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Storm Water Quality Monitoring of Rio Grande at Buckman Direct Diversion

From 2011 to 2014

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Executive Summary

The storm water monitoring effort of the Rio Grande at Buckman Direct Diversion (BDD) was conceived as a part of the five years Memorandum of Understanding (MOU) between the Buckman Direct Diversion Board and the US Department of Energy, Los Alamos National Laboratory (DOE LANL) signed by the parties in 2010. The BDD is the source of raw water for the Buckman Regional Water Treatment Plant which treats river water for drinking purposes. The treated water is then used by the City and County of Santa Fe to supply drinking water to their customers. The objective of the 2010 MOU surface water monitoring program was to sample potential flows from the Los Alamos and Pueblo Canyons watershed (LA/PCW) and from the Rio Grande watershed, and the results were to be used to evaluate the storm water quality of the Rio Grande at BDD. The Los Alamos and Pueblo Canyons are located on the Pajarito Plateau where for decades Los Alamos National Laboratory had discharged contaminated waste and wastewater as part of the "Manhattan Project" and later LANL's nuclear weapons program. The confluence of these canyons with the Rio Grande is located nearby Otowi Bridge, 3.5 miles upgradient from BDD.

The monitoring program continued for four summer seasons with strategy and sampling design changing throughout the monitoring period in order to explore different assumptions where part of the sampling equipment and analytical testing were funded by the DOE LANL. Some of the sampling equipment was funded by BDDB, and all sampling and maintenance efforts at the BDD sampling station were provided by BDD staff. As part of the storm water quality program, BDD sampled a total of 24 storm events occurring in the LA/PC and Rio Grande watershed, with many taking place during the 2011 Las Conchas fire. In addition, the state agency, New Mexico Environment Department/Department of Energy Oversight Bureau of (NMED/DOE OB), also sampled the storm water at the Diversion under a different program. Initially, LANL participated in the program with three gage stations located in the LA/P Canyons, which later were reduced to two, and these gage stations collected storm water samples from the LA/PCW.

In 2011 BDD sampled 7 out of 18 storm events in LA/PCW, and 2 RG base flow events; in 2012 BDD sampled 2 out of 14 storm events in LA/PCW; in 2013 BDD sampled 3 out of 23 storm events, and one RG base flow event; and in 2014 BDD sampled 6 out of 11 potential storm events in LA/PCW and 3 RG storm events. The analytical data collected under the 2010 MOU was very limited. Most data was collected during the 2011 season when the Las Conchas fire occurred. That fire damaged parts of the Pajarito Plateau and changed the LA/PCW. In 2012 and 2013, under the recommendation of the LANL, BDD sampled only two or three storm events each season. In 2014 most samples (except gross alpha and gross beta) for radionuclide analyses were filtered by the LANL contracted analytical laboratory, so no representative results of storm water were available for that season.

The analytical data collected pursuant to 2010 MOU was insufficient to make evaluations about the water quality of the river. However, by supplementing the data collected under the 2010 MOU with

the data collected by NMED/DOE OB, an adequate data was acquired to make some water quality assessments. The NMED/DOE OB collects storm water at the diversion under unrelated to BDD program. Analytical data collected at the BDD under the 2010 MOU and by NMED/DOE OB was used throughout this report without distinction. *However, BDD would like to stress that even though the NMED/DOE OB data was used throughout this report, data presentations, interpretations, discussions and conclusions were conducted solely by BDD staff and do not represent the opinion of the NMED/DOE OB staff and management.* All analytical data used in this report is publicly available on the web site www.intellusnmdata.com. The raw analytical results and the reports from the laboratories are not contained in that database, only results that have been reviewed and validated by LANL or NMED/DOE OB staff. The BDD analytical data was reviewed by BDD staff and validated by a different procedure than the same data validated by LANL at the above mentioned web site. Therefore, discrepancies between the Intellus database and BDD validation exist.

The LA/P Canyons are ephemeral streams and when they flow, their run off may carry contaminants from the canyons and discharge them into the Rio Grande near Otowi Bridge and transport them downstream to BDD. The contaminants of greatest concern that could potentially be transported from LA/PCW to BDD via the Rio Grande are radionuclides used and discharged throughout the years of LANL operations; specifically, Plutonium 239/240, Plutonium 238, Americium 241, Strontium 90, Cesium 137, and Uranium isotopes. These radionuclides preferentially transport by suspended sediments, thus causing storm water samples to have higher concentrations of these contaminants than under base flows conditions of the river. The sedimentary deposits in the LA/PCW and along the White Rock Canyon below Otowi Bridge where BDD Intake is located "contain man-made radionuclides from three sources: 1) Laboratory legacy waste, 2) global fallout, and 3) contaminants concentrated in ash that may contain both Laboratory and fallout contaminants." See (Englert, Dale, Granzow, & Mayer, 2007). However, the locations of the sampling stations and the analyses were not designed to identify all types of man-made radionuclides. BDD staff used all available data and made an effort to compare appropriate locations and concentrations in order to determine whether the source for a particular contaminant was the LA/PCW sediments or the upstream from Otowi Bridge sediments along the Rio Grande. The analytical technique TIMS (thermal ionization mass spectroscopy) could directly identify LANL Plutonium vs. global fallout Plutonium, and LANL is the only known laboratory that has the capabilities to conduct it. However, that analysis was not included in the BDD monitoring program either.

This report summarizes all monitoring data collected at the BDD and LA/PCW (from the middle and lower parts of the canyons). It also compares found contaminant concentrations to the BDD-calculated Rio Grande sediment background and NMWQCC surface water standards (20.6.4 NMAC) to investigate exceedances from screening values or regulatory limits. The report presents trends of the contaminant concentrations in storm water and sediments, from LA/PCW to BDD, and offers some interpretation of the data in terms of potential sources upgradient from the BDD intake. This report also offers a special study of Plutonium 239/240 with a conceptual model and recommendations on improving the monitoring program.

During storm events the surface water at the BDD has a complex origin: it is influenced by two watersheds, one is the LAC, and the other is the RG. As such this two-watershed flow is dominated by the powerful Rio Grande flow at most times, but sometimes has the strong influence of the LA/PCW storm flow. The analytical results from the four years of monitoring confirm that contaminants that may be originating from the LA/PCW arrive at the BDD at lower concentrations than similar ones found at the LA/PCW due to the RG dilution. However, even with the dilution factor of the dominant Rio Grande flow, a large number of exceedances of the Rio Grande background were detected. The analytical results also demonstrated that the forest fire damaged the LA/PCW to sufficient extend so that its contaminant transport has become more prominent during storm water flow conditions.

There are no NMWQCC surface water standards for most radionuclides of concern from LA/PCW. For this specific reach of the Rio Grande, there are screening levels for Plutonium 239/240, Plutonium 238, Americium 241, Strontium 90, and Cesium 137. Those screening levels were occasionally exceeded, most often during and shortly after the Las Conchas fire in 2011. The data indicates that the probable source for these exceedances is Los Alamos Canyon and its tributaries. The NMWQCC standards for other constituents in surface water were also exceeded. These constituents were gross alpha, radium, metals, total PCBs, and dioxins/furans. The data trends suggest that the potential source of some of these exceedances was LA/PCW, but the sources for some contaminants could also be sources upgradient from Otowi Bridge along the Rio Grande.

The report makes important conclusions about the storm water monitoring set up of the sampling stations of this program. The need for more information concerning discharge and contaminant concentrations from the lower reaches of the Los Alamos Canyon just before its confluence with the Rio Grande is critical to the understanding of the LA/PC watershed contaminants contribution to the Rio Grande and for the understanding of the complex system Rio Grande-Los Alamos Canyon Confluence. The data reveals that more effort needs to be put in place in order to characterize the lower reaches of the Los Alamos Canyon in order to model the potential contaminants transport and their timing of reaching the BDD. Currently, there is no gaging station or means for determining flow in the lower reaches of the LAC or just before its confluence with the Rio Grande. The Pu-239/240 concentrations found at BDD and analyzed in section VII.6 “Special Study of Pu-239/240” indicated that the sampling of storm water and sediment in the lower LAC is not representative of the contaminant distributions as collected from 2011 through 2013, and that the existing data underestimates the contaminant concentrations. In that sense, the monitoring program as executed under the 2010 MOU did not collect representative samples and was unsuccessful in making reliable prediction or in modeling the potential concentrations of LANL-legacy contaminants entering the RG and being transported to BDD.

In summary, the results confirmed that LANL-legacy contaminants were being transported by storm water to BDD, that the Las Conchas fire played an important role in mobilizing contaminants in LA/PCW and transporting them to BDD. The water quality effects of this fire to the Rio Grande watershed from Otowi Bridge to BDD were substantial. The monitoring results also confirmed that improving monitoring of the flows in the lower LAC is necessary and improved sampling must be ap-

plied to trace the origin and transport of LANL contaminants to the Rio Grande. In order to understand the contaminants occurrence at the BDD and their fate and transport, the need of a more permanent water quality monitoring at the BDD and along the Rio Grande might be a necessary next step of this program.

BDD continues to monitor the storm water at the Diversion under the 2015 MOU. For more information on the second phase of the program contact BDD at 505-955-4504.

Buckman Direct Diversion (BDD) would like to express its gratitude and acknowledge the Department of Energy Oversight Bureau of the New Mexico Environment Department (NMED/DOE OB) for their dedication and help with the sampling of storm water at the Diversion. Their efforts made this report possible.

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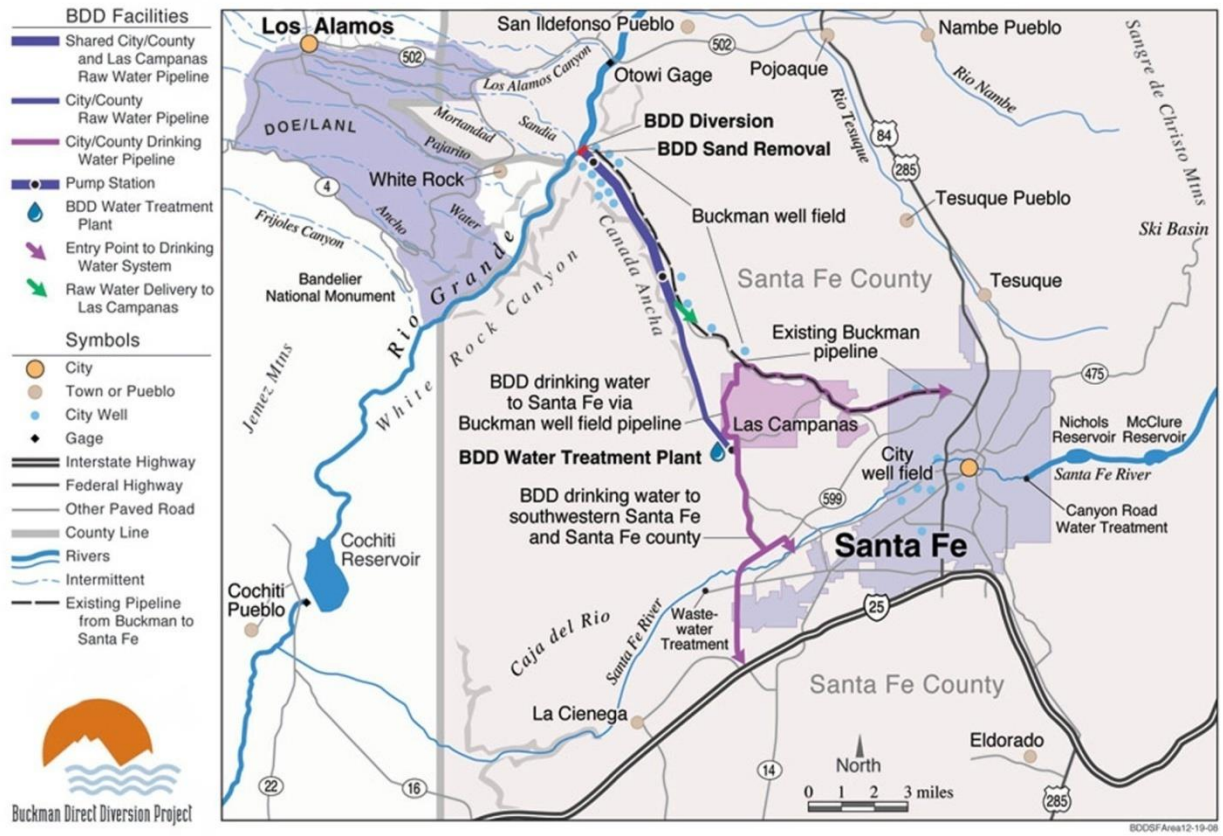
Acronyms and Abbreviations

Av	Average
BDD	Buckman Direct Diversion
BDDB	Buckman Direct Diversion Board
BDDP	Buckman Direct Diversion Project
Cfs	cubic feet per second
D/F	Dioxins and Furans
DOE	Department of Energy
DOE OB	New Mexico Environment Department/Department of Energy Oversight Bureau
F	Filtered
GCS	Grade Control Structure
Hrs	hours
HWB	New Mexico Environment Department/Hazardous Waste Bureau
LA	Los Alamos
LA/P	Los Alamos and Pueblo
LACW	Los Alamos Canyon Watershed
LANL	Los Alamos National Laboratory
MOU	Memorandum of Understanding
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
PCBs	Polychlorinated Biphenyls
PCi/g	Picocuries per gram
PCi/L	Picocuries per liter
Rads	Radionuclides
RG	Rio Grande
SCADA	Supervisory Control and Data Acquisition
UF	Unfiltered
USGS	United States Geological Survey

I. BACKGROUND

The Buckman Direct Diversion (BDD) Project was designed to divert surface water from the Rio Grande, treat it, and provide drinking water to the City and County of Santa Fe. The design of the Project began in September 2008 and construction was completed in early 2011. The point of diversion (BDD Intake) is on the east bank of the Rio Grande, about 3.5 miles downstream from where New Mexico Route 502 crosses the river at Otowi Bridge. See Figure 1. At approximately the same location, near the Otowi Bridge, the Los Alamos/Pueblo Canyons (LA/PC) watershed flows into the Rio Grande. These canyons and their tributaries have been impacted by contamination originating from Los Alamos National Laboratory (LANL) operations, when LANL discharged radioactive liquid wastes into the canyons on the Pajarito Plateau that drained into the Rio Grande. LANL occupies about 36 square miles on the Pajarito Plateau, on the western side of the river, and has operated (under various names) since 1943.

Figure 1. BDD area setting.



Periodic floods during the 1950s and 1960s of the Los Alamos/Pueblo Canyons watershed transported the discharged contaminants downstream from the source of release and ultimately to the Rio Grande, and hence to the BDD Intake location. This fact was researched and documented in the works of (Graf, 1994), (Graf, 1996), and (Englert, Dale, Granzow, & Mayer, 2007). By the 1970s the

flood frequencies and magnitudes diminished and transported contaminants were stored in sediments in and along the dry stream channels and floodplains of the canyons that run through the Laboratory. Since then and until the Cerro Grande Fire, the frequency of flooding from canyons at LANL diminished and clean sediments along the Rio Grande have covered contaminants that have reached the river.

The most serious impacts that might affect the diversion come from occasional storm water runoff flowing into the Rio Grande from Los Alamos/Pueblo Canyons. This watershed is the source of the existing LANL-derived contaminants in the Rio Grande upstream from the BDD Intake. Treated and untreated wastewaters discharged into canyons at LANL until 1986 include radioactive materials, heavy metals, solvents, and other wastes associated with the conducted research activities. According to NMED/DOE OB, since the Cerro Grande fire in 2000, canyon floods have increased in intensity and frequency and are eroding the emplaced sediments, exposing and carrying legacy contaminants to the Rio Grande at rates not seen since the discharges of the wastes in the 1950s and 1960s (NMED/DOE/OB, 2012).

Several entities conduct sampling and analyses at various points along the river and of its tributaries. The environmental samples (water, sediments, ash, soil, and biota including fish tissue) are collected by staff from the NMED, LANL, contractors to the U.S. Army Corps of Engineers, U.S. Geological Survey, and BDD. The samples are analyzed by independent commercial analytical laboratories and the data appear in published studies and reports. All results from LANL and NMED are available to the public after they are reviewed and validated through the web database Intellus at http://www.intellusnmdata.com/.

Water Quality

The water quality of Upper and Middle Rio Grande under base flow ("normal" or ambient) conditions is good overall, with few and occasional minor exceedances of individual water quality standards (NMED/DOE/OB, 2012). Sediments carried in storm water flow conditions generally exhibit concentrations that are elevated above ambient levels for certain constituents that are attached to soil and sediment particles. Storm water studies show a strong correlation between certain contaminants (radionuclides, PCBs) and sediment concentrations. That is, many of the contaminants of concern and other chemical compounds have a strong affinity for and are bound to the particles and organic matter in sediments.

Storm flow events are short lived, transient, and their sediment loads fluctuate proportionately with changing flow. However, storm water runoff can erode and transport contaminated sediments from the bottom of the LA/P Canyons watershed. In most occasions the BDD would temporary stop diversion of river water during such events in order to maintain the efficiency of its treatment process and avoid excess costs associated with removing heavy sediment loads.

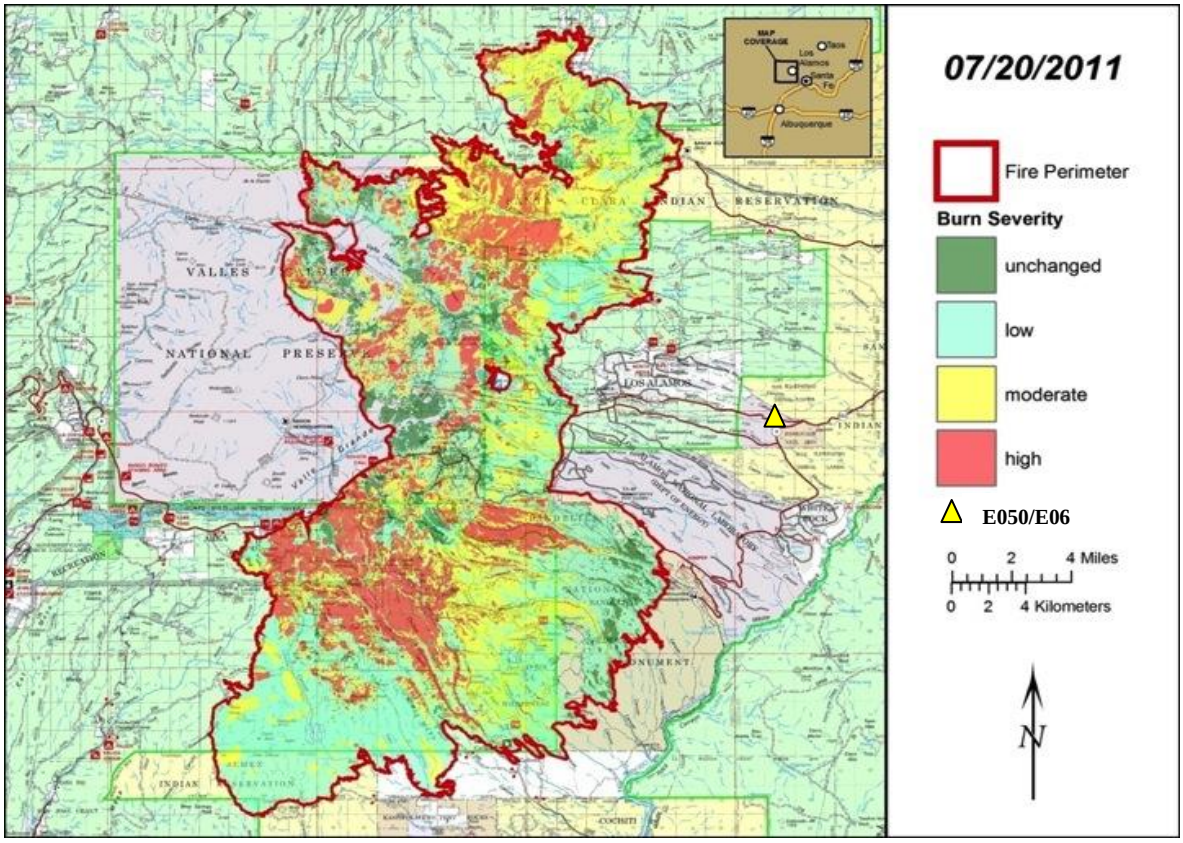
Las Conchas Fire 2011

On June 26, 2011, a tree fell on a power line and started a fire near Las Conchas Canyon. In all, the fire burned 163,000 acres, making it the largest fire in Northern New Mexico history. 16,000 acres of Santa Clara Pueblo burned in the fire—45 percent of the watershed. All the major watersheds within the Bandelier National Monument were heavily impacted by the fire including Frijoles Canyon, where the visitor center and main visited archeological sites are located. Over 75% of Frijoles Canyon lay within the fire's footprint, much of it burned with high severity. The fire was not one hundred percent contained until August 3, 2011.

Stand-replacing fires, such as La Mesa Fire (1977), Dome fire (1996), Cerro Grande Fire (2000), and Las Conchas (2011) in the Jemez Mountains are occurring more frequently. Watershed impacts such as accelerated flooding and erosion are common after high intensity crown fires. After the Las Conchas fire, debris flows into the Rio Grande caused BDD to cease operations until water quality improved.

The Las Conchas fire boundary and the burn severity are depicted on Figure 2 (inciweb.org). The LA/PC watershed was directly affected by the fire, and its impacts were documented in LANL and NMED/DOE OB stormwater monitoring. According to (Yanicak, 2012), the impacts of the fire were similar to those seen following the 2000 Cerro Grande fire, and it resulted in an increase sediment load in storm water, as well as an increase of metal and radionuclide content in the samples. The same document also stated that the impacts to the Rio Grande storm water from burned watershed inputs were infrequent and short lived.

Figure 2. Burn severity Las Conchas fire July 2011.



I.1 Memorandum of Understanding (2010 MOU)

History

The BDD Board (BDDB) voted unanimously during its October 4, 2007 meeting to request that DOE and LANL fund and implement a number of actions or specific programs to protect public water supplies. In a November 1, 2007 letter to DOE and LANL environmental officials, the Chair of the BDDB presented the following six requests to LANL:

- Stop migration of LANL contaminants to the Rio Grande and to groundwater.
- Properly monitor the transport of legacy contaminants (contaminants from the 1940s-1960s) in both the surface water and groundwater flow systems.
- Measure the radioactive and toxic contamination of buried sediments containing higher concentrations of post-World War II LANL legacy contaminants now buried in the slough (side channel) upstream of the BDD diversion site.
- Provide an early notification system so the BDD can temporarily stop diversions of any water from the Rio Grande when the Rio Grande is expected to contain elevated levels of contaminants of LANL origin.

- Monitor the mass of any LANL-origin contaminants diverted with BDD raw water supplies and account for that mass in water treatment plant residuals and treated drinking water.
- Provide funding for the BDD Board to retain independent peer review by qualified persons with regard to matters of LANL-origin contamination of the public drinking water resources of Santa Fe County and the City of Santa Fe.

It took three years of work for the DOE/LANL to consider BDDB requests. As a result of the public interest, the BDDB letter, and as means of protecting the source of drinking water for BDD, a Memorandum of Understanding (2010 MOU) was agreed upon. The parties, U.S. Department of Energy (DOE) and BDD Board, entered in 5-year agreement to implement monitoring programs in an attempt to evaluate river water quality during storm events at the BDD Intake.

2010 MOU

The Parties signed the MOU on May 12, 2010. However, the programs described in the MOU were not implemented until 2011 when the BDD began regular operations. A copy of the MOU and any revisions to its Appendix A-1 are provided as Attachment 1. The purpose of the 2010 MOU was:

- Monitoring the water quality by LANL and DOE in Los Alamos Canyon, Pueblo Canyon, and the Rio Grande; and
- Establishing the responsibilities of the two parties in the water monitoring.

The purpose of the 2010 MOU was intended to be accomplished by implementing three programs as described later. The MOU specified that the Parties would meet semiannually to review the work on the programs, and make revisions to the sampling plan in Appendix A-1 as necessary. In addition to the semiannual meetings, when necessary, technical meetings were also held. A complete record of meetings agendas, and minutes including handouts exchanged during the meetings were compiled and provided as Appendix 1. Table 1 list all meetings conducted between the staff members of both parties and the summary of discussions.

Table 1. List of 2010 MOU meetings.

Date	Meeting Type	Action/Issue Discussed
09/28/2010	1st Biannual	ENS performance and sampling results. IPR and ChemRisk report.
03/24/2011	2nd Biannual	Sampling plan for upcoming season. Changes to Appendix A-1.
10/11/2011	3rd Biannual	Status of ENS and sampling stations. Season's results. Additional samplers and analytes.
02/18/2012	Technical	Tour of ENS stations. Installation of additional equipment. Evaluation of system performance. Sampling plan for upcoming season.
04/11/2012	4th Biannual	Updates on ENS stations. Additional samplers and analytes.
09/27/2012	5th Biannual	ENS status and performance. Season's results. CFA status.

Date	Meeting Type	Action/Issue Discussed
03/27/2013	6th Biannual	Season's lessons learned. Contingency plan. Intellus. Sampling plans for upcoming season.
09/19/2013	7th Biannual	ENS status and performance. CFA results. Intellus. Season's results.
11/26/2013	Technical	ENS web access and performance. Station 109.9 status. Sampling plan recommendations. CFA data.
02/18/2014	Technical	ENS camera issues. Sampling strategy for upcoming season. LA/P damages and restoration. CFA results.
03/25/2014	8th Biannual	ENS status and preparations for upcoming season. Sampling plan. Pueblo Canyon restoration efforts.
05/15/2014	Technical	Intellus database, capabilities and design. Logistics for the upcoming season.
06/04/2014	Management	Discussion on the goals and objectives of 2015 MOU.
06/12/2014	Technical	Logistics for current season.
07/29/2014	Technical	Discussion on conditions of 2015 MOU.
09/09/2014	Technical	Discussion on conditions of 2015 MOU.
10/21/2014	9th Biannual	Status of ENS and sampling stations; season's results; conditions of the 2015 MOU.

I.2 2010 MOU Programs

ENS

The MOU described three programs: the Early Notification System (ENS) in Section E.1, the storm water quality sampling in Section E.2 and E.3, and the Contaminant Fate Analysis (CFA) in Section E.4. The objective of the ENS was to deliver real-time data from the Los Alamos and Pueblo Canyons during storm events. The equipment set up was designed to warn BDD when discharge of storm water flowing in the canyons exceeded a designated threshold (set at 5 cfs), above which the LA/P Canyons' flows might reach the Rio Grande and discharge contaminants into the river. This warning was meant to enable BDD staff to decide whether to close the diversion during storm events. This program was considered to be essential in providing preventative measures while the surface water quality of the Rio Grande was investigated throughout the years of the MOU.

Storm Water Quality Sampling System

The objective of this program was to collect samples from the LA/PC watershed and the Rio Grande in order to make determinations on the water quality of the river and LANL legacy contaminants that might reach the BDD Intake. This program consisted of two sections, a sampling program designed and implemented at LA/P Canyons watershed, and a sampling program at the BDD Intake. Both programs used ISCO 3700 portable automated samplers in order to initiate and collect storm water samples at pre-programmed design and frequencies. The triggers of the sampling of both programs

changed through the years and the set ups and sampling design changed as well. Even though the program was intended to be sampling of storm water, sampling of RG during base flow was also conducted.

In addition to the described sampling programs, the NMED/DOE OB also conducted sampling of the LA/P watershed and the BDD Intake using the same sampling equipment. In this report, whenever possible, the results from NMED/DOE OB sampling program are used to supplement the MOU sampling data in order to gain a better picture and understanding of the contaminants' transport processes.

The MOU specified that LANL would fund a total of 30 sampling events at the BDD Intake during the four summer seasons of the MOU duration with no special conditions. However, in 2014, DOE/LANL restricted the financing for the analytical work of the storm water samples to a specific budget, so BDD staff needed to make careful decisions about which samples should be sent for analyses. By the end of the 2010 MOU, the program conducted 25 sampling events. The number of samples per event varied based on the sampling designs, number of samplers, samplers malfunctioning, costs, and internal decisions and policies.

The sampling at the LA/P Canyons watershed is overseen by the NMED Hazardous Waste Bureau (HWB), which reviews and approves sampling plans and reports under the Section VII of the LANL Compliance Order on Consent. The LANL monitoring of this watershed pursuant to the Order began in 2010 as means to evaluate the implemented mitigation efforts in this watershed. The storm events at the LA/PC watershed and at the BDD Intake from 2011 through 2014 are described in detail in Section IV.

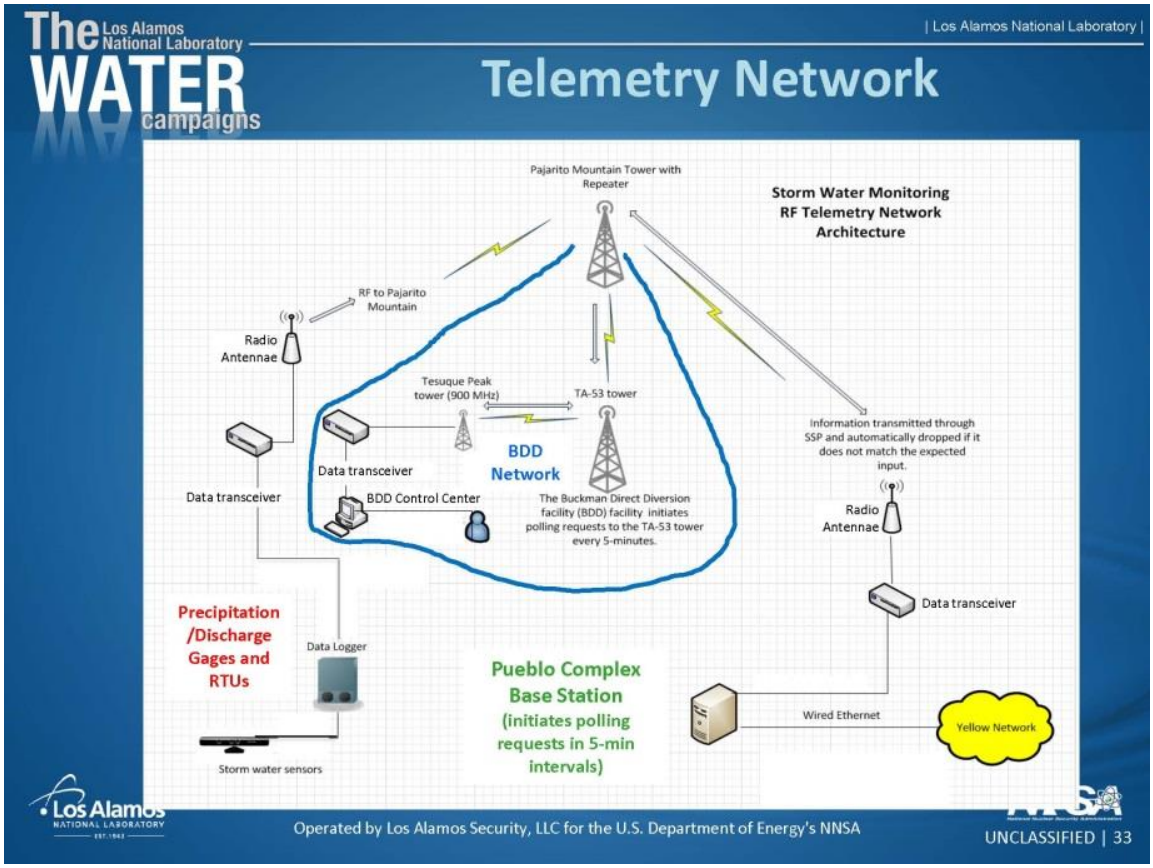
CFA

The objective of this program was to investigate the fate of contaminants within the water treatment facility with entering the BDD intake. The 2010 MOU CFA described composited sampling of the Rio Grande, the sediment return line, and the finished water produced by the treatments at BDD. The collected samples were tested for a reduced analytical suite, radionuclides only. BDD collected monthly composited samples from the earlier mentioned locations and analyzed those as described in the MOU for 12 consecutive months, from March 2012 until February 2013.

II. EARLY NOTIFICATION SYSTEM

The purpose of the early notification system (ENS) was to provide real time stream flow data to the BDD from the following LA/P watershed locations. A schematic of the BDD network incorporated in the LANL telemetry is provided on Figure 3 (LA-UR-14-25041, 2014).

Figure 3. ENS telemetry network.



A map of locations of the LANL stations is provided on Figure 4. The stations participating in the monitoring program were:

- Gage station E060.1 in Pueblo Canyon above the Los Alamos Canyon confluence and below the grade-control structure;
- Gage station E050.1 in Los Alamos Canyon above the Pueblo Canyon confluence and below the low-head weir;
- Camera station E062.1 in Los Alamos Canyon below its confluence with Pueblo Canyon. This station was added for the 2014 season; and
- Gage station E109.9 in lower Los Alamos Canyon 0.7 miles above its confluence with the Rio Grande. This station became inoperable for the 2014 season, and LANL decided not to re-store it as part of the ENS.

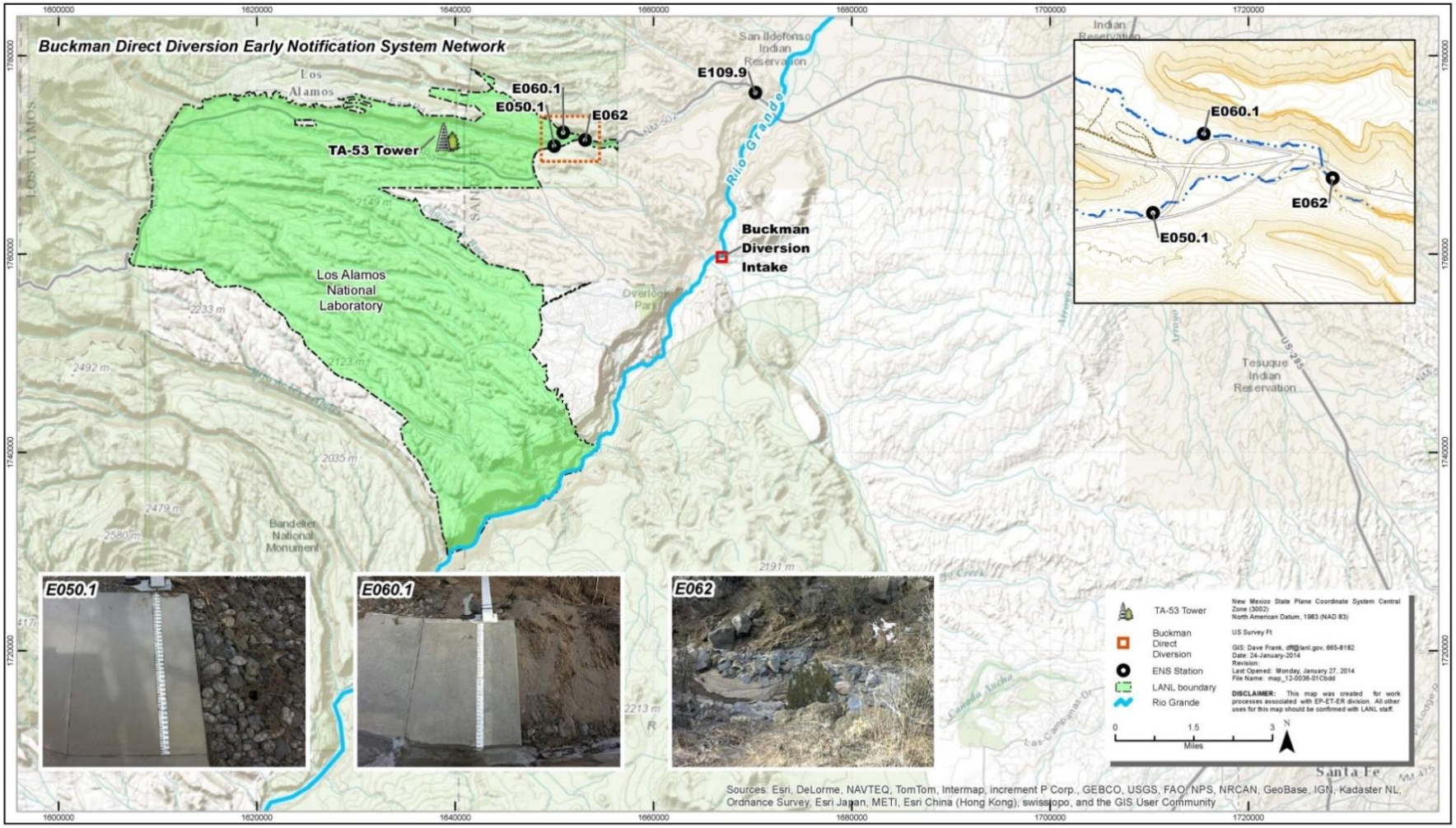
All gage stations monitor stage height at 5-minute intervals. Sutron 8210 and 9210 data loggers store each recorded stage-height measurement as it is made. Discharge is computed for each 5-minute stage measurement using rating curves for each individual gage. Shaft-encoder float sensors installed in stilling wells were used to measure water levels. Self-contained bubbler pressure sensors (Sutron

Accubar) were used to provide backup sensing at E109.9, E050.1, and E060.1 (LA-UR-11-5459, 2010). An ultrasonic probe sensor (Siemens Miltronics "The Probe") was added to all gages since the 2012 season as a backup to measure water levels. Until 2014, only gage station E109.9 was equipped with a camera. For the 2014 season, all gages were equipped with cameras as a discharge confirmation tool. Example images from those cameras are shown on Figure 4.

