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Hazardous Waste Bureau

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John Kieling, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: 2017 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project

Dear Mr. Kieling:

Enclosed please find two hard copies with electronic files of the 2017 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project. The objective of this monitoring plan is to evaluate the effects of mitigation measures undertaken in the Los Alamos and Pueblo Canyons watershed under the New Mexico Environment Department– (NMED-) approved Interim Work Plan to Mitigate Contaminated Sediment Transport in the Los Alamos and Pueblo Canyons. The monitoring plan was modified to consider comments from NMED during a pre-plan submittal meeting on January 30, 2017, and in subsequent emails. This document satisfies Appendix B, Milestones and Targets, Milestone 7, of the 2016 Compliance Order on Consent.

If you have any questions, please contact Steve Veenis at (505) 667-0013 (veenis@lanl.gov) or Cheryl Rodriguez at (505) 665-5330 (cheryl.rodriguez@em.doe.gov).

Sincerely,

Bruce Robinson, Program Director
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Los Alamos National Laboratory

Sincerely,

David S. Rhodes, Director
Office of Quality and Regulatory Compliance
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BR/DR/SV:sm

Enclosures: Two hard copies with electronic files – 2017 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project (EP2017-0043)

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LA-UR-17-23270
April 2017
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2017 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project

Prepared by the Associate Directorate for Environmental Management

EP2017-0043

2017 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project

April 2017

Responsible project manager:

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David S. Rhodes	[signature]	Office Director	Quality and Regulatory Compliance	4-25-2017
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1.0 INTRODUCTION

The objective of this monitoring plan is to describe methods and frequency of monitoring in the Los Alamos and Pueblo Canyons (LA/P) watershed. This monitoring plan has been developed to satisfy the requirements of the New Mexico Environment Department– (NMED-) approved “Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” (hereafter, the IMWP) , and NMED’s “Approval with Modification, Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” (NMED 2008, 103007). In accordance with these work plans and the approvals, Los Alamos National Laboratory (LANL or the Laboratory) has undertaken several activities to reduce flood energy and associated sediment transport. Because contaminants migrate with sediment entrained in runoff, reduced sediment transport will thus reduce contaminant transport, which is the primary objective of these activities.

Monitoring proposed within this plan is designed to satisfy four purposes:

1. Monitoring is described to support objectives of the IMWP to evaluate the performance of the controls installed to mitigate sediment transport. Two types of monitoring that began in 2010 are designed to meet the objectives of the IMWP:

   a. monitoring geomorphic changes in the canyon bottom facilitates continued evaluation of sediment control mitigation measures

   b. collecting and analyzing storm water runoff samples for sediment content supports assessment of the performance of sediment control measures

2. Monitoring is described to support the analyses requested by NMED to assess attainment of designated uses. Monitoring concentrations of dissolved metals and total recoverable metals and other pollutants as requested by NMED in its approval of the 2010 monitoring plan (NMED 2010, 108444) supports the determination of whether or not surface waters of the state are attaining designated uses.

3. Monitoring of contaminants in affected environmental media at U.S. Department of Energy (DOE) sites is required under DOE Order 450.1A, “Environmental Protection Program.”

4. Monitoring is described to satisfy requirements of the memorandum of understanding (MOU) between the U.S. Department of Energy (DOE) and the Buckman Direct Diversion Board (BDDB) regarding water-quality monitoring (hereafter, the MOU between BDDB and DOE) (DOE and BDD Board 2014, 600185). Analysis of gross beta, radium-226, and radium-228 at gaging stations E050.1 and E060.1 is being performed to fulfill requirements of the MOU between BDDB and DOE.

Storm water and geomorphic monitoring conducted under this 2017 monitoring plan will evaluate the potential impacts of the changes that occurred in the watershed and the efficacy of the mitigations over time. Figures 1.0-1 and 1.0-2 show storm water and geomorphic monitoring locations. Table 1.0-1 provides a summary of annual monitoring plans and approvals under which monitoring has been conducted since 2010.

Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided in this plan to NMED in accordance with DOE policy. Results from storm water events are systematically uploaded to the publically accessible environmental monitoring database, Intellus New Mexico, available at http://www.intellusnm.com/.
(NMED 2016, 601563)

2.0 MONITORING GEOMORPHIC CHANGES

Monitoring of geomorphic changes (e.g., sediment deposition or erosion) associated with the mitigation measures was conducted in 2016 using three methods: (1) aerial light detection and ranging (LiDAR) surveys; (2) ground-based channel thalweg and bank surveys; and (3) additional supplemental ground-based surveys (e.g., check points for digital elevation model [DEM] evaluation). The surveys have been conducted annually to document geomorphic changes that may have occurred during the previous summer monsoon season. The optimal time for conducting geomorphic surveys is determined by several factors, including the weather, the presence or absence of ponded water in sediment retention basins, and the ability to work in the canyons after dense vegetation has senesced. Typically, this work is conducted after November 1, when storm water flows are less likely to occur. Figure 1.0-1 shows the monitoring areas where surveys have been conducted in 2016 and where repeat surveys are planned in the future.

While LiDAR surveys are extremely useful, they are also costly and time-consuming. In 2017 and in the future, evaluation of geomorphic changes will rely on field observations to determine further actions. If storm water peak discharge at any gaging station in the Los Alamos/Pueblo watershed is greater than 50 cubic feet per second (cfs), the upgradient reach will be visually inspected to document qualitative geomorphic changes. Following the summer monsoon, thalweg and bank surveys will be repeated for the reaches evaluated during the previous year. Minor geomorphic changes occurred between 2015 and 2016, and this minor change will be used as a baseline for determing the level of change in future evaluations. If the visual observations or thalweg surveys indicate geomorphic changes that are not consistent with the past year's observations, a LiDAR aerial survey will be planned for the fall of 2017, and the processed data will be field-verified to ensure that geomorphic changes shown in a threshold DEM of difference comparison represent actual geomorphic changes. The following details the plan to monitor geomorphic changes via LiDAR surveys if events warrant.

If LiDAR surveys are conducted in 2017, they will measure points at a density at least equivalent to the 2016 LiDAR data set (18–24 points per square meter). The LiDAR surveys will provide a detailed DEM of the entire active channel within each monitoring area so a comparison with the previous year's DEM can show areas of geomorphic change. If noteworthy features are identified in the LiDAR comparison, the features will be field-checked and additional ground-based survey methods may be implemented. Ground−based thalweg and bank surveys will be conducted and directly compared with 2016 data to show any geomorphic changes to these specific areas. These surveys help to verify geomorphic changes to the principal erosional processes in the canyon, including bank erosion and channel incision. Independent ground-based check-point survey points will be collected and used to estimate how well the DEM represents the bare earth in each of the survey areas.

2.1 Pueblo Canyon

The following subsections describe geomorphic changes that will be evaluated within Pueblo Canyon in 2017. Ground-based visual inspections and thalweg surveys are planned for these areas.

2.1.1 Pueblo Canyon Background Area above Wastewater Treatment Facility to Pueblo Canyon Wing Ditch

The Pueblo Canyon background area and the wing ditch no longer have functional erosion control features but will be included and reported within the Pueblo Canyon geomorphic change analysis to provide historical context.

