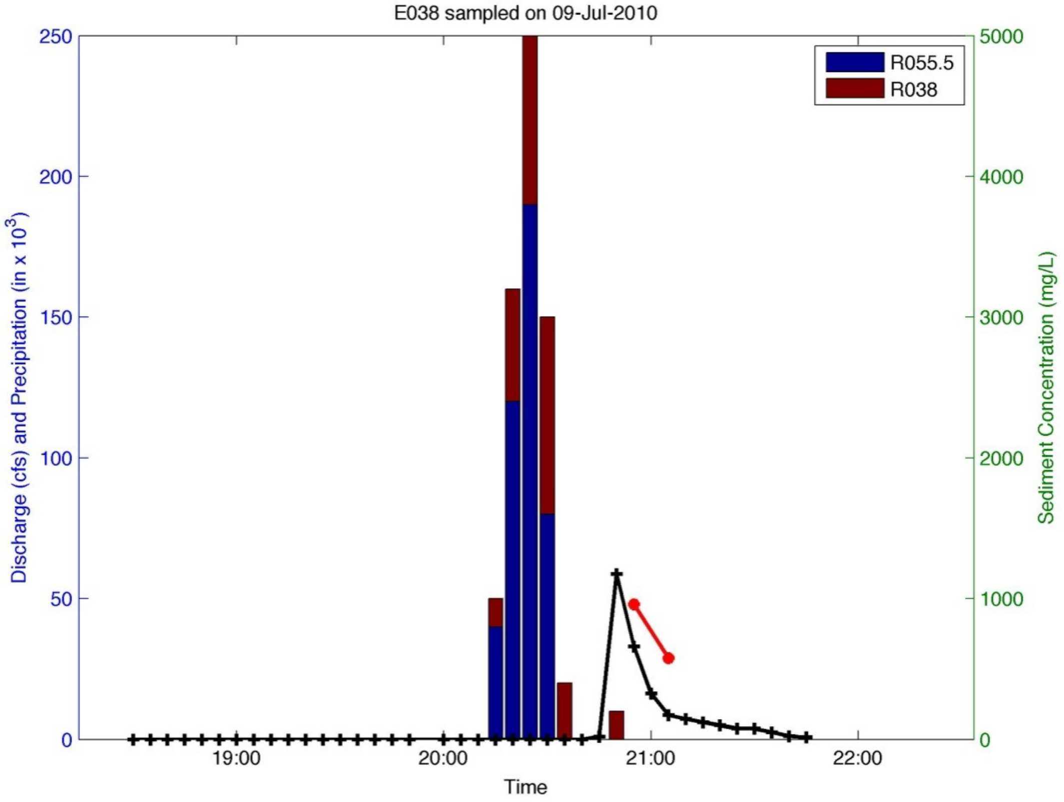

E030 sampled on 22-Jul-2010
R121.9
R055.5
R200.5
R038
TA-53
Discharge (cfs) and Precipitation (in x 10²)
Sediment Concentration (mg/L)
Time
0
10
20
30
40
50
0
2000
4000
6000
8000
10000
18:00
19:00
20:00
21:00
22:00
23:00
00:00

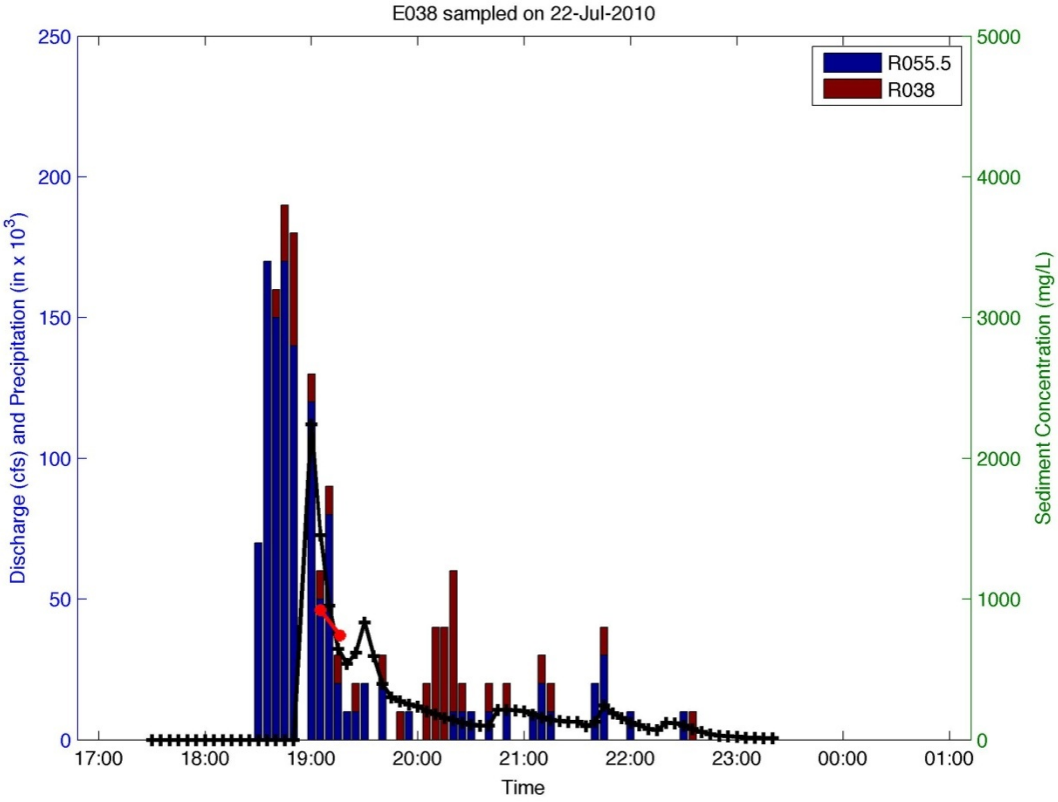

E030 sampled on 05-Aug-2010
R121.9
R055.5
R200.5
R038
TA-53
Discharge (cfs) and Precipitation (in x 10²)
Sediment Concentration (mg/L)
Time
0
10
20
30
40
50
0
2000
4000
6000
8000
10000
14:00
15:00
16:00
17:00
18:00

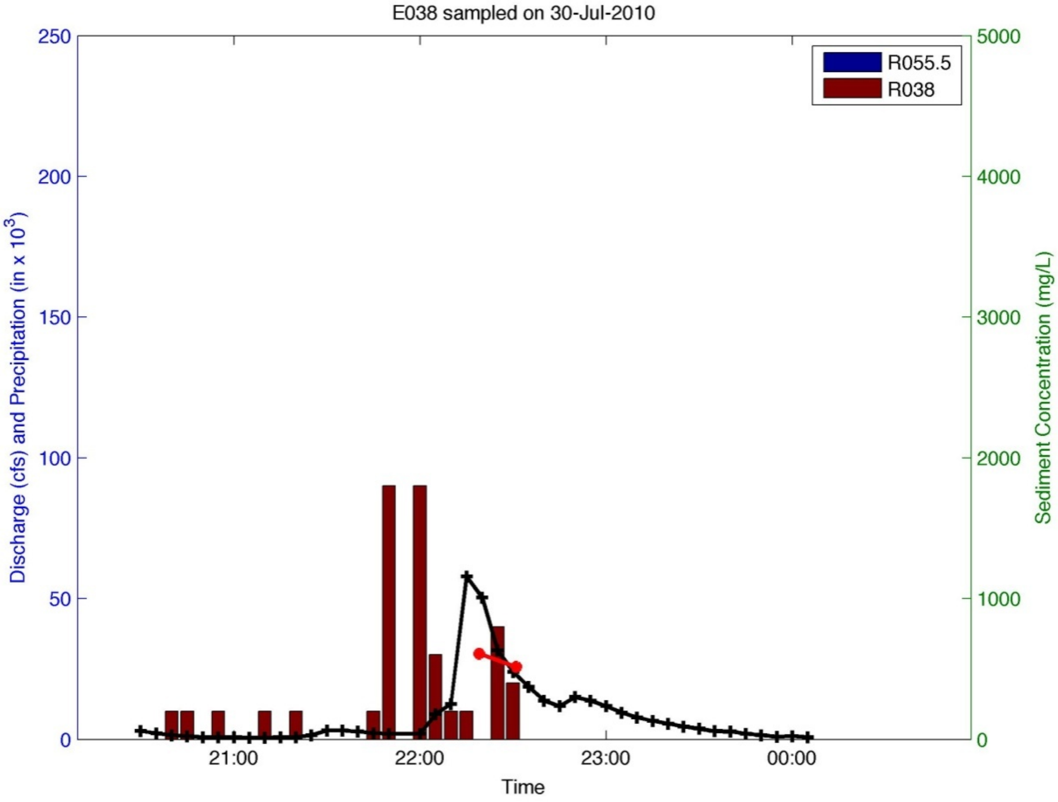

E030 sampled on 15-Aug-2010
Discharge (cfs) and Precipitation (in x 10²)
Sediment Concentration (mg/L)
Time
0
10
20
30
40
50
0
2000
4000
6000
8000
10000
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
R121.9
R055.5
R200.5
R038
TA-53

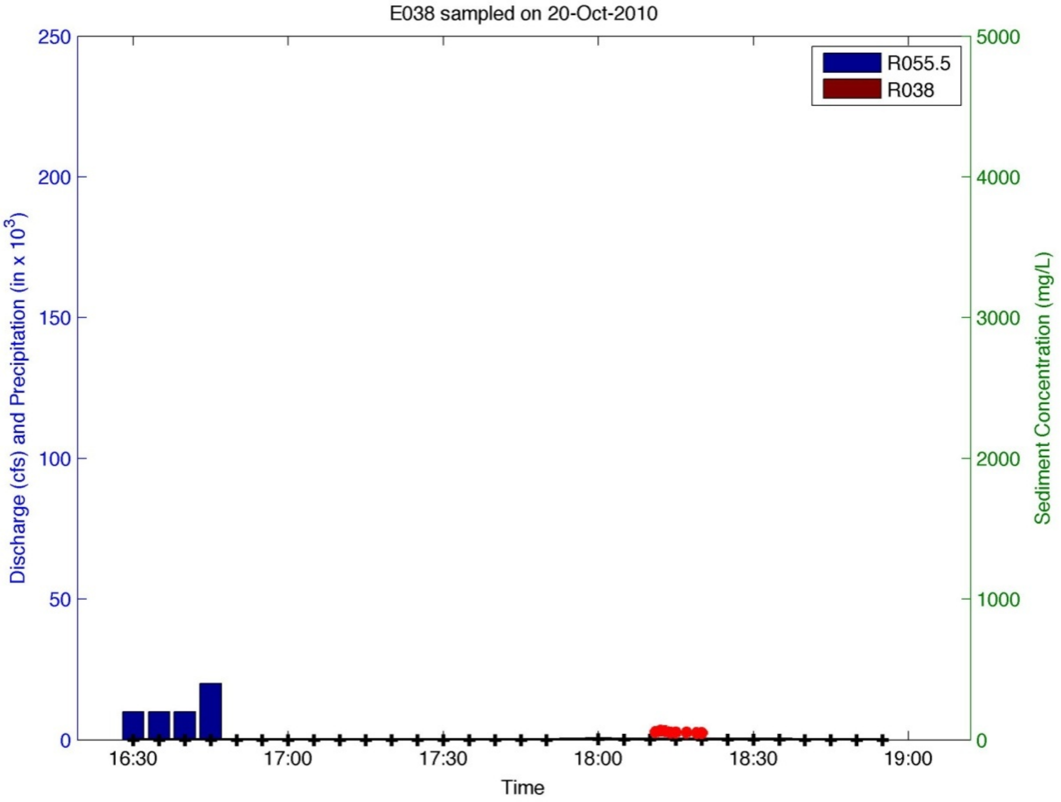

E030 sampled on 23-Aug-2010
Discharge (cfs) and Precipitation (in x 10²)
Sediment Concentration (mg/L)
Time
0
10
20
30
40
50
0
2000
4000
6000
8000
10000
19:00
20:00
21:00
22:00
R121.9
R055.5
R200.5
R038
TA-53