Figure 4 (LA-UR-14-21169, 2014) depicts the ENS stations as they existed in 2011, 2012, and 2013. On September 13, 2013, the gage station E109.9 was destroyed by large storm event, and LANL decided to abandon this location and not restore the gage station. Camera station E062 was added for season 2014. The images below are a snap shot of the cameras installed for the 2014 season. The cameras collect images every 5 minutes and are available for viewing on a special web site. Discharge data from all gage stations is transmitted to the BDD Control Room through SCADA.

The purpose of the ENS was to signal when there is a discharge in the Los Alamos and Pueblo Canyons in order for BDD to initiate closure of the intake of raw water. When discharge at the LANL gage stations was measured to be greater than 5 cfs or 10 cfs (for E109.9), the BDD Intake was closed and no river water was pumped for 10-12 hours, or until the storm event at Los Alamos region has subsided. This strategy and closure of the BDD Intake was maintained throughout the entire duration of the ENS.

Figure 4. ENS stations setting.

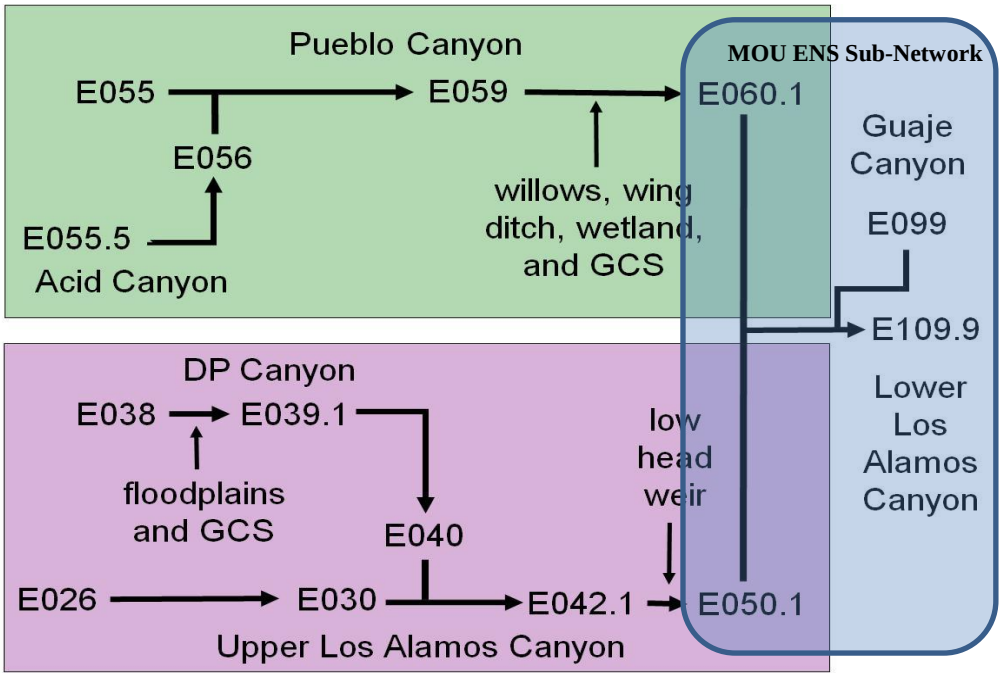


III. STORM WATER QUALITY MONITORING PROGRAM

III.1 LANL Stations, Set up, Capabilities, Triggers

LANL has extensive network of gage stations within the LA/P watershed. A schematic of the drainages as it applies to this specific watershed is shown below.

Figure 5. Flow diagram of gage stations in LA/P watershed.



LANL stations monitoring storm water pursuant to the 2010 MOU were gage stations E050.1, E060.1, and E109.9. In 2014, station E109.9 was not part of the monitoring efforts. The gage stations were equipped with concrete, trapezoidal, super-critical flow flume, see Figure 6 (LA-UR-14-25041, 2014). The gages were equipped with measuring equipment of the stage height in order to calculate an accurate discharge through the gage during storm events. In addition, E050.1 and E060.1 were equipped with automated samplers, and E109.9 was equipped with two automated samplers. Station E062 is only equipped with a camera and provides verification of flow or no flow through the LA Canyon after the Pueblo Canyon confluence. Starting in 2014, all LANL stations participating in the MOU were equipped with cameras. LANL maintains a website that hosts real-time images from the cameras to verify flow.

Figure 6. Typical LANL well-equipped gage station.

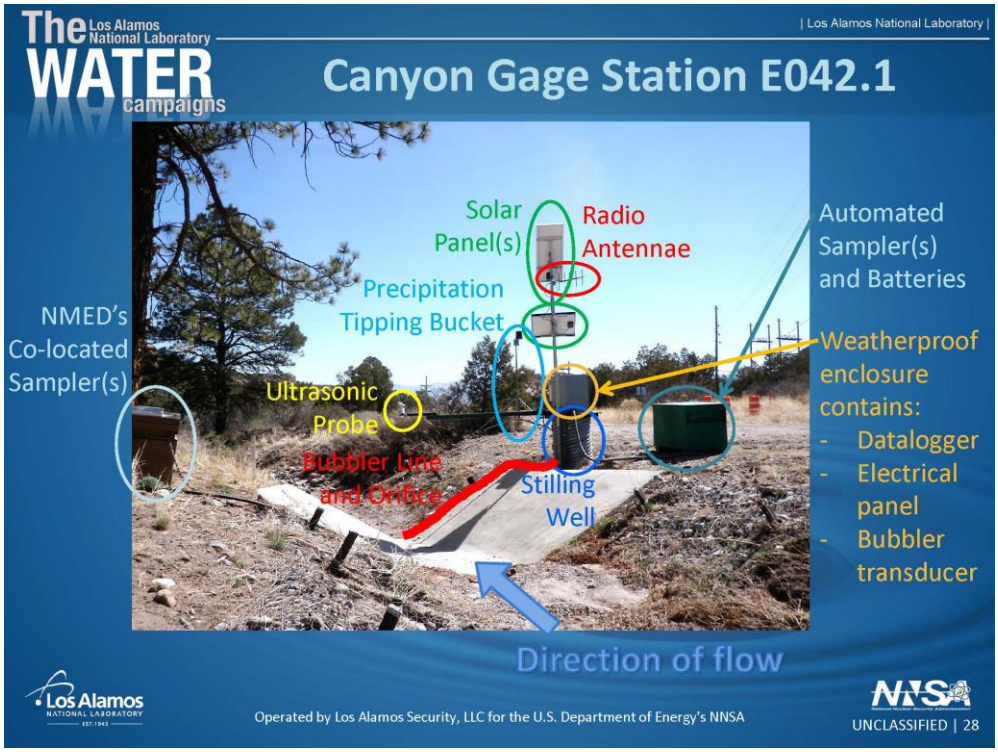
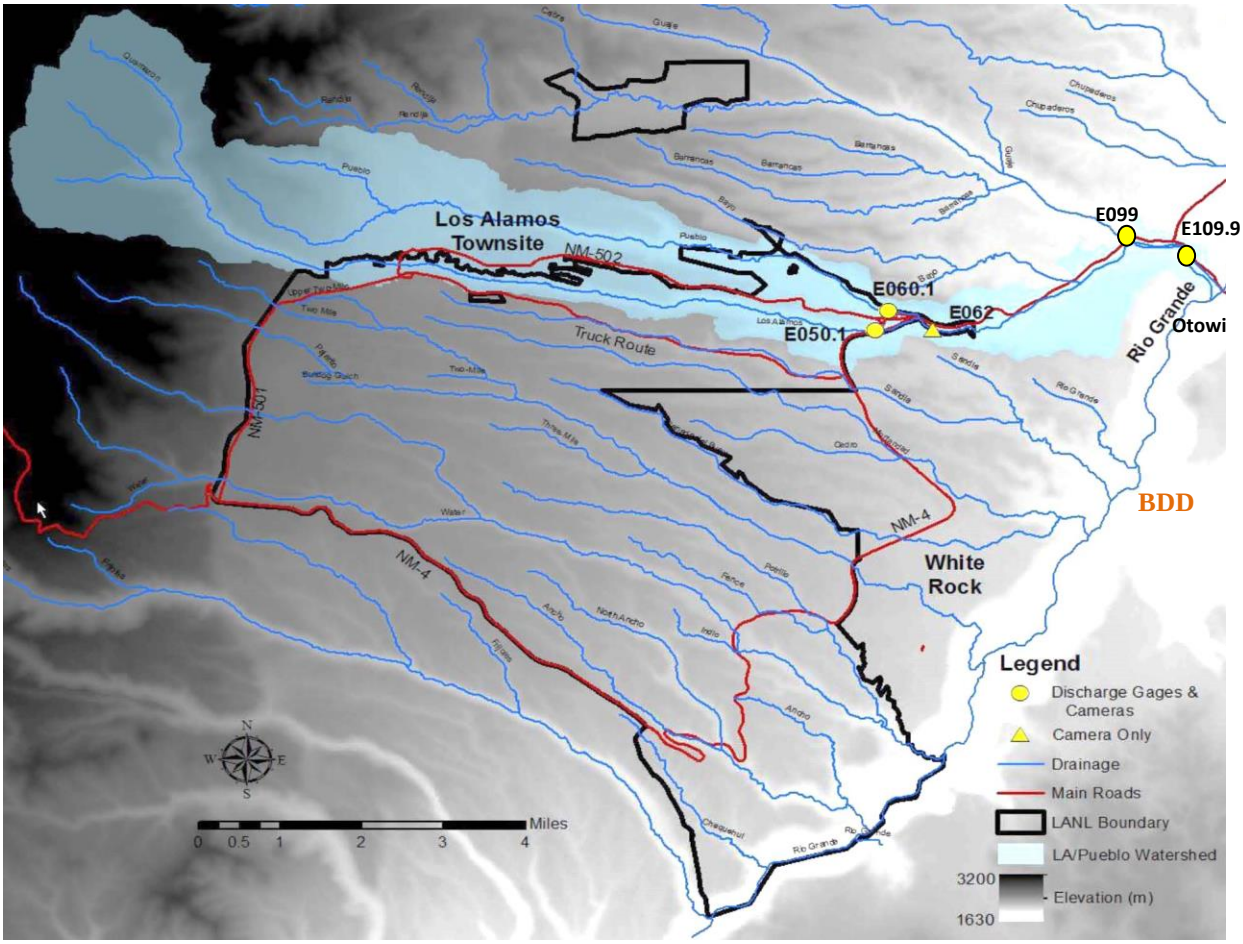


Table 2. LANL gage stations description.

Gage Station	Location ID/Sampling Dates	Latitude (decimal degree)	Longitude (decimal degree)
E050 (old)	Los Alamos below LA Weir (2001-2010)	35.867140	-106.21800
E050.1	Los Alamos below low-head weir (2011-2014)	35.867182	-106.217583
E060/E060.1	Pueblo below GCS (2010-2014)	35.870942	-106.214606
E062	Los Alamos below Pueblo (NA)	35.868828	-106.207102
E099	Guaje at SR-502 (2000-2014)	35.884540	-106.162000
E109.9	Los Alamos above Rio Grande (2010-2013)	35.881952	-106.149124

Table 2 lists some of the LANL stations in LA/P watershed. Analytical data from these stations was used in this report. The "Location ID" is the name under which a gage could be located in the online database Intellus (www.intellusnmdata.com). Station E099 was not part of the 2010 MOU. However, certain data from that station is relevant to this study, and, therefore it will be mentioned in this report.

Figure 7. LANL gage and sampling stations.



As part of the 2010 MOU, the stations were maintained and inspected by LANL staff. LANL committed to maintain the event sampling system as necessary to support the purpose and performance standards described above. The samplers were inspected no less than weekly from June to October of each year, and after each flow event and/or 72 hours between flow events to collect samples. General maintenance was performed in accordance with LANL SOPs, and included ensuring sampler is powered up and operational, load testing of battery and replacement of battery, inspection of sampler pump tubing, line, and intake to ensure no air leaks, cracks or plugs, and test sample collection cycle to ensure correct programming, tripping and volumes are correct.

III.2 BDD Intake Station: Set up, Capabilities, Triggers

The water quality sampling set up at the BDD Intake contains ISCO 3700 portable automated samplers. For the first three years of the 2010 MOU, seasons 2011, 2012, and 2013, LANL provided BDD with 2 samplers, one with 12-bottle carousel and one with 24-bottle carousel. BDD purchased two more 24-bottle carousel samplers for the monitoring season of 2014. With that, BDD amplified its ability to collect storm water over 7 hours. The samplers could communicate remotely with the BDD Control Room and programmed through the SCADA. The samplers could be started at any

time during sampling events, automatically or manually, and can be programmed to sample at pre-determined order. Sample collection timing and bottle fill sequence for each sampler could be programmed as well.

Figure 8. BDD intake station set up.

When a flow greater than 5 cfs was measured by a sensor at E050.1, E060.1 or E109.9, a signal was automatically transmitted via the LANL Telemetry Network to the BDD's SCADA system, and an alarm sounded. The BDD Operator on duty would confirm flow in the canyons through the LANL cameras. The BDD Operator could cancel closing the diversion or sampling sequence if a false signal has been detected.

The travel time of stormwater from E050.1, E060.1, and E109.9 to the BDD Intake depends on many factors including the discharge as measured at LANL stations, whether the canyon floor is saturated from a previous runoff event, and the rate of flow in the Rio Grande. SCADA would automatically transmit a start signal to autosamplers located near the BDD's diversion structure as calculated by the "time of arrival" if the BDD Operator does not cancel the action. The BDD Operator can override the start of sample collection, if conditions were warranted. A detailed description of the triggers is provided in Section III.5.b.

III.3 NMED DOE OB Stations: Set up, Capabilities

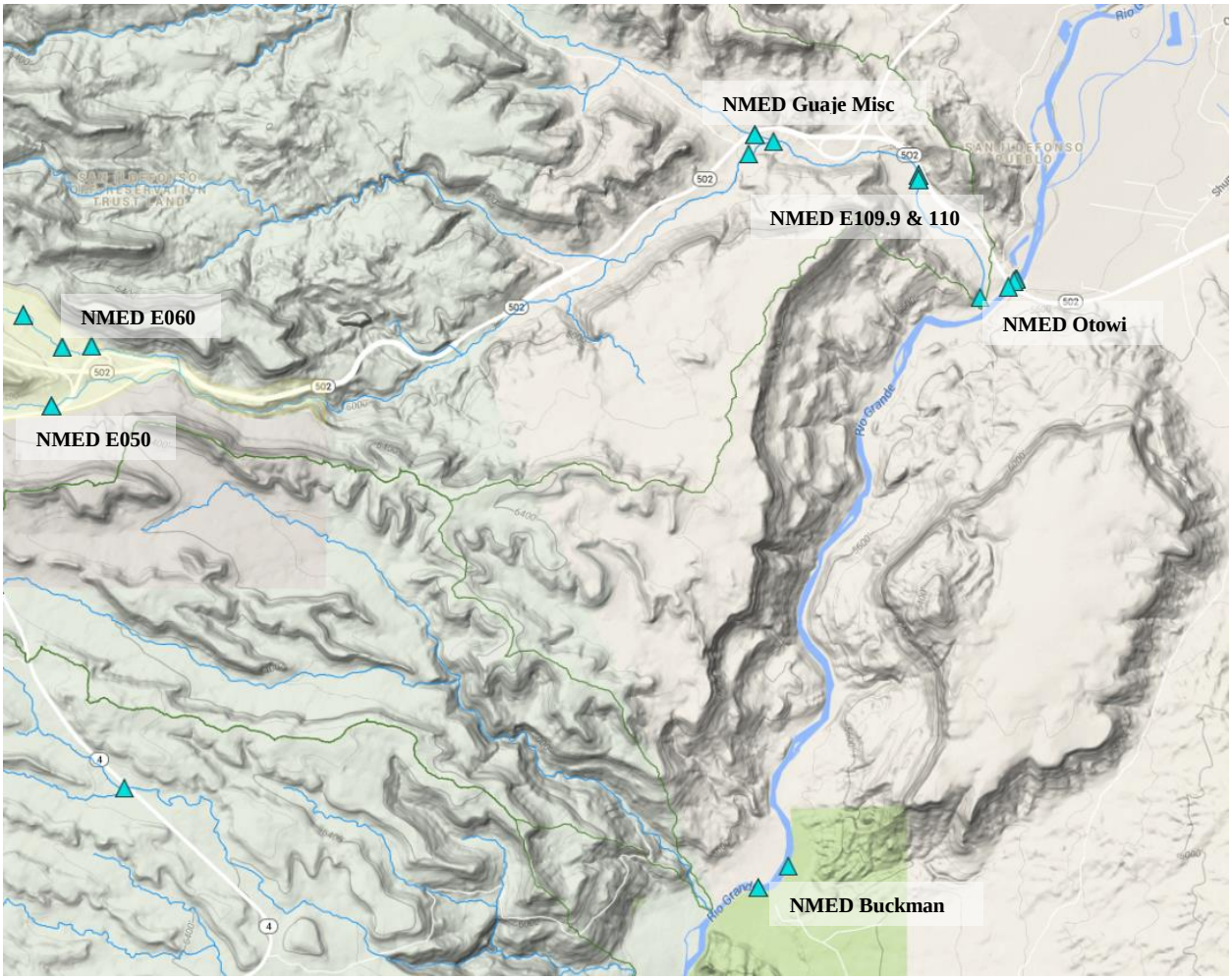
NMED has been monitoring the LA/P Canyons for many years, and initiated regular monitoring of the BDD location in 2008. This report used analytical data of the storm water sampling from the following NMED stations:

Table 3. NMED/DOE OB sampling stations.

Gage Station	Location ID/Sampling Dates	Latitude (decimal degree)	Longitude (decimal degree)
E050	Los Alamos below LA Weir E050 (2010-2014)	35.86714	-106.21778
E060.1	Pueblo below GCS E060.1 (2010)	35.87094	-106.21461
E099	Los Alamos 90 ft above Guaje (2012)	35.88414	-106.16063

Gage Station	Location ID/Sampling Dates	Latitude (decimal degree)	Longitude (decimal degree)
E099	Los Alamos 755 ft above Guaje (2013-2014)	35.88330	-106.16263
E099	Guaje at SR-502 E099 (2012)	35.88454	-106.16211
E109.9	LA above Rio Grande E109.9 (2012)	35.88195	-106.14912
E110	LA Canyon nr Otowi Bridge E110 (2004-2014)	35.88169	-106.14914
Otowi	Rio Grande at Otowi/Upper bank (2007/ 2009-2014)	35.87478/35.87513	-106.142013
Buckman (old)	Rio Grande at Buckman Landing	35.83762	-106.15947
Buckman (current)	Rio Grande at BDD Intake	35.83624	-106.16182

Figure 9. NMED/DOE OB sampling stations.



As described in (Englert & Ford-Schmid, April 2011), NMED DOE OB deploys portable ISCO® programmable liquid samplers in the Los Alamos watershed and since 2008 in the Rio Grande near BDD. Single ISCO® sampling units are capable of collecting 24 discrete 1-liter samples in varying programmable arrays. The samplers can be programmed to begin a sampling routine based on

change in stage height and the sample collection intervals can be based on elapsed time. The ISCO® 3700 sample collection equipment was deployed along open stream channels in a dormant mode until a change in stage height was detected. If the stage level increase exceeds a level prescribed as a storm event a sample routine was activated, comprised of multiple regularly timed intervals. DOE OB uses bubbler flow meters to detect changes in stage at all stations except for the two samplers that are activated on the LANL trigger signal used by BDD. The specific sampling dates of NMED/DOE OB for the duration of this MOU are marked with green triangles in Section IV.

III.4 Summary of Storm Events 2011-2014.

III.4.a LA/P Canyons Watershed Storm Events

The storm events in the LA/PC watershed are documented every year in a LANL report issued by March or April of the next year. The storm events for 2011 through 2014 are listed below as documented in LANL reports. The table describes the measured discharges and the sampling at each station. LANL table was expanded for the purposes of this report with information from the BDD Intake sampled by the BDD staff and NMED/DOE OB.

The storm and discharge data for 2011 was obtained from 2011 LANL Report (LA-UR-12-24822, September 2012), for 2012 – from 2012 LANL Report (LA-UR-13-22113, March 2013), for 2013 – from 2013 LANL Report (LA-UR-14-24516, June 2014), and for 2014 – from 2014 LANL Report (LA-UR-14-22549, May 2015).

Table 4. 2011 Storm events in LA/P canyons.

Date	2011 Station Name									
	E050.1		E099[a]	E109.9		E060.1		BDD	BDD OB[h]
07/22/2011	0	NS		53	S	0	NS	S	
07/27/2011	0	NS		10	NS[f]	0	NS	NS	S
07/28/2011	0	NS		13	S	0	NS	S	S
08/01/2011	0	NS		<1	NS	0	NS		
08/03/2011	0	NS	0.60 ft	81	S	0	NS	S	S
08/04/2011	0	NS	0.32 ft	3	NS	0	NS		
08/05/2011	0	NS	0.20 ft	70	S	0	NS	NS	S
08/13/2011	0	NS		8	NS	0	NS	NS	
08/19/2011	3	NS		3	NS	0	NS		
08/21/2011	75	S		610	NS[g]	0	NS	S	S
08/22/2011	91	S		95	S[g]	0	NS	NS	
08/26/2011	0	NS	0.14 ft	35	S[g]	0	NS	S	S
08/28/2011	0	NS		69	NS[g]	0	NS	NS	
09/01/2011	<1	NS	1.00 ft	340	NS[g]	0	NS	S	S
09/04-05/2011	188	S	1.10 ft	632	S[g]	0	NS	S	S
09/05/2011	0	NS		81	NS	0	NS	NS	
09/07/2011	11	S	0.87 ft	80	S[g]	4	NS	NS	S
09/09/2011	<1	NS		<1	NS	0	NS		
09/10/2011	15	S	0.60 ft	70	S	<1	NS	NS	

Date	2011 Station Name									
	E050.1		E099[a]	E109.9		E060.1		BDD	BDD OB[h]
09/15-16/2011	11	S	0.21 ft	8	NS	0	NS	NS	
10/02/2011	11	S		0	NS	0	NS	NS	
10/04/2011	6	S	0.16 ft	13	NS	0	NS	NS	
10/07/2011	0	NS		14	NS	0	NS	NS	

[a] E099 does not have a reliable rating curve, thus stage height is displayed in the table
S = Sample was collected. Cell is highlighted in yellow.
N or NS= Sample was not collected.
Blue highlight in cell indicates no sample was collected on a day with recorded discharge above the triggering threshold at that station.
[f]na = Not available. Gage station was damaged.
[g]Flow is estimated.
[h]BDD OB means NMED OB sampling at BDD intake.

Table 5. 2012 Storm events in LA/P canyons.

Date	2012 Station Name									
	E050.1		E099[a]		E109.9		E060.1		BDD	BDD OB[h]
07/05/2012	0	NS	3.7	NS	48	S	0	NS	NS	S
07/07/2012	0	NS	0	NS	<1	NS	0	NS		
07/11/2012	130	S	150	S	680	S	0	NS	S	S
07/16/2012	<1	NS	280	NS	270	NS	0	NS	NS	
07/24/2012	9.9	S	Na[f]	NS	25	S	0	NS	NS	S
08/03/2012	170	S	170	S	200	S	0	NS	NS	S
08/06/2012	2.5	NS	<1	NS	86	NS	0	NS	NS	
08/07/2012	4.2	NS	220	S	480	S	0	NS	NS	
08/13/2012	0	NS	4.8	NS	18	NS	0	NS	NS	
08/18/2012	0	NS	11	NS	170	NS	0	NS	NS	
08/23/2012	4.9	NS	85	S	220	S	0	NS	S	S
08/24/2012	<1	NS	7	NS	160	S	0	NS	NS	S
09/12/2012	0	NS	6	NS	12	NS	0	NS	NS	
09/28/2012	7	S	0	NS	5.9	NS	0	NS	NS	
10/12/2012	30	S	79	S	440	S	0	NS	NS	

[a]Maximum discharge values reported have an accuracy of ± 50 cfs.
S = Sample was collected. Cell is highlighted in yellow.
N or NS= Sample was not collected.
Blue highlight in cell indicates no sample was collected on a day with recorded discharge above the triggering threshold at that station.
[f]na = Not available. Gage station was damaged.
[h]BDD OB means NMED OB sampling at BDD intake.

Table 6. 2013 Storm events in LA/P canyons.

Date	2013 Station Name									
	E050.1		E099[a]		E109.9		E060.1		BDD	BDD OB[h]
06/14/2013	0	N	0	N	<1	N	0	N		
06/30/2013	0	N	3.3	N	3.2	N	0	N		
07/05/2013	0	N	0	N	<1	N	0	N		
07/08/2013	0	N	32	N	110	S	0	N	NS	
07/12/2013	32	S	230	S	180	S	0	N	S	
07/13?/2013	0	N	1100	N	251?	N				
7/20-21/2013	0	N	480	S	810	S	0	N	NS	S
07/25/2013	0	N	10	N	100	S	0	N	NS	
07/26/2013	<1	N	8	N	160	S	0	N	NS	
7/26-27/2013	0	N	0	N	2.5	N	0	N		S
07/28/2013	<1	N	<1	N	70	N	0	N	NS	
08/03/2013	0	N	0	N	950	S	0	N	NS	
08/04/2013	0	N	0	N	68	N	0	N	NS	
08/05/2013	20	S	340	S	1000	S	1.7	N	NS	
08/09/2013	0	N	360	N	270	S	0	N	NS	
08/20/2013	0	N	14	N	42	N	0	N	NS	
08/30/2013	0	N	24	N	150	N	0	N	NS	
09/02/2013	0	N	430	N	310	N	0	N	NS	
09/10/2013	11	S	1	N	130	N	0	N	S	
09/11/2013	16	S	<1	N	65	N	0	N	NS	S
09/12/2013	87	S	350	N	520	S	<1	N	S	
09/13/2013	740	N	1600	N	5000	N EST	1400	N	NS	
09/14/2013	48	N	na		na		na			
09/18/2013	1.4	N	na		na		na			
09/21/2013	8.1	N	na		na		5.7	N		
9/22-23/2013	34	N	na		na		2.2	N		
10/3-4/2013	6.7	N	na		na		0	N		
11/04/2013	3.2	N	na		na		1.7	N		

[a]Maximum discharge values reported have an accuracy of ± 50 cfs.
S = Sample was collected. Cell is highlighted in yellow.
N or NS= Sample was not collected.
Blue highlight in cell indicates no sample was collected on a day with recorded discharge above the triggering threshold at that station.
na = Not available. Gage station was damaged.
[h]BDD OB means NMED OB sampling at BDD intake.
? Information corrected by BDD

Table 7. 2014 Storm events in LA/P canyons.

Date	Station name							
	E050.1[a]		E099	E109.9	E060.1[a]	BDD		BDD OB[h]
07/07/2014	0	NS			0	NS		
07/08/2014	0	NS			0	NS		
07/09/2014	0	NS			0	NS	NS	
07/15/2014	0	NS			0	NS	S	S
7/15-16/2014	46	S			0	NS	S	
07/16/2014	0	NS	Gage Station not Restored	Gage Station not Restored	0	NS		
07/27/2014	0	NS			0	NS		
07/29/2014	63	S			0	NS	S	S
7/31-8/1/2014	210	S			54	S	S	S
08/04/2014	<1	NS			0	NS	S	
09/05/2014	0	NS			0	NS	S	
09/29/2014	0	NS			0	NS		
10/09/2014	0	NS			0	NS		

[a]Maximum discharge values reported have an accuracy of ± 50 cfs.
NS = Sample was not collected.
Blue highlight in cell indicates no sample was collected on a day with recorded discharge above the triggering threshold at that gaging station.
S = Sample was collected. Cell is highlighted in yellow.

III.4.b LA/P Canyons Daily Discharges

Each storm event as reported by LANL or BDD is very unique and some storm events may ast for a few hours while others - for a few days. In order to evaluate the discharges in each of the monitored canyons on a daily basis and to calculate the relative discharge frequency of each canyon (middle LA Canyon, Pueblo Canyon, and Guaje Canyon) with respect to the lower LA Canyon, the 5-min discharges as reported by LANL for each canyon were reviewed and the statistics from that data was presented in the table below.

The discharge data for the LA/PCW was filtered with respect to the lower LA Canyon gage station E109.9 with the criteria of discharges being 5 cfs or greater, because it was assumed that any discharge at 5 cfs or greater detected at that station could reach the Rio Grande. There were days when discharges at upper or middle LA Canyon were of such magnitude but if the flow at E109.9 was low or zero then such discharges would easily infiltrate into the canyon bed and not reach the Rio Grande by surface water route. Such occurrences were not included in this analysis because they are irrelevant to our study. For each day when the flow at E109.9 was 5 cfs or greater, the maximum flows of the other gage stations were recorded and entered in the table. If the flow rate at any other station (E050.1, E060.1, or E099) was 5 cfs or greater then such occurrence was counted toward the "Total Days" of flow for the corresponding station. If the flow rate was less than 5 cfs, then such day was not counted toward the "Total Days" of flow occurrences. Lastly, the relative frequency of discharge

at each station with respect to the lower LA Canyon (E109.9) was calculated in order to determine how often each station flowed, from 2010 until 2013 when the gage station E109.9 was in working order.

Figure 10. Daily discharges of LANL gage stations from 2010 to 2013.

	2010					2011					2012					2013				
	Date	E109.9 cfs	E050.1 cfs	E060.1 cfs	E099 rising	Date	E109.9 cfs	E050.1 cfs	E060.1 cfs	E099 ft	Date	E109.9 cfs	E050.1 cfs	E060.1 cfs	E099 cfs	Date	E109.9 cfs	E050.1 cfs	E060.1 cfs	E099 cfs
	8/15	439	18	<5	Y	7/22	53	0	0	0	7/5	48	0	0	<5	7/8	114	0	0	19
	8/16	243	79	132	Y	7/27	10	0	0	0	7/11	678	134	0	75	7/12	175	32	0	234
	8/17	4*	0	<5	N	7/28	13	0	0	0	7/12	28	<5	0	<5	7/13	251	0	0	1,138
	8/23	779	0	0	Y	8/3	81	0	0	0.60	7/16	269	<5	0	277	7/14	15	0	0	0
	9/22	48	0	0	Y	8/5	70	0	0	0.20	7/24	25	10	0	NO	7/20	808	0	0	213
						8/13	7.5	0	0	0	8/3	204	168	0	167	7/21	18	0	0	14
						8/22	95	42	0	0	8/4	13	<5	0	0.5*	7/25	97	0	0	10
						8/26	35	0	0	0.14	8/6	86	<5	0	0.4*	7/26	156	0	0	8
						8/28	69	0	0	0	8/7	481	<5	0	221	7/28	70	<5	0	<5
						9/1	340	<5	0	1.00	8/8	8	<5	0	1.5*	8/3	950	0	0	0
						9/4	632	155	0	1.10	8/13	18	0	0	3*	8/4	68	0	0	0
						9/5	81	11	0	0	8/14	14	0	0	1*	8/5	1,000	13	<5	340
						9/6	9	<5	0	0	8/18	171	0	0	11	8/9	273	0	0	357
						9/7	61	11	<5	0.87	8/19	8	0	0	1*	8/18	18	0	0	<5
						9/10	70	15	0	0.60	8/23	217	5	0	85	8/20	42	0	0	<5
						9/16	8	<5	0	0.21	8/24	157	<5	0	3*	8/30	151	0	0	24
						10/4	13	<5	0	0.16	9/12	12	0	0	6	9/1	26	0	0	<5
						10/7	14	0	0	0	9/28	6	<5	0	0	9/2	306	0	0	426
						10/8	15	0	0	0	10/12	444	30	0	79	9/3	34	0	0	48
																9/10	118	11	0	<5
																9/11	128	16	0	<5
																9/12	520	87	<5	353
																9/13	>926	>101	>56	>1,063
																...	...	...	...	...
Total Days		5	2	1	4		19	5	0	9		19	5	0	15		>23	6	1	14
% of E109.9		100%	40%	20%	80%		100%	26%	0%	47%		100%	26%	0%	<79%		100%	26%	4%	61%

Notes to Table

* sedimentation in canyon or equipment; flow rate could be higher than what was measured; it will be counted toward dischrages greater than or equal to 5 cfs

NO stands for "not operable on this date"

"Guaje rising" for 2010 means increase in stage was noticed for "Y" and not noticed for "N". For all "Y"s it was assumed the flow was greater than 5 cfs.

Guaje in 2011 was reported by LANL in feet of the stage because Guaje gage station did not have reliable rating curve. For any rise in stage it was assumed the flow was greater than 5 cfs.

There were more days in 2013 when many canyons flowed but the gage stations E109.9 and E060.1 were destroyed for the rest of the season was omitted.

For the studied period of time, Pueblo Canyon (E060.1) flowed seldom, and the middle LA Canyon (E050.1) flowed consistently 26%, except for 2010 season. The Guaje Canyon gage station (E099) does not have very reliable discharge measuring system, and, therefore the flow rates are not of "true" values. However, it could be noticed that more often when lower LA Canyon flows then the E099 flows (50% to 80% of the time) rather than E050.1 or E060.1.