Pueblo Canyon Background Area above wastewater treatment facility (*WWTF)*—The upstream extent of this area is located at the westernmost edge of reach P-2W; the downstream extent is located east of Reach P-2W. This section will be used as a background study area above the influence of the WWTF.

Pueblo Canyon Upper Willow-Planting Area—The upstream extent of this area is located west of the westernmost edge of reach P-3FW; the downstream extent is located within Reach P-3W. Between the Los Alamos County WWTF outfall and access road in Reach P-3E is the area where willows were planted in spring 2008 and 2009.

Pueblo Canyon Wing Ditch Area—The wing ditch is a short distance downstream from where the road to the Los Alamos County WWTF crosses the Pueblo Canyon stream channel. This section is located in contiguous reaches P-3C and P-3E. The wing ditch was abandoned when culverts were installed during road reconstruction completed by Los Alamos County in 2011. In 2015, major construction activities reworked this entire area, resulting in the removal of the wing ditch. These activities have been documented as a baseline for future survey comparisons in the “2015 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project” (LANL 2016, 601433).

2.1.2 Pueblo Canyon Wing Ditch Area to Pueblo Canyon GCS Area

This area of Pueblo Canyon has undergone significant channel and bank stabilization efforts following the September 2013 floods. A drop structure was installed, willows were planted, reed canarygrass was transplanted, and coir logs were installed. Stabilization efforts will be monitored using ground-based thalweg profile and bank surveys. Bank and thalweg surveys will be completed from the lower Pueblo Canyon willow planting area to the Pueblo Canyon grade-control structure (GCS) area.

Lower Pueblo Canyon Willow-Planting Area—The upstream extent of this area is at the western end of reach P-3FE, and the downstream extent is within reach P-4W. In Pueblo Canyon, reaches P-3FE and P-4W include a transition area separating a broad upcanyon wetland (reach P-3FE) from a narrower downcanyon wetland within incised geomorphic surfaces (reach P-4W) (LANL 2011, 203661). The Pueblo Canyon drop structure is located at the western end of reach P-3FE and was completed in September 2015 to prevent further headcutting. Willow plantings were completed in the section from the nick point to reach P-4C (LANL 2015, 600439). Vegetation monitoring of the willow viability via alluvial groundwater monitoring with piezometers at three transects will also be conducted in 2017 (Figure 2.1-1).

Pueblo Canyon GCS—Annual surveys in this area are intended to document expected sediment accumulation above the GCS and to monitor changes in the upcanyon wetland.

2.2 Los Alamos Canyon

The monitoring areas for Los Alamos Canyon are as follows: DP Canyon GCS (located within reach DP-2), Los Alamos Canyon low-head weir, and detention basins below the Solid Waste Management Unit (SWMU) 01-001(f) drainage.

Upper Los Alamos Canyon Retention Basins—The upper Los Alamos Canyon retention basins are constructed at the base of the drainage below SWMU 01-001(f) (LA-SMA-2 or Hillside 140). The basins and downstream vegetative buffer were constructed to capture polychlorinated biphenyl− (PCB-) laden sediments from SWMU 01-001(f). The two retention basins will be visually inspected and potentially locally hand-surveyed for sediment accumulation. Baseline conditions will be set in the spring of 2017.

DP Canyon GCS Area—The upstream extent of this area is located at the westernmost edge of reach DP-2; the downstream extent is located east of reach DP-2. The DP Canyon GCS is located in this area. Ground-based visual inspections and thalweg surveys are planned for this area.

Los Alamos Canyon Low-Head Weir—The three retention basins upstream of the low-head weir will be visually inspected and potentially locally hand-surveyed for sediment accumulation. Baseline conditions will be set in the spring of 2017.

3.0 MONITORING STORM WATER RUNOFF

In 2017, storm water monitoring will be conducted at 13 gaging stations (Figure 1.0-1) and 2 ungaged stations (denoted as sampling locations in Figure 1.0-2) within the Los Alamos and Pueblo watershed. No changes to monitoring locations are planned from 2016 to 2017. Gaging stations are sited to monitor sediment transport and performance of mitigations effectively throughout each watershed. Each gaging station automatically collects storm water runoff using ISCO samplers. Storm water analytical suites and the associated reports where data will be presented for each gaging station are presented in Table 3.0-1.

The goal of the sampling is to collect data that (1) represent spatial and temporal variations in potential contaminant concentrations and suspended sediment concentrations (SSC) in storm water; (2) allow evaluation of short- and long-term trends in contaminant concentrations, SSC, and suspended sediment yield; (3) provide data to support the determination of whether or not surface waters of the state are attaining designated uses; and (4) meet requirements of the MOU between BDDB and DOE. The monitoring strategy described below was developed to achieve these goals.

In 2017, in addition to the monitoring proposed in Table 3.0-1, the Laboratory will analyze samples (time series) collected from or during at least one storm flow event at gaging stations E050.1 and E060.1 for dissolved metals, total metals (in water), SSC, and target analyte list (TAL) metals in the sample-sediment fraction on a dry-weight basis. These special sampling event(s) will be selected per an average flow event (excluding events that are too large or too small based on the historical record at the particular gaging station) during the mid-monsoonal season such as during August. In the 2017 monitoring report, these data will be used to statistically compare the projected or estimated values from SSCs with the measured concentrations from the metals analysis on the sediment fraction. The Laboratory will adopt the sample collection and analysis methodology suggested by NMED and described in section 3.6 of this monitoring plan. Results of these analyses will be presented in the "2017 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project."

3.1 2017 Storm Water Monitoring Locations Inspection, Maintenance, and Sample Retrieval Plan

Storm water monitoring at all locations proposed for 2017 will occur using ISCO-type automated pump samplers. Two sampling locations, CO111041 and CO101038 in Figure 1.0-2, are not gaged and are proposed for monitoring at the detention basins below SWMU 01-001(f). Monitoring requirements at these locations are listed in Table 3.0-1. These sampling locations will allow the Laboratory to evaluate how the sediment detention basins and associated vegetative buffer below the basins are performing. These monitoring locations will be inspected following a rain event exceeding 0.25-in. rain intensity in a 30-min period as recorded at rain gage RG055.5.

All other storm water monitoring will occur at gaging stations. Flow-measurement devices and telemetry at gaging stations E050.1 and E060.1 will be inspected at least weekly and after each flow event throughout the year; automated samplers, flow-measurement devices, and telemetry at other gaging stations will be inspected weekly from June 1 to October 31 and monthly from November 1 to May 31. Equipment found to be damaged or malfunctioning will be repaired within 5 business days after the problem is identified. If the time to repair monitoring equipment at E050.1 and E060.1 is expected to exceed 48-h, DOE will notify BDDB per the MOU between BDDB and DOE. Sample retrieval will be attempted within 1 business day and will be performed using the following priority order:

- BDDB-related gaging stations E050.1 and E060.1;
- Gaging stations bounding watershed mitigations at E038, E039.1, E042.1, E059.5, E059.8; and
- Other gaging stations at E026, E030, E040, E055, E055.5, E056, CO101038, and CO111041.

Deviations from the planned inspection, maintenance, and sample collection objectives will be described in the "2017 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project."

