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Work Plan and Final Design for Stabilization of the Sandia Canyon Wetland


Prepared by the Environmental Programs Directorate

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Work Plan and Final Design for Stabilization of the Sandia Canyon Wetland

September 2011

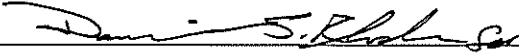
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Acronyms and Abbreviations

AOC	areas of concern
cfs	cubic feet per second
CMP	corrugated metal pipe
CN	curve number
Consent Order	Compliance Order on Consent
DOC	dissolved organic carbon
DOE	Department of Energy (U.S.)
EES	Earth and Environmental Sciences (LANL division)
GPS	global positioning system
HEC-RAS	Hydrologic Engineering Centers River Analysis System (computer code)
IP	Individual Storm Water Permit (NPDES)
LANL	Los Alamos National Laboratory
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
SERF	Sanitary Effluent Reclamation Facility
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area
TAL	target analyte list
TOC	total organic carbon
UF	unfiltered

1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) has prepared this “Work Plan and Final Design for Stabilization of the Sandia Canyon Wetland” in response to requirements set forth in the New Mexico Environment Departments (NMED’s) “Approval with Modification, Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland” (NMED 2011, 203806). The “Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland” (LANL 2011, 203454) was prepared in response to NMED’s “Approval with Modification, Phase II Investigation Work Plan for Sandia Canyon” (NMED 2011, 111518).

This work plan provides general project background and documents the final design of the proposed measures intended to physically stabilize the Sandia Canyon wetland. The overall project goals and objectives are to arrest the headcut in the lower portion of wetland and to reduce the potential for erosion at the upper end of the wetland, where the 72-inch corrugated metal pipe (CMP) culvert discharges. These two measures will stabilize the wetland reducing sediment and associated contaminant transport into the lower sections of the canyon. These measures should also maintain reducing conditions within the wetland sediments contributing to the goal of reducing potential contaminant transport.

2.0 PROJECT BACKGROUND

2.1 Project Need

Hexavalent chromium from the power plant cooling tower was historically released from Technical Area 03 (TA-03) power plant (TA-03-22) at the head of Sandia Canyon from 1956–1972. Reducing conditions within the wetland converted some of the hexavalent chromium to stable, relatively insoluble trivalent chromium. Although studies have shown that the trivalent form of chromium is unlikely to oxidize and convert to hexavalent chromium, maintaining the reducing condition is a prudent measure to ensure stability of the chromium inventory. The wetland also contains constituents adsorbed to sediments such as polychlorinated biphenyls (PCBs) that can also be actively managed if the sediment within the wetland is stable.

2.2 Current Conditions

The wetland system is located in reach S-2 of Sandia Canyon (Figure 2.2-1). The largest drainage area contributing to the wetland is conveyed through a 72-in. CMP culvert a short distance upstream of the wetland. Stormwater flows have created a scour hole where the culvert discharges upstream of the wetland.

Between the outfall and the upstream extent of the wetland, the stream is establishing an inset, narrow bankfull floodplain as it erodes older sediment deposits. In some locations, this bankfull terrace is up to 4 m wide and wetland vegetation is beginning to re-establish on this terrace, creating a more stable inset floodplain with wetland vegetation. As the stream enters the larger wetland area, a defined stream channel is evident within the upper one-third of the wetland. Wetland vegetation is well established across the entire floodplain, and the stream and wetlands are very stable. Towards the lower two-thirds of the wetland, surface water is generally present across much of the width of the wetland. A large headcut (up to 3 m high) is present and active at the terminus of the wetland. Willows have been planted in and around the headcut but have failed to stabilize its movement upstream. Downstream of the wetland, the stream system enters a narrow canyon reach and is stable, with bedrock exposed along much of the stream bed. Stream gage E123 is located a short distance below the wetland (Figure 2.2-2).