The differences in discharge frequency between the canyons are very important in order to evaluate how appropriate each and one of them was as a backup trigger to the BDD ENS and the storm water

sampling system. When in 2013, the LANL gage station E109.9 was destroyed by a strong storm flow, LANL decided not to replace the station, and therefore, BDD selected E050.1 and E060.1 as a backup trigger to their monitoring program for the following years. BDD has not been given access to real time discharge data from E099 (Guaje Canyon). Consequently, it appears that BDD monitored (in 2014 and 2015) and currently monitors only 26% of all storm events that may exceed 5 cfs flow in the lower LA Canyon and may reach the Rio Grande. In addition, the gage stations E050.1 and E060.1 are also triggers for the ENS, and, therefore BDD does not get notified 74% of the time when lower LA Canyon contaminated storm flows may reach the Rio Grande.

III.4.c BDD Documented Storm Events

A list of LA/P watershed storm events, BDD sampling events, discharges at LANL stations and RG are presented in the following tables by year. The following notes should be considered when reviewing the data in Table 8 through Table 11.

- Facts in tables were checked against LANL LA/P Stormwater Monitoring Reports, BDD SCADA data, and BDD operator's log book. A complete record of the applicable pages of the BDD Control Room Logbook is provided in Appendix 2.
- Otowi gage discharges were obtained from USGS web site.
- Discharges and flows were expressed in cfs.
- The notes in the "Comments" field expressed the opinion of BDD staff.

Table 8. 2011 Storm events and discharges.

Date	Crossover Date	PeakFlow E109.9	PeakTime E109.9	PeakFlow E050.1	PeakTime E050.1	PeakFlow E060.1	PeakTime E60.1	Samples?	OtowiFlow (cfs)	Comments
7/22/11		53	1655	0	na	0		Y	1,180	"Baseline" sampling after canyon event. No river event at time of sampling.
7/27/11		10	2120	0	na	0		N	950	No BDD record of this event. No river event.
7/28/11		13	1715	0	na	0		Y	860	No river event.
8/3/11		90	1615	0	na	0		Y	850	No river event.
8/4/11		3	2015	0	na	0		N	900	No river event.
8/5/11		70	1650	0	na	0		N	880	No river event.
8/13/11		8		0	na	0		N	1,600	No BDD record of this event. River event at 2050.
8/19/11		3	1850	3	1915	0		N	960	No river event.
8/20/11		3	1835	0	na			N	970	Small river event at 1200.
8/21/11	8/22	610	??	75	1825	0		Y	2,910	River event from 1700 to 2200. Max at 2100.
8/22/11		95	~1840	91	1610	0		N	2,930	No BDD record of this event. River event at 2054.
8/24/11		0		0		0		Y	440	"Baseline" sampling. No river event.
8/26/11		35	1920	0	na	0		Y	950	River events; 940 cfs at 1915 and 870 cfs at 2133.
8/27/11		58	1651	0	na	0		Y	747	Small river event at 2115.
8/28/11		69	2345	0	na	0		N	1,160	Multipeak event starting at 2130 until 1600 (8/29). Max discharge at 0315 (8/29).
9/1/11		340	1820	0.2	1830	0		Y	752	Insignificant river event at 2245.
9/4/11		632	1955	189	2045	0		Y	1,140	River event at 2330; continued to 9/5.
9/5/11		81	2155	0.5	contin	0		N	1,140	No BDD record of this event. River event at 2323 on 9/4.
9/6/11		7.5	1630	0.23	contin	0		N	550	No river event.
9/7/11		80	14:30	11	1648	4	1410	N	550	No river event.
9/10/11		70	0530	15	0615	0.32	1920	N	934	Small river event at 1745.
9/15/11	9/16	11 (9/15)	2145	2 (9/15) 8 (9/16)	1900 0110	0		N	550	No river event.
10/2/11		0		11	1840	0		N	460	No river event.
10/4/11	10/5	13	1925	7	0110 (10/5)	0		N	666	Small river event at 0230.
10/7/11	10/8	14	0030 (10/8)	0	na	0		N	650	No river event.

Table 9. 2012 Storm events and discharges.

Date	Crossover Date	PeakFlow E109.9	PeakTime E109.9	PeakFlow E050.1	PeakTime E050.1	PeakFlow E060.1	PeakTime E60.1	Samples?	Otowi Flow (cfs)	Comments
7/5/12		48	2044	0	na	0		N	2,300	River event at 2230. Guaje 3.7 cfs at 2040.
7/11/12	7/12	680	1900	134	2010	0		Y	2,210	River event at 2200. Additional small peak of 1100 cfs at 1115 on 7/12. Guaje 150 cfs at 1855.
7/16/12		270	1345	<1		0		N	758	No river event. Guaje 280 cfs at 1445.
7/24/12		25	1714	10	1820	0		N	1,200	No river event.
8/3/12	8/4	168 204 203	1550 1855 2100	170	1920	0		N	1,100	Small river event at 1900. Guaje 170 cfs at 1920.
8/5/12		54	1740	0.2	contin	0		N	870	No river event.
8/6/12		86	0639	2.5	1025	0		N	1,030	River event 1370 cfs at 0200.
8/7/12		480	1710	4.2	2100	0		N	920	No river event. Guaje 220 cfs at 1715 and 1840.
8/13/12	8/14	20	2358	0	na	0		N	1,170	Small river event at 2330. Guaje 5 cfs at 2345.
8/18/12	8/19	171	2145	0	na	0		N	850	Small river event at 0000. Guaje 11 cfs at 2155.
8/23/12		3.8 220	0040 1640	4.9	2020	0		Y	1,350	River event from 0100 to 0400; second peak 1,300 cfs at 1900. Guaje 85 cfs at 1700.
8/24/12		157	1455	0.3	contin	0		N	550	No river event. Guaje 7 cfs at 1445.
9/12/12		12	1940	0	na	0		N	596	No river event. River event 1070 cfs at 0333 on 9/13. Guaje 6 cfs at 1930.
9/28/12		6	2250	7	1850	0		N	500	No river event.
10/12/12	10/13	444	1620	30	1730	0		N	6,000	River event, max flow at 1930. Guaje 79 cfs at 1800.

Table 10. 2013 Storm events and discharges.

Date	Crossover Date	PeakFlow E109.9	PeakTime E109.9	PeakFlow E050.1	PeakTime E050.1	PeakFlow E060.1	PeakTime E60.1	Samples?	Otowi Flow (cfs)	Comments
5/21/13		na	na	na	na	na	na	Y	1,100	"Baseline" sampling. No river event.
7/8/13		110	1711	0	na	0	na	N	530	No river event.
7/12/13		180 167	1450 1940	34	1435	0	na	Y	240	No river event. **Guaje** 234 cfs at 1435 and 38 cfs at 1920.
7/13/13		123 251	1435 2145	0	na	0	na	N	1,190	No river event. **Guaje** 1,138 cfs at 2145.
7/20/13	7/21	810	2030	0	na	0	na	N	2,300	River event at 0200; second peak 2,000 cfs at 2300. **Guaje** 483 cfs at 2025.
7/25/13	7/26	100	2400	0	na	0	na	N	236	River event 1,200 cfs later at 0600 on 7/26. **Guaje** max 8 cfs over 6 hrs.
7/26/13	7/27	160	1820	0.8	1745	0	na	N	230	River events 2,300 cfs at 2000. No flow in **Guaje**.
7/28/13	7/29	70	1310	<1	1540	0	na	N	1,710	River event at 1602. **Guaje** <1 cfs at 1255.
8/3/13		950	1635	0	na	0	na	N	500	Small river events at 1900 and 2200. No flow in **Guaje**.
8/4/13		68	1740	0	na	0	na	N	676	Small river event at 1715. No flow in **Guaje.**
8/5/13		1,000	1930	20	1900	1.7	1900	N	520	Small river event at 1930. **Guaje** 340 cfs at 1930.
8/9/13	8/10	270	1640	0	na	0	na	N	860	Small river event at 1900. **Guaje** 357 cfs at 1630.
8/18/13		18	1805	0	na	0	na	N	407	No river event. **Guaje** 2.4 cfs at 1725.
8/20/13		42	1725	0	na	0	na	N	400	No river event. **Guaje** 14 cfs at 1705.
8/30/13		151	1855	0	na	0	na	N	700	Small river events; 700 cfs at 0700 & 650 cfs at 1800. **Guaje** 17 cfs at 1815.
9/1/13		26	1945	0	na	0	na	N	1,100	River event at 1900. **Guaje** 1 cfs at 1900.
9/2/13	9/3	310	2110	0	na	0	na	N	670	Later small river event at 0015. **Guaje** 426 cfs at 2015.
9/10/13	9/11	102 118 128	2135 2325 0210	11 16	0055 0315	0	na	Y	400	Later river events; 650 cfs at 0015 & 1050 cfs at 0800. **Guaje** 1 cfs at 2305.
9/12/13	9/13	520	1820	87	1955	0.2	1830	Y	870	Small river event 550 cfs at 2100. **Guaje** 4.4 cfs at 1810.
9/13/13		5,000		750	1025	1,400		N	8,000	Large river event 8,000 cfs from 0900 to 1200. **Guaje** 1,460 cfs at 1035.
9/14/13		41	1730	48	0120	0	na	N	2,280	Small river event at 1130.
9/21/13		station down		8	1640	30	1705	N	1,010	Small river event at 0500 at 1,220 cfs.
9/22/13	9/23	station down		34	2245	28	2316	N	4,950	Max flow at 0000 on 9/23.
10/3/13	10/4	station down		7	24 hrs	0	na	N	1,100	No river event.
11/4/13	11/5	station down		12	1947	1.7	2154	N	775	Small river event at 2346.

Table 11. 2014 Storm events and discharges.

Date	Crossover Date	PeakFlow E109.9	PeakTime E109.9	PeakFlow E050.1	PeakTime E050.1	PeakFlow E060.1	PeakTime E60.1	Samples?	Otowi Flow (cfs)	Comments
7/3/14		NMED 110						N	1,390	Small river event at 0753.
7/9/14	AM & PM	NMED 110						N	1,010	Insignificant event at 0503.
7/10/14		NMED 110						N	900	No river event.
7/15/14		no station NMED 110	na	0	na	0		Y	2,630	River event at 0645.
7/16/14		no station	na	63	0118	<1		Y	6,750	River event from 0045 to 0800.
7/24/14		no station	na	0	na	0		Y	980	Small river event from 0600 to 1500.
7/28/14	7/29	NMED 110						N	2,360	River event from 2000 to 0400.
7/29/14		no station NMED 110	na	78	1450	3	1730	Y	2,160	River event from 1630 to 1830.
7/31/14	8/1	no station NMED 110	na	220	2005	81	2115	Y	4,560	River event at 2000.
8/4/14		no station NMED 110	na	0	na	0		Y	2,300	River event at 1500.
8/26/14	08/27 AM	no station NMED 110	na	0	na	0		Y	1,240	River event starting at 1903, multi-peak and long term event.
8/27/14	PM	NMED 110						N	1,050	Insignificant event of 1,200 cfs at 0140.
9/5/14	9/6	no station	na	0	na	0		Y	2,560	River event at 1900.
9/22/14	9/23	no station	na	0	na	0		Y	7,000	River event at 2230.

During the 2014 season, the gage station E109.9 was not operational, and, therefore flow readings were not available. However, NMED/DOE OB set up a sampler E110, located near the location of E109.9. The dates in the table indicate when that sampler was triggered and/or collected samples in the lower LA Canyon. The dates when E110 was triggered (NMED, 2014) indicate potential flow in the lower LA Canyon because the sampling trigger is a specific rate of rise in the channel stage, not a measure of discharge. With the exception of one reading (7/29 for E060.1) all discharges values were taken from the ultrasound probe.

III.5 Sampling Plan During Storm Events

III.5.a LANL Stations Sampling Strategy

During each monitoring season, the samplers were reconfigured to initiate sampling routines when a preset stage height corresponding to discharge of 5 or 10 cfs was recorded on the data logger. During 2011 season, all LANL gages were configured to initiate sampling at discharge 5 cfs or greater. After 2011, gage E109.9 was re-configured to initiate sampling at discharges of 10 cfs or greater. Where two samplers were installed, one sampler was configured with a 24-bottle carousel to monitor primarily sediment, and the second sampler was 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 was installed at the other locations in the LA/P watershed to monitor suspended sediment, inorganic and organic chemicals, and radionuclides. More information on the sampling plans for LANL stations could be found in LANL annual reports of the LA/PCW.

III.5.b BDD Station Sampling Strategy

The BDD sampling design and strategy was focused on sampling LA/PC flows that may reach the Diversion. A lot of time was expended on trying to determine when such flow might arrive at the BDD Intake, and time was spent analyzing collected discharge data in order to determine whether BDD was successful in sampling potential LA/PC flow arriving at BDD with Rio Grande discharges during storm events. The detailed data from each storm event presented in Section IV give such insights.

The sampling strategy and triggers changed over the years. Table 12 lists the sampling design from 2011 through 2013. The marking "T-45" means that the sampler collected storm water at 45 minutes prior to the projected arrival of flow through E109.9; "T0" means that sampler collected water exactly at the projected time of arrival of that flow, and so on. More information on sampling plans is provided in Attachment 2.

For the first three years of the monitoring effort, the trigger for BDD sampling was LANL gage station E109.9. Whenever a discharge of 5 cfs or greater was measured at that station and verified with the gage camera, sampling sequence was initiated at the BDD Intake. During 2012 and 2013 seasons, even if samples were collected pursuant to the trigger, the samples were discarded if middle LA Canyon (E050.1) or Pueblo Canyon (E060.1) did not flow for that specific event. In this report, if the collected samples were discarded, the sampling event was considered "NS" (non-sampled). This strategy was adopted pursuant to LANL sediment studies in the lower LAC which asserted that contaminants' concentrations in the lower LA Canyon where E109.9 was located were of much lower concentrations than the concentrations at upper and middle LA Canyon and Pueblo Canyon, E050.1 and E060.1 respectively. LANL staff expressed the opinion that if surface run off through gage stations E050.1 and E060 was not flowing then the contaminants concentrations in storm water arriving at the Rio Grande would be insignificant. The Plutonium 239/240 study presented in Section VII.6 demonstrated this assumption to be incorrect. In order for the SCADA to calculate the initial times to

start sampling, it was assumed that the travel time for a flow from E109.9 to BDD Intake was approximately 90 minutes.

During the 2014 season, the autosamplers were programmed to take samples approximately 2 hrs prior to, 2 hrs during, and 3 hrs after the projected arrival of flow from LA/P Canyon system, based on the time of arrival modeled after empirical data of time of travel from E050.1 to E109.9 provided by LANL staff, and assuming that the travel time from the former E109.9 location to BDD was 60 minutes. The time of arrival from E050.1 or E060.1 to BDD Intake was calculated using the formula: $Time\ (\text{minutes}) = 313.37 \times Qpeak(cfs)^{-0.283} + 60$. The data and model are presented in Attachment 3. Even though the table below lists a specific sampling strategy, the autosamplers were not always successful in collecting storm water, or the project manager used professional judgment in selecting which samples and how many would be sent for analyses.

Table 12. BDD sampling strategy and triggers.

Analytes	**2011 Trigger E109.9**	**2012 Trigger E109.9**	**2013 Trigger E109.9**	**2014 Trigger E050.1 or E060.1 or RG[1] Turbidity**
SSC	T-45 T0 T45 T90 T135 T180	T0 T45 T90 T135 T180 T225	T0 T45 T90 T135 T180 T225	T-120 T-75 T-30 T15 T60 T115 T160
Rads (F/UF)[2]	T0 T45 T90	T0 T45 T90	T0 T45 T90	
Metals & Gross α-β (F/UF)[2]	T0	T0	T0	
D/F & TOC & TDS & Particle size	T0	T0	T0	T0 T120
PCBs	T0 T45 T90	T0 T45 T90	T0 T45 T90	T-120 T0 T120 T180
Cyanide	T0	T0	T0	T-120 T0 T120 T180

Considering the fact that LANL station E109.9 no longer existed, stations E050.1 and E060.1 became the triggers for 2014 sampling. Whenever flow of 5 cfs or greater was detected through E050.1 or

[1] Rio Grande

[2] F for filtered and UF for unfiltered field preparation method

E060.1 or both combined, the BDD SCADA would sound an alarm, and a start signal would be sent to the automated samplers.

In addition to the LA/PC watershed sampling, in 2014 BDD conducted storm water sampling based on the Rio Grande storm events only (no LAC flow). There could be river storm events when LA/PC watershed does not experience storm flow, and river events when LA/PCW is experiencing storm flow. The intent of this sampling was to test what LANL contaminants may still be stored in the river sediments between LA/PCW confluence with the Rio Grande and the BDD, and what contaminants may be brought down from the upper reaches of the Rio Grande above Otowi Bridge. However, this goal could not be accomplished with high confidence because there was no flow indicator in the lower LA Canyon in order to provide flow information on that part of the canyon. BDD obtained some information on possible flows at the former E109.9 location through NMED/DOE OB. This entity installed a sampler, NMED 110, at approximately the same location as E109.9 but it did not have a real-time communication capability with BDD SCADA. However, the data from NMED 110 will be used during the analysis of the sampling results.

III.6 Sampling and Analysis Plan

The 2010 MOU specified that LANL sampling system of LA/PC watershed would include three gage stations: E050, E060, and E109.9 equipped with automated samplers that would be triggered by detection of runoff of 5 cfs or greater. The MOU recognized the fact that the sampling and analysis plan for this system should be consistent with the NMED approved Work Plan for the specific monitoring season, but that elements in the Sampling and Analysis Plan (SAP) are negotiable. In addition, the MOU specified that sample collection and processing would be conducted per LANL SOPs and EPA-approved guidelines and methods. Appendix A-1 of the 2010 MOU listed the specific constituents, methods, detection limits, and field preparation methods as shown in Table 13. The last four analytes highlighted in the table constitute the additional analytes of the BDD station sampling list.

The suspended sediment concentration (SSC) was originally analyzed by method EPA 160.2, which analyzed the parameter TSS (Total Suspended Solids). According to the USGS (Gray, 2000), "the method for determining TSS, which was originally designed for analyses of wastewater samples, is shown to be fundamentally unreliable for the analysis of natural-water samples. In contrast, the method for determining SSC produces relatively reliable results for samples of natural water, regardless of the amount or percentage of sand-sized material in the samples." The method for SSC was revised to ASTM method D3977-97, and was subsequently used for the remaining MOU samples.

Table 13. 2010 MOU analyte list.

Analytes	Method	Detection Limit	Field Prep Code
SSC	EPA:160.2 (ASTM:D3977-97)	3 mg/L	UF
TAL metals (23) plus Hg	EPA:200.7, EPA: 200.8, EPA:245.2	0.2-300 mg/L	F, UF
Hardness	SM:A2340B	2 mg/l	UF
Gross alpha	EPA:900	3 pCi/L	F, UF
Gross beta	EPA:900	3 pCi/L	F, UF

Analytes	Method	Detection Limit	Field Prep Code
Strontium-90	EPA:905.0	0.5 pCi/L	F, UF
Americium-241	HASL-300:AM-241	0.05 pCi/L	F, UF
Gross gamma	EPA:901.1	15 pCi/L	F, UF
Cesium-137	EPA:901.1	5 pCi/L	F, UF
Cobalt-60	EPA:901.1	5 pCi/L	F, UF
Sodium-22	EPA:901.1	10 pCi/L	F, UF
Neptunium-237	EPA:901.1	40 pCi/L	F, UF
Potasium-40	EPA:901.1	75 pCi/L	F, UF
Plutonium (isotopic)	HASL-300:ISOPU	0.05 pCi/L	F, UF
Uranium (isotopic)	HASL-300:ISOU	0.05 pCi/L	F, UF
Dioxins/Furans	SW-846:8290	0.2-0.5 pCi/L	UF
PCBs	EPA 1668A	20-150 pCi/L	UF
Radium-226 & 228	EPA:903.1 & EPA:904.4	1 pCi/L	F, UF
TDS	EPA:160.1	10 mg/L	F
TOC	SW-846:9060	1 mg/L	UF
Particle size analysis	ASTM C-1070-01	0.1%	UF
Perchlorate	SW0846:6850 Modified	0.2 mg/L	UF

Table 14 is an excerpt from (LA-UR-14-22549, May 2015). The highlighted area presents the similarities in the analytical suite for the LANL LA/PC gages and the BDD sampling station. Cyanide was added to this list for the entire duration of the 2010 MOU as a result of the Las Conchas fire.

The sampling conducted by NMED/DOE OB included the contaminants Gross alpha/beta, Uranium and Plutonium isotopes (total recoverable in water and/or in suspended sediments), Americium 241, Strontium 90, and Cesium 137. Most samples were analyzed for Plutonium 238, Plutonium 239/240, and suspended sediments. The analytical suite for NMED/DOE OB was reduced to radionuclides, which are the LANL contaminants of concern for the LA/PCW. Whenever NMED funding allowed, this list was expanded to PCBs and metals.

Table 14. 2014 LA/P canyons watershed sampling suite.

Analytical Requirements for Storm Water Samples

Analytical Suite	Method	Detection Limit[a]	Upper Los Alamos Canyon	DP Canyon	Upper Pueblo Canyon and Acid Canyon	Lower Los Alamos Canyon	Lower Pueblo Canyon	BDD[b]-Required Monitoring	Detention Basins below the SWMU 01-001(f) Drainage
PCBs[c]	EPA:1668A	25 pg/L	√[d]	√	√	√	√	√	√
Isotopic plutonium	HASL-300	0.5 pCi/L	√	√	√	√	√	√	—[e]
Gamma spectroscopy	EPA:901.1	10 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[f] metals	EPA:200.7/200.8/245.2	Variable	√	√	√	√	√	√	√
Dioxins and furans	EPA:1613B	50 pg/L	√	—	—	√	—	√	—
Gross alpha	EPA:900	10 pCi/L	—	—	—	—	—	√	—
Gross beta	EPA:900	10 pCi/L	—	—	—	—	—	√	—
Radium-226/radium-228	EPA:903.1/EPA:904	0.5/0.5 pCi/L	—	—	—	—	—	√	—
SSC	EPA:160.2	10 mg/L	√	√	√	√	√	√	√
Total organic carbon	SW-846:9060	0.5 mg/L	—	—	—	—	—	—	√
Particle size	ASTM:C1070	0.01%	√	√	√	√	√	√	√

[a] MDL or MDA for radionuclides.

[b] BDD = Buckman Direct Diversion.

[c] PCBs = Polychlorinated biphenyls.

[d] √ = Monitoring planned.

[e] — = Monitoring not planned.

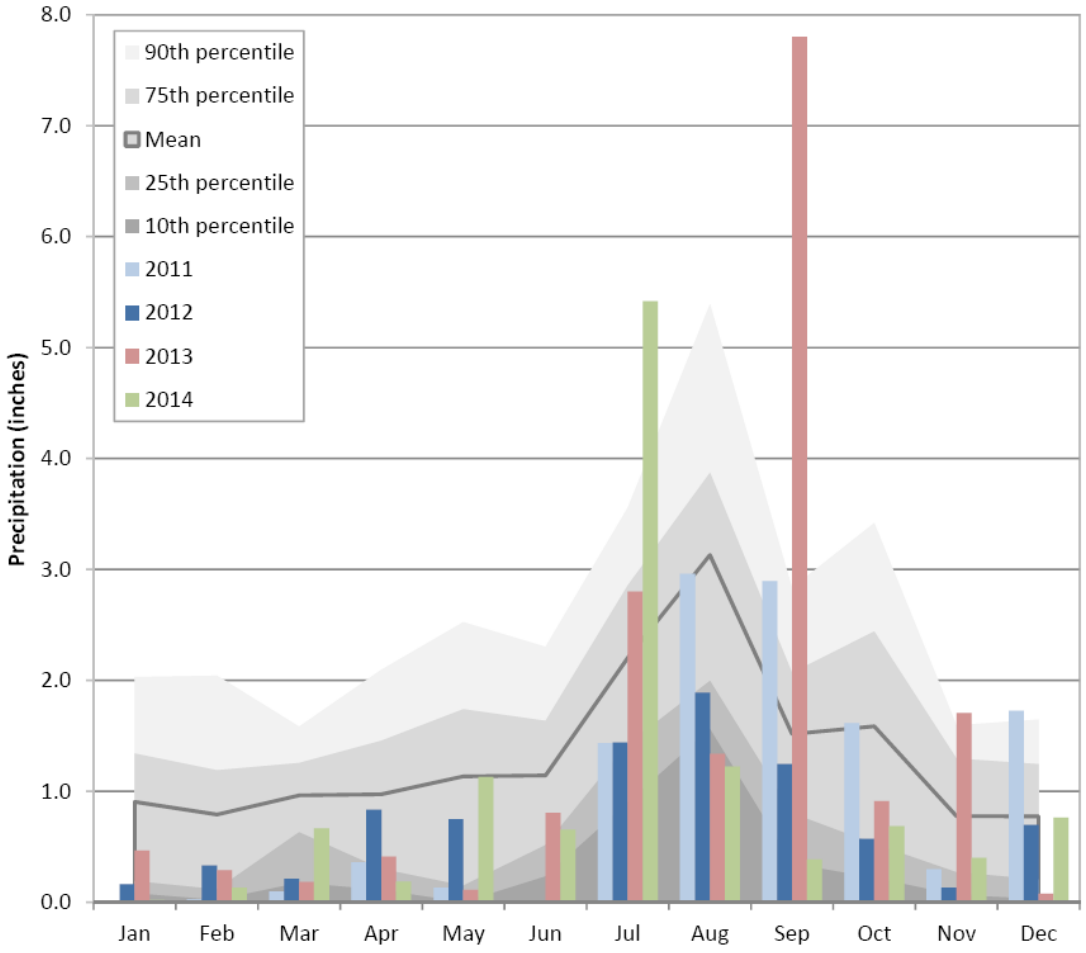
[f] TAL = Target analyte list; hardness is calculated from calcium and magnesium, components of the TAL list.

IV. BDD STORM EVENTS - DETAILS

IV.1 Summer Precipitation 2011-2014

The figure below depicts the total precipitation across LANL for each month from 2011 to 2014. The graph also plots statistical data (mean, 75th and 95th percentiles) of collected data from 1992 to 2010. The figure is based on meteorological tower data averaged across the Laboratory properties.

Figure 11. Monthly precipitation across LANL from 2011 to 2014.



The rainfall during the summer months day by day is provided in Table 15. The highlighted cells mark selected storm events in the LA/PCW during which flows from LA/PC may have reached the RG.

Station Name: Otowi Mesa, Los Alamos NM 87544
Weather station ID: KNMLOSAL6
Lat/Long: 35.897, -106.260
Altitude: 7,170 ft
Hardware: Davis Vantage Pro 2
Software: weatherlink.com 1.10

Table 15. Daily precipitation data for Los Alamos 2011-2014

2014	Precip. (in)	Events	2013	Precip. (in)	Events	2012	Precip. (in)	Events	2011	Precip. (in)	Events
Jul	sum		Jul	sum		Jul	sum		Jul	sum	
1	0	Rain	1	0		1	0		1	0	
2	0.09	Rain	2	0.03	Rain	2	0	Rain	2	0.05	Rain
3	0.09	Rain	3	0.06	Rain	3	0	Rain	3	0	Rain
4	0		4	0.04		4	0.07	Rain	4	0	
5	0.01	Rain	5	0.17	Rain	5	0	Rain	5	0	
6	0		6	0.05	Rain	6	0	Rain	6	0	
7	0	Rain	7	0.01	Rain	7	0.22	Rain	7	0	
8	0.06	Rain	8	0	Rain	8	0		8	0	
9	0.54	Rain	9	0	Rain	9	0	Rain	9	0	Rain
10	0.01	Rain	10	0	Rain	10	0	Rain	10	0	Rain
11	0	Rain	11	0.01	Rain	11	0	Rain	11	0	Rain
12	0		12	0.04	Rain	12	0		12	0	
13	0	Rain	13	0.06	Rain	13	0	Rain	13	0	
14	0	Rain	14	0.02	Rain	14	0		14	0	
15	1.22	Rain	15	0	Rain	15	0		15	0	
16	0.29	Rain	16	0		16	0	Rain	16	0	
17	0	Rain	17	0		17	0		17	0	
18	0		18	0		18	0		18	0	
19	0.09	Rain	19	0	Rain	19	0		19	0	
20	0.21	Rain	20	0.01	Rain	20	0		20	0	Rain
21	0.01	Rain	21	0.11	Rain	21	0.16	Rain	21	0	Rain
22	0		22	0.09		22	0		22	0	Rain
23	0		23	0		23	0		23	0	
24	0		24	0		24	0	Rain	24	0	Rain
25	0		25	0.22	Rain	25	0.12	Rain	25	0	Rain
26	0	Rain	26	0.25	Rain	26	0		26	0	
27	0.08	Rain	27	0.13		27	0		27	0	Rain
28	0		28	0.23	Rain	28	0		28	0.24	Rain
29	0.2	Rain	29	0		29	0		29	0.16	Rain
30	0.01	Rain	30	0	Rain	30	0		30	0.41	Rain
31	0.85	Fog, Rain	31	0	Rain	31	0		31	0	Rain
2014	**Precip. (in)**	**Events**	**2013**	**Precip. (in)**	**Events**	**2012**	**Precip. (in)**	**Events**	**2011**	**Precip. (in)**	**Events**
Aug	sum		Aug	sum		Aug	sum		Aug	sum	
1	0.25	Rain	1	0.01	Rain	1	0		1	0.45	Rain
2	0.02		2	0.04	Rain	2	0.23	Rain	2	0	
3	0		3	0		3	0.06	Rain	3	0.69	Rain
4	0.58	Rain	4	0.16	Rain	4	0		4	0.13	Rain
5	0.02	Rain	5	0.01	Rain	5	0.07	Rain	5	0.18	Rain
6	0		6	0.01	Rain	6	0.21	Rain	6	0	Rain

7	0	Rain	7	0		7	0.01	Rain	7	0	
8	0		8	0.04	Rain	8	0		8	0	
9	0		9	0.01	Rain	9	0	Rain	9	0	
10	0.28	Rain	10	0		10	0	Rain	10	0.01	Rain
11	0		11	0		11	0	Rain	11	0	Rain
12	0		12	0	Rain	12	0.04	Rain	12	0	
13	0	Rain	13	0.02	Rain	13	0	Rain	13	0.2	Rain
14	0.04	Rain	14	0.01	Rain	14	0	Rain	14	0	Rain
15	0	Rain	15	0		15	0.01	Rain	15	0.09	Rain
16	0		16	0		16	0.1	Rain	16	0	
17	0		17	0	Rain	17	0.01	Rain	17	0	
18	0		18	0.05	Rain	18	0	Rain	18	0	Rain
19	0		19	0.02		19	0	Rain	19	0.05	Rain
20	0		20	0.04	Rain	20	0.02	Rain	20	0.02	Rain
21	0		21	0.03		21	0		21	0.18	Rain
22	0.07	Rain	22	0	Rain	22	0		22	0	Rain
23	0		23	0		23		no info	23	0	
24	0		24	0		24		no info	24	0	Rain
25	0		25	0	Rain	25		no info	25	0	Rain
26	0.11	Rain	26	0		26		no info	26	0	
27	0.23	Rain	27	0		27		no info	27	0.23	Rain
28	0		28	0		28		no info	28	0.01	Rain
29	0		29	0		29	0		29	0	Rain
30	0		30	0		30	0		30	0	Rain
31	0		31	0		31	0		31	0	

2014	**Precip. (in)**	**Events**	**2013**	**Precip. (in)**	**Events**	**2012**	**Precip. (in)**	**Events**	**2011**	**Precip. (in)**	**Events**
Sep	sum		Sep	sum		Sep	sum		Sep	sum	
1	0		1	0	Rain	1	0		1	0.71	Rain
2	0		2	0.1	Rain	2	0.01	Rain	2	0	Rain
3	0		3	0.1	Rain	3	0	Rain	3	0	Rain
4	0		4	0		4	0		4	0.2	Rain
5	0.22	Rain	5	0		5	0		5	0	
6	0.06		6	0		6	0		6	0.01	Rain
7	0	Rain	7	0		7	0.01	Rain	7	0.36	Rain
8	0	Rain	8	0.02	Rain	8	0.01		8	0	Rain
9	0		9	0.02		9	0		9	0.03	Rain
10	0	Rain	10	0.86	Rain	10	0	Rain	10	0.33	Rain
11	0		11	0.29	Fog, Rain	11	0.05	Rain	11	0	
12	0	Rain	12	1.03	Rain	12	0.4	Rain	12	0.01	Rain
13	0		13	2.56	Rain	13	0.06	Rain	13	0	Rain
14	0		14	0.23	Rain	14	0		14	0.29	Rain
15	0		15	0.08	Rain	15	0		15	0.28	Rain
16	0		16	0.01		16	0		16	0.06	Rain

17	0		17	0		17	0		17	0	Rain
18	0		18	0.2	Rain	18	0		18	0	
19	0		19	0	Rain	19	0		19	0	
20	0		20	0		20	0		20	0	
21	0		21	0.51	Rain	21	0		21	0	
22	0.01	Rain	22	0.49	Rain	22	0		22	0	
23	0	Fog	23	0.21		23	0		23	0	
24	0		24	0		24	0	Rain	24	0	
25	0		25	0		25	0.01	Rain	25	0	
26	0		26	0		26	0		26	0	
27	0		27	0	Rain	27	0.09	Rain	27	0	Rain
28	0	Rain	28	0		28	0.07	Rain	28	0	
29	0.12	Rain	29	0		29	0.04	Rain	29	0	
30	0		30	0		30	0		30	0	

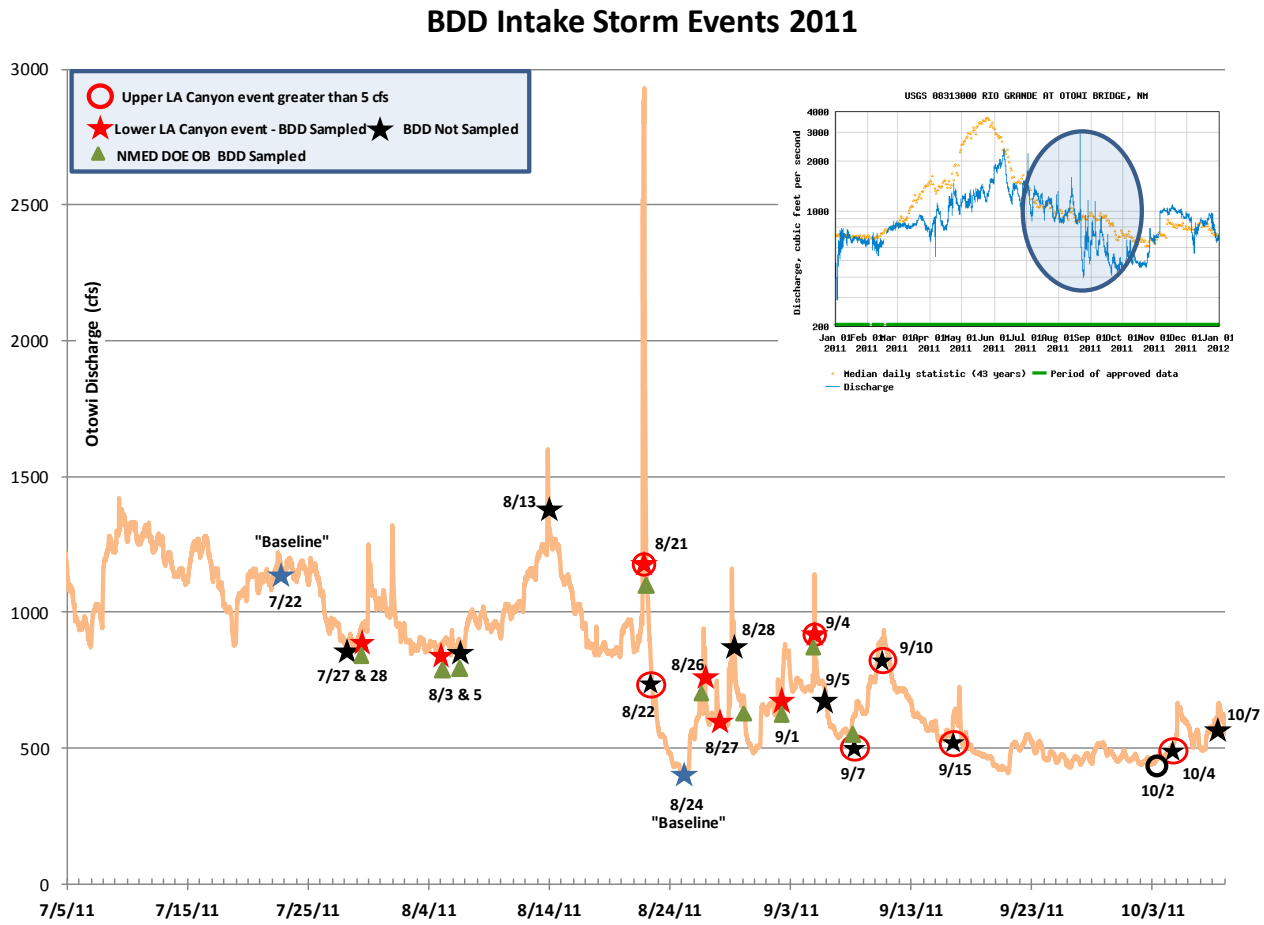
2014	**Precip. (in)**	**Events**	**2013**	**Precip. (in)**	**Events**	**2012**	**Precip. (in)**	**Events**	**2011**	**Precip. (in)**	**Events**
Oct	sum		Oct	sum		Oct	sum		Oct	sum	
1	0		1	0		1	0		1	0	
2	0		2	0		2	0		2	0	
3	0		3	0		3	0		3	0	
4	0		4	0		4	0		4	0.25	Rain
5	0		5	0		5	0		5	0.06	Rain
6	0		6	0		6	0		6	0	
7	0		7	0		7	0		7	0.31	Rain, Snow
8	0	Rain	8	0	Rain	8	0		8	0.01	Snow
9	0.69	Rain	9	0.01	Rain	9	0		9	0	
10	0.05	Rain	10	0.16		10	0		10	0	
11	0.02	Fog	11	0		11	0		11	0	
12	0.01	Rain	12	0	Rain	12	0.7	Rain	12	0	
13	0		13	0.1	Rain	13	0		13	0	
14	0		14	0	Rain	14	0		14	0	
15	0		15	0.06	Rain, Snow	15	0		15	0	
16	0		16	0.01		16	0		16	0	
17	0		17	0		17	0		17	0	
18	0.05	Rain	18	0		18	0		18	0	
19	0		19	0		19	0		19	0	
20	0		20	0		20	0		20	0	
21	0.02	Rain	21	0		21	0		21	0	
22	0		22	0		22	0		22	0	
23	0		23	0	Rain	23	0		23	0	
24	0		24	0	Rain	24	0		24	0	
25	0		25	0.28		25	0		25	0	
26	0	Rain	26	0		26	0		26	0.23	Rain

27	0		27	0		27	0		27	0.03	Fog, Rain, Snow
28	0		28	0	Rain	28	0		28	0	
29	0		29	0	Rain, Snow	29	0		29	0	
30	0		30	0		30	0		30	0	
31	0		31	0					31	0	
2014	**Precip. (in)**	**Events**	**2013**	**Precip. (in)**	**Events**	**2012**	**Precip. (in)**	**Events**	**2011**	**Precip. (in)**	**Events**
			Nov	sum							
			1	0							
			2	0							
			3	0	Rain						
			4	0.49	Fog, Rain, Snow						
			5	0.12							
			6	0							

IV.2 2011 Storm Events

The graph below pictures the Rio Grande discharge as measured at the Otowi Gage station. Superimposed on the graph are the dates of storm events that occurred in the LA/PCW whose flows might have reached the RG. The graph also marks which of those events were sampled by BDD. The green triangles mark events that were sampled by NMED/DOE OB at the BDD intake.