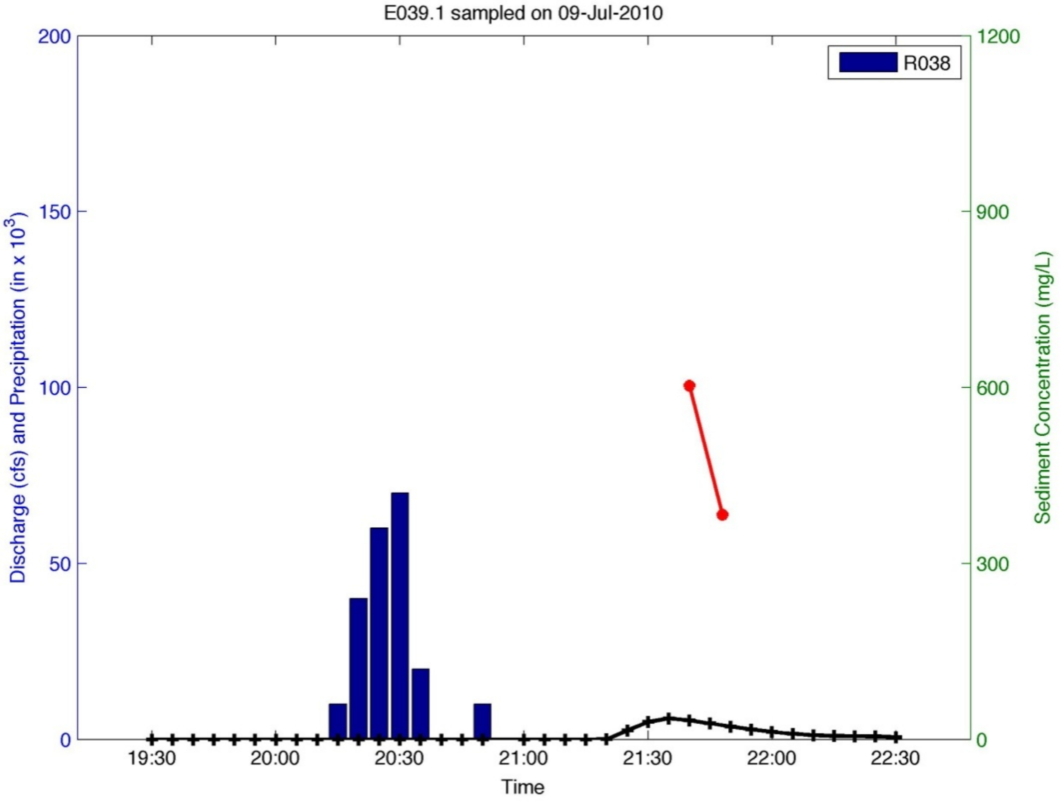

E038 sampled on 24-Jun-2010
R055.5
R038
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
0
50
100
150
200
250
0
1000
2000
3000
4000
5000
14:30
15:00
15:30
16:00
16:30
17:00

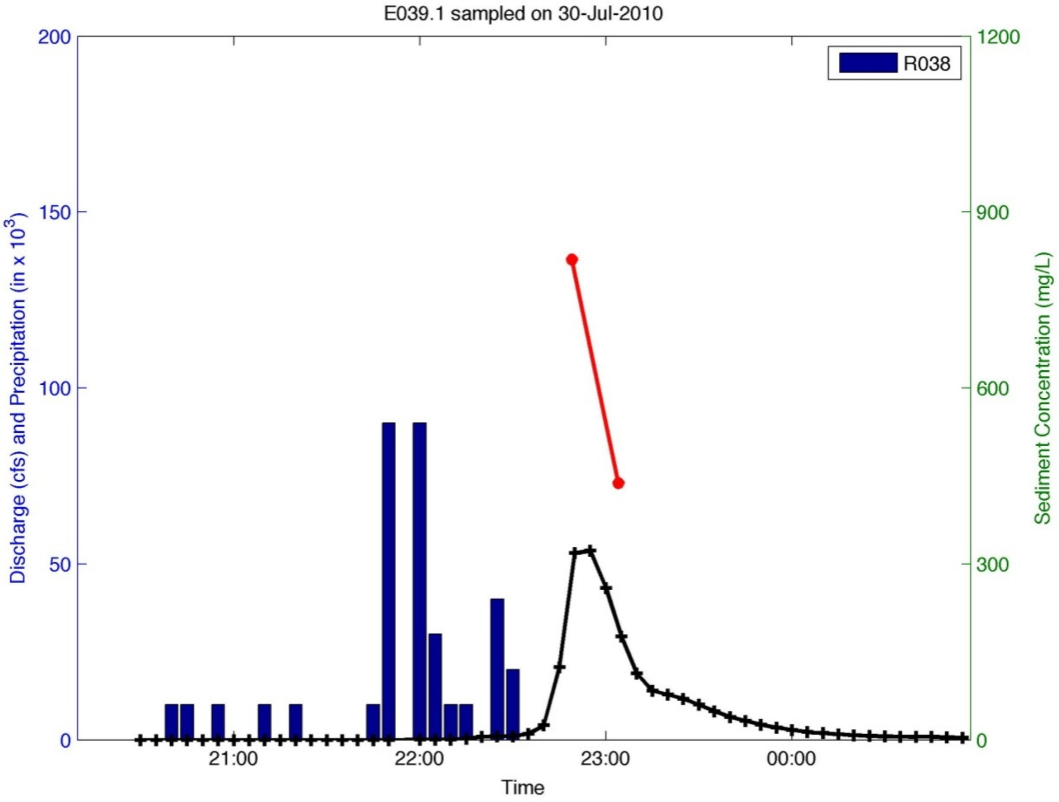

E038 sampled on 09-Jul-2010
R055.5
R038
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
0
50
100
150
200
250
0
1000
2000
3000
4000
5000
19:00
20:00
21:00
22:00

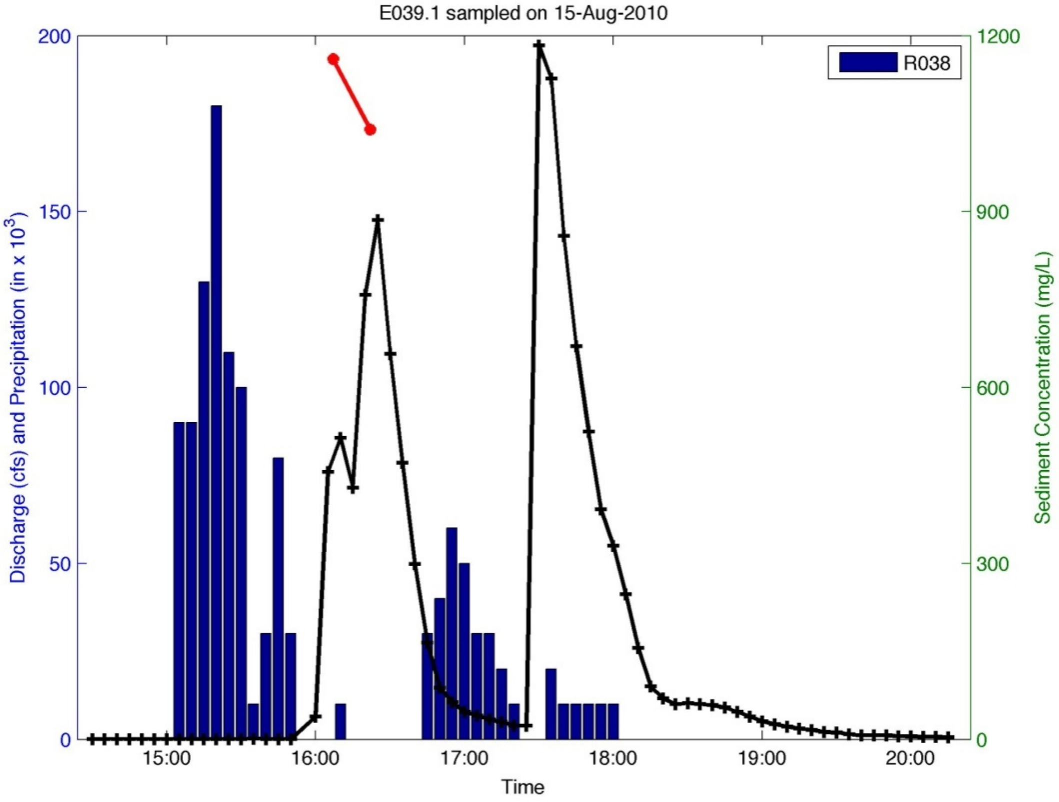

E038 sampled on 22-Jul-2010
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
R055.5
R038
0
50
100
150
200
250
0
1000
2000
3000
4000
5000
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
01:00