2.2.1 Stream Base and Stormwater Flows

Stream base flow from effluent released into Sandia Canyon through the 72-in. CMP culvert has averaged approximately 325,000 gal. per d for 2011 and consists mainly of cooling water from the TA-03 Power Plant cooling tower. These base flows feed the groundwater within the reach, providing adequate hydrology and soil moisture conditions where the wetland vegetation can flourish. Stream gage E121 upgradient and stream gage E123 downgradient (Figure 2.2-1) from the wetland have experienced peak flows approximately 140 cubic foot per second (cfs) and 88 cfs, respectively, during the period of record (1999 to 2010).

2.3 Regulatory Considerations

This section briefly describes the regulatory basis for installation of the grade-control structure and stilling basin and other regulatory requirements applicable to, or potentially impacting, the project.

The grade-control structure and stilling basin are required based on the results of investigations performed under the Compliance Order on Consent (the Consent Order). Preparation of the design presented in this work plan was directed by NMED's "Approval with Modification, Interim Measure Work Plan for Stabilization of the Sandia Canyon Wetland" (NMED 2011, 203806). The "Interim Measure Work Plan for Stabilization of the Sandia Canyon Wetland (LANL 2011, 203454) was prepared in response to NMED's "Approval with Modification, Phase II Investigation Work Plan for Sandia Canyon" (NMED 2011, 111518). The latter approval with modification required the Laboratory to submit a work plan to stabilize the eastern end of the wetland in Sandia Canyon to prevent further upstream migration of the headcut. The work to stabilize the wetland was proposed by the Laboratory as an interim measure under section VII.B of the Consent Order. As described in section VII.B.1 of the Consent Order, interim measures are conducted to reduce or prevent migration of contaminants which have or may result in an unacceptable human or environmental receptor exposure to contaminants while long-term corrective action remedies are evaluated and implemented.

In addition to this interim measure, there are other Consent Order activities associated with Sandia Canyon. A Phase II investigation of Sandia Canyon is currently being performed and a Phase II investigation report is scheduled to be submitted to NMED in 2012. A Phase II investigation work plan for solid waste management units (SWMUs) and areas of concern (AOCs) in Upper Sandia Canyon Aggregate Area (LANL 2011, 206234) has been submitted by the Laboratory and approved by NMED (NMED 2011, 206390) and will be implemented by the Laboratory. Based on the results of these investigations, additional corrective actions could be required in the Sandia Canyon wetland.

Discharges of stormwater runoff from SWMUs and AOCs at the Laboratory are regulated under a National Pollutant Discharge Elimination System (NPDES) Individual Storm Water Permit (IP), effective November 2010 (NPDES No. NM0030759). Some of the SWMUs and AOCs regulated under the IP are located upstream of the Sandia Canyon wetlands and may contribute to the flow discharged to the wetland. Any corrective actions required under the IP will be coordinated with Consent Order activities being implemented in Sandia Canyon.

The effectiveness of the grade-control structure and stilling basin will be considered in evaluating the need for, and nature of, additional corrective actions required under either the Consent Order or the IP.

Consent Order remediation activities in Sandia Canyon were considered in U.S. Department of Energy's (DOE's) "Final Environmental Assessment for the Expansion of the Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at Los Alamos National Laboratory" (DOE 2010, 206433). The grade-control structure and stilling basin are within the range of remediation

activities considered in the environmental assessment, and no additional actions under the National Environmental Policy Act are required. Because the proposed construction activities would occur within a wetland, compliance with dredge and fill permitting requirements under Section 404 of the Clean Water Act is necessary.

2.4 Work Completed to Date

In the past, willows have been planted in and around the headcut in an effort to stabilize the headcut with vegetation but have failed to stabilize its movement upstream. No other construction work has been done to date.

2.5 Project Goals and Objectives

The overall project goals and objectives are (1) to arrest the headcut in the lower portion of wetland and to reduce the potential for erosion at the entrance into the wetland from the 72-in. CMP culvert, and (2) to maintain hydrologic and geochemical conditions that will minimize contaminant migration. The headcut in the lower section of the wetland will be stabilized by constructing a stepped grade-control structure that will allow a grade transition from the current elevation of the wetland to the stream bank near stream gage E123. The area behind the grade-control structure will be backfilled, and wetland vegetation will be allowed to expand into the area behind the grade-control structure and further stabilize the area.