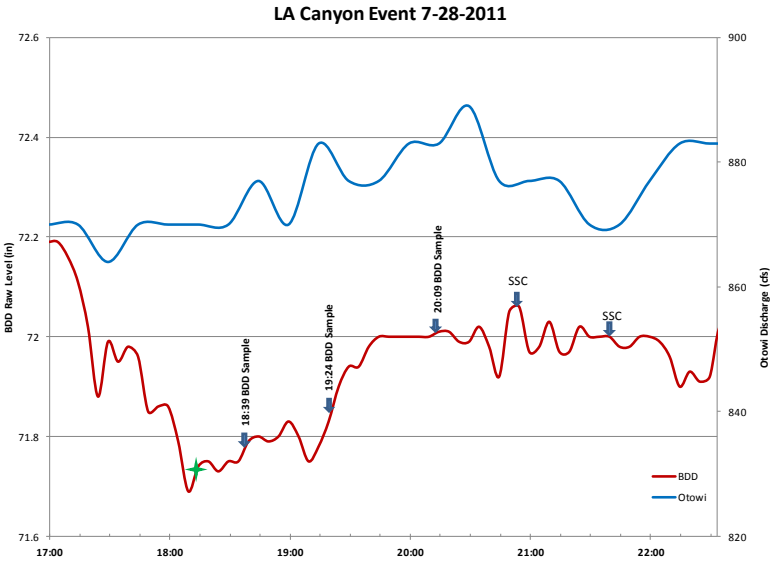
Figure 12. 2011 Otowi gage discharge and BDD Intake sampling.

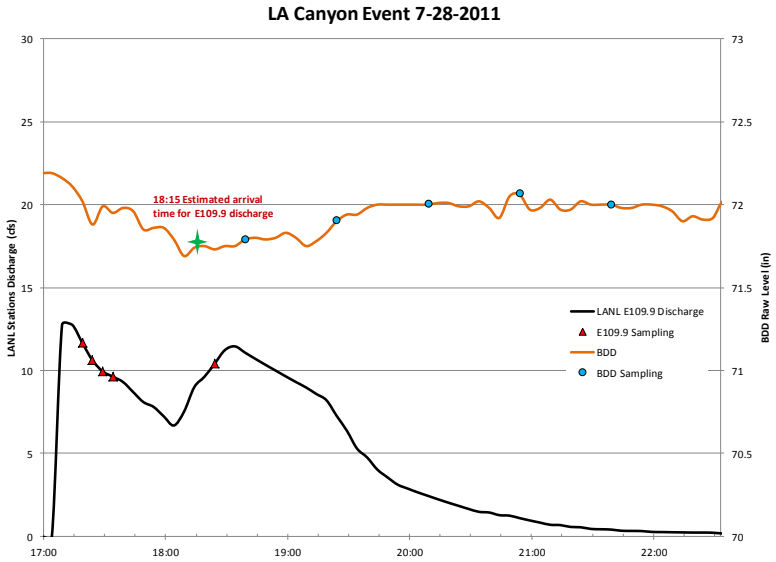


The rest of this section dedicates a page or two to each storm event or potential storm event (applicable to 2014 since there was no flow indicator in the lower LA Canyon), in terms of triggers, environment conditions, sampling pattern of the autosamplers, maximum discharges at applicable gage stations, hydrographs at Otowi Gage, BDD (transducer), and LANL gage stations. In addition, a time plot of the SSC as measured by method EPA 160.2 and ASTM D3977 was presented as well. Whenever possible, an interpretation of the plots was offered.

IV.2.a July 28, 2011 LAC

Narrative of Event: This was a LA Canyon storm event. Sampling was triggered by E109.9 flow. Its flow was too low to be observed at BDD Intake.



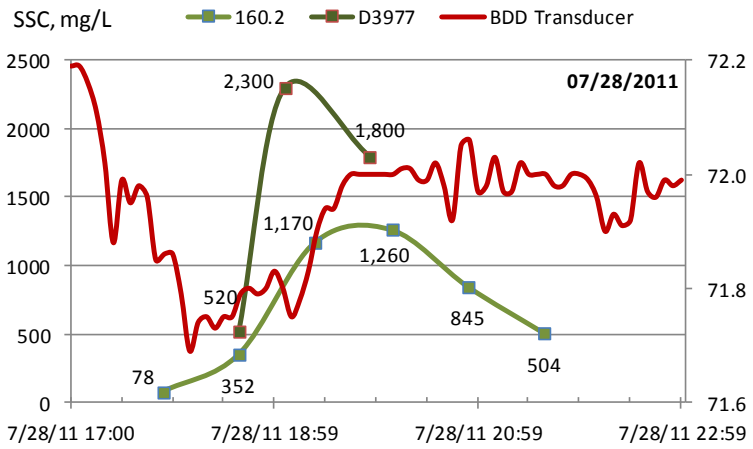


Station	Max Discharge cfs	Time
Otowi	890	na
E050.1	0	na
E060.1	0	na
E109.9	13	17:15
BDD	na	na

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	Gross a-b/Metals	18:39	870
2	PCBs	18:39	870
	PCBs QC Spike		
3	No record of this analysis	18:39	870
	PCBs Dup		
4	Lab did SSC instead	18:39	870
5	Dioxins/Furans	18:39	870
6	Perchlorate/TOC	18:39	870
7	Particle size	18:39	870
8	Gross a-b (F)	18:39	870
9	Metals (F)	18:39	870
10	TDS (F)	18:39	870
11	PCBs	19:24	870
12	PCBs	20:09	877
Bottle #	Sampler BDD1	Time	Otowi Discharge (cfs)
1	SSC	17:54	870
2	SSC	18:39	870
3	SSC	19:24	870
4	SSC	20:09	877
5	SSC	20:54	883
6	SSC	21:39	877
7	GS-IsoU/Pu/Am241	18:39	870
8	GS-IsoU/Pu/Am241 (F)	18:39	870
9	Sr 90	18:39	870
10	Sr 90 (F)	18:39	870
11	Ra 226/228	18:39	870
12	Ra 226/228 (F)	18:39	870
13	GS-IsoU/Pu/Am241	19:24	870
14	GS-IsoU/Pu/Am241 (F)	19:24	870
15	Sr 90	19:24	870
16	Sr 90 (F)	19:24	870
17	Ra 226/228	19:24	870
18	Ra 226/228 (F)	19:24	870
19	GS-IsoU/Pu/Am241	20:09	877
20	GS-IsoU/Pu/Am241 (F)	20:09	877
21	Sr 90	20:09	877
22	Sr 90 (F)	20:09	877
23	Ra 226/228	20:09	877
24	Ra 226/228 (F)	20:09	877

Week of 7-24-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Jul	high	avg	low	high	avg	low	high	avg	low	sum	
24	82	73	64	52	38	26	26	7	34	0	Rain
25	78	70	62	64	50	32	14	6	23	0	Rain
26	86	74	62	59	39	20	20	6	26	0	
27	80	70	59	77	48	29	18	3	21	0	Rain
28	82	73	64	52	41	25	25	6	33	0.24	Rain
29	78	70	62	72	50	32	16	7	31	0.16	Rain
30	78	68	59	82	60	30	23	4	26	0.41	Rain

The RG did not experience storm event on this date, therefore, the peak in SSC was the result of the LA Canyon flow. The LAC flow was estimated to arrive at BDD at 18:15, and the peak in SSC occurred at 18:45, lagging about 30 min. The increase in SSC was not very large consistent with a low LAC discharge (13 cfs).



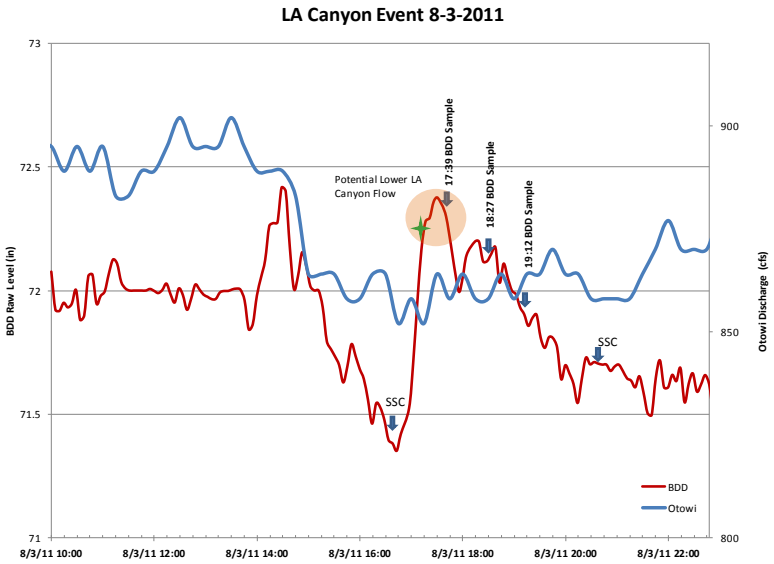
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

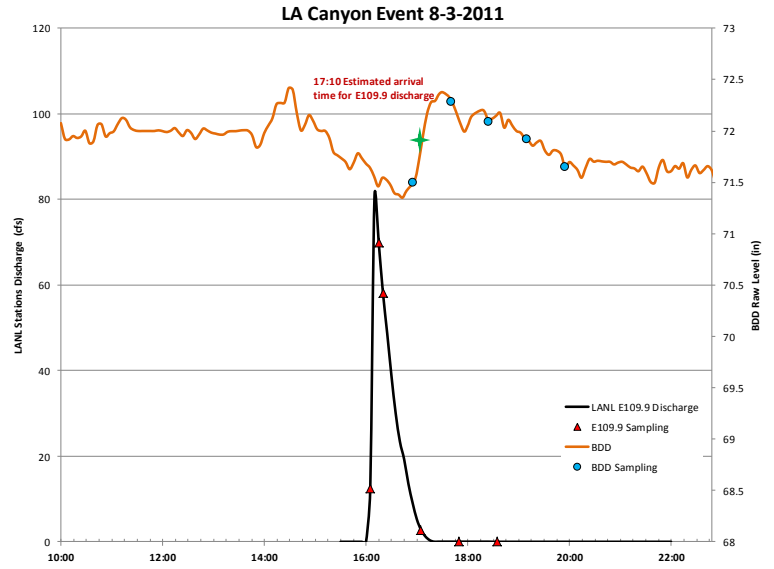
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
7/28/11 18:39	Americium-241	0.0549	pCi/L	N	HASL-300:AM-241
7/28/11 18:39	Gross alpha	7.42	pCi/L	N	EPA:900
7/28/11 18:39	Gross beta	13.2	pCi/L	N	EPA:900
7/28/11 18:39	Plutonium-239/240	0.161	pCi/L	N	HASL-300:ISOPU
7/28/11 18:39	Radium-226	1.05	pCi/L	N	EPA:903.1
7/28/11 18:39	Radium-228	1.53	pCi/L	N	EPA:904
7/28/11 18:39	SSC	520	mg/L	N	ASTM:D3977-97
7/28/11 18:39	Strontium-90	0.783	pCi/L	N	EPA:905.0
7/28/11 18:39	Uranium-234	1.98	pCi/L	N	HASL-300:ISOU
7/28/11 18:39	Uranium-234	0.758	pCi/L	Y	HASL-300:ISOU
7/28/11 18:39	Uranium-235	0.12	pCi/L	N	HASL-300:ISOU
7/28/11 18:39	Uranium-238	1.7	pCi/L	N	HASL-300:ISOU
7/28/11 18:39	Uranium-238	0.484	pCi/L	Y	HASL-300:ISOU
7/28/11 19:06	Plutonium-239/240	0.15	pCi/g	N	Generic:Alpha-Spec
7/28/11 19:06	Plutonium-239/240	0.25	pCi/L	N	Generic:Alpha-Spec
7/28/11 19:06	SSC	2300	mg/L	N	ASTM:D3977-97
7/28/11 19:06	Strontium-90	1.2	pCi/L	N	Generic:GFPC
7/28/11 19:06	Uranium-234	2.6	pCi/L	N	Generic:Alpha-Spec
7/28/11 19:06	Uranium-238	2.5	pCi/L	N	Generic:Alpha-Spec
7/28/11 19:24	Americium-241	0.0758	pCi/L	N	HASL-300:AM-241
7/28/11 19:24	Cesium-137	4.88	pCi/L	N	EPA:901.1
7/28/11 19:24	Plutonium-239/240	0.216	pCi/L	N	HASL-300:ISOPU
7/28/11 19:24	Radium-226	2.07	pCi/L	N	EPA:903.1
7/28/11 19:24	Radium-226	0.841	pCi/L	Y	EPA:903.1

7/28/11 19:24	Radium-228	2.52	pCi/L	N	EPA:904
7/28/11 19:24	Strontium-90	1.16	pCi/L	N	EPA:905.0
7/28/11 19:24	Uranium-234	2.99	pCi/L	N	HASL-300:ISOU
7/28/11 19:24	Uranium-234	0.783	pCi/L	Y	HASL-300:ISOU
7/28/11 19:24	Uranium-235	0.158	pCi/L	N	HASL-300:ISOU
7/28/11 19:24	Uranium-238	2.88	pCi/L	N	HASL-300:ISOU
7/28/11 19:24	Uranium-238	0.563	pCi/L	Y	HASL-300:ISOU
7/28/11 19:56	Plutonium-239/240	0.14	pCi/g	N	Generic:Alpha-Spec
7/28/11 19:56	Plutonium-239/240	0.21	pCi/L	N	Generic:Alpha-Spec
7/28/11 19:56	SSC	1800	mg/L	N	ASTM:D3977-97
7/28/11 19:56	Uranium-234	3.2	pCi/L	N	Generic:Alpha-Spec
7/28/11 19:56	Uranium-238	3.3	pCi/L	N	Generic:Alpha-Spec
7/28/11 20:09	Americium-241	0.115	pCi/L	N	HASL-300:AM-241
7/28/11 20:09	Cesium-137	5.12	pCi/L	N	EPA:901.1
7/28/11 20:09	Plutonium-239/240	0.18	pCi/L	N	HASL-300:ISOPU
7/28/11 20:09	Potassium-40	54.7	pCi/L	N	EPA:901.1
7/28/11 20:09	Radium-226	2.14	pCi/L	N	EPA:903.1
7/28/11 20:09	Radium-228	2.41	pCi/L	N	EPA:904
7/28/11 20:09	Strontium-90	0.821	pCi/L	N	EPA:905.0
7/28/11 20:09	Strontium-90	0.98	pCi/L	Y	EPA:905.0
7/28/11 20:09	Uranium-234	2.58	pCi/L	N	HASL-300:ISOU
7/28/11 20:09	Uranium-234	0.874	pCi/L	Y	HASL-300:ISOU
7/28/11 20:09	Uranium-235	0.0931	pCi/L	N	HASL-300:ISOU
7/28/11 20:09	Uranium-238	2.59	pCi/L	N	HASL-300:ISOU
7/28/11 20:09	Uranium-238	0.682	pCi/L	Y	HASL-300:ISOU

IV.2.b August 3, 2011 LAC

Narrative of Event: This was a LA Canyon storm event. Sampling was triggered by E109.9 flow. Its flow was observed at BDD Intake at the estimated time as indicated on the graph.





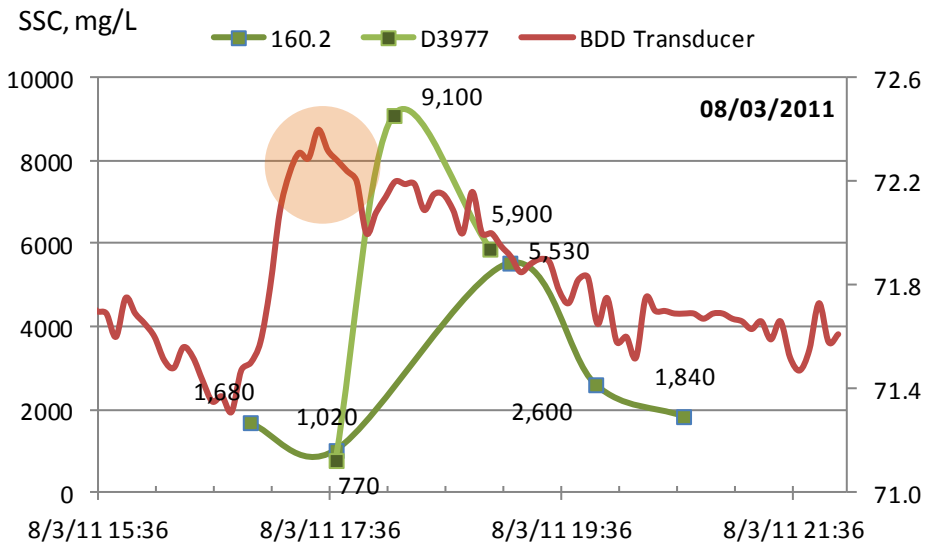
Station	Max Discharge cfs	Time
Otowi	864	na
E050.1	0	na
E060.1	0	na
E109.9	90	16:15
BDD	na	17:30

Sampling & Analyses Information			
Bottle #	**Sampler BDD2**	**Time**	**Otowi Discharge (cfs)**
1	Gross a-b	17:39	858
2	PCBs	17:39	858
3	Gross a-b (F)	17:39	858
4	Perchlorate/TOC	17:39	858
5	Dioxins/Furans	17:39	858
6	Metals (F)	17:39	858
7	Metals	17:39	858
8	Metals QC Spike/Dup	17:39	858
9	Particle size	17:39	858
10	PCBs	18:24	858
11		18:47	864
12	PCBs	19:09	864
Bottle #	**Sampler BDD1**	**Time**	**Otowi Discharge (cfs)**
1	SSC	16:54	858
2	SSC	17:39	858
3	sampler failure		
4	SSC	19:09	864
5	SSC	19:54	864
6	SSC	20:39	858
7	GS-IsoU/Pu/Am241	17:38	858
8	GS-IsoU/Pu/Am241 (F)	17:38	858
9	Sr 90	17:38	858
10	Sr 90 (F)	17:38	858
11	Ra 226/228	17:38	858
12	Ra 226/228 (F)	17:38	858
13	Sr 90	18:27	858
14	Sr 90 (F)	18:27	858
15	GS-IsoU/Pu/Am241	18:27	858
16	GS-IsoU/Pu/Am241 (F)	18:27	858
17	Ra 226/228	18:27	858
18	Ra 226/228 (F)	18:27	858
19	Sr 90	19:12	864
20	Sr 90 (F)	19:12	864
21	GS-IsoU/Pu/Am241	19:12	864
22	GS-IsoU/Pu/Am241 (F)	19:12	864
23	Ra 226/228	19:12	864
24	Ra 226/228 (F)	19:12	864

Samples processed on 8/8/2011 15:30

Week of 8-1-11 Weather Information - Los Alamos											
2011	**Temp. (°F)**			**Humidity (%)**			**Wind (mph)**			**Precip. (in)**	**Events**
Aug	high	avg	low	high	avg	low	high	avg	high	sum	
1	80	70	59	82	58	26	12	5	24	0.45	Rain
2	82	72	62	68	46	23	18	5	25	0	
3	80	70	60	82	55	24	22	7	29	0.69	Rain
4	77	72	66	64	54	36	20	5	26	0.13	Rain
5	73	65	59	82	48	27	32	6	40	0.18	Rain
6	82	76	73	24	23	20	20	6	39	0	Rain

The RG did not experience storm event on this date, therefore, the peak in SSC was the result of the LAC flow observed at the BDD Intake as marked on the graph. The delay in the SSC peak was about 1 hr and 40 min (BDD transducer peak at 17:30 and SSC peak at 19:10).



DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

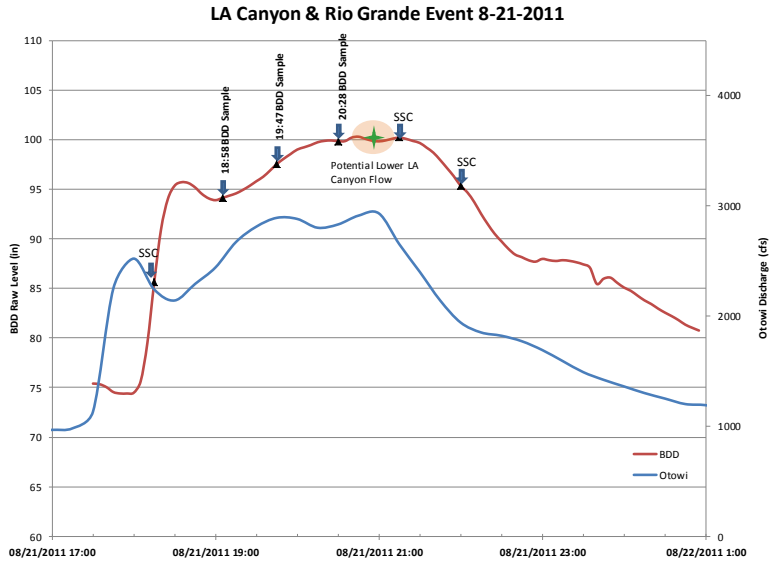
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
8/3/11 17:38	Radium-226	0.626	pCi/L	N	EPA:903.1
8/3/11 17:38	Radium-228	1.23	pCi/L	N	EPA:904
8/3/11 17:38	Uranium-234	0.928	pCi/L	N	HASL-300:ISOU
8/3/11 17:38	Uranium-234	0.746	pCi/L	Y	HASL-300:ISOU
8/3/11 17:38	Uranium-238	0.706	pCi/L	N	HASL-300:ISOU
8/3/11 17:38	Uranium-238	0.5	pCi/L	Y	HASL-300:ISOU
8/3/11 17:39	Gross alpha	10.9	pCi/L	N	EPA:900
8/3/11 17:39	Gross beta	4.42	pCi/L	N	EPA:900
8/3/11 17:39	Gross beta	3.85	pCi/L	Y	EPA:900
8/3/11 18:09	Cesium-137	10	pCi/L	N	Generic:Gamma Spec.
8/3/11 18:09	Gross alpha	330	pCi/L	N	Generic:GFPC
8/3/11 18:09	Gross beta	570	pCi/L	N	Generic:GFPC
8/3/11 18:09	Uranium-234	19	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:09	Uranium-234	1.7	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:09	Uranium-238	18	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:09	Uranium-238	1.7	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:27	Cesium-137	34.4	pCi/L	N	EPA:901.1
8/3/11 18:27	Potassium-40	185	pCi/L	N	EPA:901.1
8/3/11 18:27	Radium-226	7.74	pCi/L	N	EPA:903.1
8/3/11 18:27	Radium-226	0.681	pCi/L	Y	EPA:903.1
8/3/11 18:27	Radium-228	14.2	pCi/L	N	EPA:904
8/3/11 18:27	Uranium-234	10.5	pCi/L	N	HASL-300:ISOU
8/3/11 18:27	Uranium-234	1.77	pCi/L	Y	HASL-300:ISOU

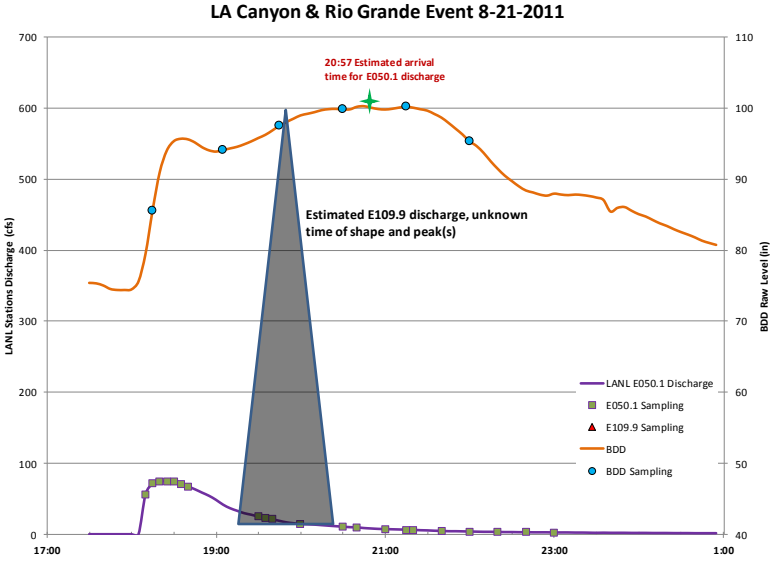
8/3/11 18:27	Uranium-238	11.4	pCi/L	N	HASL-300:ISOU
8/3/11 18:27	Uranium-238	1.45	pCi/L	Y	HASL-300:ISOU
8/3/11 18:09	Americium-241	0.074	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:59	Americium-241	0.077	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:59	Gross alpha	73	pCi/L	N	Generic:GFPC
8/3/11 18:59	Gross beta	92	pCi/L	N	Generic:GFPC
8/3/11 18:59	Uranium-234	16	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:59	Uranium-234	2	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:59	Americium-241	0.18	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:59	Uranium-238	14	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:59	Uranium-238	1.8	pCi/g	N	Generic:Alpha-Spec
8/3/11 19:12	Cesium-137	20.6	pCi/L	N	EPA:901.1
8/3/11 19:12	Potassium-40	75.8	pCi/L	N	EPA:901.1
8/3/11 19:12	Radium-226	4.56	pCi/L	N	EPA:903.1
8/3/11 19:12	Radium-228	9.72	pCi/L	N	EPA:904
8/3/11 19:12	Uranium-234	12.1	pCi/L	N	HASL-300:ISOU
8/3/11 19:12	Uranium-234	1.74	pCi/L	Y	HASL-300:ISOU
8/3/11 19:12	Uranium-238	11.2	pCi/L	N	HASL-300:ISOU
8/3/11 19:12	Uranium-238	1.12	pCi/L	Y	HASL-300:ISOU
8/3/11 18:09	Americium-241	0.37	pCi/L	N	Generic:Alpha-Spec
8/3/11 17:39	SSC	770	mg/L	N	ASTM:D3977-97
8/3/11 18:27	Americium-241	0.385	pCi/L	N	HASL-300:AM-241
8/3/11 18:09	Plutonium-239/240	1.8	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:09	Plutonium-239/240	0.23	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:09	SSC	9100	mg/L	N	ASTM:D3977-97
8/3/11 18:27	Plutonium-239/240	1.81	pCi/L	N	HASL-300:ISOPU
8/3/11 18:59	Plutonium-239/240	1.2	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:59	Plutonium-239/240	0.21	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:59	SSC	5900	mg/L	N	ASTM:D3977-97
8/3/11 19:12	Plutonium-239/240	0.617	pCi/L	N	HASL-300:ISOPU
8/3/11 18:09	Strontium-90	1.5	pCi/L	Y	Generic:GFPC
8/3/11 18:59	Strontium-90	1.6	pCi/L	Y	Generic:GFPC
8/3/11 19:12	Strontium-90	1.27	pCi/L	Y	EPA:905.0
8/3/11 19:12	Strontium-90	5.02	pCi/L	N	EPA:905.0
8/3/11 18:27	Strontium-90	8.92	pCi/L	N	EPA:905.0
8/3/11 18:59	Strontium-90	3.6	pCi/L	N	Generic:GFPC
8/3/11 18:09	Strontium-90	5.1	pCi/L	N	Generic:GFPC
8/3/11 17:38	Uranium-235	0.0561	pCi/L	Y	HASL-300:ISOU
8/3/11 17:38	Uranium-235	0.0578	pCi/L	N	HASL-300:ISOU
8/3/11 18:09	Uranium-235	0.094	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:59	Uranium-235	0.095	pCi/g	N	Generic:Alpha-Spec
8/3/11 18:27	Uranium-235	0.0629	pCi/L	Y	HASL-300:ISOU
8/3/11 18:59	Uranium-235	0.72	pCi/L	N	Generic:Alpha-Spec
8/3/11 18:09	Uranium-235	0.74	pCi/L	N	Generic:Alpha-Spec

8/3/11 19:12	Uranium-235	0.0997	pCi/L	Y	HASL-300:ISOU
8/3/11 19:12	Uranium-235	0.443	pCi/L	N	HASL-300:ISOU
8/3/11 18:27	Uranium-235	0.911	pCi/L	N	HASL-300:ISOU

IV.2.c August 21-22, 2011 LAC & RG

Narrative of Event: This was a LA Canyon and Rio Grande storm event. Sampling was triggered by E109.9 flow. Its flow was observed at BDD Intake at the estimated time as indicated on the graph.



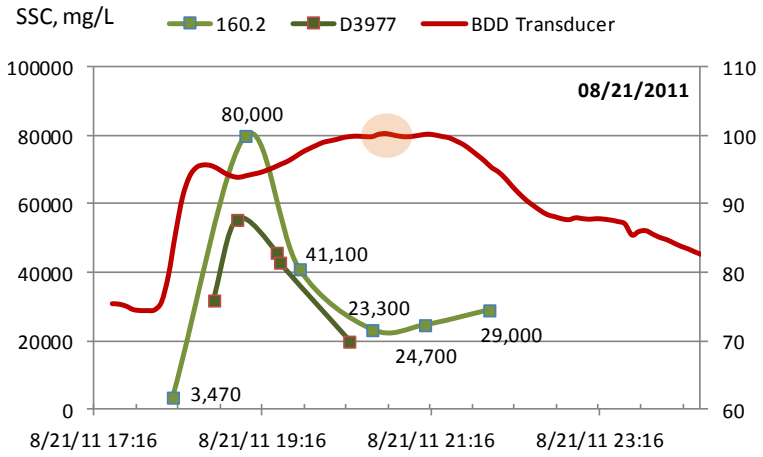


Station	Max Discharge cfs	Time
Otowi	2910	21:00
E050.1	75	18:25
E060.1	0	na
E109.9	610 (estimated)	unknown
BDD	na	21:20

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	Gross a-b (F)/Metals (F)	18:59	870
2	PCBs	18:59	870
3	Perchlorate/TDS (F)	18:59	870
4	Dioxins/Furans	18:59	870
5	Gross a-b/Metals/TOC	18:59	870
6		18:59	870
7	Perchlorate Spike/Dup	18:59	870
8		18:59	870
9	Particle size	18:59	870
10	PCBs	19:44	870
11		20:07	870
12	PCBs	20:30	877
Bottle #	Sampler BDD1	Time	Otowi Discharge (cfs)
1	SSC	18:13	870
2	SSC	19:05	870
3	SSC	19:43	870
4	SSC	20:35	877
5	SSC	21:13	883
6	SSC	21:58	877
7	GS-IsoU/Pu/Am241	18:58	870
8	GS-IsoU/Pu/Am241 (F)	18:58	870
9	Ra 226/228	18:58	870
10	Ra 226/228 (F)	18:58	870
11	Sr 90	18:58	870
12	Sr 90 (F)	18:58	870
13	GS-IsoU/Pu/Am241	19:47	870
14	GS-IsoU/Pu/Am241 (F)	19:47	870
15	Ra 226/228	19:47	870
16	Ra 226/228 (F)	19:47	870
17	Sr 90	19:47	870
18	Sr 90 (F)	19:47	870
19	GS-IsoU/Pu/Am241	20:28	877
20	GS-IsoU/Pu/Am241 (F)	20:28	877
21	Ra 226/228	20:28	877
22	Ra 226/228 (F)	20:28	877
23	Sr 90	20:28	877
24	Sr 90 (F)	20:28	877

Week of 8-21-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Aug	high	avg	low	high	avg	low	high	avg	low	sum	
21	73	64	55	100	78	53	22	5	31	0.18	Rain
22	77	67	57	88	66	34	14	5	-	0	Rain
23	82	71	60	59	42	23	16	6	21	0	
24	86	76	66	46	34	20	23	5	32	0	Rain
25	80	70	59	77	50	26	18	9	29	0	Rain
26	80	71	62	63	44	26	14	4	21	0	
27	80	71	62	73	47	30	23	8	33	0.23	Rain

The lower LA Canyon discharge profile (E109.9) was unknown for this storm event. The discharge was estimated only. The peak in the SSC at BDD Intake (19:05) appears to be in response to the RG peak discharge (18:25) with 1 hr and 40 min delay. The peak SSC value was very large consistent with strong discharge.



DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

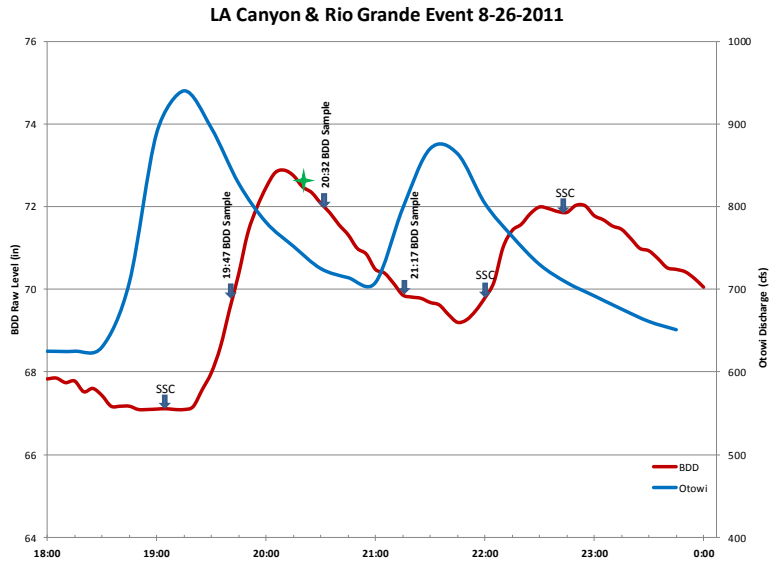
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
8/21/11 18:42	Americium-241	0.81	pCi/L	N	Generic:Alpha-Spec
8/21/11 18:42	Gross alpha	990	pCi/L	N	Generic:GFPC
8/21/11 18:42	Gross beta	1600	pCi/L	N	Generic:GFPC
8/21/11 18:42	Plutonium-238	0.29	pCi/L	N	Generic:Alpha-Spec
8/21/11 18:42	Plutonium-239/240	2	pCi/L	N	Generic:Alpha-Spec
8/21/11 18:42	Plutonium-239/240	0.078	pCi/g	N	Generic:Alpha-Spec
8/21/11 18:42	SSC	32000	mg/L	N	ASTM:D3977-97
8/21/11 18:42	Strontium-90	11	pCi/L	N	Generic:GFPC
8/21/11 18:42	Strontium-90	0.43	pCi/g	N	Generic:GFPC
8/21/11 18:42	Strontium-90	1.8	pCi/L	Y	Generic:GFPC
8/21/11 18:42	Uranium-234	35	pCi/L	N	Generic:Alpha-Spec
8/21/11 18:42	Uranium-235	1.5	pCi/L	N	Generic:Alpha-Spec
8/21/11 18:42	Uranium-238	34	pCi/L	N	Generic:Alpha-Spec
8/21/11 18:58	Plutonium-239/240	3.6	pCi/L	N	HASL-300:ISOPU
8/21/11 18:58	Potassium-40	95.8	pCi/L	N	EPA:901.1
8/21/11 18:58	Radium-226	1	pCi/L	N	EPA:903.1
8/21/11 18:58	Radium-228	6.32	pCi/L	N	EPA:904
8/21/11 18:58	Radium-228	3.69	pCi/L	Y	EPA:904
8/21/11 18:58	Strontium-90	5.91	pCi/L	N	EPA:905.0
8/21/11 18:58	Uranium-234	119	pCi/L	N	HASL-300:ISOU
8/21/11 18:58	Uranium-234	1.66	pCi/L	Y	HASL-300:ISOU
8/21/11 18:58	Uranium-235	0.0715	pCi/L	Y	HASL-300:ISOU
8/21/11 18:58	Uranium-235	6.43	pCi/L	N	HASL-300:ISOU
8/21/11 18:58	Uranium-238	124	pCi/L	N	HASL-300:ISOU

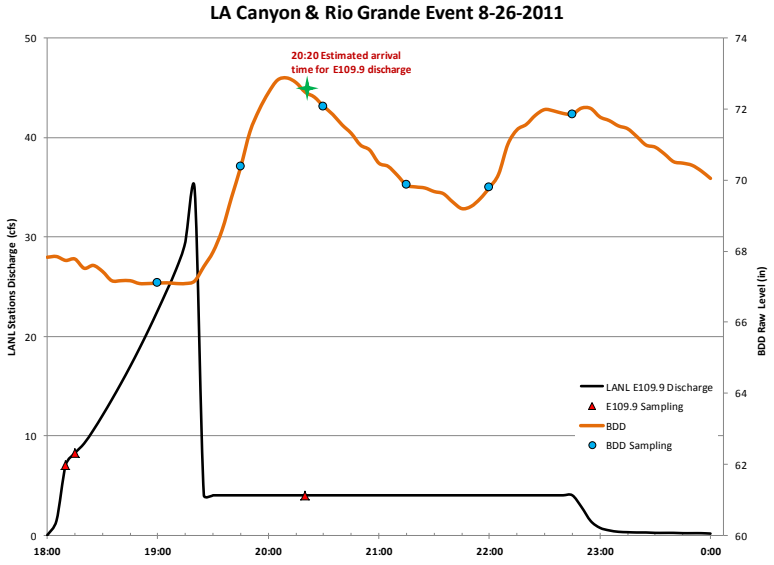
8/21/11 18:58	Uranium-238	1.6	pCi/L	Y	HASL-300:ISOU
8/21/11 18:59	Gross alpha	953	pCi/L	N	EPA:900
8/21/11 18:59	Gross alpha	5.39	pCi/L	Y	EPA:900
8/21/11 18:59	Gross beta	1430	pCi/L	N	EPA:900
8/21/11 18:59	SSC	55650	mg/L	N	ASTM:D3977-97
8/21/11 19:27	Americium-241	0.44	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:27	Gross alpha	950	pCi/L	N	Generic:GFPC
8/21/11 19:27	Gross beta	1500	pCi/L	N	Generic:GFPC
8/21/11 19:27	Plutonium-238	0.16	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:27	Plutonium-239/240	0.88	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:27	Plutonium-239/240	0.032	pCi/g	N	Generic:Alpha-Spec
8/21/11 19:27	SSC	46000	mg/L	N	ASTM:D3977-97
8/21/11 19:27	Uranium-234	40	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:27	Uranium-235	1.9	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:27	Uranium-238	42	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:29	Americium-241	0.52	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:29	Gross alpha	990	pCi/L	N	Generic:GFPC
8/21/11 19:29	Gross beta	1400	pCi/L	N	Generic:GFPC
8/21/11 19:29	Plutonium-239/240	1	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:29	Plutonium-239/240	0.018	pCi/g	N	Generic:Alpha-Spec
8/21/11 19:29	SSC	43000	mg/L	N	ASTM:D3977-97
8/21/11 19:29	Uranium-234	50	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:29	Uranium-235	3.1	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:29	Uranium-238	50	pCi/L	N	Generic:Alpha-Spec
8/21/11 19:44	Plutonium-239/240	0.797	pCi/L	N	HASL-300:ISOPU
8/21/11 19:44	Radium-226	2.11	pCi/L	N	EPA:903.1
8/21/11 19:44	Radium-228	7.96	pCi/L	N	EPA:904
8/21/11 19:44	Strontium-90	3.32	pCi/L	N	EPA:905.0
8/21/11 19:44	Uranium-234	42.6	pCi/L	N	HASL-300:ISOU
8/21/11 19:44	Uranium-235	1.79	pCi/L	N	HASL-300:ISOU
8/21/11 19:44	Uranium-238	45	pCi/L	N	HASL-300:ISOU
8/21/11 19:47	Potassium-40	66.1	pCi/L	Y	EPA:901.1
8/21/11 19:47	Radium-228	1.2	pCi/L	Y	EPA:904
8/21/11 19:47	Uranium-234	1.62	pCi/L	Y	HASL-300:ISOU
8/21/11 19:47	Uranium-235	0.0929	pCi/L	Y	HASL-300:ISOU
8/21/11 19:47	Uranium-238	1.32	pCi/L	Y	HASL-300:ISOU
8/21/11 20:19	Americium-241	0.6	pCi/L	N	Generic:Alpha-Spec
8/21/11 20:19	Gross alpha	530	pCi/L	N	Generic:GFPC
8/21/11 20:19	Gross beta	800	pCi/L	N	Generic:GFPC
8/21/11 20:19	Plutonium-238	0.23	pCi/L	N	Generic:Alpha-Spec
8/21/11 20:19	Plutonium-238	0.0054	pCi/g	N	Generic:Alpha-Spec
8/21/11 20:19	Plutonium-239/240	0.86	pCi/L	N	Generic:Alpha-Spec
8/21/11 20:19	Plutonium-239/240	0.032	pCi/g	N	Generic:Alpha-Spec
8/21/11 20:19	SSC	20000	mg/L	N	ASTM:D3977-97

8/21/11 20:19	Strontium-90	0.87	pCi/L	Y	Generic:GFPC
8/21/11 20:19	Uranium-234	55	pCi/L	N	Generic:Alpha-Spec
8/21/11 20:19	Uranium-235	2.9	pCi/L	N	Generic:Alpha-Spec
8/21/11 20:19	Uranium-238	55	pCi/L	N	Generic:Alpha-Spec
8/21/11 20:28	Plutonium-239/240	1.95	pCi/L	N	HASL-300:ISOPU
8/21/11 20:28	Radium-226	0.848	pCi/L	N	EPA:903.1
8/21/11 20:28	Radium-228	12.8	pCi/L	N	EPA:904
8/21/11 20:28	Strontium-90	1.55	pCi/L	N	EPA:905.0
8/21/11 20:28	Uranium-234	40.4	pCi/L	N	HASL-300:ISOU
8/21/11 20:28	Uranium-234	2.24	pCi/L	Y	HASL-300:ISOU
8/21/11 20:28	Uranium-235	0.0875	pCi/L	Y	HASL-300:ISOU
8/21/11 20:28	Uranium-235	1.71	pCi/L	N	HASL-300:ISOU
8/21/11 20:28	Uranium-238	41	pCi/L	N	HASL-300:ISOU
8/21/11 20:28	Uranium-238	1.91	pCi/L	Y	HASL-300:ISOU

IV.2.d August 26, 2011 LAC & RG

Narrative of Event: This was a LA Canyon and Rio Grande storm event. Sampling was triggered by E109.9 flow. Its flow was too low in comparison the RG flow to be observed at BDD Intake.



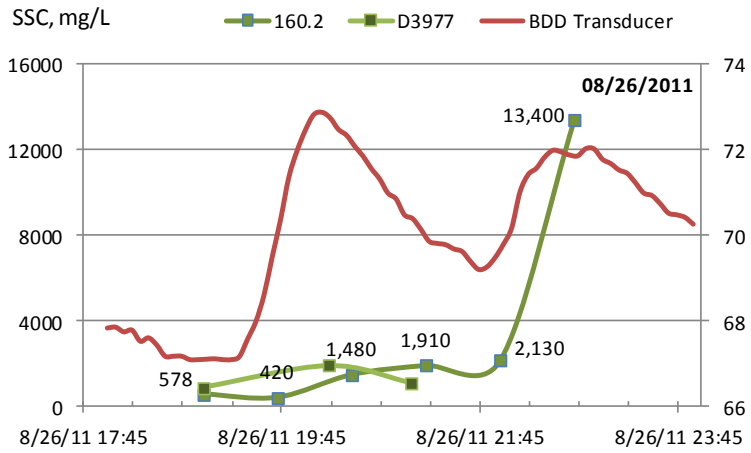


Station	Max Discharge cfs	Time
Otowi	940	19:15
E050.1	0	na
E060.1	0	na
E109.9	35	19:20
BDD	na	20:10

Sampling & Analyses Information			
Bottle #	**Sampler BDD2**	**Time**	**Otowi Discharge (cfs)**
1	TDS (F)/Perchlorate	19:43	940
2		19:43	940
3	Gross a-b (F)/Metals (F)	19:43	940
4	Dioxins/Furans	19:43	940
5	Gross a-b/Metals	19:43	940
6		19:43	940
7	TOC	19:43	940
8	PCBs	19:43	940
9	Particle size	19:43	940
10	PCBs	20:28	780
11		20:51	752
12	PCBs	21:14	725
Bottle #	**Sampler BDD1**	**Time**	**Otowi Discharge (cfs)**
1	SSC	18:58	630
2	SSC	19:43	940
3	SSC	20:28	780
4	SSC	21:13	725
5	SSC	21:58	798
6	SSC	22:43	764
7	GS-IsoU/Pu/Am241	19:47	940
8	GS-IsoU/Pu/Am241 (F)	19:47	940
9	Ra 226/228	19:47	940
10	Ra 226/228 (F)	19:47	940
11	Sr 90	19:47	940
12	Sr 90 (F)	19:47	940
13	GS-IsoU/Pu/Am241	20:32	780
14	GS-IsoU/Pu/Am241 (F)	20:32	780
15	Ra 226/228	20:32	780
16	Ra 226/228 (F)	20:32	780
17	Sr 90	20:32	780
18	Sr 90 (F)	20:32	780
19	GS-IsoU/Pu/Am241	21:17	725
20	GS-IsoU/Pu/Am241 (F)	21:17	725
21	Ra 226/228	21:17	725
22	Ra 226/228 (F)	21:17	725
23	Sr 90	21:17	725
24	Sr 90 (F)	21:17	725

Week of 8-23-11 Weather Information - Los Alamos											
2011	**Temp. (°F)**			**Humidity (%)**			**Wind (mph)**			**Precip. (in)**	**Events**
Aug	high	avg	low	high	avg	low	high	avg	low	sum	
23	82	71	60	59	42	23	16	6	21	0	
24	86	76	66	46	34	20	23	5	32	0	Rain
25	80	70	59	77	50	26	18	9	29	0	Rain
26	80	71	62	63	44	26	14	4	21	0	
27	80	71	62	73	47	30	23	8	33	0.23	Rain
28	80	71	62	63	47	30	12	6	18	0.01	Rain
29	82	70	59	82	55	28	18	6	32	0	Rain

The RG storm event was concurrent with the LA Canyon event, which was of much lesser strength to be observed at the BDD Intake. The SSC peaks appear to be a response to the RG discharge peaks with approximately one hour time delay.



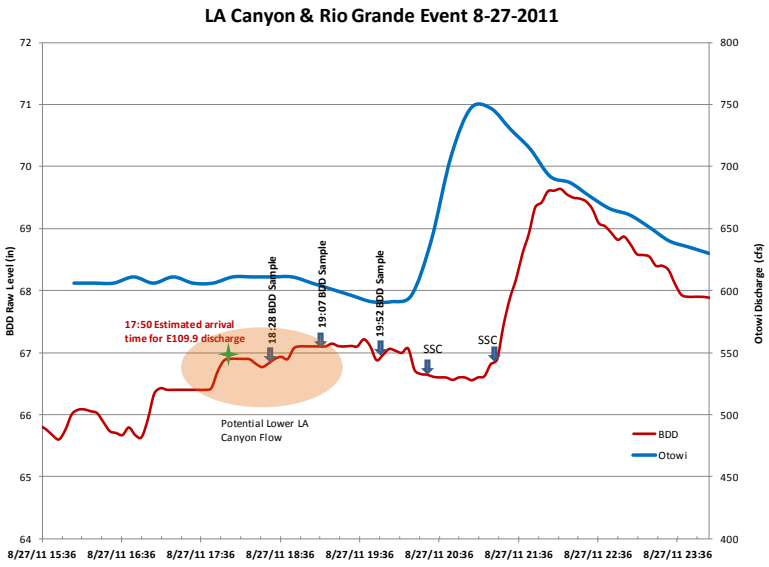
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
8/26/11 19:43	Gross alpha	9.9	pCi/L	N	EPA:900
8/26/11 19:43	Gross alpha	4.13	pCi/L	Y	EPA:900
8/26/11 19:43	Gross beta	17.4	pCi/L	N	EPA:900
8/26/11 19:43	SSC	890	mg/L	N	ASTM:D3977-97
8/26/11 19:47	Radium-226	0.653	pCi/L	N	EPA:903.1
8/26/11 19:47	Radium-226	0.513	pCi/L	Y	EPA:903.1
8/26/11 19:47	Uranium-234	10.8	pCi/L	N	HASL-300:ISOU
8/26/11 19:47	Uranium-234	0.828	pCi/L	Y	HASL-300:ISOU
8/26/11 19:47	Uranium-235	0.0594	pCi/L	Y	HASL-300:ISOU
8/26/11 19:47	Uranium-235	0.499	pCi/L	N	HASL-300:ISOU
8/26/11 19:47	Uranium-238	9.75	pCi/L	N	HASL-300:ISOU
8/26/11 19:47	Uranium-238	0.682	pCi/L	Y	HASL-300:ISOU
8/26/11 20:14	Americium-241	0.062	pCi/L	N	Generic:Alpha-Spec
8/26/11 20:14	Gross alpha	29	pCi/L	N	Generic:GFPC
8/26/11 20:14	Gross beta	55	pCi/L	N	Generic:GFPC
8/26/11 20:14	Plutonium-239/240	0.12	pCi/L	N	Generic:Alpha-Spec
8/26/11 20:14	Plutonium-239/240	0.068	pCi/g	N	Generic:Alpha-Spec
8/26/11 20:14	SSC	1900	mg/L	N	ASTM:D3977-97
8/26/11 20:14	Uranium-234	3	pCi/L	N	Generic:Alpha-Spec
8/26/11 20:14	Uranium-235	0.11	pCi/L	N	Generic:Alpha-Spec
8/26/11 20:14	Uranium-238	2.7	pCi/L	N	Generic:Alpha-Spec
8/26/11 20:32	Plutonium-238	0.101	pCi/L	N	HASL-300:ISOPU
8/26/11 20:32	Plutonium-239/240	0.171	pCi/L	N	HASL-300:ISOPU
8/26/11 20:32	Radium-226	1.73	pCi/L	N	EPA:903.1
8/26/11 20:32	Radium-226	0.678	pCi/L	Y	EPA:903.1

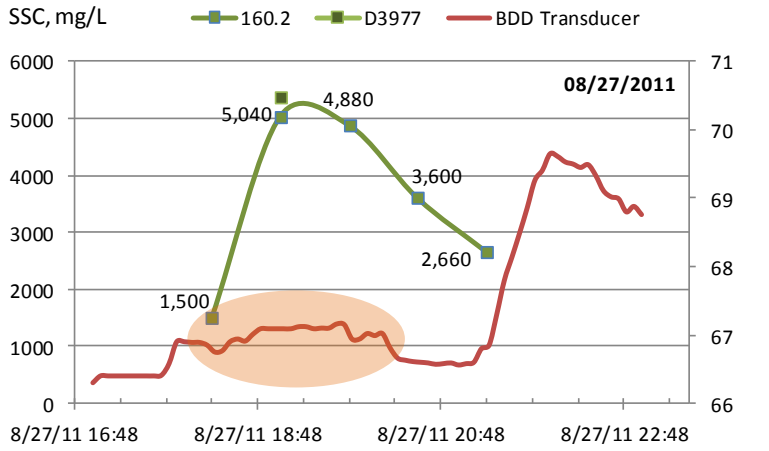
8/26/11 20:32	Radium-228	1.22	pCi/L	N	EPA:904
8/26/11 20:32	Strontium-90	0.578	pCi/L	N	EPA:905.0
8/26/11 20:32	Uranium-234	1.78	pCi/L	N	HASL-300:ISOU
8/26/11 20:32	Uranium-234	0.803	pCi/L	Y	HASL-300:ISOU
8/26/11 20:32	Uranium-235	0.0459	pCi/L	Y	HASL-300:ISOU
8/26/11 20:32	Uranium-238	1.26	pCi/L	N	HASL-300:ISOU
8/26/11 20:32	Uranium-238	0.529	pCi/L	Y	HASL-300:ISOU
8/26/11 21:04	Americium-241	0.085	pCi/L	N	Generic:Alpha-Spec
8/26/11 21:04	Gross alpha	37	pCi/L	N	Generic:GFPC
8/26/11 21:04	Gross beta	57	pCi/L	N	Generic:GFPC
8/26/11 21:04	Plutonium-239/240	0.1	pCi/L	N	Generic:Alpha-Spec
8/26/11 21:04	Plutonium-239/240	0.081	pCi/g	N	Generic:Alpha-Spec
8/26/11 21:04	SSC	1100	mg/L	N	ASTM:D3977-97
8/26/11 21:04	Strontium-90	0.81	pCi/L	N	Generic:GFPC
8/26/11 21:04	Uranium-234	2.6	pCi/L	N	Generic:Alpha-Spec
8/26/11 21:04	Uranium-235	0.099	pCi/L	N	Generic:Alpha-Spec
8/26/11 21:04	Uranium-238	2.3	pCi/L	N	Generic:Alpha-Spec
8/26/11 21:17	Plutonium-239/240	0.22	pCi/L	N	HASL-300:ISOPU
8/26/11 21:17	Radium-226	2.67	pCi/L	N	EPA:903.1
8/26/11 21:17	Radium-228	2.74	pCi/L	N	EPA:904
8/26/11 21:17	Uranium-234	8.89	pCi/L	N	HASL-300:ISOU
8/26/11 21:17	Uranium-234	0.98	pCi/L	Y	HASL-300:ISOU
8/26/11 21:17	Uranium-235	0.414	pCi/L	N	HASL-300:ISOU
8/26/11 21:17	Uranium-238	8.86	pCi/L	N	HASL-300:ISOU
8/26/11 21:17	Uranium-238	0.647	pCi/L	Y	HASL-300:ISOU

IV.2.e August 27, 2011 LAC & RG

Narrative of Event: This was a LA Canyon and Rio Grande storm event. Sampling was triggered by E109.9 flow. Its flow was observed at BDD Intake at the estimated time as indicated on the graph. LANL does not have a record of this event, so discharge for the LA Canyon gage station(s) was not obtained.



Station	Max Discharge cfs	Time
Otowi	747	21:15
E050.1	0	na
E060.1	0	na
E109.9	58	16:50
BDD	na	22:00



The peak in RG discharge occurred later on this date. Otowi SSC at 16:00 was 419 mg/L. Therefore, the peak in SSC could have been in response to the LAC flow, observed at the BDD Intake.

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	TDS (F)/Perchlorate	19:01	611
2	PCBs	19:01	611
3	Gross a-b (F)/Metals (F)	19:01	611
4	TDS Spike/Dup	19:01	611
5	Gross a-b/Metals	19:01	611
6	Dioxins/Furans	19:01	611
7		19:01	611
8		19:01	611
9	Particle size	19:01	611
10	PCBs	19:46	606
11		20:09	606
12	PCBs	20:32	590
Bottle #	Sampler BDD1	Time	Otowi Discharge (cfs)
1	sampler failure	17:33	
2	SSC	18:18	606
3	SSC	19:03	611
4	SSC	19:48	606
5	SSC	20:33	590
6	SSC	21:18	747
7	GS-IsoU/Pu/Am241	18:22	606
8	GS-IsoU/Pu/Am241 (F)	18:22	606
9	Ra 226/228	18:22	606
10	Ra 226/228 (F)	18:22	606
11	Sr 90	18:22	606
12	Sr 90 (F)	18:22	606
13	GS-IsoU/Pu/Am241	19:07	611
14	GS-IsoU/Pu/Am241 (F)	19:07	611
15	Ra 226/228	19:07	611
16	Ra 226/228 (F)	19:07	611
17	Sr 90	19:07	611
18	Sr 90 (F)	19:07	611
19	GS-IsoU/Pu/Am241	19:52	606
20	GS-IsoU/Pu/Am241 (F)	19:52	606
21	Ra 226/228	19:52	606
22	Ra 226/228 (F)	19:52	606
23	Sr 90	19:52	606
24	Sr 90 (F)	19:52	606

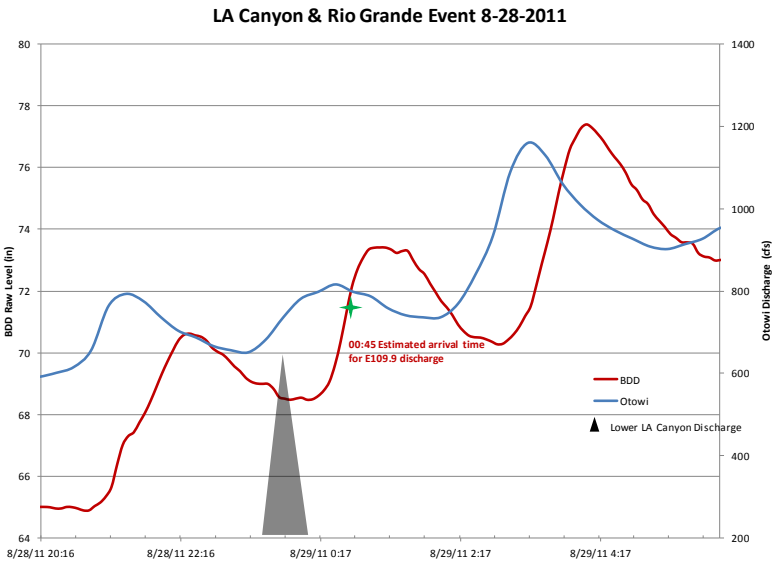
Week of 8-23-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Aug	high	avg	low	high	avg	low	high	avg	low	sum	
23	82	71	60	59	42	23	16	6	21	0	
24	86	76	66	46	34	20	23	5	32	0	Rain
25	80	70	59	77	50	26	18	9	29	0	Rain
26	80	71	62	63	44	26	14	4	21	0	
27	80	71	62	73	47	30	23	8	33	0.23	Rain
28	80	71	62	63	47	30	12	6	18	0.01	Rain
29	82	70	59	82	55	28	18	6	32	0	Rain

DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
8/27/11 18:22	Radium-228	1.09	pCi/L	Y	EPA:904
8/27/11 18:22	Uranium-234	1.63	pCi/L	N	HASL-300:ISOU
8/27/11 18:22	Uranium-234	0.951	pCi/L	Y	HASL-300:ISOU
8/27/11 18:22	Uranium-238	1.28	pCi/L	N	HASL-300:ISOU
8/27/11 18:22	Uranium-238	0.759	pCi/L	Y	HASL-300:ISOU
8/27/11 19:01	Gross alpha	21.7	pCi/L	N	EPA:900
8/27/11 19:01	Gross alpha	35.8	pCi/L	Y	EPA:900
8/27/11 19:01	Gross beta	226	pCi/L	N	EPA:900
8/27/11 19:01	Gross beta	11.2	pCi/L	Y	EPA:900
8/27/11 19:01	SSC	5380	mg/L	N	ASTM:D3977-97
8/27/11 19:07	Americium-241	0.285	pCi/L	N	HASL-300:AM-241
8/27/11 19:07	Plutonium-239/240	0.62	pCi/L	N	HASL-300:ISOPU
8/27/11 19:07	Radium-226	3.56	pCi/L	N	EPA:903.1
8/27/11 19:07	Radium-228	1.9	pCi/L	N	EPA:904
8/27/11 19:07	Strontium-90	0.764	pCi/L	Y	EPA:905.0
8/27/11 19:07	Strontium-90	2.64	pCi/L	N	EPA:905.0
8/27/11 19:07	Uranium-234	1.5	pCi/L	N	HASL-300:ISOU
8/27/11 19:07	Uranium-234	2.15	pCi/L	Y	HASL-300:ISOU
8/27/11 19:07	Uranium-235	0.0897	pCi/L	Y	HASL-300:ISOU
8/27/11 19:07	Uranium-238	1.33	pCi/L	N	HASL-300:ISOU
8/27/11 19:07	Uranium-238	1.89	pCi/L	Y	HASL-300:ISOU
8/27/11 19:52	Plutonium-239/240	0.499	pCi/L	N	HASL-300:ISOPU
8/27/11 19:52	Radium-226	3.34	pCi/L	N	EPA:903.1
8/27/11 19:52	Radium-228	3.65	pCi/L	N	EPA:904
8/27/11 19:52	Strontium-90	1.08	pCi/L	Y	EPA:905.0
8/27/11 19:52	Strontium-90	2.23	pCi/L	N	EPA:905.0
8/27/11 19:52	Uranium-234	2.47	pCi/L	N	HASL-300:ISOU
8/27/11 19:52	Uranium-234	0.8	pCi/L	Y	HASL-300:ISOU
8/27/11 19:52	Uranium-238	2.23	pCi/L	N	HASL-300:ISOU
8/27/11 19:52	Uranium-238	0.728	pCi/L	Y	HASL-300:ISOU

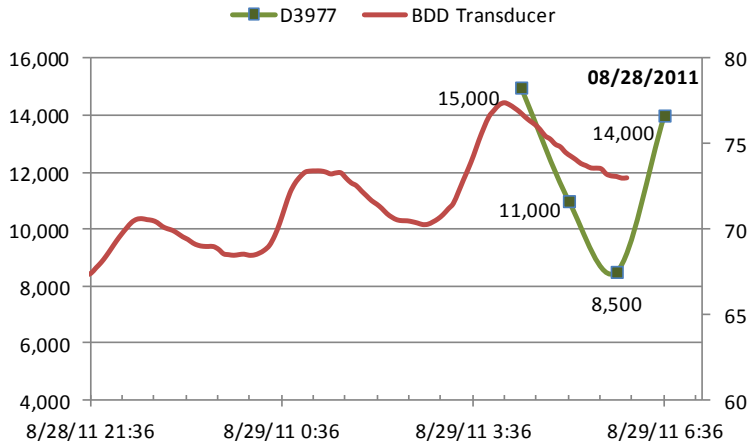
IV.2.f August 28, 2011 LAC & RG

Narrative of Event: This was a LA canyon and Rio Grande storm event. BDD sampling was not conducted. Due to the concurrent Rio Grande event, the lower LA Canyon flow was not readily observed at BDD Intake. Sampling was conducted by NMED only, and the SSC results are presented below.



Station	Max Discharge cfs	Time
Otowi	1,160	03:15 8/29
E050.1	0	na
E060.1	0	na
E109.9	69	23:45
BDD	na	04:05 8/29

The E109.9 discharge peak was presented in stylized form.



The SSC data was very limited. However, it appears there was a peak in SSC caused by the peak in the RG discharge.

Week of 8-23-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Aug	high	avg	low	high	avg	low	high	avg	low	sum	
23	82	71	60	59	42	23	16	6	21	0	
24	86	76	66	46	34	20	23	5	32	0	Rain
25	80	70	59	77	50	26	18	9	29	0	Rain
26	80	71	62	63	44	26	14	4	21	0	
27	80	71	62	73	47	30	23	8	33	0.23	Rain
28	80	71	62	63	47	30	12	6	18	0.01	Rain
29	82	70	59	82	55	28	18	6	32	0	Rain

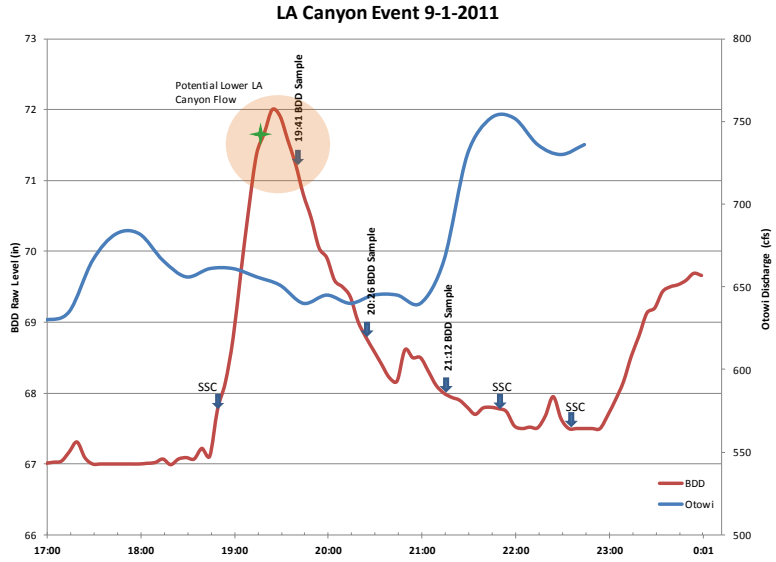
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

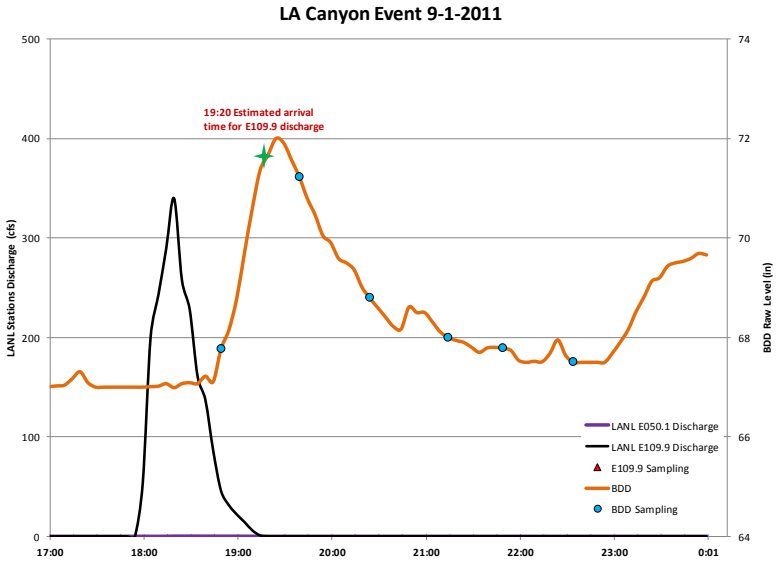
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
8/29/11 4:21	Americium-241	0.31	pCi/L	N	Generic:Alpha-Spec
8/29/11 4:21	Gross alpha	640	pCi/L	N	Generic:GFPC
8/29/11 4:21	Gross beta	800	pCi/L	N	Generic:GFPC
8/29/11 4:21	Plutonium-238	0.064	pCi/L	N	Generic:Alpha-Spec
8/29/11 4:21	Plutonium-239/240	0.76	pCi/L	N	Generic:Alpha-Spec
8/29/11 4:21	Plutonium-239/240	0.051	pCi/g	N	Generic:Alpha-Spec
8/29/11 4:21	Potassium-40	770	pCi/L	N	Generic:Gamma Spec.
8/29/11 4:21	SSC	15000	mg/L	N	ASTM:D3977-97
8/29/11 4:21	Strontium-90	10	pCi/L	N	Generic:GFPC
8/29/11 4:21	Strontium-90	1.1	pCi/L	Y	Generic:GFPC
8/29/11 4:21	Uranium-234	71	pCi/L	N	Generic:Alpha-Spec
8/29/11 4:21	Uranium-235	3	pCi/L	N	Generic:Alpha-Spec
8/29/11 4:21	Uranium-238	66	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:06	Americium-241	0.15	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:06	Gross alpha	280	pCi/L	N	Generic:GFPC
8/29/11 5:06	Gross beta	440	pCi/L	N	Generic:GFPC
8/29/11 5:06	Plutonium-239/240	0.071	pCi/g	N	Generic:Alpha-Spec
8/29/11 5:06	Plutonium-239/240	0.42	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:06	SSC	11000	mg/L	N	ASTM:D3977-97
8/29/11 5:06	Strontium-90	0.46	pCi/g	N	Generic:GFPC
8/29/11 5:06	Strontium-90	1.2	pCi/L	Y	Generic:GFPC
8/29/11 5:06	Uranium-234	14	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:06	Uranium-235	0.71	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:06	Uranium-238	14	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:51	Americium-241	0.17	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:51	Gross alpha	190	pCi/L	N	Generic:GFPC
8/29/11 5:51	Gross beta	290	pCi/L	N	Generic:GFPC
8/29/11 5:51	Plutonium-239/240	0.52	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:51	Plutonium-239/240	0.054	pCi/g	N	Generic:Alpha-Spec
8/29/11 5:51	SSC	8500	mg/L	N	ASTM:D3977-97
8/29/11 5:51	Strontium-90	1.1	pCi/L	N	Generic:GFPC
8/29/11 5:51	Strontium-90	1.1	pCi/L	Y	Generic:GFPC
8/29/11 5:51	Uranium-234	12	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:51	Uranium-235	0.56	pCi/L	N	Generic:Alpha-Spec
8/29/11 5:51	Uranium-238	9.6	pCi/L	N	Generic:Alpha-Spec
8/29/11 6:36	Americium-241	0.18	pCi/L	N	Generic:Alpha-Spec
8/29/11 6:36	Gross alpha	450	pCi/L	N	Generic:GFPC
8/29/11 6:36	Gross beta	650	pCi/L	N	Generic:GFPC
8/29/11 6:36	Plutonium-238	0.0029	pCi/g	N	Generic:Alpha-Spec
8/29/11 6:36	Plutonium-239/240	0.72	pCi/L	N	Generic:Alpha-Spec
8/29/11 6:36	Plutonium-239/240	0.054	pCi/g	N	Generic:Alpha-Spec
8/29/11 6:36	SSC	14000	mg/L	N	ASTM:D3977-97

8/29/11 6:36	Strontium-90	0.35	pCi/g	N	Generic:GFPC
8/29/11 6:36	Strontium-90	1.2	pCi/L	Y	Generic:GFPC
8/29/11 6:36	Strontium-90	2.3	pCi/L	N	Generic:GFPC
8/29/11 6:36	Uranium-234	25	pCi/L	N	Generic:Alpha-Spec
8/29/11 6:36	Uranium-235	1.1	pCi/L	N	Generic:Alpha-Spec
8/29/11 6:36	Uranium-238	22	pCi/L	N	Generic:Alpha-Spec

IV.2.g September 1, 2011 LAC

Narrative of Event: This was a LA Canyon storm event. Sampling was triggered by E109.9 flow. Its flow was observed at BDD Intake at the estimated time as indicated on the graph.