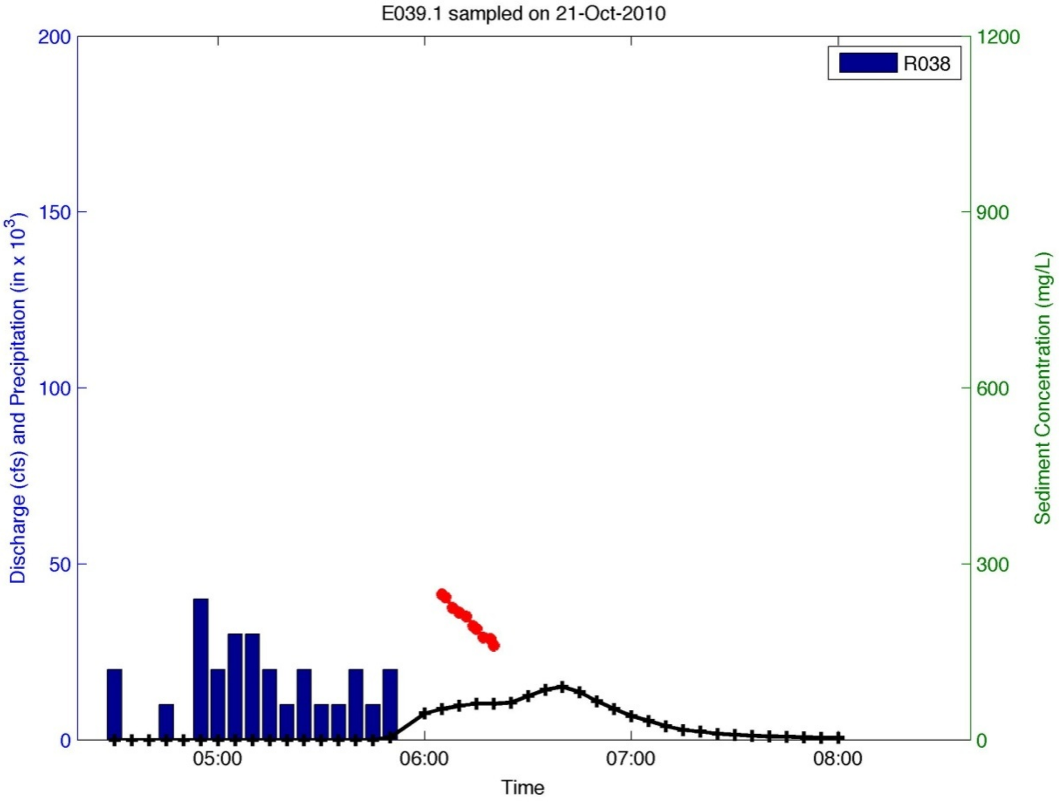

E038 sampled on 30-Jul-2010
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
R055.5
R038
0
50
100
150
200
250
0
1000
2000
3000
4000
5000
21:00
22:00
23:00
00:00

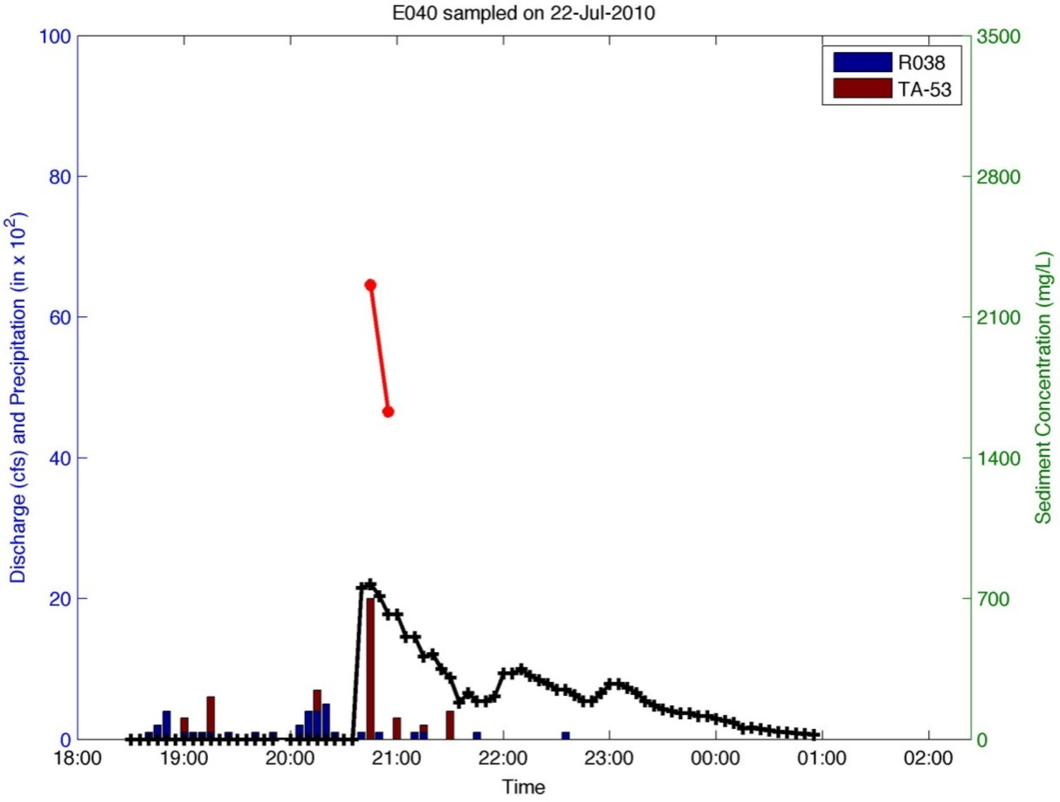

E038 sampled on 20-Oct-2010
R055.5
R038
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
0
50
100
150
200
250
0
1000
2000
3000
4000
5000
16:30
17:00
17:30
18:00
18:30
19:00

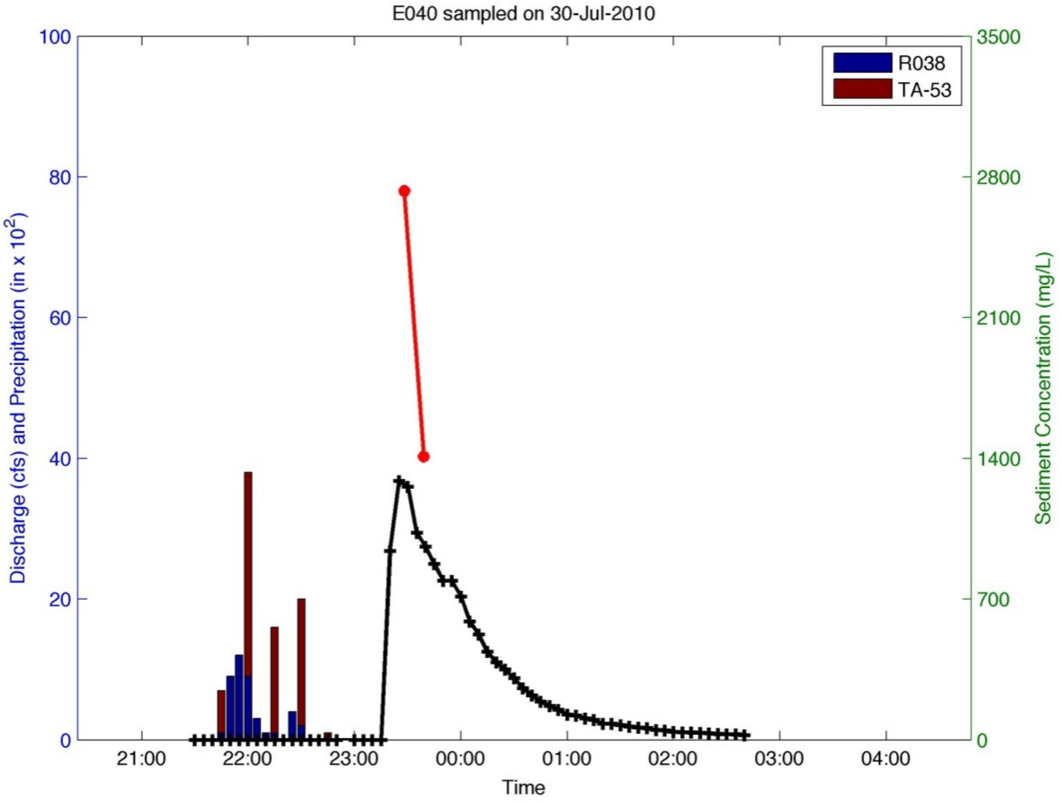

E039.1 sampled on 09-Jul-2010
R038
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
0
50
100
150
200
0
300
600
900
1200
19:30
20:00
20:30
21:00
21:30
22:00
22:30

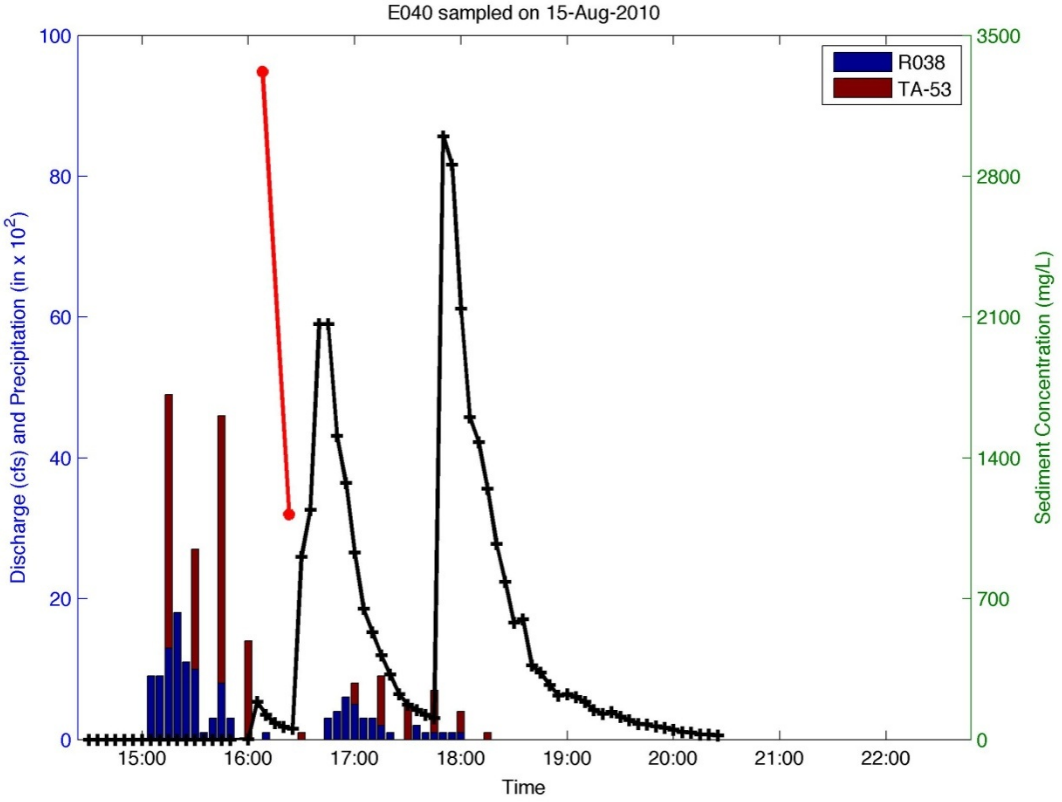

E039.1 sampled on 30-Jul-2010
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
R038
Time
200
150
100
50
0
1200
900
600
300
0
21:00
22:00
23:00
00:00