The source of the fill may include post-1942 alluvial sediments downstream of the grade-control structure. Use of this source fill is contingent on characterization of the levels of contamination present in these sediments and the associated regulatory status of this material once excavated.

To reduce erosion at the outlet of the 72-in. CMP culvert, a hardened plunge pool stilling basin will be constructed to stabilize the area and minimize the potential for further erosion.

2.6 Performance Requirements/Criteria

The following are the performance criteria for the grade-control structure and the stilling basin:

- The grade-control structure will be backfilled to allow wetland expansion and further stabilization.
- The grade-control structure will be sufficiently impervious to prevent the draining of wetland soils behind the structure.
- The grade-control structure will reduce channelized flow.
- The stilling basin will dissipate the energy of maximum flow of the 72-in. culvert.
- The stilling basin will be armored to reduce erosion.
- Each structure will be able to pass the 25-yr, 2 h peak event without failing.
- The grade-control structure will reduce velocity and shear for the 10-yr, 25-yr, 50-yr, and 100-yr flow events.

3.0 PROJECT DATA

3.1 Hydrology

The 25-yr, 2-h storm event was used for the design of the interim measures as required by the Laboratory design guidance.

3.2 Base Mapping and Survey

A site survey was conducted in the field using global positioning system (GPS) survey equipment at the end of July and early August. The survey data was used to create 3-dimensional models of each of the sites (grade-control structure and stilling basin) and to create cross-sections for HEC-RAS modeling.

3.3 Site Access

Access roads needed for construction of the proposed structures will require internal approval for environmental, engineering, safety, and security concerns. These issues are currently being addressed through normal Laboratory procedures. If unforeseen circumstances arise, the implementation schedule for this work plan may be impacted.

4.0 GRADE-CONTROL STRUCTURE

There are two actions planned for the wetlands as discussed above: (1) construction of a grade-control structure and (2) hardening of stilling basin near the head of the wetland. This section describes the proposed grade-control structure.

4.1 Design Development

The grade-control structure, as shown in Figure 2.2-2, is required to transition the grade of the existing wetland and mitigate headcutting. The grade-control structure will transition the grade approximately 11 ft from the elevation of the current wetland just upgradient of the headcut to the natural stream bed just upstream of stream gage E123. In order to maintain a gentle grade and to reduce the overall fill and size of the structure, a set of three steel-sheet pile structures, as shown in Figure 4.1-1, will be installed with smaller elevation drops. The final structure will also have a series of step pools made of boulders and rocks to transition to the final grade in a more natural way.

The grade-control structure was designed using peak flows for the 10-yr, 25-yr, 50-yr, 100-yr events. The primary goal was to reduce the stream velocity in the area of the grade-control structure for the 25-yr, 2-h event (approximately 500 cfs) to less than 6.0 feet per second. The secondary design parameter was to have a design that reduced the velocity from pre- grade-control structure velocities to post- grade-control velocities for the peak flow events evaluated. These parameters were determined using HEC-RAS modeling.

Gabion structures have been used in the past at the Laboratory. In this setting, gabions will not be used for the following reasons:

- Continued exposure of gabion baskets to the low flows from the cooling towers can accelerate corrosion of the baskets, causing failure modes.
- If gabion baskets fail, high flows could create a large headcut that will move swiftly through the wetland.

- Gabion structures require dewatering, trenching, and other significant intrusion into the wetland. Sheet piles can be installed with less extensive requirements for this type of work.
- Gabions are not impervious and require the installation of a separate design element such as liners, sheet piles, concrete, etc. to create imperviousness.

Composite or vinyl sheet piles are not being used for this project for the following reasons:

- Composite and vinyl sheet piles require additional anchoring to maintain grade controls.
- Composite and vinyl sheet piles will melt and completely fail during fires.
- These sheet piles can become brittle after approximately 10 yr and then fail when impacted by items carried downstream by the flow.
- Composite and vinyl sheet piles can be difficult to get to depth by driving and may require trenches to install.