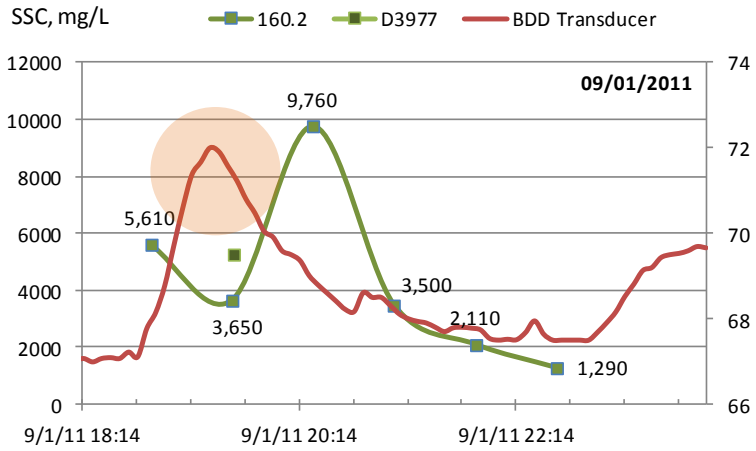


Station	Max Discharge cfs	Time
Otowi	752	22:45
E050.1	0.2	18:30
E060.1	0	na
E109.9	340	18:20
BDD	na	19:45

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	TDS (F)/Perchlorate	19:38	635
2	PCBs	19:38	635
3	Gross a-b (F)/Metals (F)	19:38	635
4	Perchlorate Spike/Dup/ TOC	19:38	635
5	Dioxins/Furans	19:38	635
6	Gross a-b/Metals	19:38	635
7		19:38	635
8		19:38	635
9	Particle size	19:38	635
10	PCBs	20:23	682
11		20:46	661
12	PCBs	21:09	651
Bottle #	Sampler BDD1	Time	Otowi Discharge (cfs)
1	SSC	18:52	635
2	SSC	19:37	635
3	SSC	20:22	635
4	SSC	21:07	661
5	SSC	21:52	651
6	SSC	22:37	640
7	GS-IsoU/Pu/Am241	19:41	635
8	GS-IsoU/Pu/Am241 (F)	19:41	635
9	Ra 226/228	19:41	635
10	Ra 226/228 (F)	19:41	635
11	Sr 90	19:41	635
12	Sr 90 (F)	19:41	635
13	GS-IsoU/Pu/Am241	20:26	682
14	GS-IsoU/Pu/Am241 (F)	20:26	682
15	Ra 226/228	20:26	682
16	Ra 226/228 (F)	20:26	682
17	Sr 90	20:26	682
18	Sr 90 (F)	20:26	682
19	GS-IsoU/Pu/Am241	21:12	661
20	GS-IsoU/Pu/Am241 (F)	21:12	661
21	Ra 226/228	21:12	661
22	Ra 226/228 (F)	21:12	661
23	Sr 90	21:12	661
24	Sr 90 (F)	21:12	661

Week of 9-1-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Sep	high	avg	low	high	avg	low	high	avg	low	sum	
1	78	68	59	82	49	28	17	4	33	0.71	Rain
2	78	66	55	94	60	28	13	6	18	0	Rain
3	78	70	62	52	36	22	22	4	37	0	Rain

There was no RG event at this time and the discharge peak in the river occurred later that day. Otowi Gage SSC at 16:00 was 298 mg/L. Therefore, the SSC peak appears to be in response to the LAC flow and had an hour delay from the discharge peak (discharge peak at 19:25, SSC peak at 20:22).



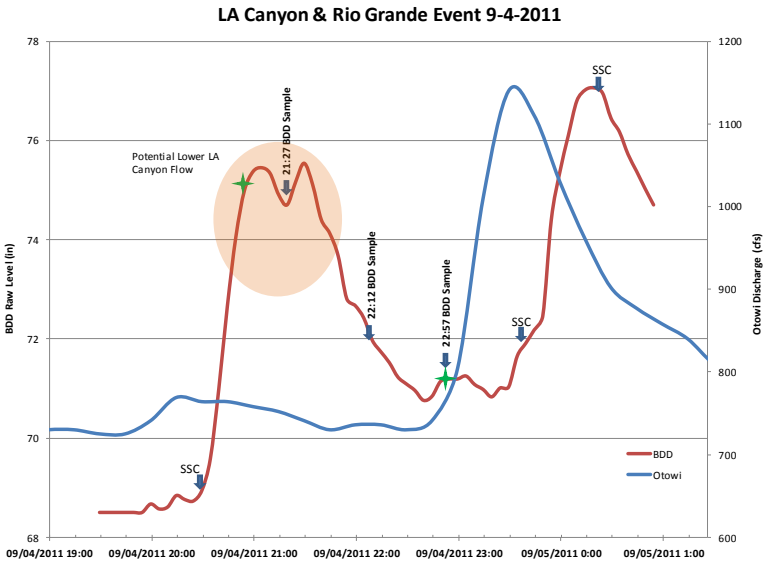
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

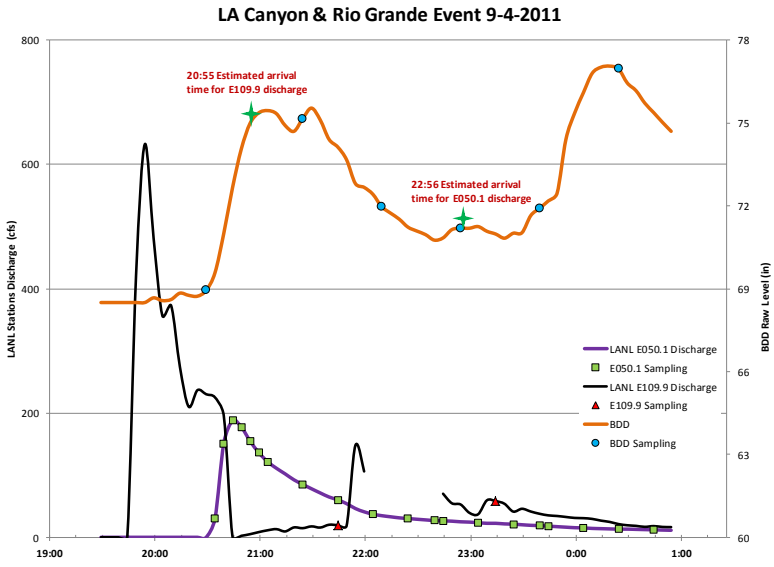
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
9/1/11 19:38	Gross alpha	111	pCi/L	N	EPA:900
9/1/11 19:38	Gross alpha	3.2	pCi/L	Y	EPA:900
9/1/11 19:38	Gross beta	106	pCi/L	N	EPA:900
9/1/11 19:38	Gross beta	4.89	pCi/L	Y	EPA:900
9/1/11 19:38	SSC	5280	mg/L	N	ASTM:D3977-97
9/1/11 19:41	Potassium-40	71	pCi/L	Y	EPA:901.1
9/1/11 19:41	Radium-226	2.91	pCi/L	N	EPA:903.1
9/1/11 19:41	Radium-228	2.64	pCi/L	N	EPA:904
9/1/11 19:41	Radium-228	0.986	pCi/L	Y	EPA:904
9/1/11 19:41	Strontium-90	0.743	pCi/L	Y	EPA:905.0
9/1/11 19:41	Strontium-90	1.1	pCi/L	N	EPA:905.0
9/1/11 19:41	Uranium-234	1.57	pCi/L	N	HASL-300:ISOU
9/1/11 19:41	Uranium-234	1.34	pCi/L	Y	HASL-300:ISOU
9/1/11 19:41	Uranium-238	1	pCi/L	N	HASL-300:ISOU
9/1/11 19:41	Uranium-238	0.79	pCi/L	Y	HASL-300:ISOU
9/1/11 20:26	Radium-226	4.71	pCi/L	N	EPA:903.1
9/1/11 20:26	Radium-228	4.81	pCi/L	N	EPA:904
9/1/11 20:26	Strontium-90	1.72	pCi/L	N	EPA:905.0
9/1/11 20:26	Strontium-90	1.87	pCi/L	Y	EPA:905.0
9/1/11 20:26	Uranium-234	1.35	pCi/L	N	HASL-300:ISOU
9/1/11 20:26	Uranium-234	1.09	pCi/L	Y	HASL-300:ISOU
9/1/11 20:26	Uranium-238	1.08	pCi/L	N	HASL-300:ISOU
9/1/11 20:26	Uranium-238	0.834	pCi/L	Y	HASL-300:ISOU
9/1/11 21:12	Radium-226	2.79	pCi/L	N	EPA:903.1
9/1/11 21:12	Radium-228	4.38	pCi/L	N	EPA:904

9/1/11 21:12	Uranium-234	1.28	pCi/L	N	HASL-300:ISOU
9/1/11 21:12	Uranium-234	1.1	pCi/L	Y	HASL-300:ISOU
9/1/11 21:12	Uranium-238	0.983	pCi/L	N	HASL-300:ISOU
9/1/11 21:12	Uranium-238	0.785	pCi/L	Y	HASL-300:ISOU

IV.2.h September 4-5, 2011 LAC & RG

Narrative of Event: This was a LA Canyon and Rio Grande storm event. Sampling was triggered by E109.9 flow. The LA Canyon flow was observed at the BDD Intake as marked on the graph.



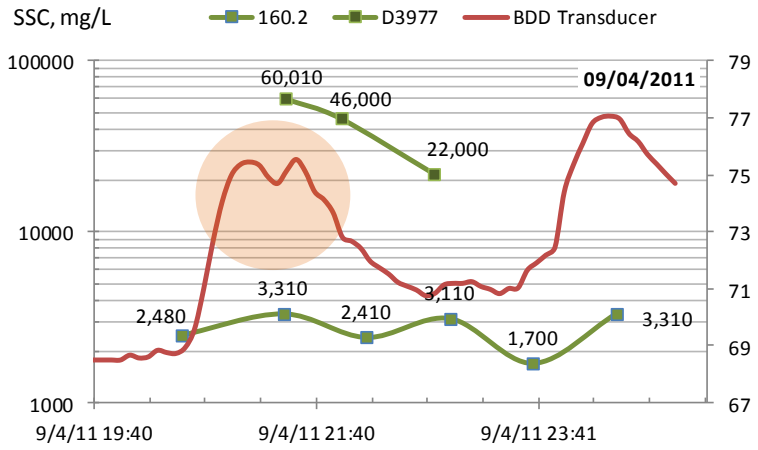


Station	Max Discharge cfs	Time
Otowi	1,140	23:30
E050.1	188	20:45
E060.1	0	na
E109.9	632	19:55
BDD	na	21:30

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	Gross a-b	21:24	764
2	PCBs	21:24	764
3	Gross a-b (F)	21:24	764
	TDS (F)		
4	Perchlorate/TOC	21:24	764
5	Dioxins/Furans	21:24	764
6	Metals (F)/ Spike/Dup	21:24	764
7		21:24	764
8	Metals	21:24	764
9	Particle size	21:24	764
10	PCBs	22:09	741
11		22:32	736
12	PCBs	22:55	736
Bottle #	Sampler BDD1	Time	Otowi Discharge (cfs)
1	SSC	20:28	725
2	SSC	21:23	764
3	SSC	22:08	741
4	SSC	22:53	736
5	SSC	23:38	804
6	SSC	0:23	1110
7	GS-IsoU/Pu/Am241 (F)	21:27	764
8	GS-IsoU/Pu/Am241	21:27	764
9	Sr 90 (F)	21:27	764
10	Sr 90	21:27	764
11	Ra 226/228 (F)	21:27	764
12	Ra 226/228	21:27	764
13	Sr 90	22:12	741
14	Sr 90 (F)	22:12	741
15	GS-IsoU/Pu/Am241	22:12	741
16	GS-IsoU/Pu/Am241 (F)	22:12	741
17	Ra 226/228	22:12	741
18	Ra 226/228 (F)	22:12	741
19	Sr 90	22:57	736
20	Sr 90 (F)	22:57	736
21	GS-IsoU/Pu/Am241	22:57	736
22	GS-IsoU/Pu/Am241 (F)	22:57	736
23	Ra 226/228	22:57	736
24	Ra 226/228 (F)	22:57	736

Week of 9-4-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Sep	high	avg	low	high	avg	low	high	avg	low	sum	
4	64	58	51	94	77	59	25	10	34	0.2	Rain
5	69	60	50	87	69	33	14	7	20	0	
6	69	64	59	68	56	46	13	4	18	0.01	Rain
7	68	62	53	88	78	56	17	4	24	0.36	Rain
8	66	58	51	72	57	40	14	8	21	0	Rain
9	55	50	46	93	77	58	18	9	26	0.03	Rain
10	57	50	44	100	85	67	14	4	18	0.33	Rain

The RG storm event occurred later (23:30) that day, so the main peak in SSC (60,010 mg/L by method D3977) appears to be a response to the potential LAC flow observed at the Intake. The wave pattern in method EPA 160.2 matches the peaks in the discharge. For this event, there is good correlation between flow and SSC.



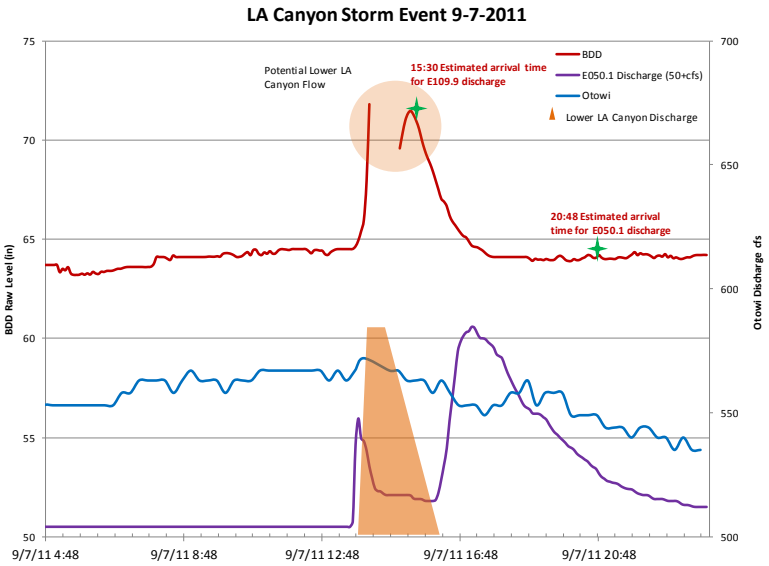
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
9/4/11 21:24	Gross alpha	449	pCi/L	N	EPA:900
9/4/11 21:24	Gross beta	581	pCi/L	N	EPA:900
9/4/11 21:24	Gross beta	18.1	pCi/L	Y	EPA:900
9/4/11 21:24	SSC	60010	mg/L	N	ASTM:D3977-97
9/4/11 21:27	Radium-226	7.73	pCi/L	N	EPA:903.1
9/4/11 21:27	Radium-228	2.31	pCi/L	N	EPA:904
9/4/11 21:27	Strontium-90	0.612	pCi/L	Y	EPA:905.0
9/4/11 21:27	Strontium-90	1.28	pCi/L	N	EPA:905.0
9/4/11 21:27	Uranium-234	1.8	pCi/L	N	HASL-300:ISOU
9/4/11 21:27	Uranium-234	1.85	pCi/L	Y	HASL-300:ISOU
9/4/11 21:27	Uranium-235	0.127	pCi/L	Y	HASL-300:ISOU
9/4/11 21:27	Uranium-238	1.38	pCi/L	N	HASL-300:ISOU
9/4/11 21:27	Uranium-238	1.56	pCi/L	Y	HASL-300:ISOU
9/4/11 21:54	Americium-241	0.52	pCi/L	N	Generic:Alpha-Spec
9/4/11 21:54	Gross alpha	1300	pCi/L	N	Generic:GFPC
9/4/11 21:54	Gross beta	1800	pCi/L	N	Generic:GFPC
9/4/11 21:54	Plutonium-239/240	3.5	pCi/L	N	Generic:Alpha-Spec
9/4/11 21:54	Plutonium-239/240	0.096	pCi/g	N	Generic:Alpha-Spec
9/4/11 21:54	SSC	46000	mg/L	N	ASTM:D3977-97
9/4/11 21:54	Strontium-90	3.3	pCi/L	N	Generic:GFPC
9/4/11 21:54	Strontium-90	0.52	pCi/g	N	Generic:GFPC
9/4/11 21:54	Strontium-90	2.5	pCi/L	Y	Generic:GFPC
9/4/11 21:54	Uranium-234	45	pCi/L	N	Generic:Alpha-Spec
9/4/11 21:54	Uranium-235	1.1	pCi/L	N	Generic:Alpha-Spec
9/4/11 21:54	Uranium-238	39	pCi/L	N	Generic:Alpha-Spec

9/4/11 22:12	Radium-226	4.25	pCi/L	N	EPA:903.1
9/4/11 22:12	Radium-228	4.27	pCi/L	N	EPA:904
9/4/11 22:12	Radium-228	1.02	pCi/L	Y	EPA:904
9/4/11 22:12	Strontium-90	0.6	pCi/L	N	EPA:905.0
9/4/11 22:12	Uranium-234	1.46	pCi/L	N	HASL-300:ISOU
9/4/11 22:12	Uranium-234	1.86	pCi/L	Y	HASL-300:ISOU
9/4/11 22:12	Uranium-235	0.11	pCi/L	Y	HASL-300:ISOU
9/4/11 22:12	Uranium-235	0.123	pCi/L	N	HASL-300:ISOU
9/4/11 22:12	Uranium-238	1.15	pCi/L	N	HASL-300:ISOU
9/4/11 22:12	Uranium-238	1.38	pCi/L	Y	HASL-300:ISOU
9/4/11 22:44	Americium-241	0.29	pCi/L	N	Generic:Alpha-Spec
9/4/11 22:44	Gross alpha	700	pCi/L	N	Generic:GFPC
9/4/11 22:44	Gross beta	980	pCi/L	N	Generic:GFPC
9/4/11 22:44	Plutonium-239/240	1.6	pCi/L	N	Generic:Alpha-Spec
9/4/11 22:44	Plutonium-239/240	0.081	pCi/g	N	Generic:Alpha-Spec
9/4/11 22:44	SSC	22000	mg/L	N	ASTM:D3977-97
9/4/11 22:44	Strontium-90	0.38	pCi/g	N	Generic:GFPC
9/4/11 22:44	Strontium-90	2	pCi/L	Y	Generic:GFPC
9/4/11 22:44	Uranium-234	29	pCi/L	N	Generic:Alpha-Spec
9/4/11 22:44	Uranium-235	1.2	pCi/L	N	Generic:Alpha-Spec
9/4/11 22:44	Uranium-238	26	pCi/L	N	Generic:Alpha-Spec
9/4/11 22:57	Radium-226	3.44	pCi/L	N	EPA:903.1
9/4/11 22:57	Radium-226	0.381	pCi/L	Y	EPA:903.1
9/4/11 22:57	Radium-228	11.6	pCi/L	N	EPA:904
9/4/11 22:57	Radium-228	2.07	pCi/L	Y	EPA:904
9/4/11 22:57	Strontium-90	0.599	pCi/L	N	EPA:905.0
9/4/11 22:57	Uranium-234	2.12	pCi/L	N	HASL-300:ISOU
9/4/11 22:57	Uranium-234	1.88	pCi/L	Y	HASL-300:ISOU
9/4/11 22:57	Uranium-235	0.125	pCi/L	Y	HASL-300:ISOU
9/4/11 22:57	Uranium-235	0.127	pCi/L	N	HASL-300:ISOU
9/4/11 22:57	Uranium-238	1.51	pCi/L	N	HASL-300:ISOU
9/4/11 22:57	Uranium-238	1.24	pCi/L	Y	HASL-300:ISOU

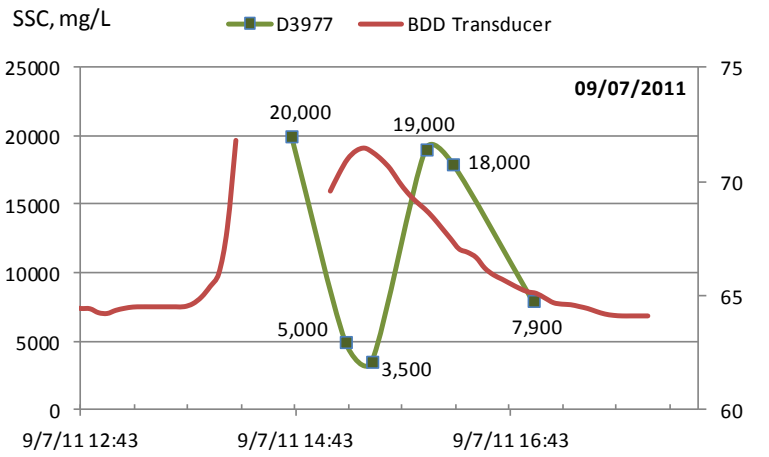
IV.2.i September 7, 2011 LAC & RG

Narrative of Event: This was a LA Canyon and Rio Grande storm event. Sampling by BDD was not conducted but NMED collected storm water. Considering that the Rio Grande at Otowi Gage did not peak around 14:00, we can conclude that the LAC flow was observed at the Intake as shown on the figure. The BDD transducer had some faulty readings at that time, so those were remove from the graphical presentation.



Station	Max Discharge cfs	Time
Otowi	550	-
E050.1	11	16:48
E060.1	0	na
E109.9	80	~14:30
BDD	na	14:10-15:45

The E109.9 discharge peak was presented in stylized form for reference only.



The NMED collected samples for this storm event, and the SSC results are presented in the figure to the left. It appears that the peaks in SSC are in response to the LAC flow since the RG did not experience storm event.

Week of 9-4-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Sep	high	avg	low	high	avg	low	high	avg	low	sum	
4	64	58	51	94	77	59	25	10	34	0.2	Rain
5	69	60	50	87	69	33	14	7	20	0	
6	69	64	59	68	56	46	13	4	18	0.01	Rain
7	68	62	53	88	78	56	17	4	24	0.36	Rain
8	66	58	51	72	57	40	14	8	21	0	Rain
9	55	50	46	93	77	58	18	9	26	0.03	Rain
10	57	50	44	100	85	67	14	4	18	0.33	Rain

DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

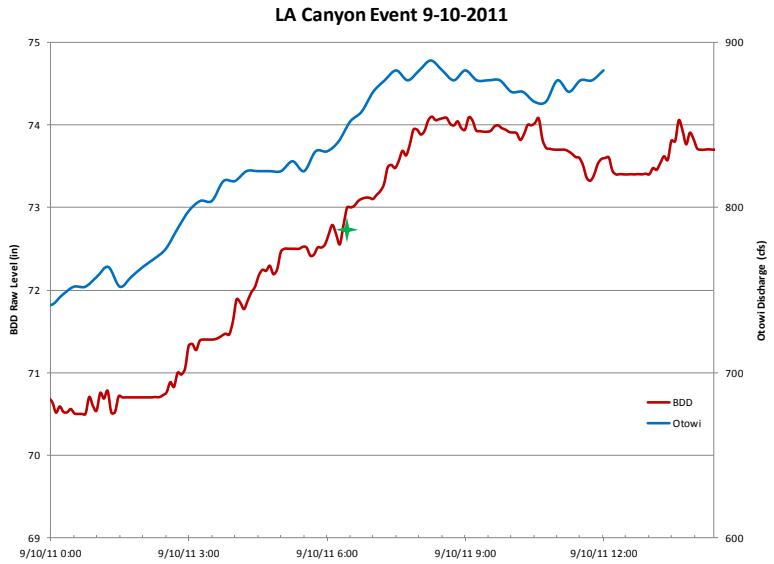
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
9/7/11 14:41	Americium-241	0.032	pCi/g	N	Generic:Alpha-Spec
9/7/11 14:41	Americium-241	0.15	pCi/L	N	Generic:Alpha-Spec
9/7/11 14:41	Gross alpha	310	pCi/L	N	Generic:GFPC
9/7/11 14:41	Gross alpha	7.7	pCi/g	N	Generic:GFPC
9/7/11 14:41	Gross beta	390	pCi/L	N	Generic:GFPC
9/7/11 14:41	Gross beta	7	pCi/g	N	Generic:GFPC
9/7/11 14:41	Plutonium-238	0.15	pCi/L	N	Generic:Alpha-Spec
9/7/11 14:41	Plutonium-239/240	0.29	pCi/L	N	Generic:Alpha-Spec
9/7/11 14:41	Plutonium-239/240	0.02	pCi/g	N	Generic:Alpha-Spec
9/7/11 14:41	SSC	20000	mg/L	N	ASTM:D3977-97
9/7/11 14:41	Strontium-90	2.1	pCi/L	N	Generic:GFPC
9/7/11 14:41	Uranium-234	14	pCi/L	N	Generic:Alpha-Spec
9/7/11 14:41	Uranium-234	0.68	pCi/L	Y	Generic:Alpha-Spec
9/7/11 14:41	Uranium-234	0.84	pCi/g	N	Generic:Alpha-Spec
9/7/11 14:41	Uranium-235	0.025	pCi/g	N	Generic:Alpha-Spec
9/7/11 14:41	Uranium-235	0.76	pCi/L	N	Generic:Alpha-Spec
9/7/11 14:41	Uranium-238	15	pCi/L	N	Generic:Alpha-Spec
9/7/11 14:41	Uranium-238	0.5	pCi/L	Y	Generic:Alpha-Spec
9/7/11 14:41	Uranium-238	0.91	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:11	Plutonium-239/240	0.03	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:11	SSC	5000	mg/L	N	ASTM:D3977-97
9/7/11 15:11	Uranium-234	1	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:11	Uranium-235	0.055	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:11	Uranium-238	0.96	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:26	Americium-241	0.033	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:26	Gross alpha	58	pCi/L	N	Generic:GFPC
9/7/11 15:26	Gross beta	95	pCi/L	N	Generic:GFPC
9/7/11 15:26	Plutonium-238	0.0073	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:26	Plutonium-238	0.032	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:26	Plutonium-239/240	0.024	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:26	Plutonium-239/240	0.054	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:26	SSC	3500	mg/L	N	ASTM:D3977-97
9/7/11 15:26	Uranium-234	3.9	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:26	Uranium-234	0.82	pCi/L	Y	Generic:Alpha-Spec
9/7/11 15:26	Uranium-234	1	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:26	Uranium-235	0.048	pCi/L	Y	Generic:Alpha-Spec
9/7/11 15:26	Uranium-235	0.049	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:26	Uranium-235	0.16	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:26	Uranium-238	3.7	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:26	Uranium-238	0.61	pCi/L	Y	Generic:Alpha-Spec
9/7/11 15:26	Uranium-238	0.95	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:56	Gross alpha	400	pCi/L	N	Generic:GFPC

9/7/11 15:56	Gross alpha	7.8	pCi/g	N	Generic:GFPC
9/7/11 15:56	Gross beta	600	pCi/L	N	Generic:GFPC
9/7/11 15:56	Gross beta	8.9	pCi/g	N	Generic:GFPC
9/7/11 15:56	Plutonium-238	0.0088	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:56	Plutonium-239/240	1.5	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:56	Plutonium-239/240	0.089	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:56	SSC	19000	mg/L	N	ASTM:D3977-97
9/7/11 15:56	Uranium-234	18	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:56	Uranium-234	1.3	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:56	Uranium-235	0.84	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:56	Uranium-235	0.044	pCi/g	N	Generic:Alpha-Spec
9/7/11 15:56	Uranium-238	19	pCi/L	N	Generic:Alpha-Spec
9/7/11 15:56	Uranium-238	1.4	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:11	Americium-241	0.18	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:11	Americium-241	0.016	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:11	Americium-241	0.023	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:11	Gross alpha	400	pCi/L	N	Generic:GFPC
9/7/11 16:11	Gross alpha	9.6	pCi/g	N	Generic:GFPC
9/7/11 16:11	Gross beta	610	pCi/L	N	Generic:GFPC
9/7/11 16:11	Gross beta	10	pCi/g	N	Generic:GFPC
9/7/11 16:11	Plutonium-238	0.014	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:11	Plutonium-239/240	0.0077	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:11	Plutonium-239/240	0.86	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:11	Plutonium-239/240	0.12	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:11	SSC	18000	mg/L	N	ASTM:D3977-97
9/7/11 16:11	Strontium-90	1.5	pCi/L	N	Generic:GFPC
9/7/11 16:11	Strontium-90	0.86	pCi/L	Y	Generic:GFPC
9/7/11 16:11	Uranium-234	18	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:11	Uranium-234	1	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:11	Uranium-234	1.3	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:11	Uranium-235	0.062	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:11	Uranium-235	0.064	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:11	Uranium-235	0.85	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:11	Uranium-238	18	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:11	Uranium-238	0.78	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:11	Uranium-238	1.4	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:56	Americium-241	0.13	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:56	Americium-241	0.021	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:56	Americium-241	0.021	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:56	Gross alpha	340	pCi/L	N	Generic:GFPC
9/7/11 16:56	Gross beta	340	pCi/L	N	Generic:GFPC
9/7/11 16:56	Plutonium-238	0.0091	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:56	Plutonium-239/240	0.08	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:56	Plutonium-239/240	0.4	pCi/L	N	Generic:Alpha-Spec

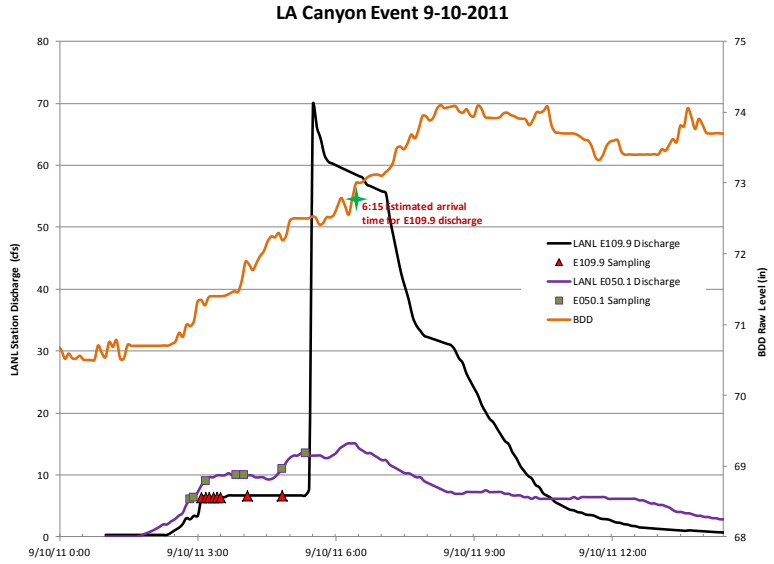
9/7/11 16:56	SSC	7900	mg/L	N	ASTM:D3977-97
9/7/11 16:56	Uranium-234	11	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:56	Uranium-234	0.89	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:56	Uranium-234	1.7	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:56	Uranium-235	0.038	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:56	Uranium-235	0.08	pCi/g	N	Generic:Alpha-Spec
9/7/11 16:56	Uranium-235	0.52	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:56	Uranium-238	10	pCi/L	N	Generic:Alpha-Spec
9/7/11 16:56	Uranium-238	0.57	pCi/L	Y	Generic:Alpha-Spec
9/7/11 16:56	Uranium-238	1.5	pCi/g	N	Generic:Alpha-Spec

IV.2.j September 10, 2011 LAC & RG

Narrative of Event: This was a LA Canyon storm event. Sampling was not conducted. The flow from the LA Canyon was not observed at the BDD Intake.