3.2 Storm Water Sampling and Analysis Plan

Evaluation of the performance of sediment controls will be supported by repeat analyses of SSC through each monitored storm at gaging stations above and below each watershed mitigation. Storm water runoff sampling at E050.1 and E060.1 will be triggered by discharges of approximately 5 cfs. Storm water runoff sampling at E038 will be triggered by discharges of approximately 40 cfs. Storm water runoff sampling at the remainder of the gaging stations will be triggered by discharges of approximately 10 cfs.

Storm water runoff sampling for chemical and radiochemical analyses at all gaging stations will be triggered 10 min after the maximum discharge exceeding the triggering discharge. Sampling at the detention basins below SWMU 01-001(f) will be triggered by liquid-level actuators detecting the presence of water above each sampler's intake. The chemical and radiochemical analyses will be bounded by analysis of SSC to calculate an estimate of the sediment content of each chemical and radiochemical analysis.

Analytical requirements for storm water samples collected to satisfy the four monitoring purposes are presented in Table 3.2-1. Samples at gaging stations will be collected using automated storm water samplers that contain a carousel of twenty-four 1-L bottles and/or twelve 1-L bottles, as specified in Tables 3.2-2 through 3.2-7. Sample collection inlets will be placed a minimum of 0.33 ft above the bottom of natural stream channels and at 0.17 ft above the bottom of supercritical flumes. The sampling approach summarized above is intended to allow characterization of suspended sediment flux and contaminant concentrations from each portion of the hydrograph, consisting of the following:

1. rapidly rising limb
2. short-duration peak
3. rapidly receding limb following the peak
4. longer-duration recessional limb following the peak

To characterize water quality entering and leaving the sediment detention basins and adjoining vegetative buffer below the SWMU 01-001(f) drainage, automated pump samplers will collect storm water from one location immediately upstream of sediment basin 1 and one location at the terminus of the vegetative buffer up to four times annually when storm water discharge is occurring (Figure 1.0-2).

Analytical suites vary according to monitoring groups and are based on key indicator contaminants, NMED requests, and the MOU between BDDB and DOE for portions of each watershed. Table 3.0-1 shows the monitoring groups, the analytical suite for each location, and the report associated with each monitoring suite. The results of SSC analyses will be used to calculate the total mass/activity transported during storm water runoff events at the gaging stations. Particle-size analyses conducted in conjunction with selected SSC analyses will support characterization of organic chemicals and radionuclides.

The list of analytical suites for each monitoring group presented in Table 3.0-1 is prioritized to guide what analyses will be conducted if the water volume collected from a storm event is not sufficient for all the planned suites. The analytical method, expected method detection limit (MDL), and minimal detectable activity (MDA) (for radionuclides) are presented in Table 3.2-1. The sampling sequence for CO101038 and CO111041 is presented in Table 3.2-2. The sampling sequence for E026, E030, E055, E055.5, and E056 is presented in Table 3.2-3. Table 3.2-4 presents the sampling sequence at E038, E039.1, and E040. Table 3.2-5 presents the sampling sequence at E042.1. Table 3.2-6 presents the sampling sequence at E059.5 and E059.8. Table 3.2-7 presents the sampling sequence at E050.1 and E060.1. Additional samples beyond the four required samples will be submitted for chemical and radiochemical analyses at gaging stations E038, E059.8, and E042.1 if samples are collected during an event at their paired downstream gaging stations (E039.1, E060.1, and E050.1, respectively).

Total suspended sediment transport during a storm event is determined by sampling discharge periodically for SSC analysis throughout the hydrograph. Samples for SSC measurements will be collected at 2-min intervals for the first 30 min, then at 20-min intervals for the following 160 min if runoff is available. Repeat measurements will be taken above and below the DP Canyon GCS at E038 and E039.1, above and below the Los Alamos Canyon low-head weir at E042.1 and E050.1, and above and below the Pueblo Canyon GCS at E059.8 and E060.1 to better characterize the performance of the structures. At these stations, a second sampler is dedicated to collecting storm water for SSC analyses with the objective of representing most or all of the duration of runoff. Collecting SSC samples at 2-min intervals during the first 30 min allows characterization of the rapidly changing early part of the hydrograph.

Except at E050.1 and E060.1, where all storm events are monitored for all parameters, if four events have been sampled at a gaging station during the monitoring year, subsequent events with discharge less than the largest discharge of the sampled storm events will not be analyzed. Also, in Pueblo Canyon at E059.5 and E059.8, all storms will be monitored for all parameters to characterize performance of the newly installed drop structure. If a partial sample is collected, that is, if approximately 75% of the planned bottles were collected, the sample will count toward the four events.

3.3 Stage and Discharge Monitoring

Storm water runoff (in the form of stage and discharge) at each of the gaging stations listed in Table 3.0-1 and gaging station E099 will be monitored continuously throughout the year. Rating curves are used to convert stage to discharge. Rating curves for the gaging stations are updated following channel-forming flood events.

3.4 Inspections of Erosion and Sediment Control Structures

Erosion and sediment control structures and monitoring stations will be inspected after storm events exceeding 50 cfs, or other channel-forming flood events, within 3 business days. Repairs will be made as necessary to ensure such structures and other storm water mitigation features continue to function as intended.

3.5 Sediment Sampling and Analysis Plan

Sediment sampling is conducted annually within the Los Alamos/Pueblo watershed as part of voluntary monitoring conducted for the Annual Site Environmental Report (ASER). The results of this voluntary or NMED-directed sediment sampling conducted in 2017 will be presented in the 2017 ASER.

3.6 Comparison of Unfiltered Metals and Metals Suspended in Sediment

Storm water collected in two 1-L polyethylene sample bottles from each storm event at E050.1 and E060.1 will be quantitatively split using the Dekaport sample splitter into 2/10 (400-mL), 2/10 (400-mL), 3/10 (600-mL), and 3/10 (600-mL) portions. One of the 400-mL aliquots will be filtered using a 0.45-µm pore size membrane for dissolved TAL metals analysis. The other 400-mL aliquot will be submitted for total recoverable TAL metals analysis. One of the 600-mL aliquots will be submitted for SSC analysis. Solids from the remaining 600-mL aliquot will be separated from the liquid phase using filtration techniques, dried, and submitted for TAL metals analysis. Concentrations of metals analyzed from the solid sample will be reported on a dry weight basis. These data collected in 2017 will be used to evaluate the precision and accuracy of normalized concentrations of metals estimated from analysis of SSC and unfiltered storm water collected in previous years.

4.0 2017 MONITORING PLAN CHANGES

Changes from 2016 to 2017 monitoring are as follows:

- LiDAR evaluations from 2014 to 2015 and from 2015 to 2016 showed only minor geomorphic changes in the Los Alamos/Pueblo watershed. During these years, rainfall was minimal and discharge in Los Alamos and Pueblo Canyons rarely exceeded 50 cfs at the gaging stations. The geomorphic changes detected during these years are not signficant and were adequately monitored via visual inspections following storm events, thalweg surveys, and bank surveys. LiDAR evaluations are best suited for estimating sediment transport and system-wide geomorphic changes that tend to occur during years with greater rainfall. Therefore, LiDAR aerial surveys will be conducted only if either of the following ground-based efforts identifies significant geomorphic changes: (1) if storm water peak discharge at any gaging station in the Los Alamos/Pueblo watershed is greater than 50 cfs, the upgradient reach will be visually inspected to document qualitative geomorphic changes; and (2) following the summer monsoon, thalweg and bank surveys will be repeated for the reaches evaluated during the previous year.