Steel sheet piles are being used, with the following constraints:

- Steel sheet piles can corrode when exposed to the atmosphere. The sheet piles to be used will be limited to the area exposed to the atmosphere (no more than 3 ft).
- The sheet piles will be driven to refusal.
- Holes or notches will be cut at consistent elevations across the sheet pile to encourage smaller, braided channels through the restored sections of wetland during base and low flow events. High flow events will sheet flow over the cap elevation of the sheet pile.
- Stone will be used just downgradient of each sheet pile to prevent water from creating scour holes as it flows over each structure. The stone will create a splash pad that slows the water.
- A stone step and pool structure will be installed at the bottom end of the grade-control structure to complete the final transition into the native channel just upgradient of gage station E-123.

4.2 Design Features

The grade-control structure will be seated in bedrock. The structure is designed to prevent groundwater from seeping through the structure as noted above. Maintaining the groundwater elevation is important to maintaining soil moisture conditions, wetland vegetation, and reducing conditions. If the groundwater is allowed to seep through the structure, the groundwater elevation will be lowered and the wetland vegetation behind the structure will likely die off, thus reducing its stabilizing effect and role in reducing flow velocity. The transition from the wetland above the grade-control structure to the stream channel below the grade-control structure is a gradual smooth transition in a stepped fashion to prevent erosive flows that could scour and destabilize the stream reach below the structure. In addition, the stepped nature of the design reduces the risk of catastrophic failure of the grade-control structure in the event of a localized failure. This will minimize the possibility of contaminated sediments being transported downstream into other locations within Sandia Canyon.

Fill will be brought in and placed behind the grade-control structure to replace the area of the wetland that has been eroded. This area will be filled to match the elevation of the surrounding wetland areas to prevent the formation of a pool behind the grade-control structure. Native wetland vegetation will be re-established on the fill to stabilize it and expand the footprint of the wetland. The source of the fill may include post-1942 alluvial sediments downstream of the grade-control structure. Use of this source fill is

contingent on characterization of the levels of contamination present in these sediments and the associated regulatory status of this material once excavated.

5.0 STILLING BASIN

This section describes the proposed stilling basin.

5.1 Design Features

The stilling basin at the end of the 72-in. CMP culvert, shown in Figure 5.1-1, has been designed using the U.S. Department of Agriculture (USDA) plunge pool spreadsheet (USDA-NRCS Design Note No. 6 - Riprap Lined Plunge Pool for Cantilever Outlet). The pool will be excavated in the area of the current scour hole and armored with field stones. The area around the current scour hole has limited access and construction disturbances will be minimized.

The 25-yr, 2-h peak flow event of 360 cfs was used for design purposes of the stilling basin. The peak flows described here are less than the grade-control structure because of its upstream position. The two gage stations just upstream of the culvert show that the peak events have not been above 355 cfs during the period of record (1999 to 2010). The stilling basin has been conservatively designed because the peak flow calculation did not take into account the impact on the culvert in attenuating peak flow. In addition, the maximum capacity of the culvert appears to be approximately 355 cfs, which is less than the peak flow used for design.

The outlet of the stilling basin releases base flows and flows resulting from smaller storm events directly into the stream at the elevation of the main stream channel. The structure is designed to release the peak flows from higher storm events over a wider area, reducing the concentration of high-velocity flows into the stream channel. This overflow is placed at the elevation of the new bankfull floodplain, allowing it to convey high flows and reduce erosion potential within the stream channel.