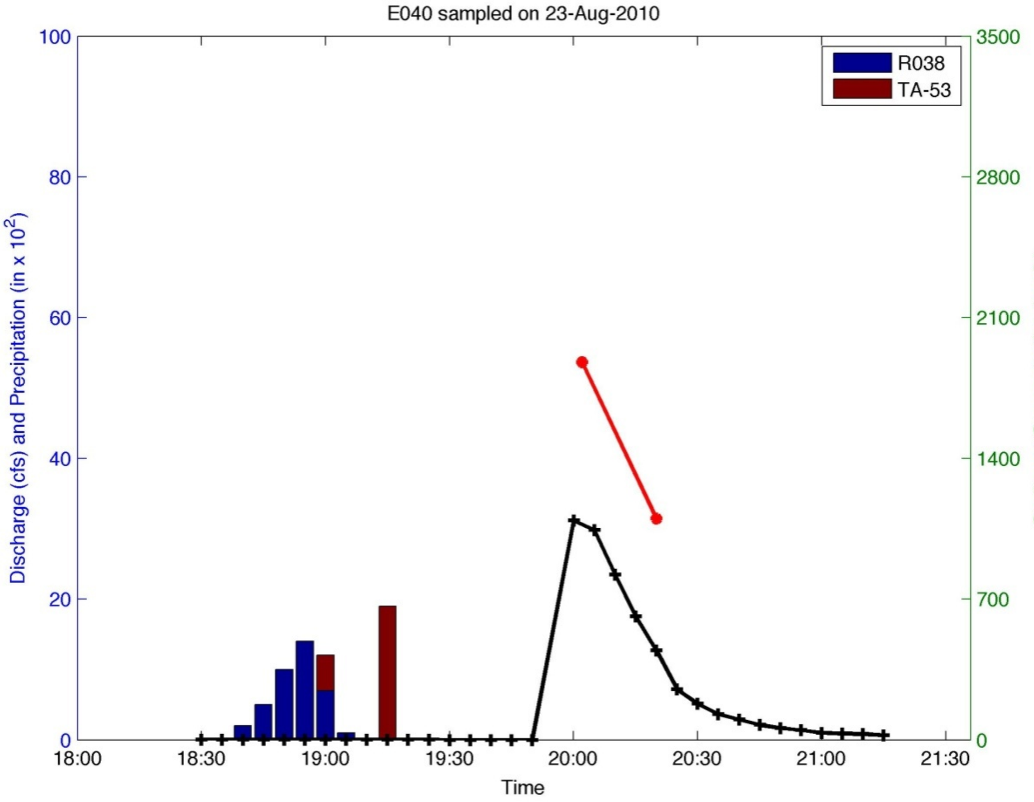

E039.1 sampled on 15-Aug-2010
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
R038
Time
200
150
100
50
0
1200
900
600
300
0
15:00
16:00
17:00
18:00
19:00
20:00

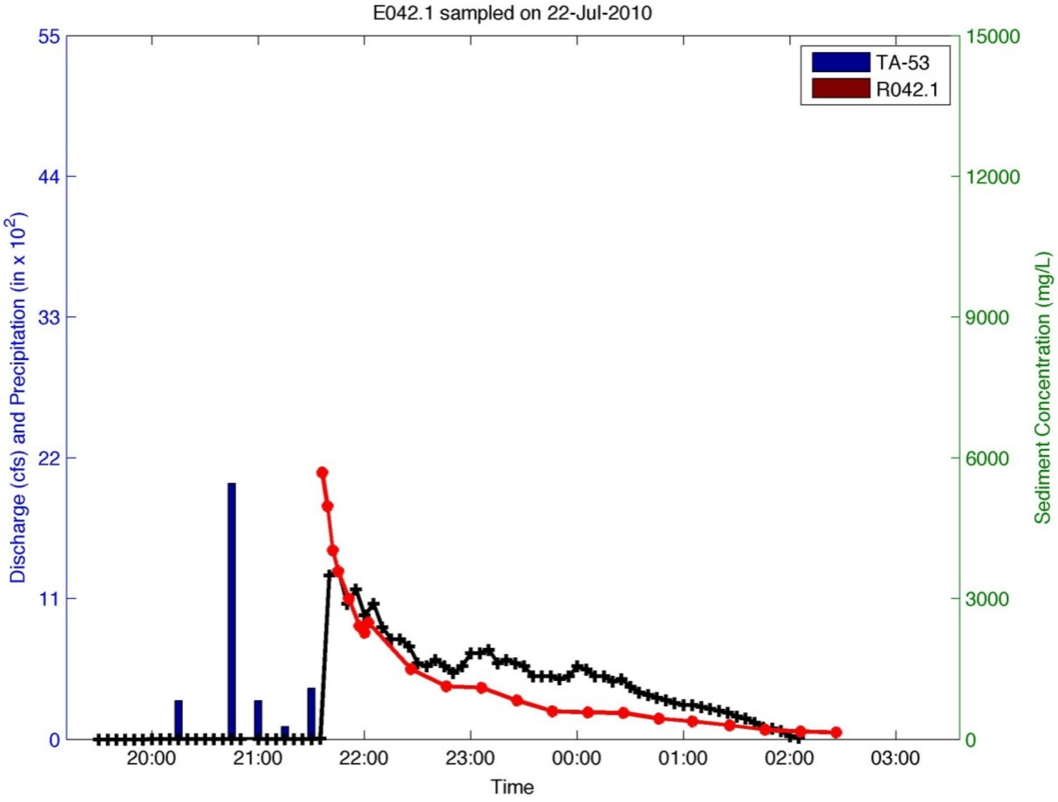

E039.1 sampled on 21-Oct-2010
R038
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
200
150
100
50
0
1200
900
600
300
0
05:00
06:00
07:00
08:00
Time

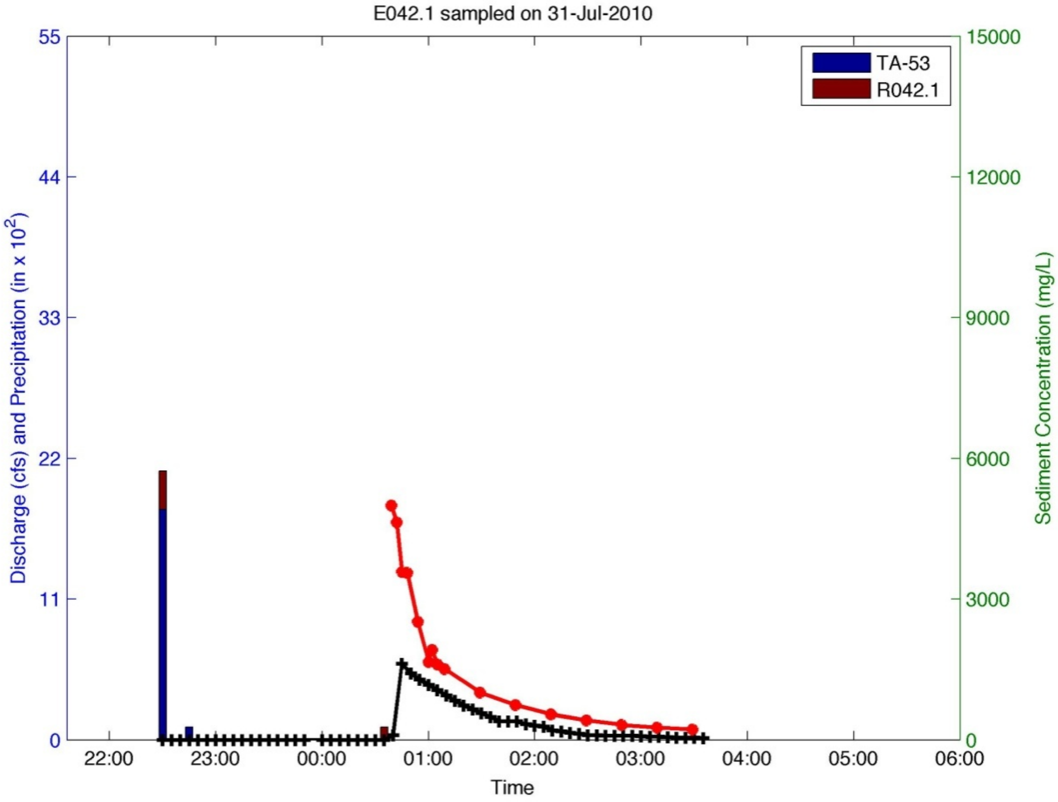

E040 sampled on 22-Jul-2010
R038
TA-53
Discharge (cfs) and Precipitation (in x 10^2)
Sediment Concentration (mg/L)
100
80
60
40
20
0
3500
2800
2100
1400
700
0
18:00
19:00
20:00
21:00
22:00
23:00
00:00
01:00
02:00
Time

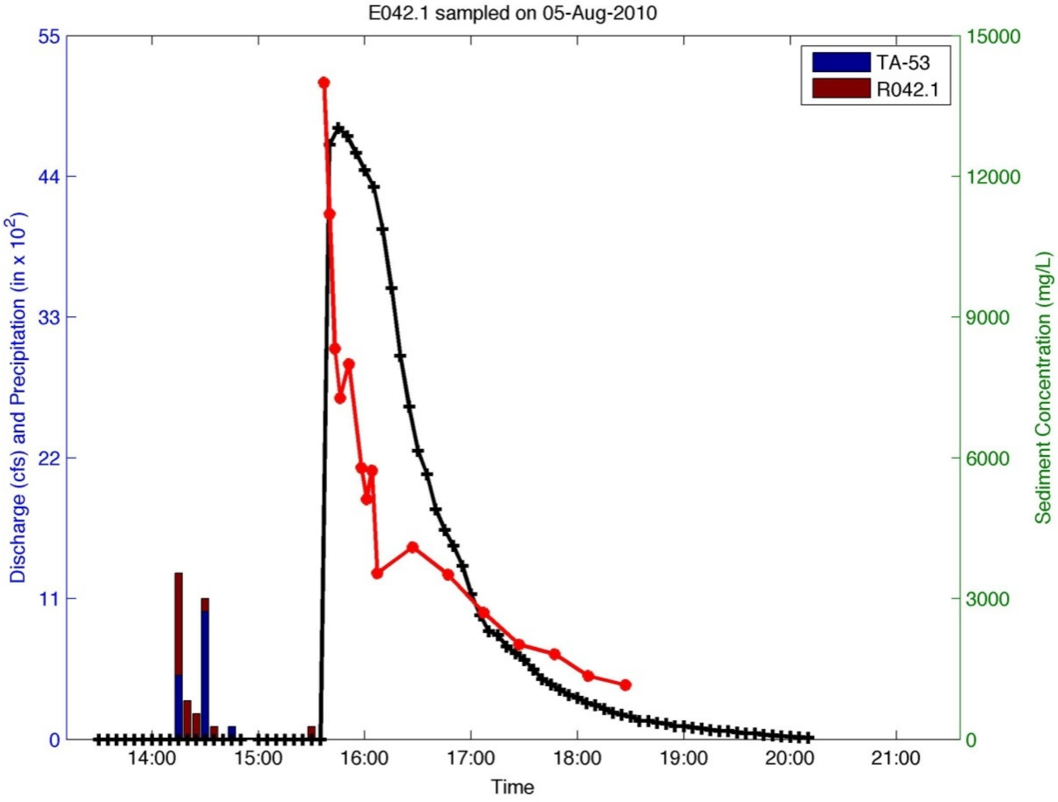

E040 sampled on 30-Jul-2010
R038
TA-53
Discharge (cfs) and Precipitation (in x 10^2)
0
20
40
60
80
100
Sediment Concentration (mg/L)
0
700
1400
2100
2800
3500
21:00
22:00
23:00
00:00
01:00
02:00
03:00
04:00
Time