- Reduction of sampling to four samples and additional samplesanalyses only if a subsequent event has a larger peak discharge than the four storm events that have already been sampled. Previously, if four samples had been collected and a storm occurred with a peak discharge less than the peaks of the four storms already sampled the following sampling would occur:

  - At BDDB-related stations E050.1 and E060.1, all events are monitored for all parameters;
  - At gaging stations that are up- or downstream of watershed mitigations, one bottle from each of the four portions of the hydrograph (rapidly rising limb, peak, rapidly receding limb following the peak, and longer-duration recessional limb following the peak) would be analyzed for SSC; and
  - At gaging stations that are not up/downstream of watershed mitigations, the first and last bottle collected would be analyzed for SSC.

The Laboratory proposes to eliminate the additional SSC sampling (i.e., from the 4 portions of the hydrograph and the first/last bottle) because it adds very little information to the Los Alamos/Pueblo watershed database and an extensive number of 24-bottle, sedigraph-generating storms have already been sampled at locations up- and downstream of watershed mitigations. The exception is in Pueblo Canyon up- and downstream of the newly constructed drop structure at E059.5/E059.8, where all storms will be monitored for all parameters in 2018 to characterize performance.

- The priority of gaging stations to collect samples from after a storm event were reorganized from a two-tiered to a three-tiered approach that will create more efficiencies in the field (see section 3.1).

5.0 REPORTING

All data collected as part of this 2017 monitoring plan will be presented in the "2017 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project," to be submitted to NMED by April 30, 2018. The "2018 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project" will also be submitted to NMED by April 30, 2018. Monitoring conducted as part of this 2017 monitoring plan to determine whether or not waters of the state are attaining designated uses and to fulfill monitoring requirements in DOE Order 450.1A will be reported in the "2017 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project." Monitoring conducted as part of this 2017 monitoring plan solely to fulfill requirements of the MOU between BDDB and DOE will be made available publically in Intellus NM. All analytical data, stream discharge measurements, and DEM measurements collected as a result of this plan will be provided in the "2017 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project."

6.0 REFERENCES AND MAP DATA SOURCES

6.1 References

The following list includes all documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID or ESH ID. This information is also included in text citations. ER IDs were assigned by the Environmental Programs Directorate's Records Processing Facility (IDs through 599999), and ESH IDs are assigned by the Environment, Safety, and Health (ESH) Directorate (IDs 600000 and above). IDs are used to locate documents in the Laboratory's Electronic Document Management System and, where applicable, in the master reference set.

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

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LANL (Los Alamos National Laboratory), April 2016. "2016 Monitoring Plan for Los Alamos/ Pueblo Watershed Sediment Transport Mitigation Project," Los Alamos National Laboratory document LA-UR-16-22543, Los Alamos, New Mexico. (LANL 2016, 601434)

NMED (New Mexico Environment Department), July 18, 2008. "Approval with Modifications, Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 103007)

NMED (New Mexico Environment Department), January 11, 2010. "Approval with Modifications, Los Alamos and Pueblo Canyons Sediment Transport Monitoring Plan," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 108444)

NMED (New Mexico Environment Department), June 3, 2011. "Approval with Modifications, 2011 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 203705)

NMED (New Mexico Environment Department), January 23, 2013. "Approval, 2012 Monitoring Plan for Los Alamos and Pueblo Canyons, Sediment Transport Mitigation Project, Revision 2," New Mexico Environment Department letter to P. Maggiore (DOE-LASO) and J.D. Mousseau (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2013, 521854)

NMED (New Mexico Environment Department), July 19, 2013. "Approval, 2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 1," New Mexico Environment Department letter to P. Maggiore (DOE-LASO) and J.D. Mousseau (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2013, 523106)

NMED (New Mexico Environment Department), June 12, 2015. "Approval with Modifications, 2015 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project," New Mexico Environment Department letter to C. Gelles (DOE-NA-LA) and M.T. Brandt (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2015, 600507)

NMED (New Mexico Environment Department), June 18, 2016. "[Approval for the] 2016 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project, Los Alamos National Laboratory," New Mexico Environment Department letter to D. Rhodes (DOE-EM-LA) and J. McCann (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2016, 601563)

6.2 Map Data Sources

GageStation; Los Alamos National Laboratory, ER-ES, As published, project folder 15-0013; \\slip\gis\GIS\Projects\15-Projects\15-0013\zip\2015_E059.8_GageStation.shp; 2015

Facility location; Los Alamos National Laboratory, ER-ES, As published, project folder 15-0013;\\slip\gis\GIS\Projects\15-Projects\15-0013\project_data.gdb;merge_sandia_features_AGAIN;2015

Erosion control structure; Los Alamos National Laboratory, ER-ES, As published, project folder 15-0013;\\slip\gis\GIS\Projects\15-Projects\15-0013\project_data.gdb;merge_sandia_features_AGAIN;2015

Sediment control structure; Los Alamos National Laboratory, ER-ES, As published, project folder 15-0013;\\slip\gis\GIS\Projects\15-Projects\15-0013\project_data.gdb;merge_sandia_features_AGAIN;2015

Willow planting area;Los Alamos National Laboratory, ER-ES, As published, project folder 14-0015; \\slip\gis\GIS\Projects\14-Projects\14-0015\shp\as_built_willow_banks.shp; 2015

Structures; County of Los Alamos, Information Services; as published 29 October 2007.

Drainage; County of Los Alamos, Information Services; as published 16 May 2006.

Los Alamos County Boundary; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; Unknown publication date.

Road Centerlines for the County of Los Alamos; County of Los Alamos, Information Services; as published 04 March 2009.

Watersheds; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; EP2006-0942; 1:2,500 Scale Data; 27 October 2006.

Contour, 4-ft interval; Los Alamos National Laboratory, ER-ES, As published, project folder 15-0013;\\slip\gis\Data\HYP\LiDAR\2014\Bare_Earth\BareEarth_DEM_Mosaic.gdb; 2015

Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 13 August 2010.

Sediment Geomorphology; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2002-0589; 1:1,200 Scale Data; 01 January 2002.

Monitoring area; Los Alamos National Laboratory, ER-ES, As published, project folder 15-0013; \\slip\gis\GIS\Projects\15-Projects\15-0013\zip\ZoomAreas.shp; 2015