6.0 MONITORING PLAN FOR SANDIA WETLAND AND VICINITY

As described in this work plan, installation of the grade-control structure is expected to facilitate physical stability and hydrologic and geochemical function of the Sandia wetland. Maintenance of physical and chemical stability will in turn help prevent potential physical mobilization of adsorbed contaminants along with sediment and chemical mobilization of precipitated contaminants under changing geochemical conditions (LANL, 2011; 203454). The Sandia wetland will likely, however, experience decreased effluent volume (both daily and annual) from NPDES Permitted Outfall 001 as part of the Sanitary Effluent Reclamation Facility (SERF) expansion project. As part of the SERF expansion, a portion of the effluent currently released to Sandia Canyon will be rerouted to cooling towers at TA-03. Effluent releases to Sandia Canyon will be reduced, though at levels sufficient to maintain the ecologic, hydrologic, and geochemical functioning of the Sandia wetland. It is anticipated that effluent discharges will be subject to an adaptive management approach that will adjust to changing wetland conditions as necessary. Treated product water from SERF will be back-blended with Sanitary Wastewater Systems plant effluent (DOE 2010, 206433) (SERF EA) such that the basic underlying environmental chemistry (oxidation reduction potential, pH, alkalinity, total suspended solids) of the blended SERF discharge should not significantly alter conditions present in the hydrological system of Sandia Canyon. A monitoring approach is presented below to evaluate hydrologic or geochemical changes associated with either the engineered controls described in this plan and/or those associated with the SERF expansion and subsequent effluent reduction.

The monitoring will be conducted from a series of 12 wells installed in the Sandia wetland and vicinity at the approximate locations shown in Figure 2.2-1. Shown in Figure 2.2-1 are areas of active cattail wetland as of 2007 (c1ct and c2ct geomorphic units, the “Sandia wetland”) and other post-1942 geomorphic units in the vicinity (c1, c2a, c2b, and c3). This area is collectively referred to as reach S-2 as stated in the “Investigation Report for Sandia Canyon” (LANL 2009, 107453). The goal of the monitoring is to evaluate changes in hydrology that may be manifested as changing (specifically lowering) water levels or establishment of preferential (less uniform) flow paths through the alluvium. Either of these indicators would suggest potential detrimental effects to wetland function associated with reduced outfall volumes. The monitoring will also include evaluation of key geochemical indicators near the water table and deeper within saturated alluvium. Key indicators will be used to monitor for potentially adverse changes in the favorably strongly reducing conditions that maintain stability of adsorbed and reduced contaminant species.

Wells 1-3 will be located near the active channel (c1 geomorphic unit) towards the western end of reach S-2 (east of stilling basin) that has experienced channel incision and dewatering relative to historical conditions (Figure 2.2-1). These wells will be located on the c3 geomorphic unit away from the active channel and associated inset terrace (c2a geomorphic unit), which are locations of recent cattail expansion. Well 1 will be screened towards the base of alluvial fill estimated at approximately 12 ft depth, while wells 2 and 3 will be screened approximately 3 ft below the lowest average water table level. Wells 4-6 will form a transect in the widest portion of the wetland. These wells will be screened at approximately 3 ft below the water table. It is at these shallowest depths that changes in water level and sediment oxidation state would be expected to manifest as a result of reduced effluent discharge. Similarly, the lateral margins of the wetland may dewater before the longitudinal axis of the wetland with a condition of reduced effluent volume. This effect could be most pronounced where the wetland is widest and water flux is most spread out. It is also at such locations that preferential flow paths might be expected to form. Well transect 7-9 will be located in a narrow part of the wetland closer to its distal (eastern) end. This set of wells will include two shallow wells (screened at approximately 3 ft below the water table) and one well screened just above the base of the alluvium. These wells will provide indications of changes near the surface of the wetland and at depth in a narrow portion of the wetland where preferential flow paths are less likely to develop. The final transect of wells (10-12) will be located immediately above current alluvial well SCA-1-DP and will monitor the effect of the grade-control structure on wetland performance. All wells will be installed as shielded drive point wells with screened intervals of 1 ft. All wells will have dedicated pressure transducers to measure fluctuations in water level.

The sampling and analysis plan for these 12 wells is shown in Table 6.0-1.

Most of the planned analyses are designed as indicators of redox changes and/or indicators of organic matter degradation associated with potential dewatering of the wetland. If wetland sediments were to oxidize, it is possible, though unlikely (LANL, 2009, 107453), that some reduced Cr(III) could oxidize to Cr(VI). For most analytes, the dissolved fraction will be targeted using filtered samples.

Monitoring of the newly installed wells described in this work plan is proposed to replace monitoring at existing alluvial well SCA-1-DP.