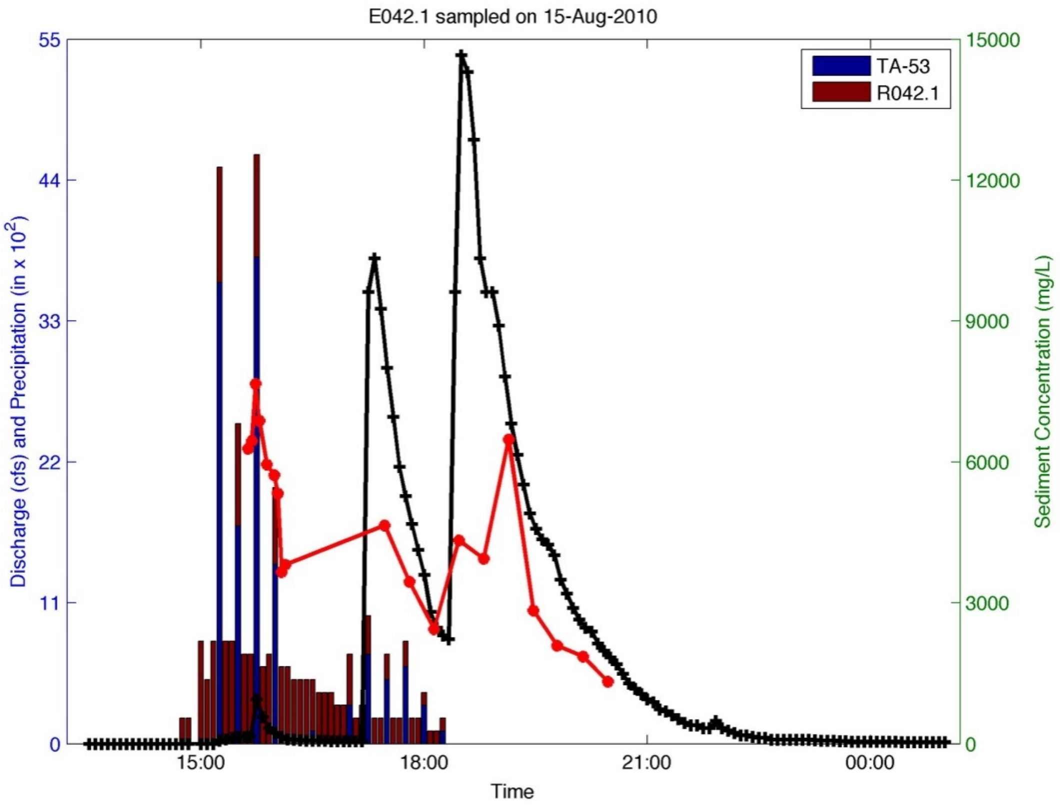

E040 sampled on 15-Aug-2010
R038
TA-53
Discharge (cfs) and Precipitation (in x 10^2)
0
20
40
60
80
100
Sediment Concentration (mg/L)
0
700
1400
2100
2800
3500
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
Time

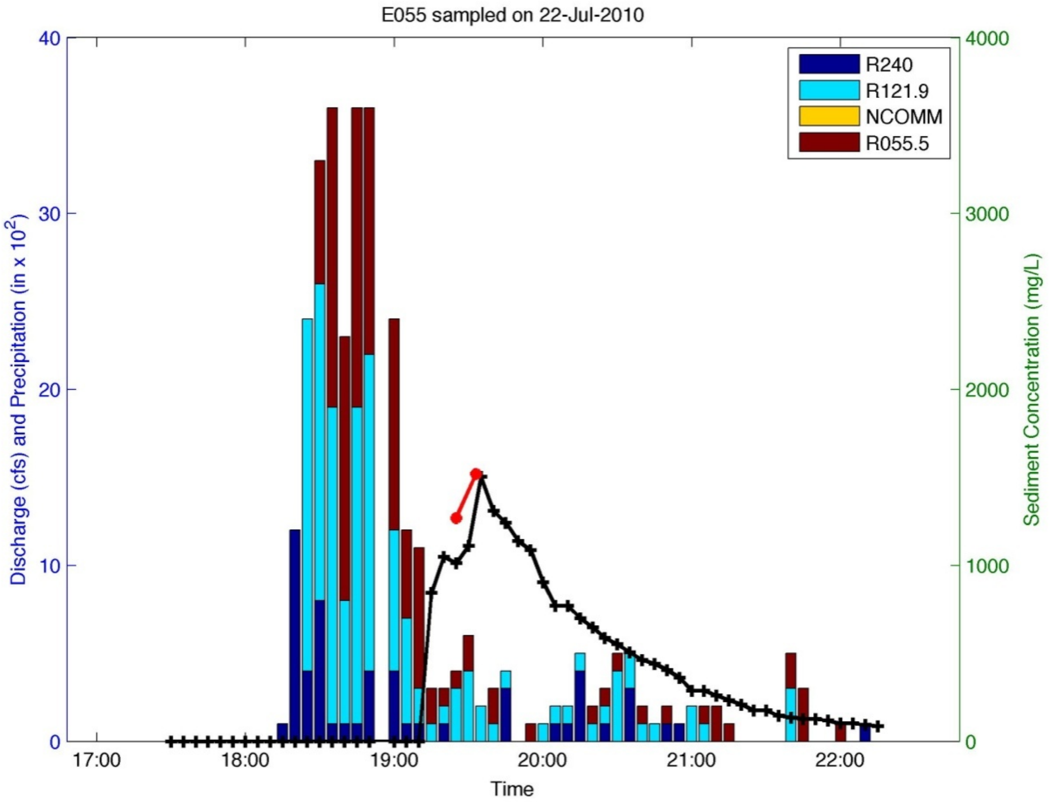

E040 sampled on 23-Aug-2010
R038
TA-53
Discharge (cfs) and Precipitation (in x 10²)
Sediment Concentration (mg/L)
Time
0
20
40
60
80
100
0
700
1400
2100
2800
3500
18:00
18:30
19:00
19:30
20:00
20:30
21:00
21:30

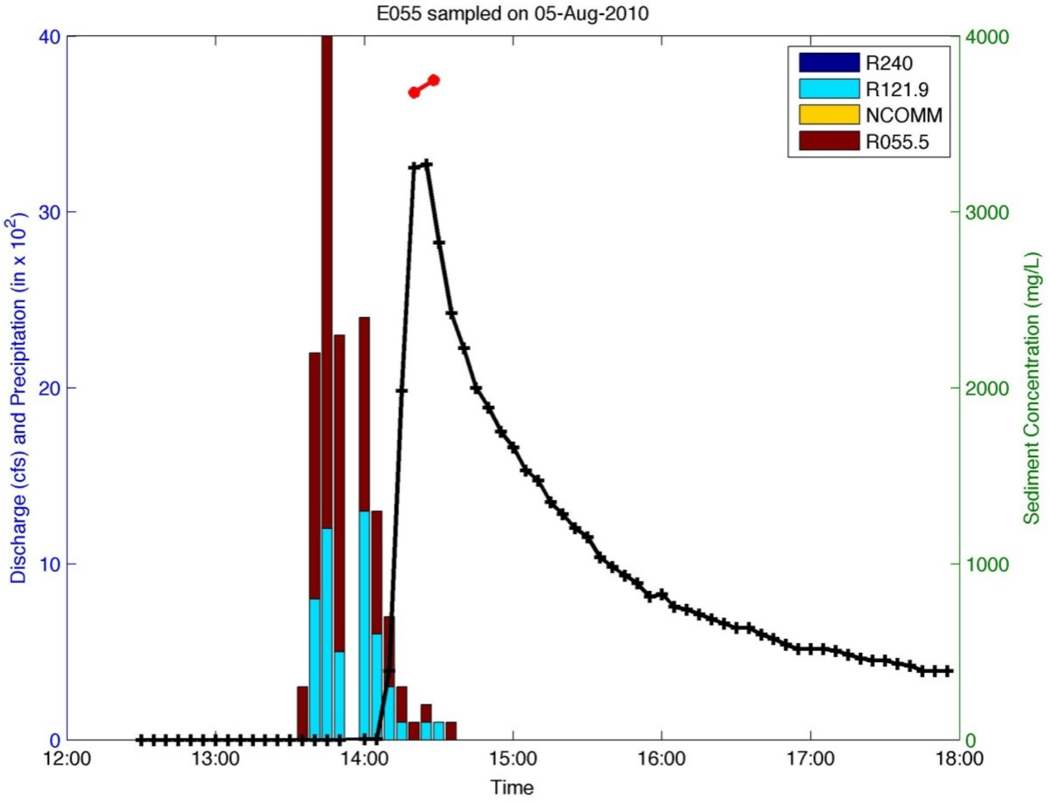

E042.1 sampled on 22-Jul-2010
TA-53
R042.1
Discharge (cfs) and Precipitation (in x 10²)
Sediment Concentration (mg/L)
Time
0
11
22
33
44
55
0
3000
6000
9000
12000
15000
20:00
21:00
22:00
23:00
00:00
01:00
02:00
03:00

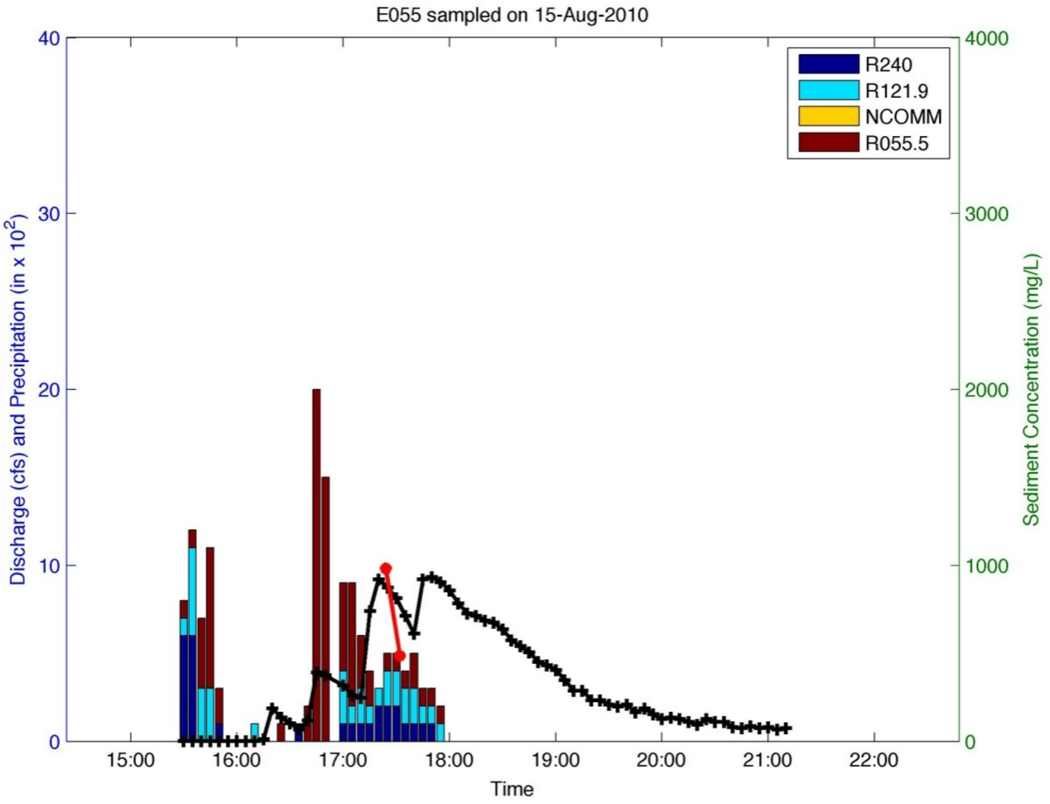

E042.1 sampled on 31-Jul-2010
TA-53
R042.1
Discharge (cfs) and Precipitation (in x 10^2)
Sediment Concentration (mg/L)
55
44
33
22
11
0
15000
12000
9000
6000
3000
0
22:00
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
Time