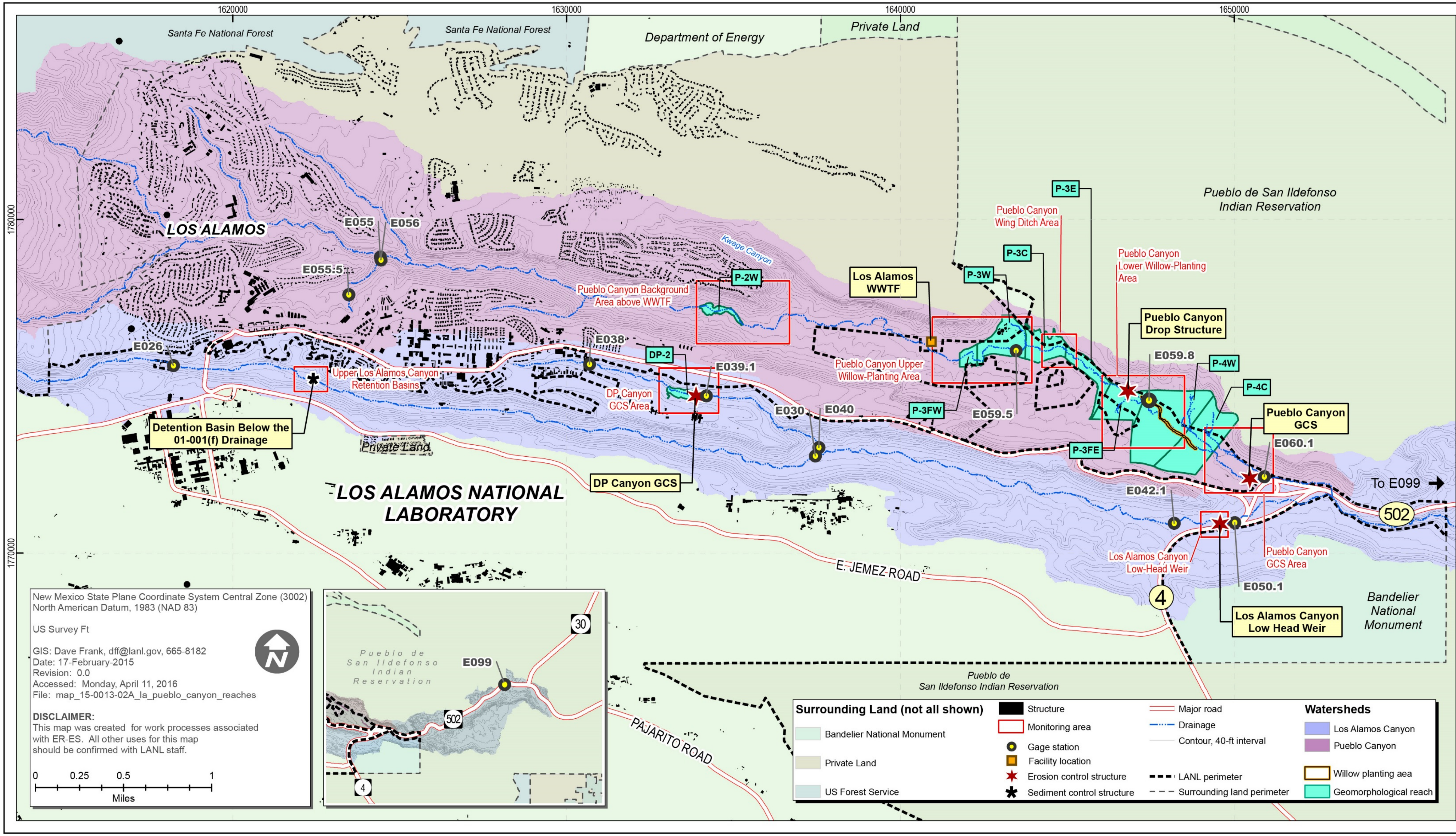

Figure 1.0-1 Monitoring locations and sediment trap mitigation sites in Los Alamos and Pueblo Canyons

“sampling location

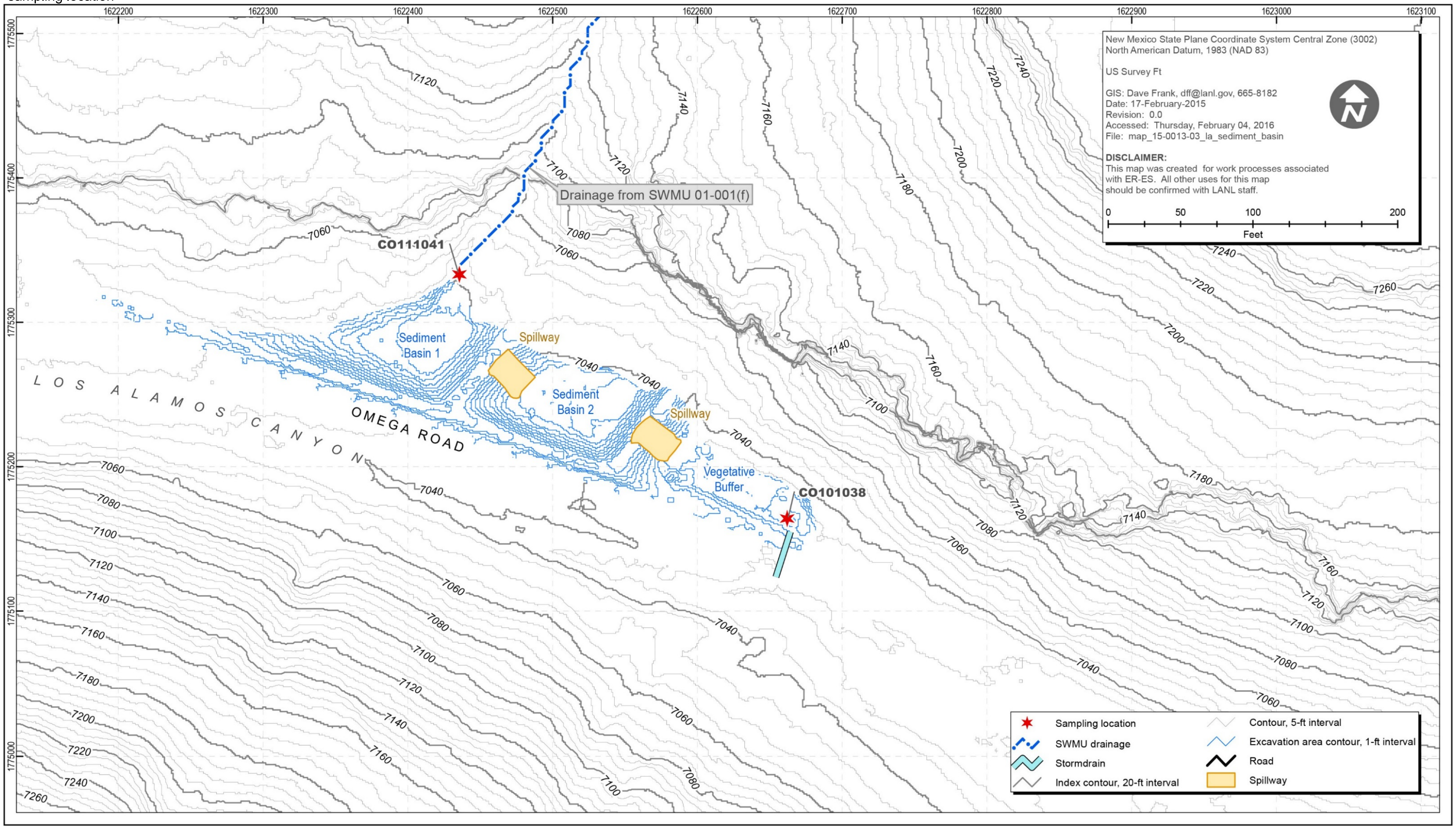

Figure 1.0-2 **Detention basins and sampling locations below the SWMU 01-001(f) drainage**