Surface-water monitoring of dissolved fractions will be conducted at locations above the wetland and reach S-2, at gages E121 and E122, and at gage E123 downstream of the wetland in the eastern part of S-2. The 2011 Interim Facility-Wide Groundwater Monitoring Plan (currently under NMED review) (LANL 2011, 205231) proposes monitoring of base flow (flow associated with daily effluent releases) on an annual basis at these locations. Sampling will be increased to quarterly for at least the first year after installation of the grade-control structure and reduction of effluent discharge volumes.

Stormwater samples will be collected from 4 events per year at gages E121, E122, and E123. Each of the gage locations will be monitored at 5-min intervals for stage height and discharge. Samples will be collected at each gage using two automated stormwater samplers containing a carousel of 24 1-L bottles and of 12 1-L bottles as specified in Table 6.0-2. Stormwater sample collection will be initiated for suspended sediment analyses using the 24-bottle sampler when triggering discharges of 10 cfs are measured at the gage. Stormwater sample collection will be initiated for contaminant analyses using the 12-bottle sampler 10 min after detection of peak discharge. Samples for suspended sediment analyses will be collected every 5 min for the first 30 min of flow, and then continue every 20 min for 370 min or until no more discharge can be collected. Contaminant analyses will be conducted at 10, 50, and 90 min following the detection of peak discharge.

Vegetation monitoring will be conducted via semi-annual photo surveys and other means occurring every 2 yr starting in the summer of 2012.

As specified in the "Interim Measure Work Plan for Stabilization of the Sandia Canyon Wetland" (LANL 2011, 203454), a series of repeat cross-sections will be established in the western portion of reach S-2 and in the vicinity of the current headcut location to document geomorphic changes. In the western portion of S-2, 10 cross-sections will be established at 100-ft intervals beginning 50 ft east of the culvert and extending into the western part of the primary wetland. In the area above the planned grade-control structure, which includes the current headcut location, five cross-sections will be established at 100-ft intervals, beginning 50 ft west of the structure. All cross-sections will be monumented with rebar at each end and surveyed once a year with a differentially corrected GPS. Initial surveys will occur within 2 mo of completion of the grade-control structure and associated site-restoration activities, and subsequent surveys will occur after the end of the 2012 summer monsoon season. To help ensure the best quality surveys and worker safety, surveys in the wetland will probably occur in late winter or early spring when the previous year's cattails have been laid down by snow and before the new growth occurs.

All data will be reported to NMED annually in a monitoring report to be submitted by April 30 of each year.

7.0 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. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

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

DOE (U.S. Department of Energy), August 24, 2010. "Final Environmental Assessment for the Expansion of the Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at Los Alamos National Laboratory, Los Alamos, New Mexico," U.S. Department of Energy document DOE/EA-1736, Los Alamos Site Office, Los Alamos, New Mexico. (DOE 2010, 206433)

- LANL (Los Alamos National Laboratory), October 2009. "Investigation Report for Sandia Canyon," Los Alamos National Laboratory document LA-UR-09-6450, Los Alamos, New Mexico. (LANL 2009, 107453)
- LANL (Los Alamos National Laboratory), May 2011. "Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland," Los Alamos National Laboratory document LA-UR-11-2186, Los Alamos, New Mexico. (LANL 2011, 203454)
- LANL (Los Alamos National Laboratory), August 2011. "2011 Interim Facility-Wide Groundwater Monitoring Plan," Los Alamos National Laboratory document LA-UR-11-2183, Los Alamos, New Mexico. (LANL 2011, 205231)
- LANL (Los Alamos National Laboratory), September 2011. "Phase II Investigation Work Plan for Upper Sandia Canyon Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-11-4912, Los Alamos, New Mexico. (LANL 2011, 206234)
- NMED (New Mexico Environment Department), January 4, 2011. "Approval with Modification, Phase II Investigation Work Plan for Sandia Canyon," 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 2011, 111518)
- NMED (New Mexico Environment Department), June 9, 2011. "Approval with Modification, Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kielling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 203806)
- NMED (New Mexico Environment Department), September 13, 2011. "Approval with Modifications, Phase II Investigation Work Plan, Upper Sandia Canyon Aggregate Area," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kielling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 206390)