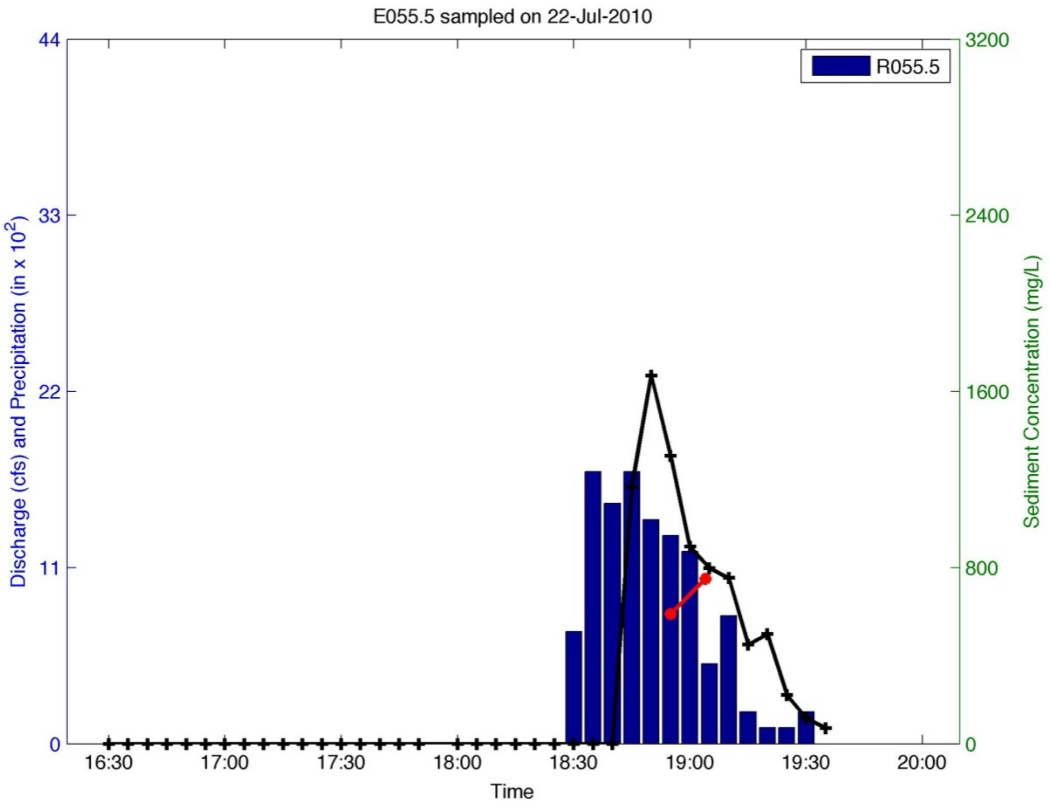

E042.1 sampled on 05-Aug-2010
TA-53
R042.1
Discharge (cfs) and Precipitation (in x 10^2)
Sediment Concentration (mg/L)
55
44
33
22
11
0
15000
12000
9000
6000
3000
0
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
Time

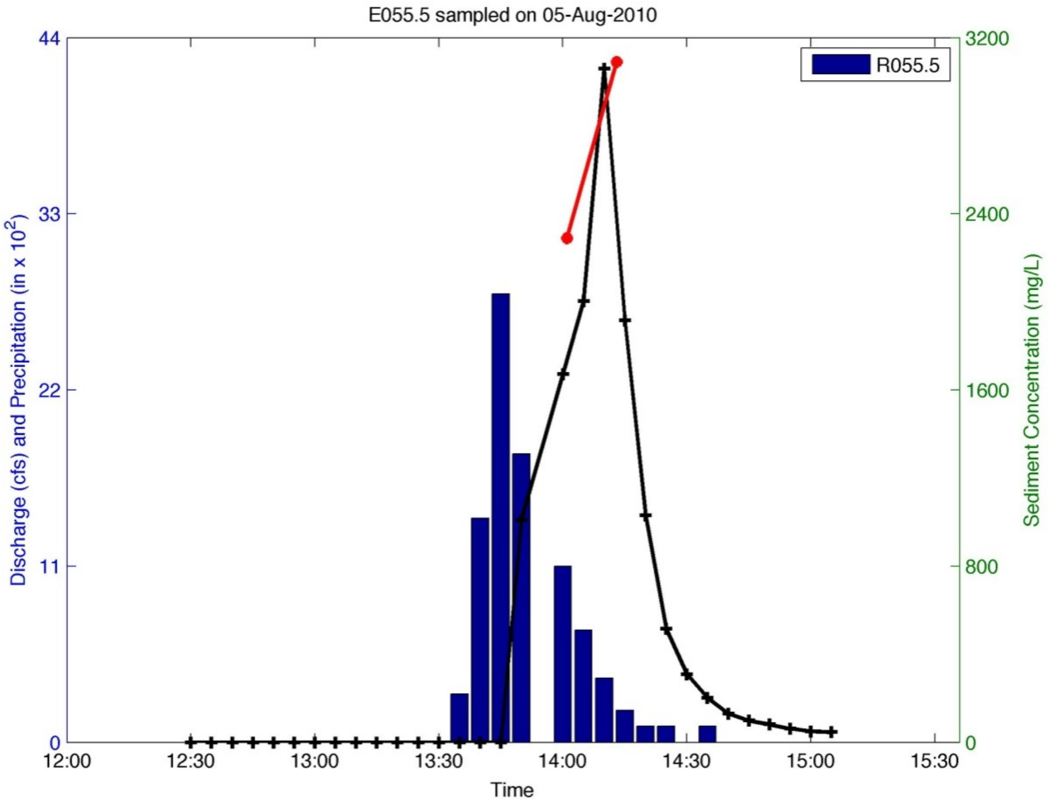

E042.1 sampled on 15-Aug-2010
Discharge (cfs) and Precipitation (in x 10^2)
Sediment Concentration (mg/L)
Time
TA-53
R042.1
0
11
22
33
44
55
0
3000
6000
9000
12000
15000
15:00
18:00
21:00
00:00

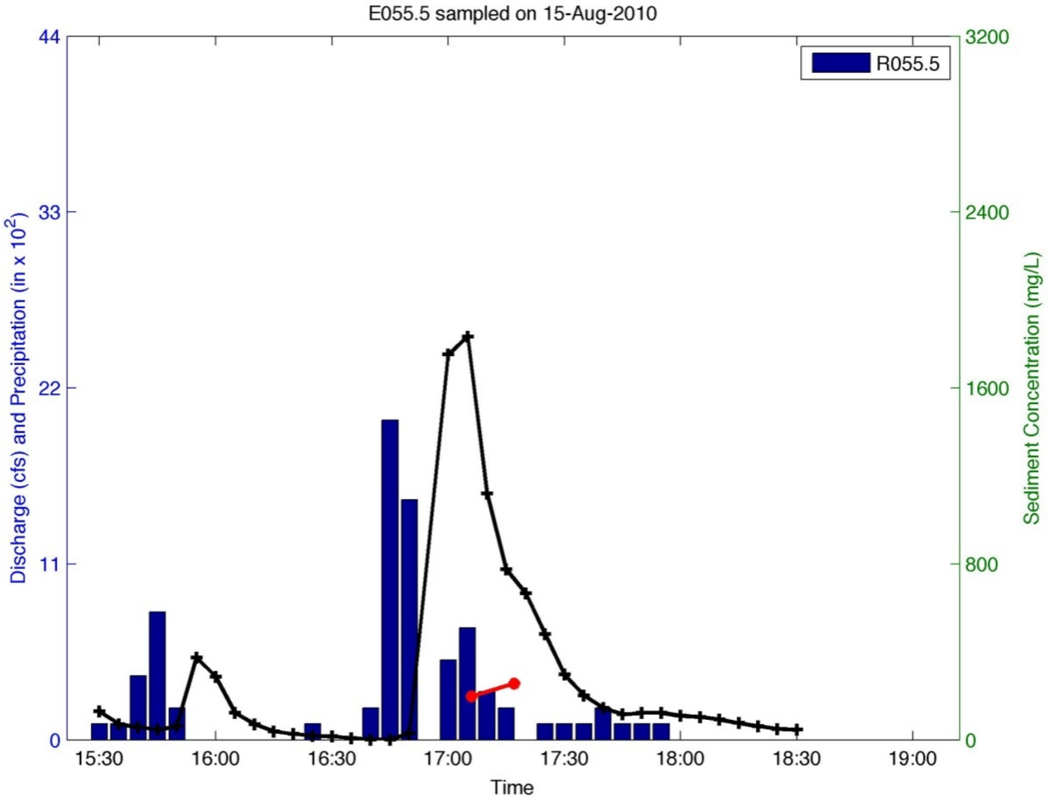

E055 sampled on 22-Jul-2010
Discharge (cfs) and Precipitation (in x 10^2)
Sediment Concentration (mg/L)
Time
R240
R121.9
NCOMM
R055.5
0
10
20
30
40
0
1000
2000
3000
4000
17:00
18:00
19:00
20:00
21:00
22:00