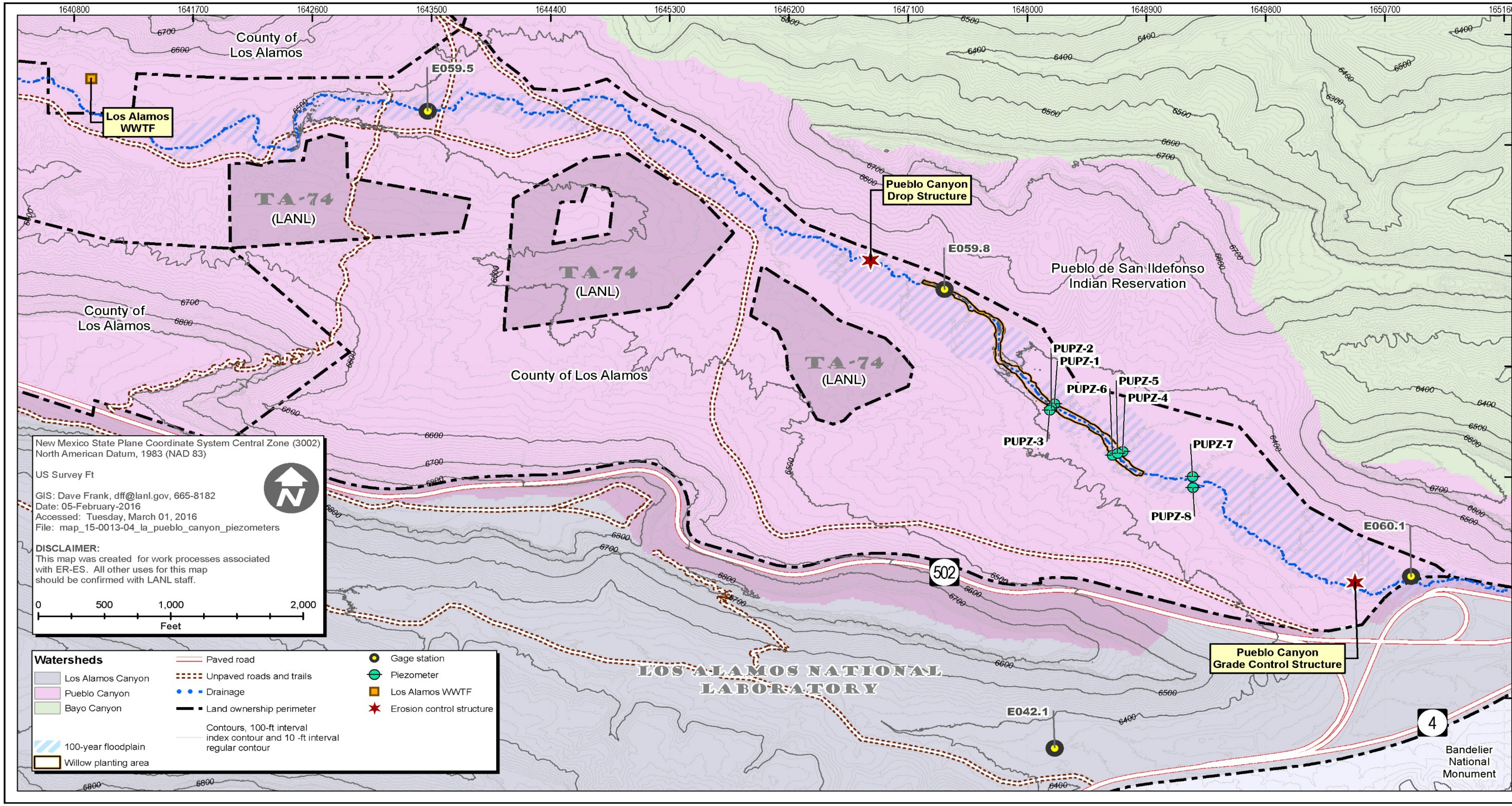

Figure 2.1-1 Piezometer transect locations; 2014 willow planting area; Los Alamos WWTF; gaging stations E059.5, E059.8, and E060.1; precipitation gage E042.1; new Pueblo Canyon drop structure; and Pueblo Canyon grade-control structure

Table 1.0-1
Monitoring Plans Submitted since 2010

Monitoring Year	Monitoring Plan Name	Reference and Date Submitted	Approval	NMED Approval and Approval Date
2010	Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL 2009, 107457, 10/15/2009	Approval with Modifications, Los Alamos and Pueblo Canyons Sediment Transport Monitoring Plan	NMED 2010, 108444, 1/11/2010
2011	2011 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL, 2011, 201578, 3/23/2011	Approval with Modifications [for the] 2011 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	NMED 2011, 203705, 6/3/2011
2012	2012 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 2	LANL 2012, 222833, 9/28/2012	Approval [for the] 2012 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 2	NMED 2013, 521854, 1/23/2013
2013	2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 1	LANL 2013, 243432, 6/21/2013	Approval [for the] 2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 1	NMED 2013, 523106, 7/19/2013
2014	2014 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL, 2014, 256575, 5/15/2014	Neither approved nor denied	n/a*
2015	2015 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL, 2015, 600438, 5/15/2015	Approval with Modifications [for the] 2015 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	NMED 2015, 600507, 6/12/2015
2016	2016 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL 2016, 601434, 4/28/2016	Approval with Modifications [for the] 2016 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	NMED 2016, 601563, 6/16/2016

*n/a = Not applicable.

Table 3.0-1
Locations and Analytical Suites for Storm Water Samples

Monitoring Group	Locations	Analytical Suites[a]		
		Associated Report: 2016 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project[b]	Associated Report: 2016 Annual Site Environment Report	MOU between BDDB and DOE
Upper Los Alamos Canyon gaging stations	E026, E030	PCBs (by Method 1668A), gamma spectroscopy radionuclides, dioxin/furans, strontium-90, isotopic plutonium, SSC, particle size	Dissolved TAL metals[c] + B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, total uranium, gross alpha, BLM suite[d]	n/a[e]
DP Canyon gaging stations	E038, E039.1, E040	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, strontium-90, SSC, particle size	Dissolved TAL metals + B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, total uranium, gross alpha, BLM suite	n/a
Upper Pueblo Canyon, and Acid Canyon gaging stations	E055, E055.5, E056	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, americium-241 (by alpha spectroscopy), total recoverable silver, SSC, particle size, total recoverable silver	Dissolved TAL metals + B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, total uranium, gross alpha, BLM suite	n/a
Lower Los Alamos Canyon gaging station	E042.1	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, americium-241 (by alpha spectroscopy), dioxins/furans, strontium-90, SSC, particle size	Dissolved TAL metals + B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, total uranium, gross alpha, BLM suite	n/a
Lower Los Alamos Canyon gaging station	E050.1	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, americium-241 (by alpha spectroscopy),dioxins/furans, strontium-90, solid phase TAL metals, SSC, particle size	Dissolved TAL metals + B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, total uranium, gross alpha, BLM suite	PCBs (by Method 1668A), dioxins/furans, gamma spectroscopy radionuclides, isotopic plutonium, isotopic uranium, americium-241 (by alpha spectroscopy), strontium-90, gross alpha, gross beta, radium-226/radium-228, dissolved and total recoverable TAL metals, hardness, SSC, particle size

Table 3.0-1 (continued)