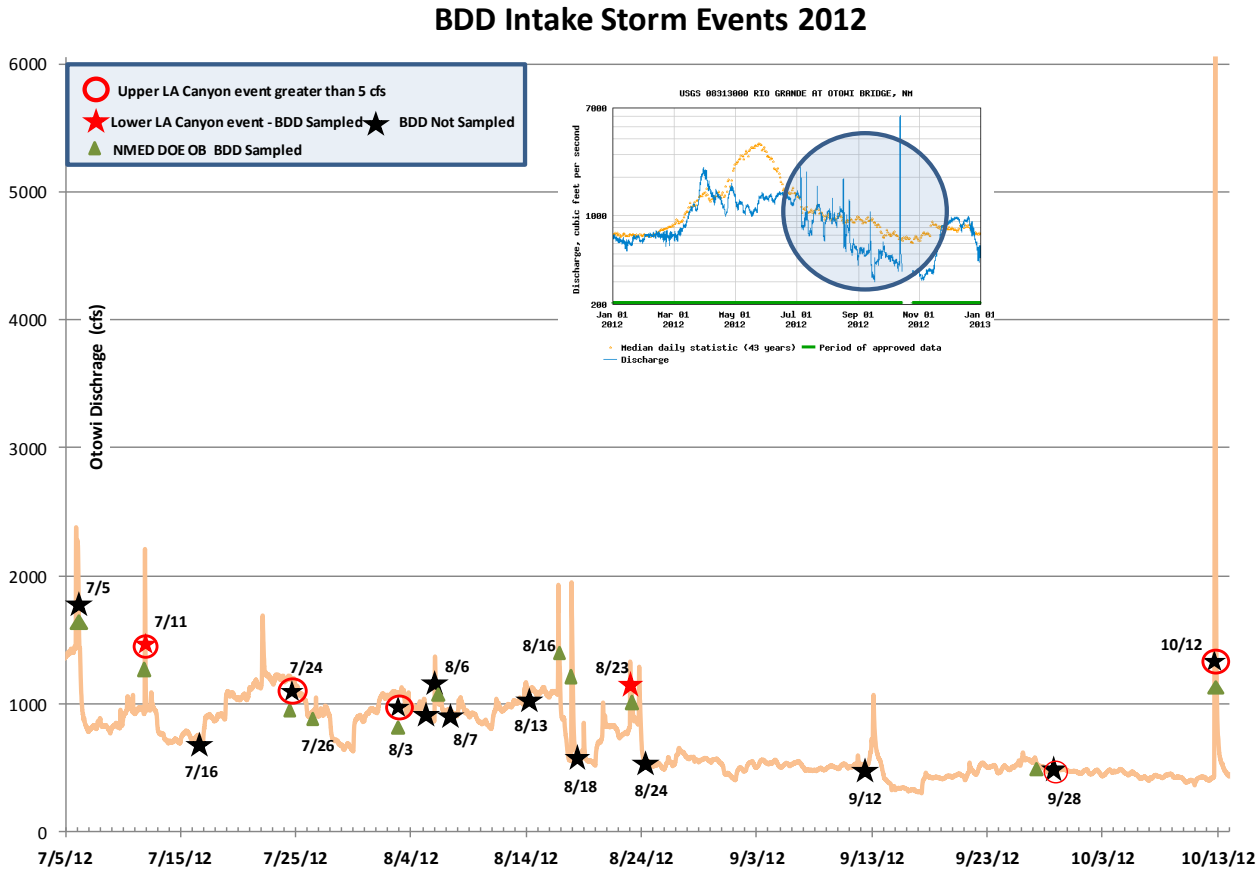
Station	Max Discharge cfs	Time
Otowi	890	08:15
E050.1	15	06:15
E060.1	0	na
E109.9	70	05:30
BDD	na	08:15



Week of 9-4-11 Weather Information - Los Alamos											
2011	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Sep	high	avg	low	high	avg	low	high	avg	low	sum	
4	64	58	51	94	77	59	25	10	34	0.2	Rain
5	69	60	50	87	69	33	14	7	20	0	
6	69	64	59	68	56	46	13	4	18	0.01	Rain
7	68	62	53	88	78	56	17	4	24	0.36	Rain
8	66	58	51	72	57	40	14	8	21	0	Rain
9	55	50	46	93	77	58	18	9	26	0.03	Rain
10	57	50	44	100	85	67	14	4	18	0.33	Rain

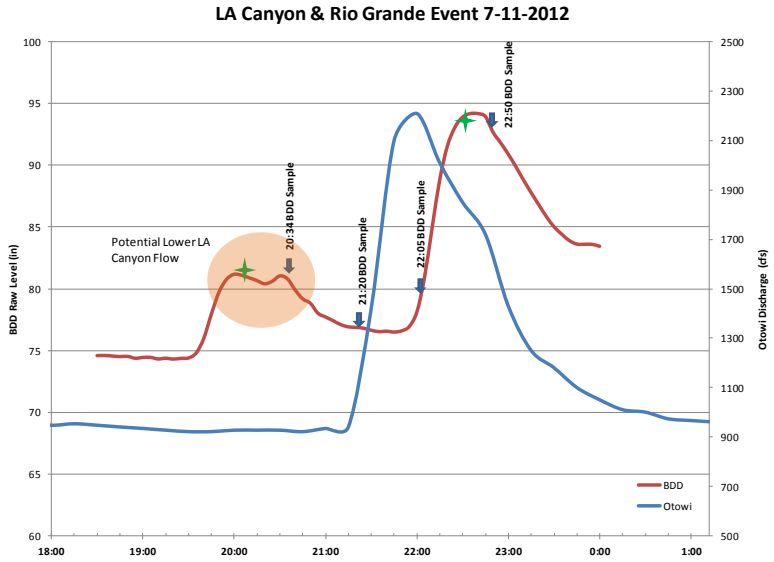
IV.3 2012 Storm Events

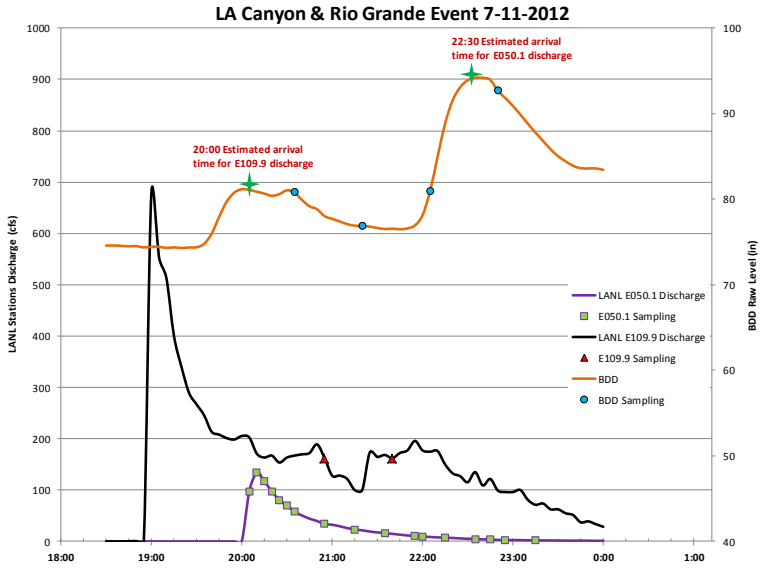
Figure 13. 2012 Otowi gage discharge and BDD Intake sampling.



IV.3.a July 11-12, 2012 LAC & RG

Narrative of Event: This was a LA Canyon and Rio Grande storm event. Sampling was triggered by E109.9 flow. Its flow was observed at BDD Intake at the estimated time as indicated on the graph.





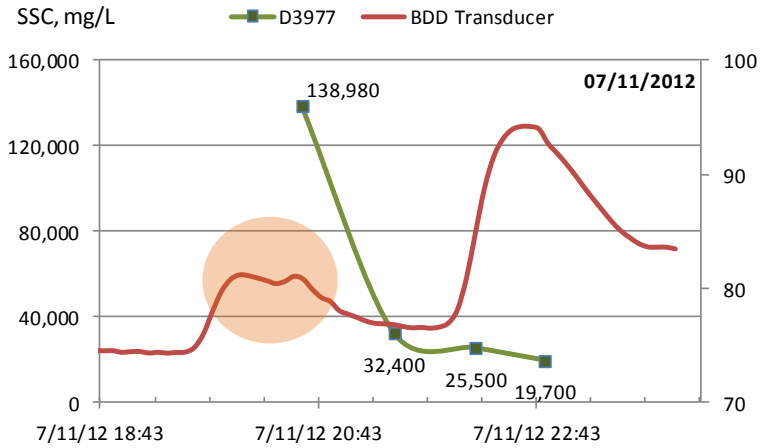
Station	Max Discharge cfs	Time
Otowi	2210	22:00
E050.1	134	20:10
E060.1	0	na
E109.9	680	19:00
BDD	na	22:35

Sampling & Analyses Information			
Bottle #	**Sampler BDD2**	**Time**	**Otowi Discharge (cfs)**
1		20:34	234
2	Metals/Particle size	20:34	234
3	Alkalinity	20:34	234
4	PCBs	20:34	234
5	Dioxins/Furans	20:34	234
6	Perchlorate/Alk/Gross a-b	20:34	234
7	Gross a-b (F)/Metals (F)	20:34	234
8	Dioxins/Furans	20:34	234
9	Cyanide/Gross a-b/ Metals/TOC	20:34	234
10	PCBs	21:19	232
11		21:42	229
12	PCBs	22:05	229
Bottle #	**Sampler BDD1**	**Time**	**Otowi Discharge (cfs)**
1	sampler failure	20:33	234
2	SSC	21:25	232
3	SSC	22:10	229
4	SSC	22:48	227
5	sampler failure	23:33	229
6	sampler failure	0:18	225
7	GS-IsoU/Pu/Am241	21:18	234
8	Ra226/228	21:18	234
9	Sr 90	21:18	234
10	GS-IsoU/Pu/Am241 (F)	21:18	234
11	Ra226/228 (F)	21:18	234
12	Sr 90 (F)	21:18	234
13	GS-IsoU/Pu/Am241	22:03	232
14	Ra226/228	22:03	232
15	Sr 90	22:03	232
16	GS-IsoU/Pu/Am241 (F)	22:03	232
17	Ra226/228 (F)	22:03	232
18	Sr 90 (F)	22:03	232
19	GS-IsoU/Pu/Am241	22:52	229
20	Ra226/228	22:52	229
21	Sr 90	22:52	229
22	GS-IsoU/Pu/Am241 (F)	22:52	229
23	Ra226/228 (F)	22:52	229
24	Sr 90 (F)	22:52	229

Week of 7-8-12 Weather Information - Los Alamos											
2012	**Temp. (°F)**			**Humidity (%)**			**Wind (mph)**			**Precip. (in)**	**Events**
Jul	high	avg	low	high	avg	low	high	avg	low	sum	
8	80	70	34	63	42	20	21	6	24	0	
9	73	66	41	72	56	35	17	6	26	0	Rain
10	77	68	41	77	55	29	22	6	26	0	Rain
11	78	68	41	88	63	31	18	7	25	0	Rain
12	86	72	32	63	40	14	15	5	25	0	
13	82	72	36	55	37	19	15	5	20	0	Rain
14	82	73	34	49	32	18	17	5	28	0	

Week of 7-8-12 Weather Information - Santa Fe											
2012	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Jul	high	avg	low	high	avg	low	high	avg	high	sum	
8	88	72	57	87	47	21	15	9	21	0	
9	84	70	57	87	64	34	22	9	31	0.22	Rain , Thunderstorm
10	80	68	57	93	59	36	18	5	22	0	Rain
11	86	72	60	90	61	31	13	5	25	0	Rain , Thunderstorm
12	88	72	57	81	55	24	15	7	20	0.06	Rain , Thunderstorm
13	90	74	60	67	38	19	15	7	26	0	
14	91	76	63	56	30	16	13	6	25	0	

The RG storm event occurred later (22:30) than the LAC event. All high SSC values appear to be in response to the LAC flow. The Otowi Gage SSC at 16:00 was 361 mg/L and at 23:08 was 6,220 mg/L, which confirms that the high BDD SSC values were due to LAC flow.



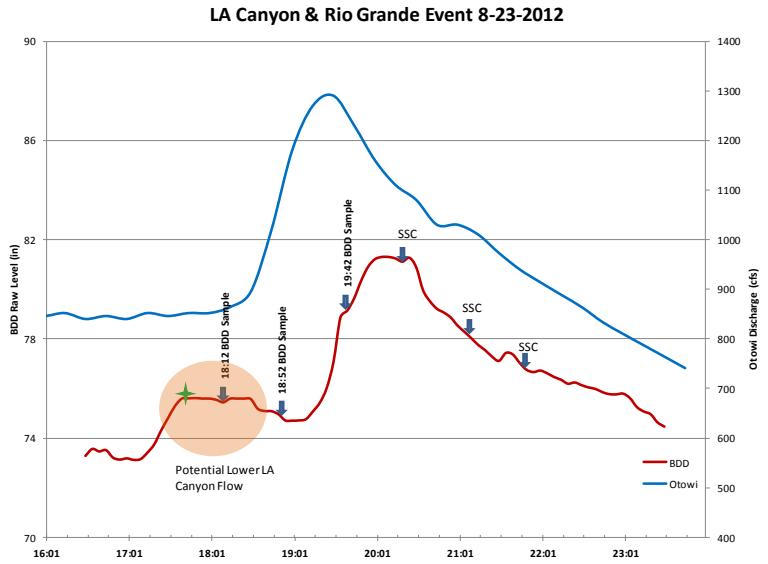
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

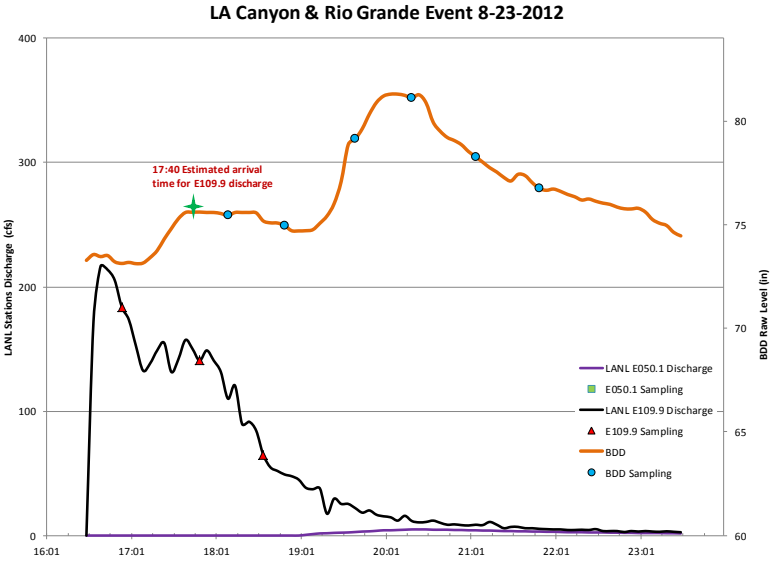
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
7/11/12 20:34	Gross alpha	3250	pCi/L	N	EPA:900
7/11/12 20:34	Gross alpha	9.52	pCi/L	Y	EPA:900
7/11/12 20:34	Gross beta	3430	pCi/L	N	EPA:900
7/11/12 20:34	Gross beta	15.5	pCi/L	Y	EPA:900
7/11/12 20:34	SSC	138980	mg/L	N	ASTM:D3977-97
7/11/12 20:58	Gross alpha	1100	pCi/L	N	EPA:900
7/11/12 20:58	Gross beta	1100	pCi/L	N	EPA:900
7/11/12 20:58	Plutonium-239/240	0.043	pCi/g	N	HASL-300:ISOPU
7/11/12 20:58	Plutonium-239/240	2.4	pCi/L	N	HASL-300:ISOPU
7/11/12 20:58	SSC	49000	mg/L	N	ASTM:D3977-97
7/11/12 20:58	Strontium-90	0.41	pCi/g	N	ASTM:D5811-95M
7/11/12 20:58	Strontium-90	2.3	pCi/L	Y	ASTM:D5811-95M
7/11/12 20:58	Strontium-90	6	pCi/L	N	ASTM:D5811-95M
7/11/12 21:18	Cesium-137	25.4	pCi/L	N	EPA:901.1
7/11/12 21:18	Potassium-40	771	pCi/L	N	EPA:901.1
7/11/12 21:18	Radium-226	44.3	pCi/L	N	EPA:903.1

7/11/12 21:18	Radium-228	9.89	pCi/L	N	EPA:904
7/11/12 21:18	Radium-228	0.695	pCi/L	Y	EPA:904
7/11/12 21:18	Strontium-90	7.55	pCi/L	N	EPA:905.0
7/11/12 21:18	Uranium-234	78.1	pCi/L	N	HASL-300:ISOU
7/11/12 21:18	Uranium-234	1.68	pCi/L	Y	HASL-300:ISOU
7/11/12 21:18	Uranium-235	0.0999	pCi/L	Y	HASL-300:ISOU
7/11/12 21:18	Uranium-238	75.3	pCi/L	N	HASL-300:ISOU
7/11/12 21:18	Uranium-238	1.42	pCi/L	Y	HASL-300:ISOU
7/11/12 21:25	SSC	32400	mg/L	N	ASTM:D3977-97
7/11/12 22:03	Cesium-137	11.1	pCi/L	N	EPA:901.1
7/11/12 22:03	Potassium-40	464	pCi/L	N	EPA:901.1
7/11/12 22:03	Radium-226	35.5	pCi/L	N	EPA:903.1
7/11/12 22:03	Radium-228	19.5	pCi/L	N	EPA:904
7/11/12 22:03	Strontium-90	13.2	pCi/L	N	EPA:905.0
7/11/12 22:03	Uranium-234	41.8	pCi/L	N	HASL-300:ISOU
7/11/12 22:03	Uranium-234	1.49	pCi/L	Y	HASL-300:ISOU
7/11/12 22:03	Uranium-235	0.0382	pCi/L	Y	HASL-300:ISOU
7/11/12 22:03	Uranium-238	37	pCi/L	N	HASL-300:ISOU
7/11/12 22:03	Uranium-238	0.955	pCi/L	Y	HASL-300:ISOU
7/11/12 22:10	SSC	25500	mg/L	N	ASTM:D3977-97
7/11/12 22:48	SSC	19700	mg/L	N	ASTM:D3977-97
7/11/12 22:52	Plutonium-239/240	1.42	pCi/L	N	HASL-300:ISOPU
7/11/12 22:52	Potassium-40	455	pCi/L	N	EPA:901.1
7/11/12 22:52	Radium-226	18.2	pCi/L	N	EPA:903.1
7/11/12 22:52	Radium-226	0.593	pCi/L	Y	EPA:903.1
7/11/12 22:52	Radium-228	8.63	pCi/L	N	EPA:904
7/11/12 22:52	Strontium-90	3.75	pCi/L	Y	EPA:905.0
7/11/12 22:52	Strontium-90	3.9	pCi/L	N	EPA:905.0
7/11/12 22:52	Uranium-234	29	pCi/L	N	HASL-300:ISOU
7/11/12 22:52	Uranium-234	0.988	pCi/L	Y	HASL-300:ISOU
7/11/12 22:52	Uranium-235	0.0425	pCi/L	Y	HASL-300:ISOU
7/11/12 22:52	Uranium-235	1.48	pCi/L	N	HASL-300:ISOU
7/11/12 22:52	Uranium-238	29.3	pCi/L	N	HASL-300:ISOU
7/11/12 22:52	Uranium-238	0.742	pCi/L	Y	HASL-300:ISOU

IV.3.b August 23, 2012 LAC & RG

Narrative of Event: This was a LA Canyon and Rio Grande storm event. Sampling was triggered by E109.9 flow. Its flow was observed at BDD Intake at the estimated time as indicated on the graph.





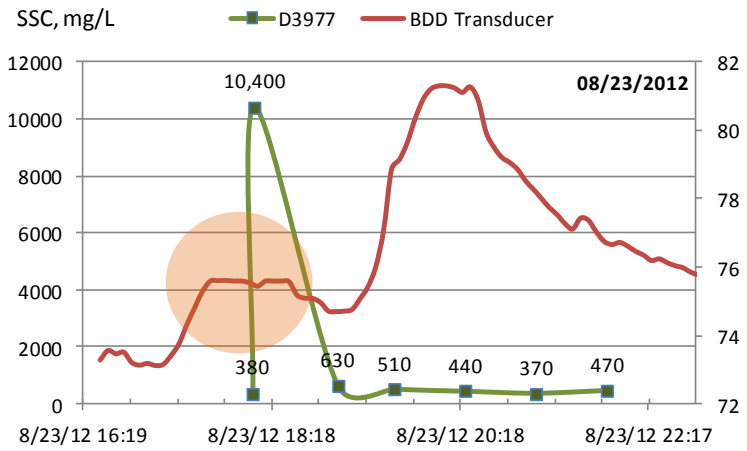
Station	Max Discharge cfs	Time
Otowi	1290	19:30
E050.1	4.92	20:20
E060.1	0	na
E109.9	217	16:35
BDD	na	20:10

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	Gross a-b (F)/Metals (F)	18:08	846
2	TDS (F)	18:08	846
3	Gross a-b (F/UF)/ Metals (F)	18:08	846
4	PCBs	18:08	846
5	Particle size	18:08	846
6	Cyanide	18:08	846
7	Dioxins/Furans	18:08	846
8	Metals (UF)/TOC	18:08	846
9	Perchlorate/Alk	18:08	846
10	PCBs	18:53	864
11		19:16	1020
12	PCBs	19:39	1180
Bottle #	Sampler BDD1	Time	Otowi Discharge (cfs)
1	SSC	18:07	846
2	SSC	19:01	864
3	SSC	19:37	1020
4	SSC	20:22	1230
5	SSC	21:07	1030
6	SSC	21:52	1010
7	GS-IsoU/Pu/Am241	18:12	852
8	Ra226/228	18:12	852
9	Sr 90	18:12	852
10	GS-IsoU/Pu/Am241 (F)	18:12	852
11	Ra226/228 (F)	18:12	852
12	Sr 90 (F)	18:12	852
13	GS-IsoU/Pu/Am241	18:52	864
14	Ra226/228	18:52	864
15	Sr 90	18:52	864
16	GS-IsoU/Pu/Am241 (F)	18:52	864
17	Ra226/228 (F)	18:52	864
18	Sr 90 (F)	18:52	864
19	GS-IsoU/Pu/Am241	19:42	1270
20	Ra226/228	19:42	1270
21	Sr 90	19:42	1270
22	GS-IsoU/Pu/Am241 (F)	19:42	1270
23	Ra226/228 (F)	19:42	1270
24	Sr 90 (F)	19:42	1270

Samples processed on 8/30/2012 17:00

Week of 8-19-12 Weather Information - Santa Fe										
2012	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Aug	high	avg	low	high	avg	low	high	avg	high	sum	
19	84	72	61	64	45	26	17	9	24	0	
20	84	72	61	84	62	29	26	9	46	0.48	Rain , Thunderstorm
21	84	70	57	96	58	21	17	8	18	0.01	
22	81	70	61	84	61	39	21	9	28	0	
23	81	68	57	93	62	36	31	6	41	0	
24	78	66	60	80	60	40	14	5	23	0.04	Rain , Thunderstorm
25	88	72	57	81	44	18	20	9	26	0	

The SSC measured during this event is presented in the graph below but it will be not be used for interpretation for the following reasons. The value of 10,400 mg/L was the result of the particle size analysis and inconsistent with the rest of the SSCs. On the other hand, the measured SSCs during the RG event (being approximately 500 mg/L) were inconsistent with the SSC as measured by the USGS at Otowi Gage at 19:52 (being 3,820 mg/L.)



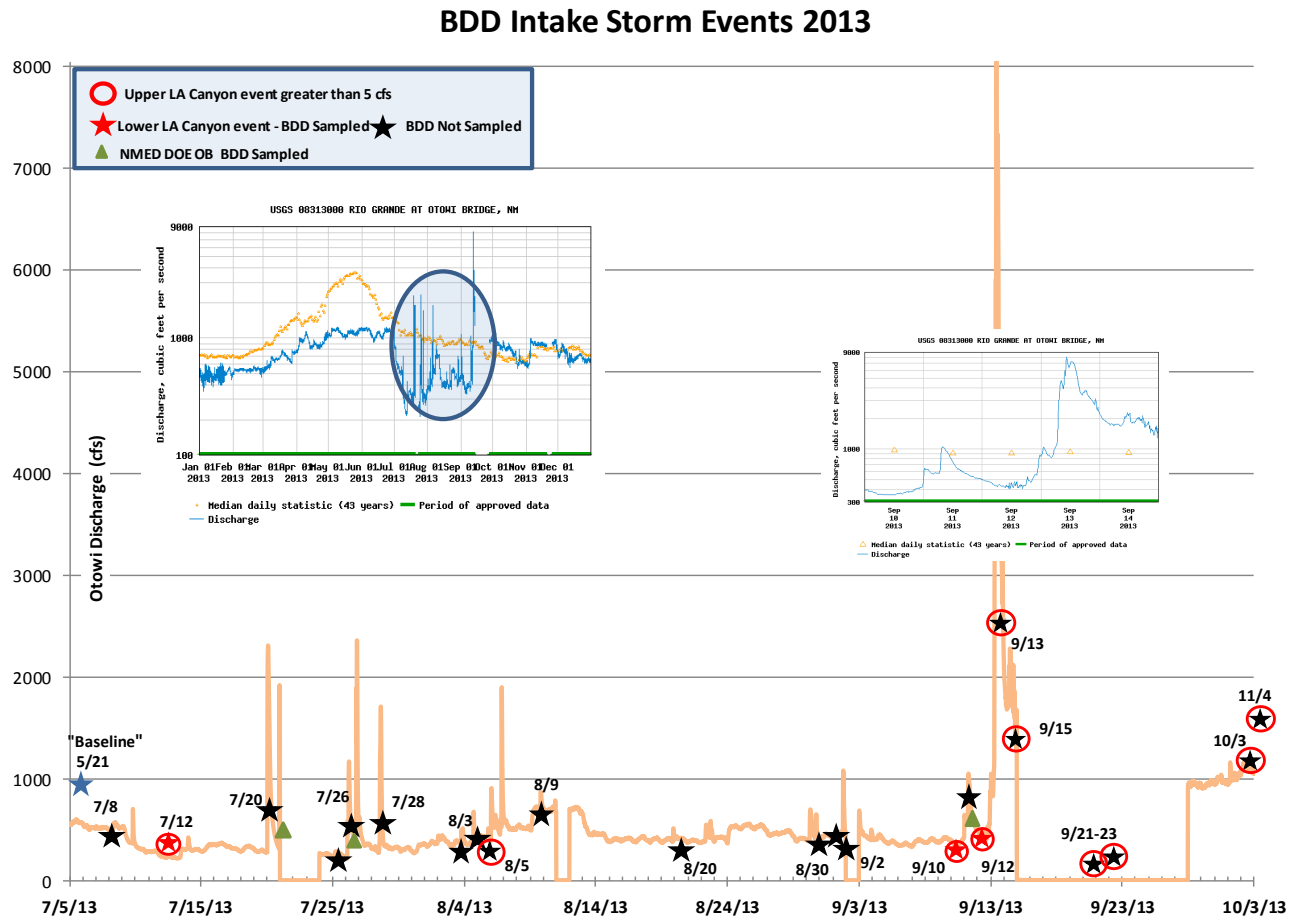
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
8/23/12 17:52	Gross alpha	30	pCi/L	N	EPA:900
8/23/12 17:52	Gross beta	49	pCi/L	N	EPA:900
8/23/12 17:52	Plutonium-239/240	0.048	pCi/L	N	HASL-300:ISOPU
8/23/12 17:52	SSC	1800	mg/L	N	ASTM:D3977-97
8/23/12 18:07	SSC	380	mg/L	N	ASTM:D3977-97
8/23/12 18:08	Gross alpha	607	pCi/L	N	EPA:900
8/23/12 18:08	Gross beta	1290	pCi/L	N	EPA:900
8/23/12 18:08	Gross beta	7.13	pCi/L	Y	EPA:900
8/23/12 18:08	SSC	10400	mg/L	N	ASTM:D3977-97
8/23/12 18:12	Radium-226	0.487	pCi/L	N	EPA:903.1
8/23/12 18:12	Uranium-234	5.09	pCi/L	N	HASL-300:ISOU
8/23/12 18:12	Uranium-234	4.41	pCi/L	Y	HASL-300:ISOU
8/23/12 18:12	Uranium-235	0.132	pCi/L	N	HASL-300:ISOU
8/23/12 18:12	Uranium-235	0.18	pCi/L	Y	HASL-300:ISOU
8/23/12 18:12	Uranium-238	3.54	pCi/L	N	HASL-300:ISOU
8/23/12 18:12	Uranium-238	2.82	pCi/L	Y	HASL-300:ISOU
8/23/12 18:52	Radium-226	0.613	pCi/L	N	EPA:903.1
8/23/12 18:52	Radium-226	0.327	pCi/L	Y	EPA:903.1
8/23/12 18:52	Radium-228	1.61	pCi/L	N	EPA:904
8/23/12 18:52	Uranium-234	3.69	pCi/L	N	HASL-300:ISOU
8/23/12 18:52	Uranium-234	3.17	pCi/L	Y	HASL-300:ISOU
8/23/12 18:52	Uranium-235	0.0854	pCi/L	Y	HASL-300:ISOU
8/23/12 18:52	Uranium-235	0.134	pCi/L	N	HASL-300:ISOU
8/23/12 18:52	Uranium-238	2.65	pCi/L	N	HASL-300:ISOU

8/23/12 18:52	Uranium-238	2.16	pCi/L	Y	HASL-300:ISOU
8/23/12 19:01	SSC	630	mg/L	N	ASTM:D3977-97
8/23/12 19:37	SSC	510	mg/L	N	ASTM:D3977-97
8/23/12 19:42	Radium-226	0.587	pCi/L	N	EPA:903.1
8/23/12 19:42	Uranium-234	3.29	pCi/L	N	HASL-300:ISOU
8/23/12 19:42	Uranium-234	2.47	pCi/L	Y	HASL-300:ISOU
8/23/12 19:42	Uranium-235	0.101	pCi/L	Y	HASL-300:ISOU
8/23/12 19:42	Uranium-235	0.102	pCi/L	N	HASL-300:ISOU
8/23/12 19:42	Uranium-238	2.36	pCi/L	N	HASL-300:ISOU
8/23/12 19:42	Uranium-238	1.75	pCi/L	Y	HASL-300:ISOU
8/23/12 20:22	SSC	440	mg/L	N	ASTM:D3977-97
8/23/12 21:07	SSC	370	mg/L	N	ASTM:D3977-97
8/23/12 21:52	SSC	470	mg/L	N	ASTM:D3977-97

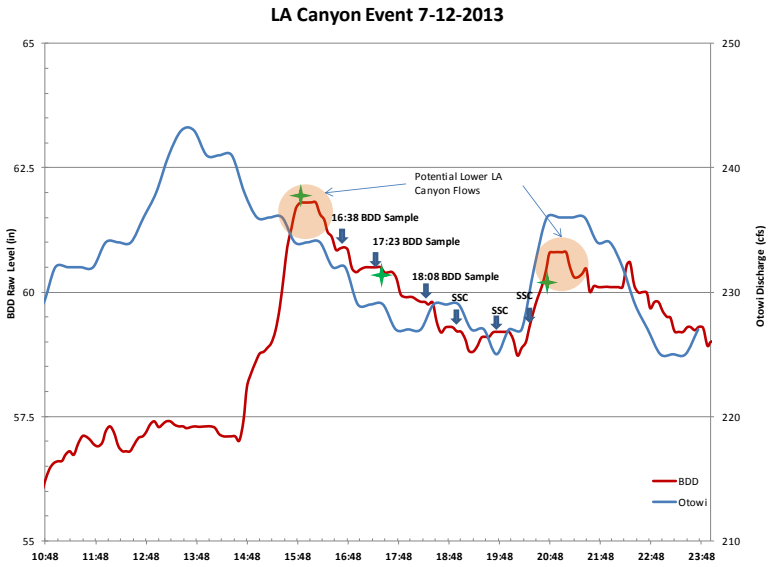
IV.4 2013 Storm Events

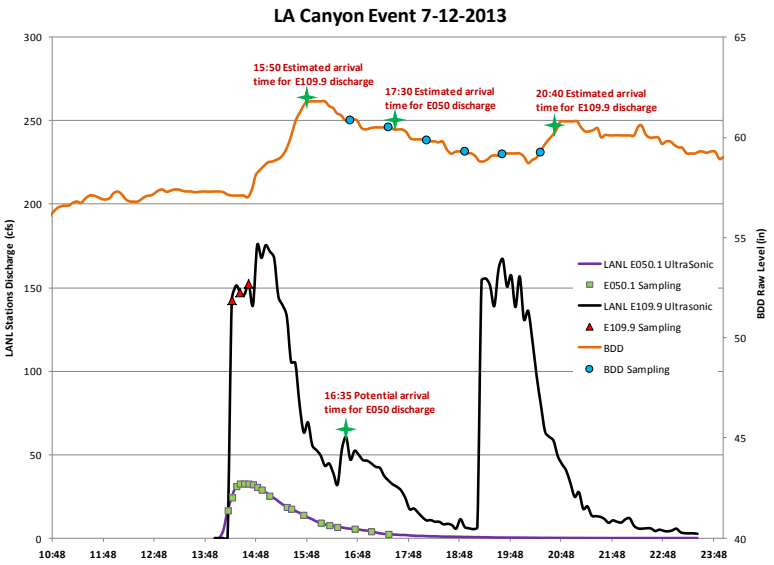
Figure 14. 2013 Otowi gage discharge and BDD Intake sampling.



IV.4.a July 12, 2013 LAC

Narrative of Event: This was a LA Canyon storm event. Sampling was triggered by E109.9. Its flow was observed at BDD Intake at the estimated time as indicated on the graph.





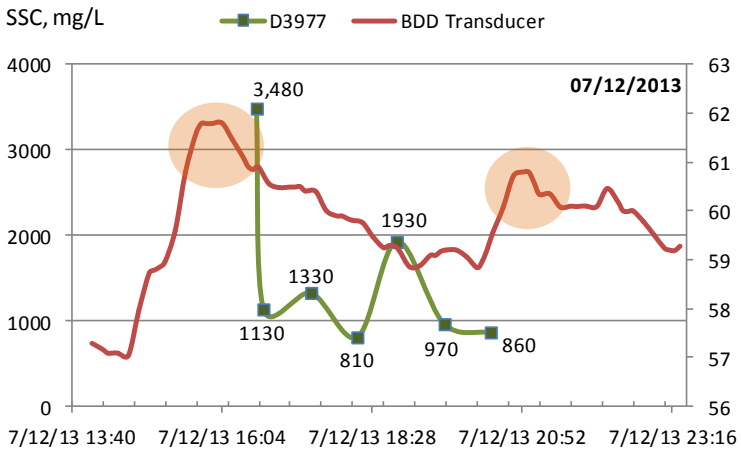
Station	Max Discharge cfs	Time
Otowi	243	13:51
E050.1	34	14:35
E060.1	0	0:00
E109.9	180/167	14:50/19:40
BDD	na	16:10/20:45

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	Gross a-b (F)	16:38	234
2	PCBs	16:38	234
3	Perchlorate	16:38	234
4	Dioxins/Furans	16:38	234
5	Alkalinity/TOC	16:38	234
6	Gross a-b	16:38	234
7	Particle size	16:38	234
8	Metals	16:38	234
9	Metals (F)	16:38	234
10	PCBs	17:23	232
11	insufficient volume	17:46	229
12	PCBs	18:09	229
Bottle #	Sampler BDD3	Time	Otowi Discharge (cfs)
1	SSC	16:45	234
2	SSC	17:30	232
3	SSC	18:15	229
4	SSC	18:53	227
5	SSC	19:38	229
6	SSC	20:23	225
7	Sr 90	16:38	234
8	GS-IsoU/Pu/Am241	16:38	234
9	Ra226/228	16:38	234
10	Sr 90 (F)	16:38	234
11	GS-IsoU/Pu/Am241 (F)	16:38	234
12	Ra226/228 (F)	16:38	234
13	Sr 90	17:23	232
14	GS-IsoU/Pu/Am241	17:23	232
15	Ra226/228	17:23	232
16	Sr 90 (F)	17:23	232
17	GS-IsoU/Pu/Am241 (F)	17:23	232
18	Ra226/228 (F)	17:23	232
19	Sr 90	18:08	229
20	GS-IsoU/Pu/Am241	18:08	229
21	Ra226/228	18:08	229
22	Sr 90 (F)	18:08	229
23	GS-IsoU/Pu/Am241 (F)	18:08	229
24	Ra226/228 (F)	18:08	229

Samples processed on 7/18/2013 13:00-14:00

Week of 7-7-13 Weather Information - Los Alamos											
2013	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Jul	high	avg	low	high	avg	low	high	avg	low	sum	
7	82	71	60	86	55	26	15	4	23	0.01	Rain
8	83	73	63	72	46	23	20	6	24	0	Rain
9	87	76	64	68	44	21	22	4	30	0	Rain
10	84	75	66	56	40	22	22	7	30	0	Rain
11	83	74	64	72	45	25	26	7	38	0.01	Rain
12	79	71	63	83	55	36	31	5	37	0.04	Rain
13	85	74	64	77	50	27	20	6	28	0.06	Rain

The RG did not experience any storm event on this date. Therefore, the changes in SSC were the result of the LAC flow as observed at the BDD Intake.