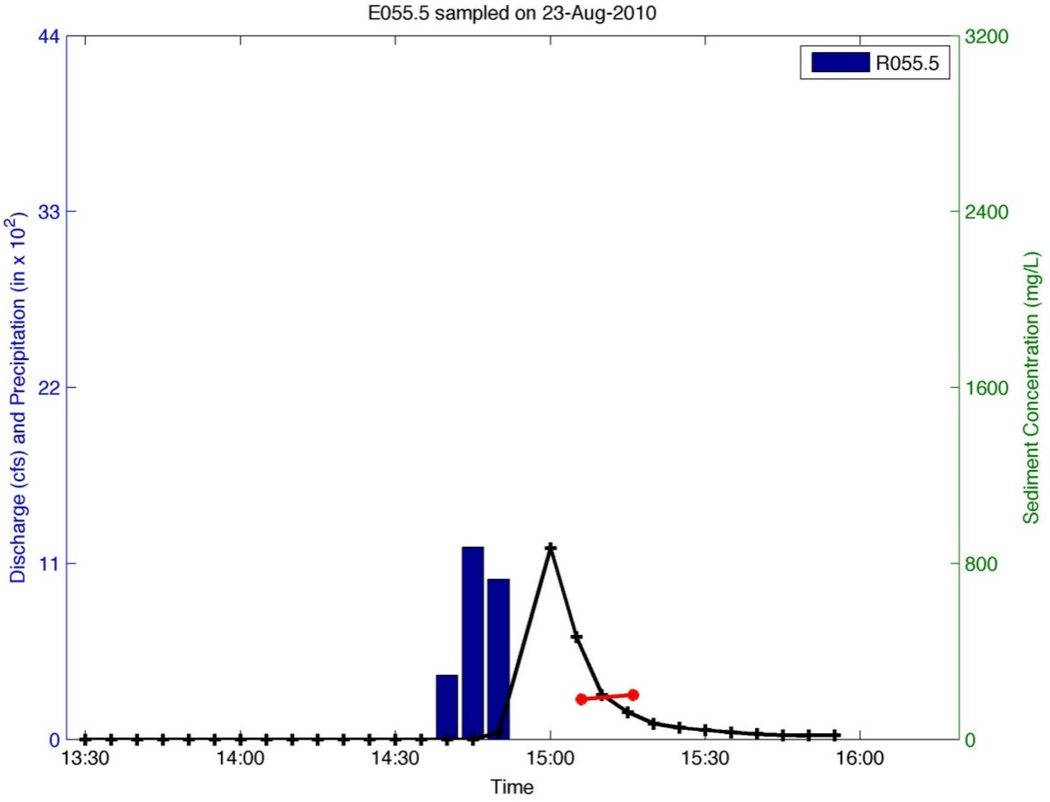

E055 sampled on 05-Aug-2010
Discharge (cfs) and Precipitation (in x 10^2)
Sediment Concentration (mg/L)
Time
R240
R121.9
NCOMM
R055.5
0
10
20
30
40
0
1000
2000
3000
4000
12:00
13:00
14:00
15:00
16:00
17:00
18:00

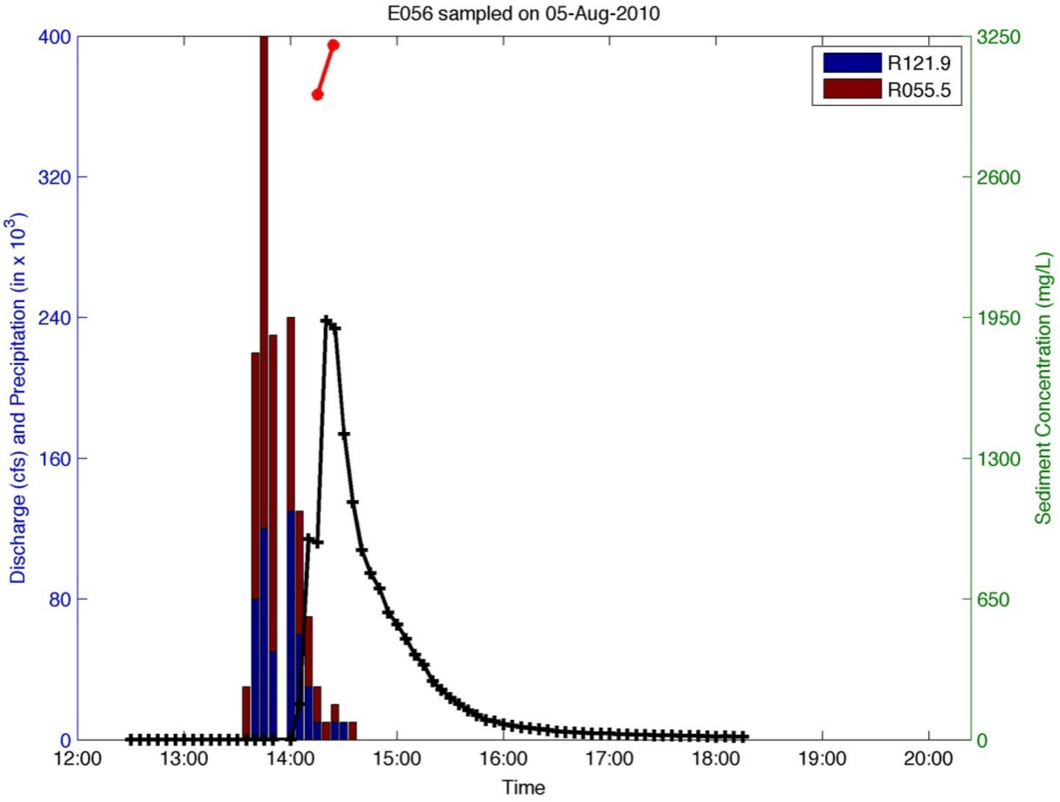

E055 sampled on 15-Aug-2010
Discharge (cfs) and Precipitation (in x 10^2)
Sediment Concentration (mg/L)
Time
R240
R121.9
NCOMM
R055.5
0
10
20
30
40
0
1000
2000
3000
4000
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00

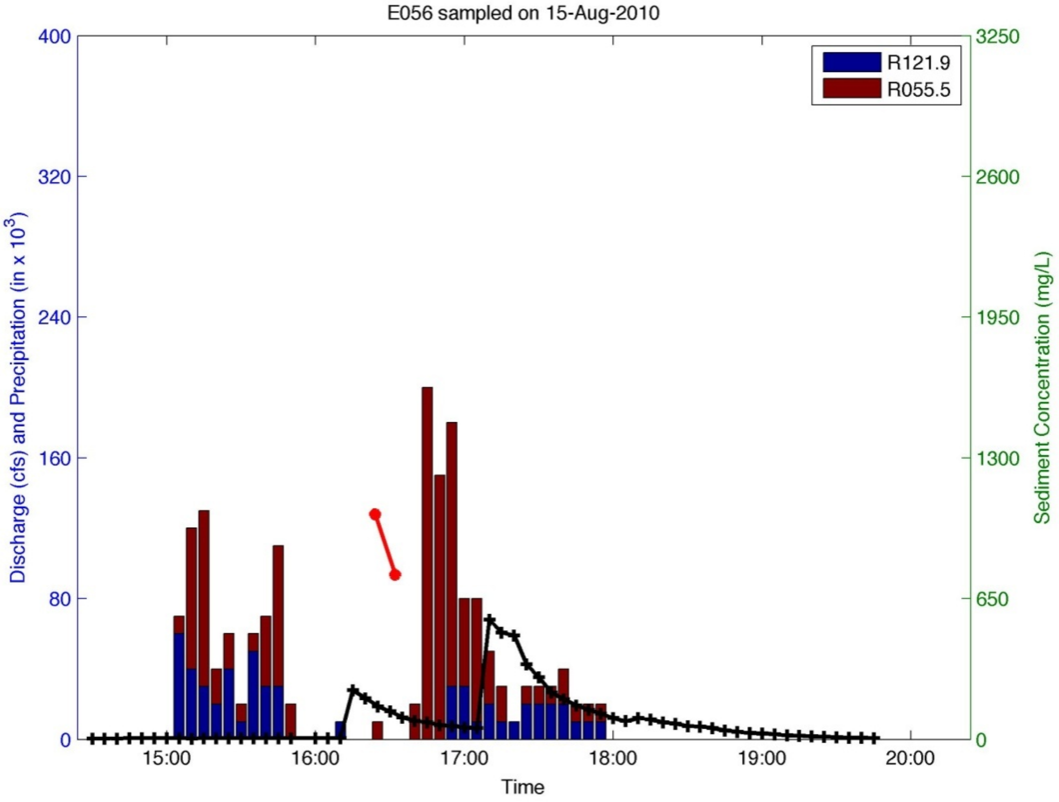

E055.5 sampled on 22-Jul-2010
R055.5
Discharge (cfs) and Precipitation (in x 10^2)
44
33
22
11
0
Sediment Concentration (mg/L)
3200
2400
1600
800
0
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
Time

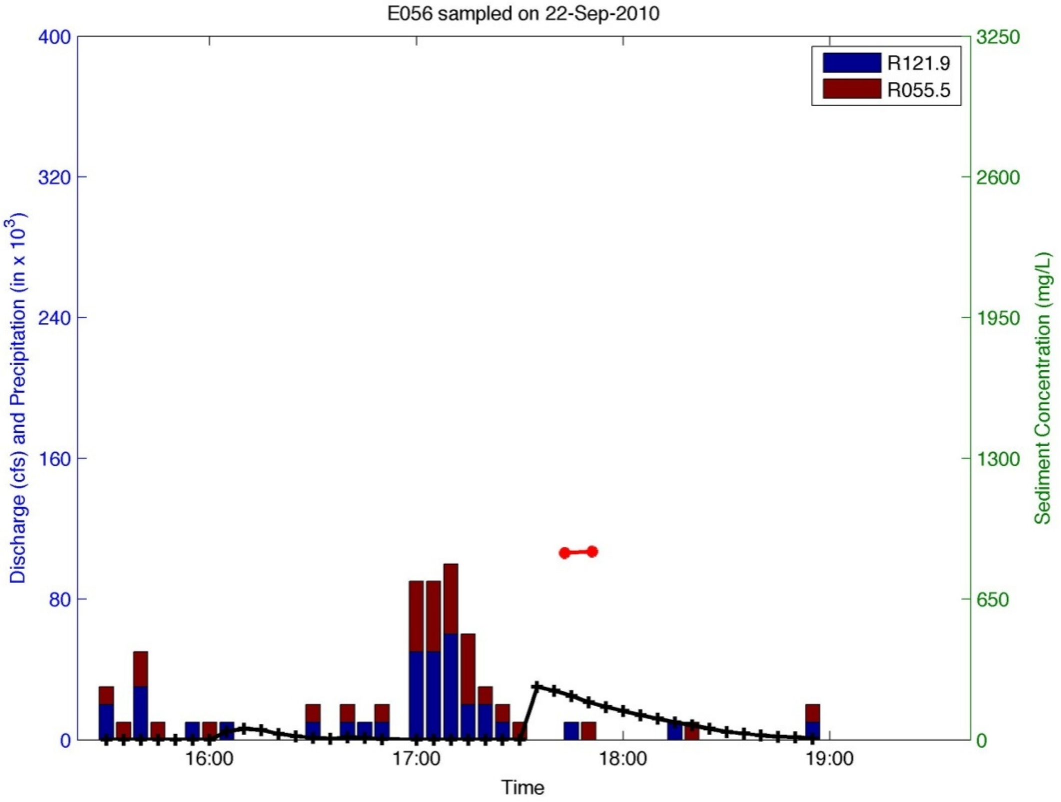

E055.5 sampled on 05-Aug-2010
R055.5
Discharge (cfs) and Precipitation (in x 10^2)
44
33
22
11
0
Sediment Concentration (mg/L)
3200
2400
1600
800
0
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
Time