Monitoring Group	Locations	Analytical Suites[a]		
		Associated Report: 2016 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project[b]	Associated Report: 2016 Annual Site Environment Report	MOU between BDDB and DOE
Lower Pueblo Canyon gaging stations	E059.5, E059.8	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, americium-241 (by alpha spectroscopy), isotopic uranium, strontium-90, SSC, particle size, total recoverable silver	Dissolved TAL metals + B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, total uranium, gross alpha, BLM suite	n/a
Lower Pueblo Canyon gaging station	E060.1	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, americium-241 (by alpha spectroscopy), strontium-90, solid phase TAL metals, SSC, particle size, total recoverable silver	Dissolved TAL metals+ B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, total uranium, gross alpha, BLM suite	PCBs (by Method 1668A), dioxins/furans, gamma spectroscopy radionuclides, isotopic plutonium, isotopic uranium, americium-241 (by alpha spectroscopy), strontium-90, gross alpha, gross beta, radium-226/radium-228, dissolved and total recoverable TAL metals, hardness, SSC, particle size
Detention basins and vegetative buffer below the SWMU 01-001(f) drainage	CO101038, CO111041	PCBs (by Method 1668A), total organic carbon, SSC, particle size	Dissolved TAL metals + B + U, hardness, total recoverable aluminum, total recoverable selenium, total mercury, gross alpha, BLM suite	n/a

[a] Suites are listed in order of priority to guide analysis of limited water volume. SSC and particle size are independent of prioritization because they are derived from separate sample bottles.

[b] Radionuclides are collected and reported per DOE Order 450.1.

[c] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[d] BLM suite = Biotic ligand model (BLM) suite, which includes dissolved organic carbon, chloride, sulfate, alkalinity, and pH.

[e] n/a = Not applicable.

Table 3.2-1
Analytical Requirements for Storm Water Samples

Analytical Suite	Method	Contract-Required Reporting Limit	Typical Detection Limit in Storm Water[a]	Upper Los Alamos Canyon (E026, E030)	Upper Pueblo Canyon and Acid Canyon (E055, E056, E055.5)	DP Canyon (E038, E039.1, E040)	Lower Los Alamos Canyon (E042.1, E050.1)	Lower Pueblo Canyon (E059.5, E059.8, E060.1)	BDDB-Required Monitoring (E050.1, E060.1)	Detention Basins below the SWMU 01-001(f) Drainage
PCBs	EPA:1668A	n/a[b]	25 pg/L	X[c]	X	X	X	X	X	X
Isotopic plutonium	HASL-300	0.075 pCi/L	0.5 pCi/L	X	X	X	X	X	X	—[d]
Gamma spectroscopy	EPA:901.1	8 pCi/L (Cs-137)	10 pCi/L (Cs-137)	X	X	X	X	X	X	—
Isotopic uranium	HASL-300	0.1 pCi/L	0.5 pCi/L	—	—	—	—	—	X	—
Americium-241	HASL-300	0.075 pCi/L	0.5 pCi/L	—	X	—	X	X	X	—
Strontium-90	EPA:905.0	0.5 pCi/L	0.5 pCi/L	X	—	X	X	X	X	—
TAL metals[e] + B + U	EPA:200.7/200.8/245.2	Variable	Variable	X	X	X	X	X	X	X
TAL metals + B + U	SW846:6010C/6020/ 7471A; ASTM: D3977-97	Variable	Variable	—	—	—	—	—	X	—
Dioxins and furans	EPA:1613B	10–50 ng/L	50 pg/L	X	—	—	X	—	X	—
Gross alpha	EPA:900	3 pCi/L	10 pCi/L	X	X	X	X	X	X	X
Gross beta	EPA:900	3 pCi/L	10 pCi/L	—	—	—	—	—	X	—
Radium-226/radium-228	EPA:903.1/EPA:904	1 pCi/L	0.5/0.5 pCi/L	—	—	—	—	—	X	—
SSC	ASTM: D3977-97	3 mg/L	10 mg/L	X	X	X	X	X	X	X
Particle size	ASTM:C1070	n/a	0.01%	X	X	X	X	X	X	X

Table 3.2-1 (continued)

Analytical Suite	Method	Contract-Required Reporting Limit	Typical Detection Limit in Storm Water[a]	Upper Los Alamos Canyon (E026, E030)	Upper Pueblo Canyon and Acid Canyon (E055, E056, E055.5)	DP Canyon (E038, E039.1, E040)	Lower Los Alamos Canyon (E042.1, E050.1)	Lower Pueblo Canyon (E059.5, E059.8, E060.1)	BDDB-Required Monitoring (E050.1, E060.1)	Detention Basins below the SWMU 01-001(f) Drainage
Alkalinity	EPA:310	n/a	n/a	X	X	X	X	X	X	X
pH	EPA:150.1	n/a	n/a	X	X	X	X	X	X	X
Chloride	EPA:300	n/a	0.1 mg/L	X	X	X	X	X	X	X
Sulfate	EPA:300	n/a	0.5 mg/L	X	X	X	X	X	X	X
Dissolved organic carbon	EPA:415.1	n/a	0.5 mg/L	X	X	X	X	X	X	X

[a] MDL or MDA for radionuclides.

[b] n/a = Not applicable.

[c] X = Monitoring planned.

[d] — = Monitoring not planned.

[e] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

Table 3.2-2
Sampling Sequence for Collection of Storm Water Samples at the Detention Basins and Vegetative Buffer below the SWMU 01-001(f) Drainage

Sample Bottle (1 L)	CO101038, CO111041	
	Start Time (min) 12-Bottle ISCO	Analytical Suite
1	Trigger	SSC, particle size
2	Trigger +2	PCBs (UF[a]), TOC[b] (UF), DOC[c] (F[d]), chloride (F), sulfate (F), alkalinity (UF), pH (UF)
3	Trigger +4	
4	Trigger +6	
5	Trigger +8	TAL metals[e] + B + U + hardness (F)
6	Trigger +10	Total recoverable selenium (UF), total mercury (UF), total uranium (UF)
7	Trigger +12	Gross alpha (UF)
8	Trigger +14	SSC
9	Trigger +16	Extra bottle
10	Trigger +18	Extra bottle
11	Trigger +20	Extra bottle
12	Trigger +22	Extra bottle

[a] UF = Unfiltered.

[b] TOC = Total organic carbon.

[c] DOC = Dissolved organic carbon.

[d] F = Filtered using 0.45-µm filter membrane.

[e] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

Table 3.2-3
Sampling Sequence for Collection of
Storm Water Samples at E026, E030, E055, E055.5, and E056

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	E026 and E030 Analytical Suites	E055, E055.5, and E056 Analytical Suites
1	Max+10	SSC, particle size	SSC, particle size
2	Max+12	PCBs (UF[a]), TOC[b] (UF), DOC[c] (F[d]), chloride (F), sulfate (F), alkalinity (UF), pH (UF)	PCBs (UF), TOC (UF), DOC (F), chloride (F), sulfate (F), alkalinity (UF), pH (UF)
3	Max+14		
4	Max+16		
5	Max+18	TAL metals[e] + B + U + hardness (F)	TAL metals + B + U + hardness (F)
6	Max+20	Total recoverable selenium (UF), total mercury (UF), total uranium (UF)	Total recoverable selenium (UF), total mercury (UF), total uranium (UF), total recoverable silver (UF)
7	Max+22	Dioxins and furans (UF)	Americium-241 (UF), isotopic plutonium (UF)
8	Max+24		Gamma spectroscopy (UF), gross alpha (UF)
9	Max+26	Strontium-90 (UF)	
10	Max+28	Gamma spectroscopy (UF), gross alpha (UF), isotopic plutonium (UF)	SSC
11	Max+30		Extra bottle
12	Max+32	SSC	Extra bottle

[a] UF = Unfiltered.