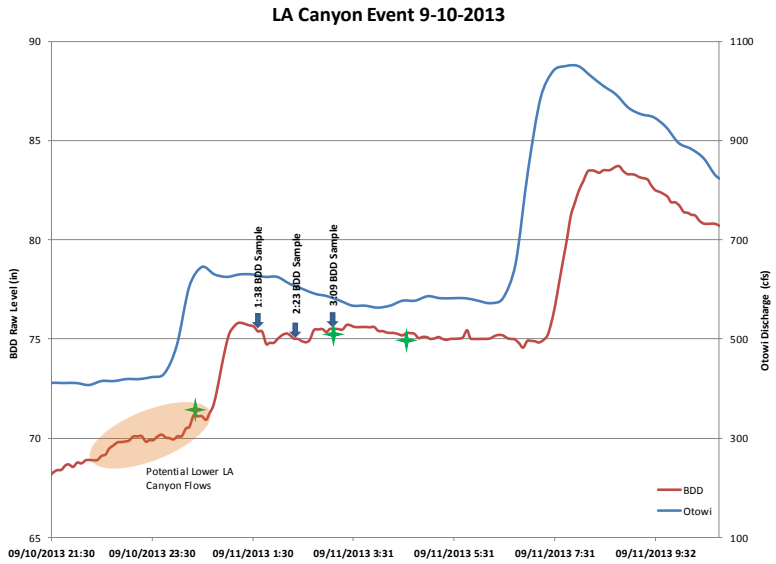
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
7/12/13 16:38	Gross alpha	64.7	pCi/L	N	EPA:900
7/12/13 16:38	Gross alpha	4.52	pCi/L	Y	EPA:900
7/12/13 16:38	Gross beta	110	pCi/L	N	EPA:900
7/12/13 16:38	Gross beta	5.76	pCi/L	Y	EPA:900
7/12/13 16:38	Radium-228	1.93	pCi/L	N	EPA:904
7/12/13 16:38	SSC	3480	mg/L	N	ASTM:D3977-97
7/12/13 16:38	Uranium-234	13.6	pCi/L	N	HASL-300:ISOU
7/12/13 16:38	Uranium-234	13.1	pCi/L	Y	HASL-300:ISOU
7/12/13 16:38	Uranium-235	0.414	pCi/L	Y	HASL-300:ISOU
7/12/13 16:38	Uranium-235	0.43	pCi/L	N	HASL-300:ISOU
7/12/13 16:38	Uranium-238	8.98	pCi/L	N	HASL-300:ISOU
7/12/13 16:38	Uranium-238	9.06	pCi/L	Y	HASL-300:ISOU
7/12/13 16:45	SSC	1130	mg/L	N	ASTM:D3977-97
7/12/13 17:23	Radium-226	1.07	pCi/L	N	EPA:903.1
7/12/13 17:23	Radium-228	2.19	pCi/L	N	EPA:904
7/12/13 17:23	Radium-228	2.13	pCi/L	Y	EPA:904
7/12/13 17:23	Uranium-234	14.5	pCi/L	Y	HASL-300:ISOU
7/12/13 17:23	Uranium-235	0.506	pCi/L	Y	HASL-300:ISOU
7/12/13 17:23	Uranium-238	9.54	pCi/L	Y	HASL-300:ISOU
7/12/13 17:27	Uranium-234	14.9	pCi/L	N	HASL-300:ISOU
7/12/13 17:27	Uranium-235	0.665	pCi/L	N	HASL-300:ISOU
7/12/13 17:27	Uranium-238	10.1	pCi/L	N	HASL-300:ISOU
7/12/13 17:30	SSC	1330	mg/L	N	ASTM:D3977-97
7/12/13 18:08	Radium-226	1.04	pCi/L	N	EPA:903.1
7/12/13 18:08	Radium-226	1.2	pCi/L	Y	EPA:903.1
7/12/13 18:08	Radium-228	1.71	pCi/L	N	EPA:904

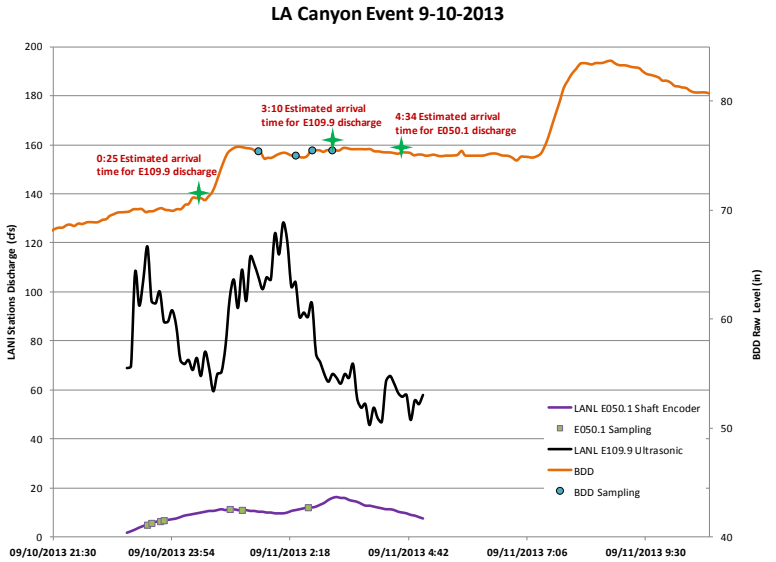
7/12/13 18:08	Uranium-234	14.7	pCi/L	N	HASL-300:ISOU
7/12/13 18:08	Uranium-234	13.6	pCi/L	Y	HASL-300:ISOU
7/12/13 18:08	Uranium-235	0.449	pCi/L	Y	HASL-300:ISOU
7/12/13 18:08	Uranium-238	8.66	pCi/L	N	HASL-300:ISOU
7/12/13 18:08	Uranium-238	9.14	pCi/L	Y	HASL-300:ISOU
7/12/13 18:15	SSC	810	mg/L	N	ASTM:D3977-97
7/12/13 18:53	SSC	1930	mg/L	N	ASTM:D3977-97
7/12/13 19:38	SSC	970	mg/L	N	ASTM:D3977-97
7/12/13 20:23	SSC	860	mg/L	N	ASTM:D3977-97

IV.4.b September 10-11, 2013 LAC

Narrative of Event: This was a LA Canyon storm event. Sampling was triggered by E109.9. Its flow was observed at BDD Intake at the first estimated time as indicated on the graph.



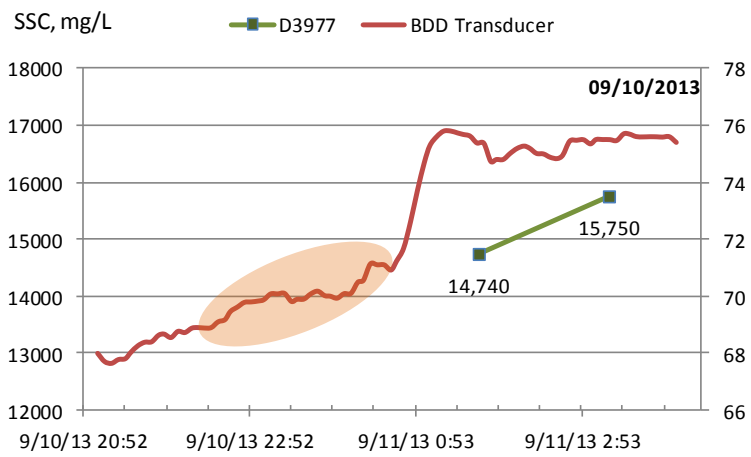
Station	Max Discharge (cfs)	Time
Otowi	645/1050	0:30/8:00 (9/11)
E050.1	11/16	0:55 (9/11)/3:15 (9/11)
E060.1	0	0:00
E109.9	102/118/128	21:35 (9/10)/ 23:25 (9/10)/ 2:10 (9/11)
BDD	na	1:00 (9/11)/8:06 (9/11)



Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	Gross a-b (UF & F)	1:38	625
2	Dioxins/Furans	1:38	625
3	Metals (UF & F)	1:38	625
4	PCBs	1:38	625
5	GS/Np237-IsoU/Pu/Am241	1:38	625
6	GS/Np237-IsoU/Pu/ Am241 (F)	1:38	625
7	Sr 90	1:38	625
8	Sr 90 (F)	1:38	625
9	Particle size	1:38	625
10	PCBs	2:23	625
11	Perchlorate/Alkalinity Cyanide/TDS (F)	2:46	625
12	PCBs	3:09	601
Bottle #	Sampler BDD3	Time	Otowi Discharge (cfs)
1-24	sampler failure	1:38	625
3	SSC	3:12	601

Week of 9-8-13 Weather Information - Los Alamos											
2013	Temp. (°C)			Humidity (%)			Wind (km/h)			Precip. (in)	Events
Sep	high	avg	low	high	avg	low	high	avg	low	sum	
8	27	21	16	76	38	21	35	10	42	0.02	Rain
9	26	21	16	63	45	26	29	11	37	0.02	
10	18	16	13	100	86	58	21	11	35	0.86	Rain
11	22	18	13	100	83	46	21	5	29	0.29	Fog , Rain
12	16	14	14	100	94	83	21	10	34	1.03	Rain
13	16	13	11	100	95	72	21	10	29	2.56	Rain
14	18	14	12	100	87	66	26	10	37	0.23	Rain

There were only two SSC measurements for this event. Considering the RG storm event followed closely the LA Canyon event, we cannot draw any conclusions about the SSC values.



DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

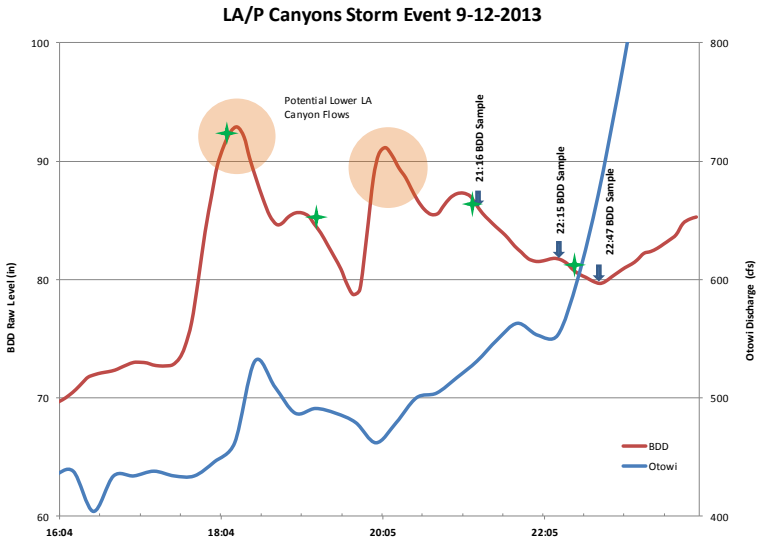
Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
9/11/13 1:38	Gross alpha	293	pCi/L	N	EPA:900
9/11/13 1:38	Gross alpha	3.45	pCi/L	Y	EPA:900
9/11/13 1:38	Gross beta	317	pCi/L	N	EPA:900
9/11/13 1:38	SSC	14740	mg/L	N	ASTM:D3977-97
9/11/13 1:38	Uranium-234	24.5	pCi/L	N	HASL-300:ISOU
9/11/13 1:38	Uranium-234	1.52	pCi/L	Y	HASL-300:ISOU
9/11/13 1:38	Uranium-235	1.07	pCi/L	N	HASL-300:ISOU
9/11/13 1:38	Uranium-238	23.5	pCi/L	N	HASL-300:ISOU
9/11/13 1:38	Uranium-238	1.06	pCi/L	Y	HASL-300:ISOU
9/11/13 2:33	Gross alpha	200	pCi/L	N	EPA:900
9/11/13 2:33	Gross alpha	4.8	pCi/g	N	EPA:900
9/11/13 2:33	Gross beta	210	pCi/L	N	EPA:900
9/11/13 2:33	Gross beta	4.3	pCi/g	N	EPA:900
9/11/13 2:33	Plutonium-239/240	0.017	pCi/g	N	HASL-300:ISOPU
9/11/13 2:33	Plutonium-239/240	0.091	pCi/L	N	HASL-300:ISOPU
9/11/13 2:33	SSC	5800	mg/L	N	ASTM:D3977-97
9/11/13 2:33	Strontium-90	0.4	pCi/L	N	ASTM:D5811-95M
9/11/13 2:33	Uranium-234	7.9	pCi/L	N	HASL-300:ISOU
9/11/13 2:33	Uranium-235	0.34	pCi/L	N	HASL-300:ISOU
9/11/13 2:33	Uranium-238	7.3	pCi/L	N	HASL-300:ISOU
9/11/13 3:12	SSC	15750	mg/L	N	ASTM:D3977-97
9/11/13 3:33	Gross alpha	7.1	pCi/g	N	EPA:900
9/11/13 3:33	Gross beta	6.2	pCi/g	N	EPA:900
9/11/13 4:33	Gross alpha	110	pCi/L	N	EPA:900
9/11/13 4:33	Gross alpha	6.6	pCi/g	N	EPA:900
9/11/13 4:33	Gross beta	100	pCi/L	N	EPA:900
9/11/13 4:33	Gross beta	5.1	pCi/g	N	EPA:900

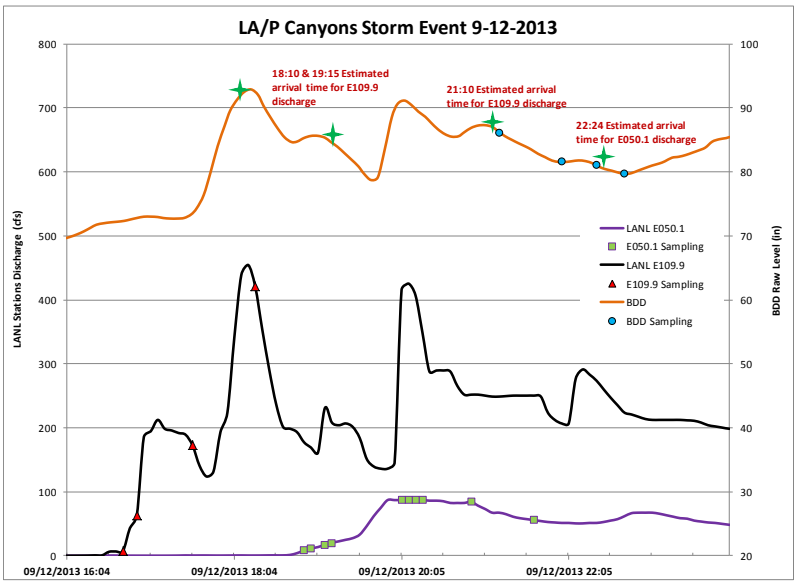
9/11/13 4:33	Plutonium-239/240	0.0091	pCi/g	N	HASL-300:ISOPU
9/11/13 4:33	Plutonium-239/240	0.45	pCi/L	N	HASL-300:ISOPU
9/11/13 4:33	SSC	43000	mg/L	N	ASTM:D3977-97
9/11/13 4:33	Uranium-234	50	pCi/L	N	HASL-300:ISOU
9/11/13 4:33	Uranium-235	2.6	pCi/L	N	HASL-300:ISOU
9/11/13 4:33	Uranium-238	46	pCi/L	N	HASL-300:ISOU
9/11/13 5:33	Gross alpha	170	pCi/L	N	EPA:900
9/11/13 5:33	Gross alpha	7.2	pCi/g	N	EPA:900
9/11/13 5:33	Gross beta	150	pCi/L	N	EPA:900
9/11/13 5:33	Gross beta	6.1	pCi/g	N	EPA:900
9/11/13 5:33	Plutonium-239/240	0.019	pCi/g	N	HASL-300:ISOPU
9/11/13 5:33	Plutonium-239/240	0.23	pCi/L	N	HASL-300:ISOPU
9/11/13 5:33	SSC	32000	mg/L	N	ASTM:D3977-97
9/11/13 5:33	Strontium-90	0.8	pCi/L	Y	ASTM:D5811-95M
9/11/13 5:33	Uranium-234	31	pCi/L	N	HASL-300:ISOU
9/11/13 5:33	Uranium-235	1.5	pCi/L	N	HASL-300:ISOU
9/11/13 5:33	Uranium-238	30	pCi/L	N	HASL-300:ISOU
9/11/13 6:33	Gross alpha	140	pCi/L	N	EPA:900
9/11/13 6:33	Gross alpha	5.2	pCi/g	N	EPA:900
9/11/13 6:33	Gross beta	150	pCi/L	N	EPA:900
9/11/13 6:33	Gross beta	4.9	pCi/g	N	EPA:900
9/11/13 6:33	Plutonium-239/240	0.2	pCi/L	N	HASL-300:ISOPU
9/11/13 6:33	SSC	21000	mg/L	N	ASTM:D3977-97
9/11/13 6:33	Strontium-90	0.36	pCi/L	Y	ASTM:D5811-95M
9/11/13 6:33	Uranium-234	34	pCi/L	N	HASL-300:ISOU
9/11/13 6:33	Uranium-235	1.7	pCi/L	N	HASL-300:ISOU
9/11/13 6:33	Uranium-238	32	pCi/L	N	HASL-300:ISOU
9/11/13 7:33	Gross alpha	170	pCi/L	N	EPA:900
9/11/13 7:33	Gross alpha	7.7	pCi/g	N	EPA:900
9/11/13 7:33	Gross beta	200	pCi/L	N	EPA:900
9/11/13 7:33	Gross beta	5.4	pCi/g	N	EPA:900
9/11/13 7:33	SSC	22000	mg/L	N	ASTM:D3977-97
9/11/13 7:33	Strontium-90	1.4	pCi/L	Y	ASTM:D5811-95M
9/11/13 7:33	Uranium-234	18	pCi/L	N	HASL-300:ISOU
9/11/13 7:33	Uranium-235	0.81	pCi/L	N	HASL-300:ISOU
9/11/13 7:33	Uranium-238	17	pCi/L	N	HASL-300:ISOU
9/11/13 8:33	Gross alpha	180	pCi/L	N	EPA:900
9/11/13 8:33	Gross alpha	3.3	pCi/g	N	EPA:900
9/11/13 8:33	Gross beta	310	pCi/L	N	EPA:900
9/11/13 8:33	Gross beta	2.4	pCi/g	N	EPA:900
9/11/13 8:33	SSC	23000	mg/L	N	ASTM:D3977-97
9/11/13 8:33	Strontium-90	0.5	pCi/L	Y	ASTM:D5811-95M
9/11/13 8:33	Uranium-234	20	pCi/L	N	HASL-300:ISOU
9/11/13 8:33	Uranium-235	0.88	pCi/L	N	HASL-300:ISOU

9/11/13 8:33	Uranium-238	19	pCi/L	N	HASL-300:ISOU

IV.4.c September 12, 2013 LAC

Narrative of Event: This was a LA/P Canyons storm event. Sampling was triggered by E109.9 flow. Its flow was observed at BDD Intake at the estimated times as indicated on the graph.

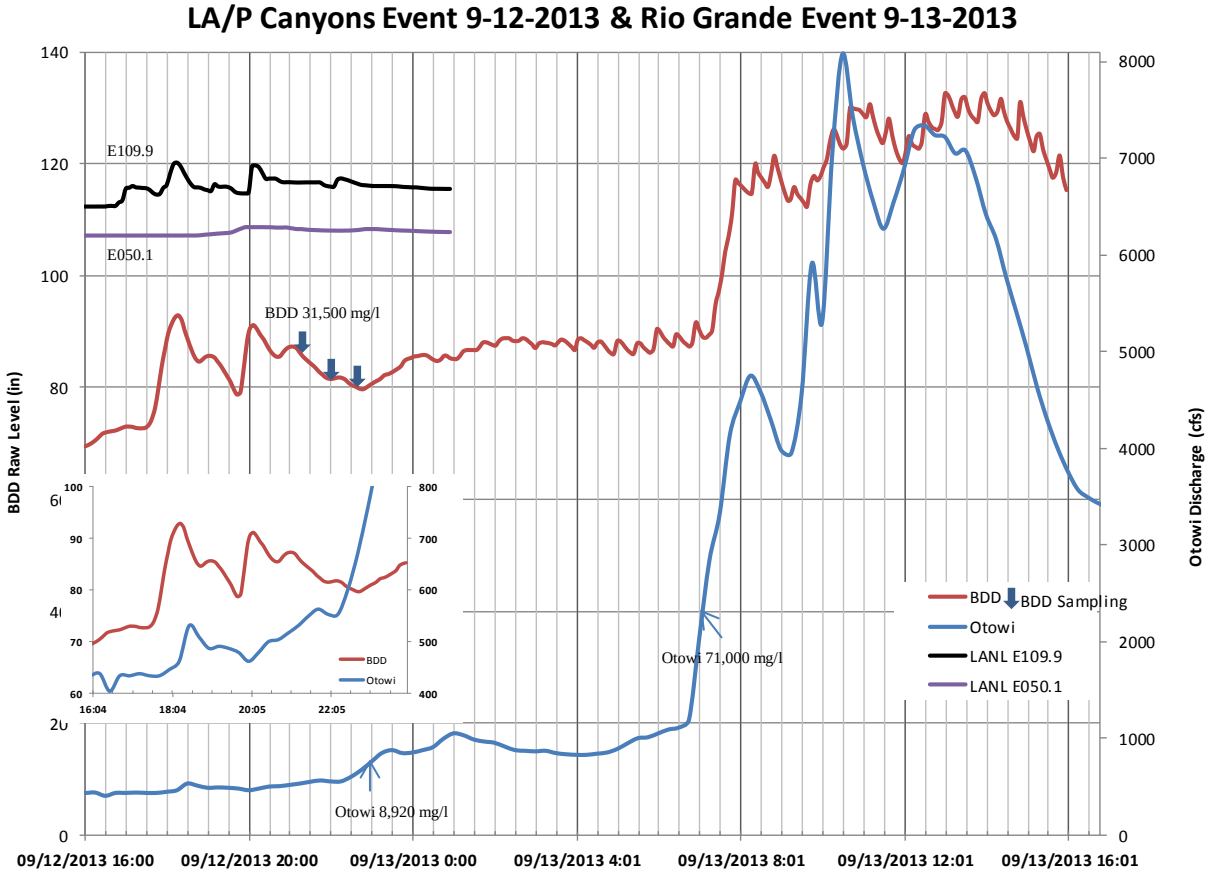




Station	Max Discharge cfs	Time
Otowi	877	23:30
E050.1	87	19:55
E060.1	0.2	18:30
E109.9	454/425	18:15/20:10
BDD	na	18:17/20:10

Sampling & Analyses Information			
Bottle #	Sampler BDD2	Time	Otowi Discharge (cfs)
1	Gross a-b (UF & F)	21:16	500
2	Dioxins/Furans	21:16	500
3	Metals (UF & F)	21:16	500
4	PCBs	21:16	500
5	GS-IsoU/Pu/Am241	21:16	500
6	GS-IsoU/Pu/Am241	21:16	500
7	Sr 90	21:16	500
8	Sr 90 (F)	21:16	500
9	Particle size/SSC	21:16	500
10	PCBs	22:01	530
11	Perchlorate/Alkalinity Cyanide/TDS (F)	22:24	563
12	PCBs	22:47	553
Bottle #	Sampler BDD3	Time	Otowi Discharge (cfs)
1-24	sampler failure		
7	SSC	21:16	500
8	GS-IsoU/Pu/Am241 (F)	21:16	500
	Samples processed on 9/24/2013 11:00 to 15:00		

Week of 9-8-13 Weather Information - Los Alamos											
2013	Temp. (°C)			Humidity (%)			Wind (km/h)			Precip. (in)	Events
Sep	high	avg	low	high	avg	low	high	avg	low	sum	
8	27	21	16	76	38	21	35	10	42	0.02	Rain
9	26	21	16	63	45	26	29	11	37	0.02	
10	18	16	13	100	86	58	21	11	35	0.86	Rain
11	22	18	13	100	83	46	21	5	29	0.29	Fog , Rain
12	16	14	14	100	94	83	21	10	34	1.03	Rain
13	16	13	11	100	95	72	21	10	29	2.56	Rain
14	18	14	12	100	87	66	26	10	37	0.23	Rain



There was only one SSC measured for this event at 21:16 as marked on the graph. Its value was 31,000 mg/L, and that value was the result of the LAC flow highlighted in the previous graph. The Otowi SSC as measured by USGS at 23:00 was merely 8,920 mg/L which confirms that the high SSC value was in response to LAC storm flow.

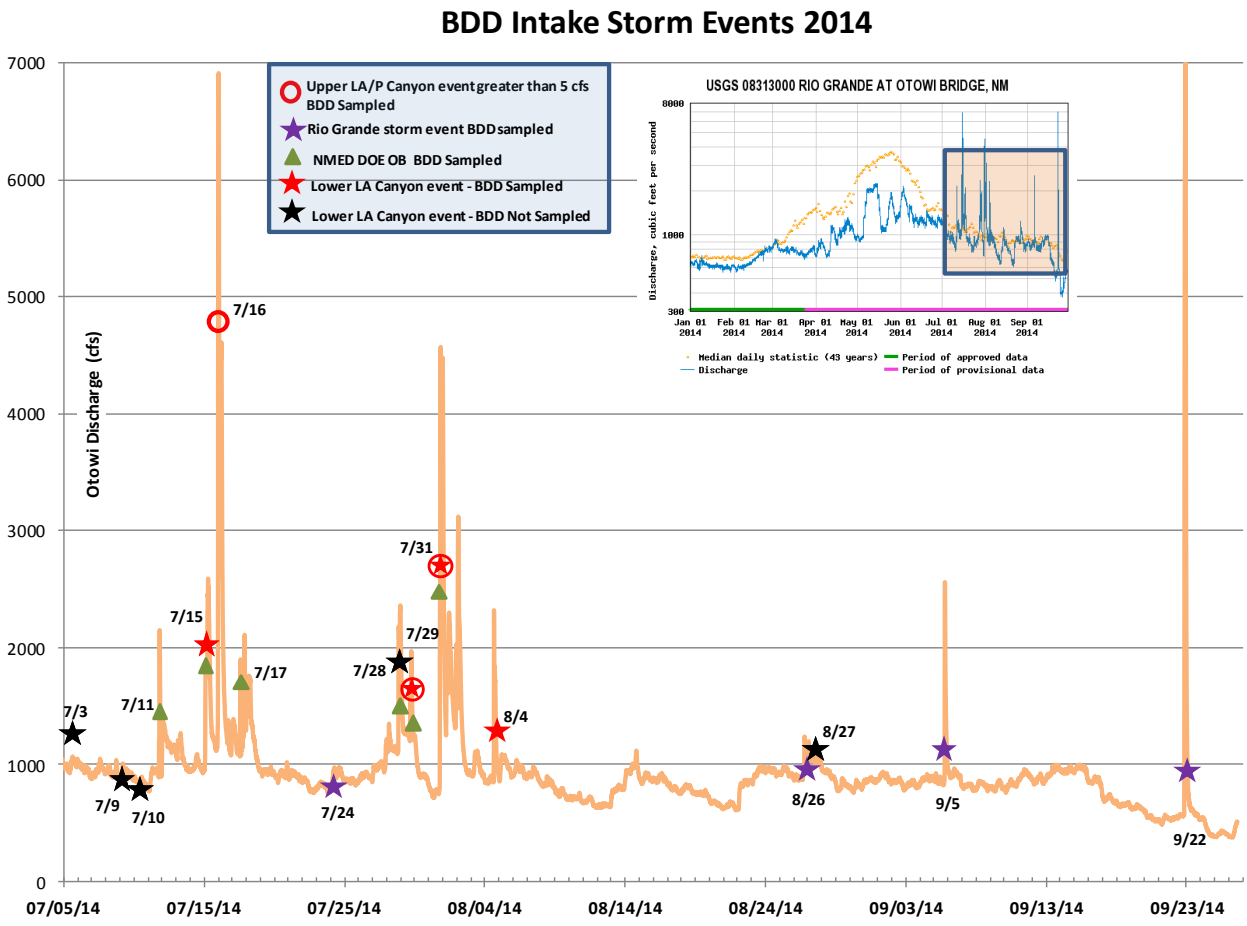
DETECTION OF RADIONUCLIDES AND SSC FOR THIS SAMPLING EVENT

Date & Time	Parameter	Result	Unit	Filtered	Analytical Method
9/12/13 21:16	Americium-241	1.1	pCi/L	N	HASL-300:AM-241
9/12/13 21:16	SSC	44910	mg/L	N	ASTM:D3977-97
9/12/13 21:16	SSC	17980	mg/L	N	ASTM:D3977-97
9/12/13 21:16	Cesium-137	7.97	pCi/L	Y	EPA:901.1
9/12/13 21:16	Gross alpha	964	pCi/L	N	EPA:900
9/12/13 21:16	Gross alpha	8.78	pCi/L	N	EPA:900
9/12/13 21:16	Gross beta	1200	pCi/L	N	EPA:900
9/12/13 21:16	Gross beta	7.72	pCi/L	N	EPA:900
9/12/13 21:16	Strontium-90	0.816	pCi/L	Y	EPA:905.0
9/12/13 21:16	Potassium-40	605	pCi/L	N	EPA:901.1
9/12/13 21:16	Potassium-40	643	pCi/L	Y	EPA:901.1
9/12/13 21:16	Uranium-234	115	pCi/L	N	HASL-300:ISOU
9/12/13 21:16	Uranium-234	1.49	pCi/L	Y	HASL-300:ISOU

9/12/13 21:16	Uranium-238	106	pCi/L	N	HASL-300:ISOU
9/12/13 21:16	Uranium-238	1.33	pCi/L	Y	HASL-300:ISOU
9/12/13 21:16	Uranium-235	8.58	pCi/L	N	HASL-300:ISOU

IV.5 2014 Storm Events

Figure 15. 2014 Otowi gage discharge and BDD Intake sampling.

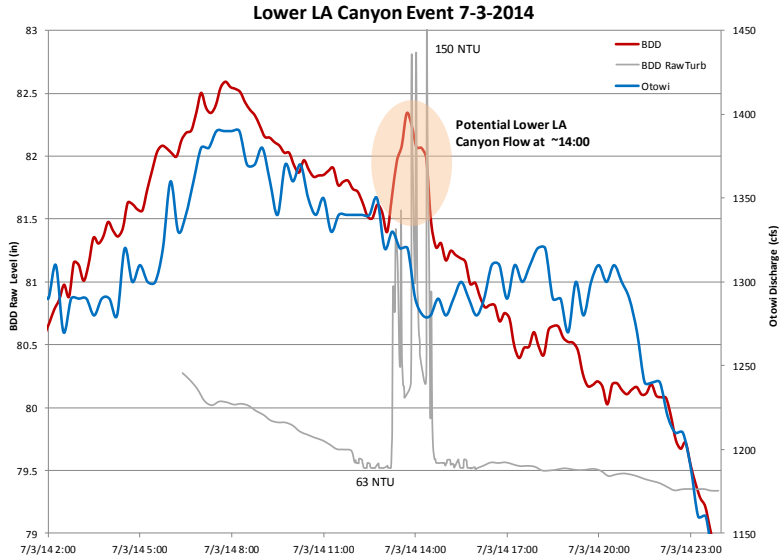


During the 2014 season, the gage station E109.9 was not operational, and, therefore flow readings were not available. However, NMED DOE OB set up a sampler E110, located near the location of E109.9. The dates in the table indicate when that sampler was triggered and/or collected samples in the lower LA Canyon. The dates when E110 was triggered (NMED, 2014) indicate potential flow in the lower LA Canyon because the sampling trigger is a specific rate of rise in the channel stage, not a measure of discharge. With the exception of one reading (7/29 for E060.1) all discharges were taken from the ultrasound probe.

Since E109.9 flows much more frequently than E050.1 and E060.1, BDD staff tried to identify the storm events during which the LLAC flowed even though the middle canyons did not flow. In order to do that BDD reviewed the raw water turbidimeter readings collected almost continuously. At storm events when the turbidity in the river is too high (greater than 2,000 NTU), the sample pump to the turbidimeter is shut off, and does not collect data. At those occasions, readings are not available. The suspected lower LAC flows were attempted to be confirmed with the BDD raw water turbidimeter when readings were available. This confirmation was conducted after the season, so in most cases, sampling was not conducted at the "suspected" potential lower LAC events.

IV.5.a July 3, 2014 LLAC & RG

Narrative of Event: This event was a small RG event and potential lower LA Canyon event. The NMED 110 sampler was triggered in lower LAC, and its flow was observed at BDD at around 14:00 as indicated on the graph. No sampling was initiated at the BDD Intake on this date.



Station	Max Discharge (cfs)	Time
Otowi	1390	7:45
E050.1	-	-
E060.1	-	-
E109.9	>5	-
BDD	na	7:45

The potential lower LAC flow on this date was confirmed by the BDD raw water turbidimeter, where rise in the river turbidity could be observed.

Week of 7-1-14 Weather Information - Los Alamos											
2014	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Jul	high	avg	low	high	avg	low	high	avg	high	sum	
1	79	71	63	75	34	20	20	10	30	0	Rain
2	79	67	55	84	56	27	24	10	36	0.09	Rain
3	77	66	56	91	55	16	33	9	45	0.09	Rain
4	80	68	56	75	48	22	18	5	30	0	
5	78	67	56	84	53	28	21	5	30	0.01	Rain

Week of 7-1-14 Weather Information - Santa Fe											
2014	Temp. (°F)			Humidity (%)			Wind (mph)			Precip. (in)	Events
Jul	high	avg	low	high	avg	low	high	avg	high	sum	
1	86	73	57	78	37	23	26	13	34	0.02	Rain , Thunderstorm
2	82	70	57	84	59	27	23	10	33	0.17	Rain , Thunderstorm
3	84	70	57	90	56	19	18	11	28	0.03	Rain , Thunderstorm
4	84	68	52	84	47	23	17	6	17	0	
5	87	74	61	75	47	23	21	10	28	0	