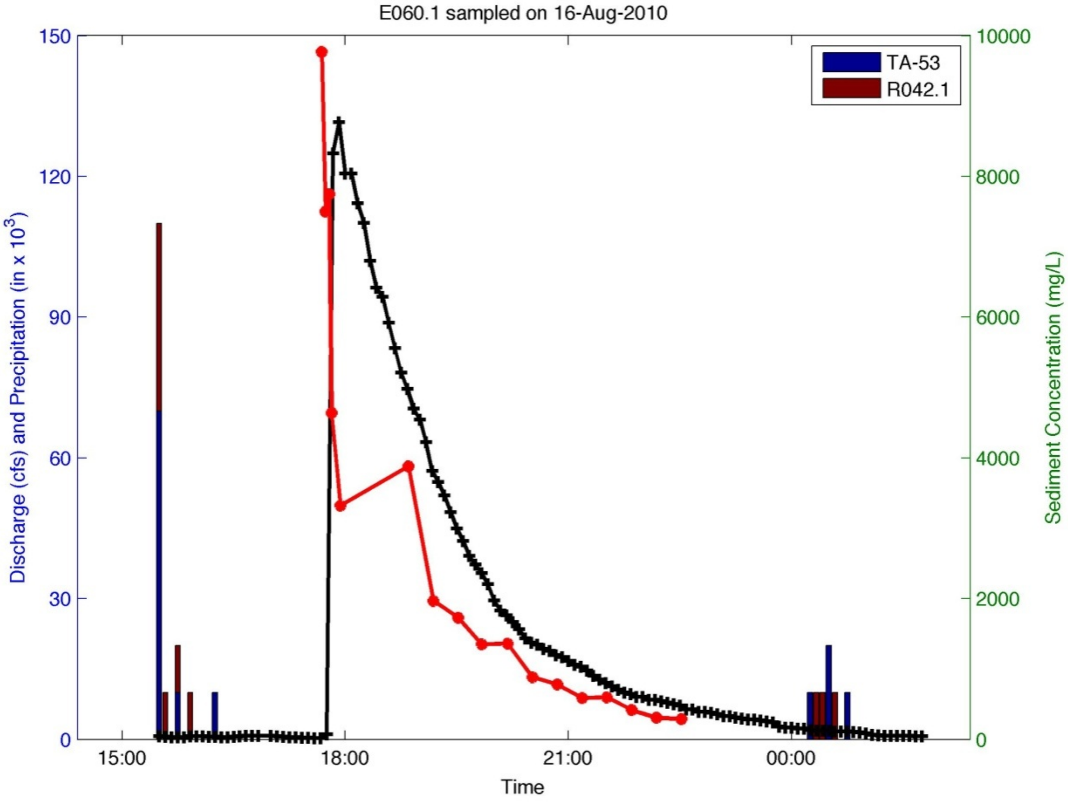

E055.5 sampled on 15-Aug-2010
R055.5
Discharge (cfs) and Precipitation (in x 10^2)
0
11
22
33
44
Sediment Concentration (mg/L)
0
800
1600
2400
3200
Time
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00

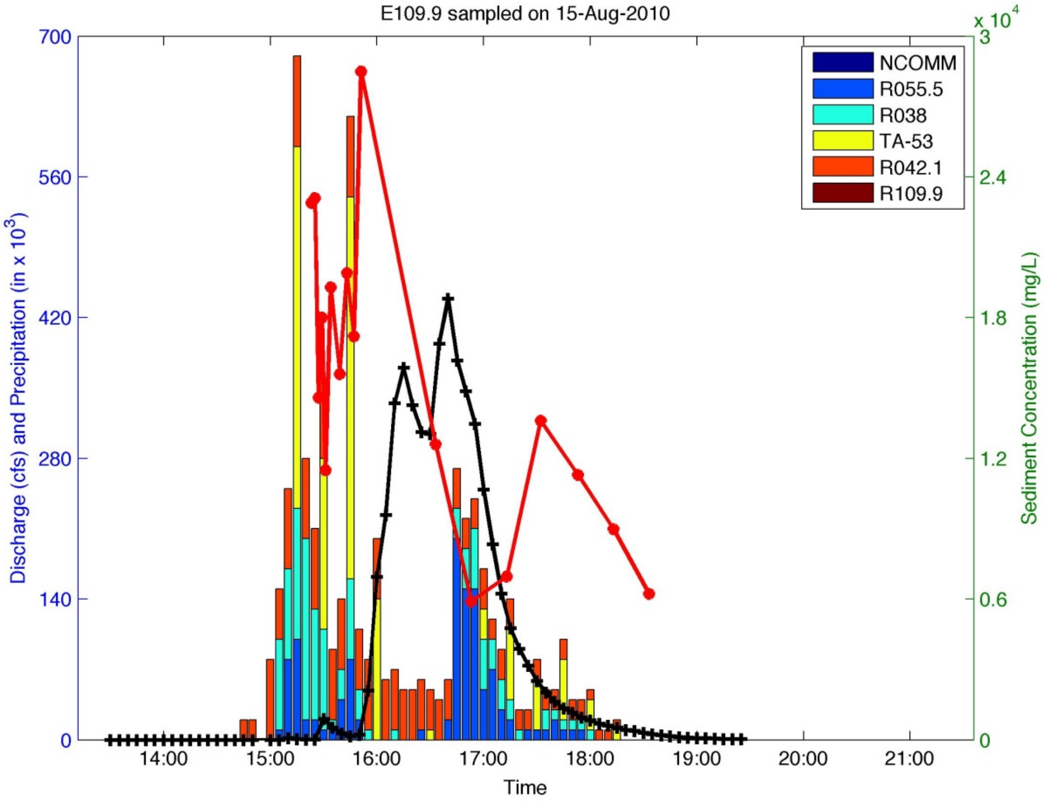

E055.5 sampled on 23-Aug-2010
R055.5
Discharge (cfs) and Precipitation (in x 10^2)
0
11
22
33
44
Sediment Concentration (mg/L)
0
800
1600
2400
3200
Time
13:30
14:00
14:30
15:00
15:30
16:00

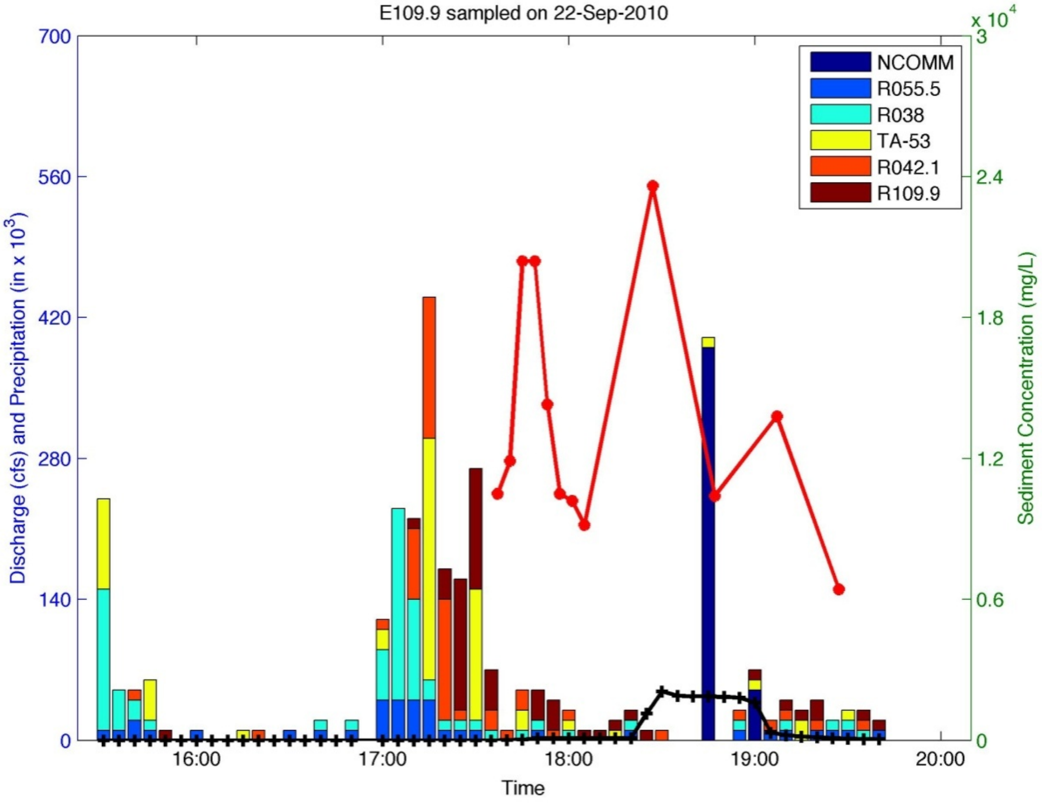

E056 sampled on 05-Aug-2010
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
R121.9
R055.5
0
80
160
240
320
400
0
650
1300
1950
2600
3250
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00


E056 sampled on 15-Aug-2010
Discharge (cfs) and Precipitation (in x 10^3)
Sediment Concentration (mg/L)
Time
R121.9
R055.5
0
80
160
240
320
400
0
650
1300
1950
2600
3250
15:00
16:00
17:00
18:00
19:00
20:00


E056 sampled on 22-Sep-2010
R121.9
R055.5
Discharge (cfs) and Precipitation (in x 10^3)
400
320
240
160
80
0
Sediment Concentration (mg/L)
3250
2600
1950
1300
650
0
16:00
17:00
18:00
19:00
Time


E060.1 sampled on 16-Aug-2010
TA-53
R042.1
Discharge (cfs) and Precipitation (in x 10^3)
150
120
90
60
30
0
Sediment Concentration (mg/L)
10000
8000
6000
4000
2000
0
15:00
18:00
21:00
00:00
Time


E109.9 sampled on 15-Aug-2010
Discharge (cfs) and Precipitation (in x 10^3)
700
560
420
280
140
0
x 10^4
3
2.4
1.8
1.2
0.6
0
Sediment Concentration (mg/L)
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
Time
NCOMM
R055.5
R038
TA-53
R042.1
R109.9


E109.9 sampled on 22-Sep-2010
Discharge (cfs) and Precipitation (in x 10^3)
700
560
420
280
140
0
x 10^4
3
2.4
1.8
1.2
0.6
0
Sediment Concentration (mg/L)
16:00
17:00
18:00
19:00
20:00
Time
NCOMM
R055.5
R038
TA-53
R042.1
R109.9

Appendix B

Analytical Results and 5-Minute Discharge Results
(on CD included with this document)

This appendix presents (on CD included with this report) the analytical suites and results for the monitoring conducted in the Los Alamos/Pueblo Canyon Watershed during 2010. Also presented are 5-minute discharge results at each gage for the monitoring period from May 1, 2010, through October 30, 2010.

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Author: Veenis, Steven J 667-0013 veenis@lanl.gov

Organuzation: EP-CAP

Document Team:
Burgess, Margaret 5-4632 mburgess@lanl.gov
Mark, Paul 662-0690 Paul.Mark@apogentec
Marquez, Julie 667-0650 jquez@lanl.gov

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