[b] TOC = Total organic carbon.

[c] DOC = Dissolved organic carbon.

[d] F = Filtered using 0.45-µm filter membrane.

[e] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

Table 3.2-4
Sampling Sequence for Collection of Storm Water Samples at E038, E039.1, and E040

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	E038, E039.1, and E040	E038 and E039.1	
		Analytical Suites	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC, particle size	Trigger	SSC
2	Max+12	PCBs (UF[a]), TOC[b] (UF), DOC[c] (F[d]), chloride (F), sulfate (F), alkalinity (UF), pH (UF)	Trigger+2	SSC
3	Max+14		Trigger+4	SSC
4	Max+16		Trigger+6	SSC
5	Max+18	TAL metals[e] + B + U + hardness (F)	Trigger+8	SSC
6	Max+20	Total recoverable selenium (UF), total mercury (UF), total uranium (UF)	Trigger+10	SSC
7	Max+22	Strontium-90 (UF)	Trigger+12	SSC
8	Max+24	Gamma spectroscopy (UF), gross alpha (UF), isotopic plutonium (UF)	Trigger+14	SSC
9	Max+26		Trigger+16	SSC
10	Max+28	SSC	Trigger+18	SSC
11	Max+30	Extra bottle	Trigger+20	SSC
12	Max+32	Extra bottle	Trigger+22	SSC
13	n/a[f]	n/a	Trigger+24	SSC
14	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	Trigger+130	SSC
22	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	Trigger+190	SSC

[a] UF = Unfiltered.

[b] TOC = Total organic carbon.

[c] DOC = Dissolved organic carbon.

[d] F = Filtered using 0.45-µm filter membrane.

[e] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

Table 3.2-5
Sampling Sequence for Collection of Storm Water Samples at E042.1

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC, particle size	Trigger	SSC
2	Max+12	PCBs (UF[a]), TOC[b] (UF), DOC[c] (F[d]), chloride (F), sulfate (F), alkalinity (UF), pH (UF)	Trigger+2	SSC
3	Max+14		Trigger+4	SSC
4	Max+16		Trigger+6	SSC
5	Max+18	TAL metals[e] + B + U + hardness (F)	Trigger+8	SSC
6	Max+20	Dioxins/furans (UF)	Trigger+10	SSC
7	Max+22	Strontium-90 (UF)	Trigger+12	SSC
8	Max+24	Gamma spectroscopy (UF), gross alpha (UF)	Trigger+14	SSC
9	Max+26		Trigger+16	SSC
10	Max+28	SSC	Trigger+18	Total recoverable selenium (UF), total mercury (UF), total uranium (UF)
11	Max+60	PCBs (UF)	Trigger+20	SSC
12	Max+62	Isotopic plutonium (UF)	Trigger+22	Americium-241 (UF), isotopic plutonium (UF)
13	n/a[f]	n/a	Trigger+24	SSC
14	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	Trigger+130	SSC

Table 3.2-5 (continued)

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
22	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	Trigger+190	SSC

[a] UF = Unfiltered.

[b] TOC = Total organic carbon.

[c] DOC = Dissolved organic carbon.

[d] F = Filtered using 0.45-µm filter membrane.

[e] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[f] n/a = Not applicable.

Table 3.2-6
Sampling Sequence for Collection of Storm Water Samples at E059.5 and E059.8

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC, particle size	Trigger	SSC
2	Max+12	PCBs (UF[a]), TOC[b] (UF), DOC[c] (F[d]), chloride (F), sulfate (F), alkalinity (UF), pH (UF)	Trigger+2	SSC
3	Max+14		Trigger+4	SSC
4	Max+16		Trigger+6	SSC
5	Max+18	TAL metals[e] + B + U + hardness (F)	Trigger+8	SSC
6	Max+20	Total recoverable selenium (UF), total mercury (UF), total uranium (UF), total recoverable silver (UF)	Trigger+10	SSC
7	Max+22	Strontium-90 (UF)	Trigger+12	SSC
8	Max+24	Americium-241 (UF), isotopic plutonium (UF)	Trigger+14	SSC
9	Max+26	Gamma spectroscopy (UF), gross alpha (UF)	Trigger+16	SSC
10	Max+28	SSC	Trigger+18	SSC
11	Max+60	PCBs (UF)	Trigger+20	SSC
12	Max+62	Isotopic plutonium (UF)	Trigger+22	SSC
13	n/a[f]	n/a	Trigger+24	SSC
14	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	Trigger+130	SSC

Table 3.2-6 (continued)

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
22	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	Trigger+190	SSC

[a] UF = Unfiltered.

[b] TOC = Total organic carbon.

[c] DOC = Dissolved organic carbon.

[d] F = Filtered using 0.45-µm filter membrane.

[e] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[f] n/a = Not applicable.

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Table 3.2-7
Sampling Sequence for Collection of Storm Water Samples at E050.1 and E060.1

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC, particle size	Trigger	SSC
2	Max+12	PCBs (UF[a]), TOC[b] (UF), DOC[c] (F[d]), chloride (F), sulfate (F), alkalinity (UF), pH (UF)	Trigger+2	SSC
3	Max+14		Trigger+4	SSC
4	Max+16	TAL metals[e] + B + U + hardness (F)	Trigger+6	SSC
5	Max+18	Dioxins/furans (UF)	Trigger+8	SSC
6	Max+20	Strontium-90 (UF)	Trigger+12	SSC
7	Max+22	Isotopic plutonium (UF), americium-241 (UF), isotopic uranium (UF)	Trigger+14	SSC
8	Max+24		Trigger+16	Gross beta (UF)
9	Max+26	Gamma spectroscopy (UF), gross alpha (UF)	Trigger+18	SSC
10	Max+28	SSC	Trigger+20	Radium-226/radium-228 (UF)
11	Max+60	PCB (UF)	Trigger+22	
12	Max+62	Isotopic plutonium (UF)	Trigger+24	SSC
13	n/a[f]	n/a	Trigger+26	Per this monitoring plan, section 3.6: TAL metals + B + U + hardness (F/UF), solid phase TAL metals + B + U, SSC
14	n/a	n/a	Trigger+28	
15	n/a	n/a	Trigger+30	SSC
16	n/a	n/a	Trigger+50	SSC
17	n/a	n/a	Trigger+70	SSC
18	n/a	n/a	Trigger+90	SSC
29	n/a	n/a	Trigger+110	SSC
20	n/a	n/a	Trigger+130	SSC

Table 3.2-7 (continued)

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
21	n/a	n/a	Trigger+150	SSC
21	n/a	n/a	Trigger+170	SSC
23	n/a	n/a	Trigger+190	SSC
24	n/a	n/a	Trigger+210	SSC

[a] UF = Unfiltered.

[b] TOC = Total organic carbon.

[c] DOC = Dissolved organic carbon.

[d] F = Filtered using 0.45-μm filter membrane.

[e] TAL metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[f] n/a = Not applicable.