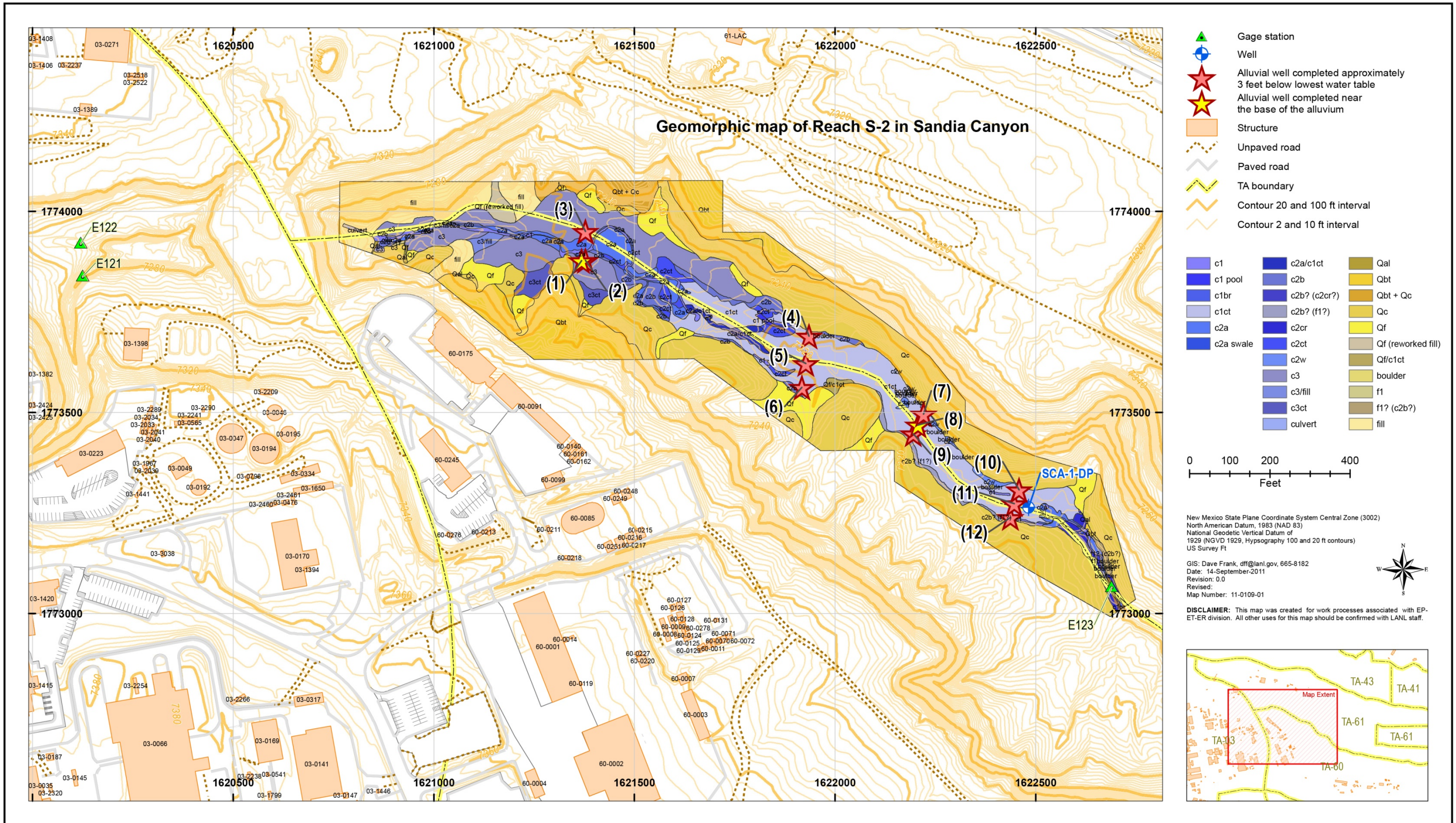


Figure 2.2-1 Monitoring locations

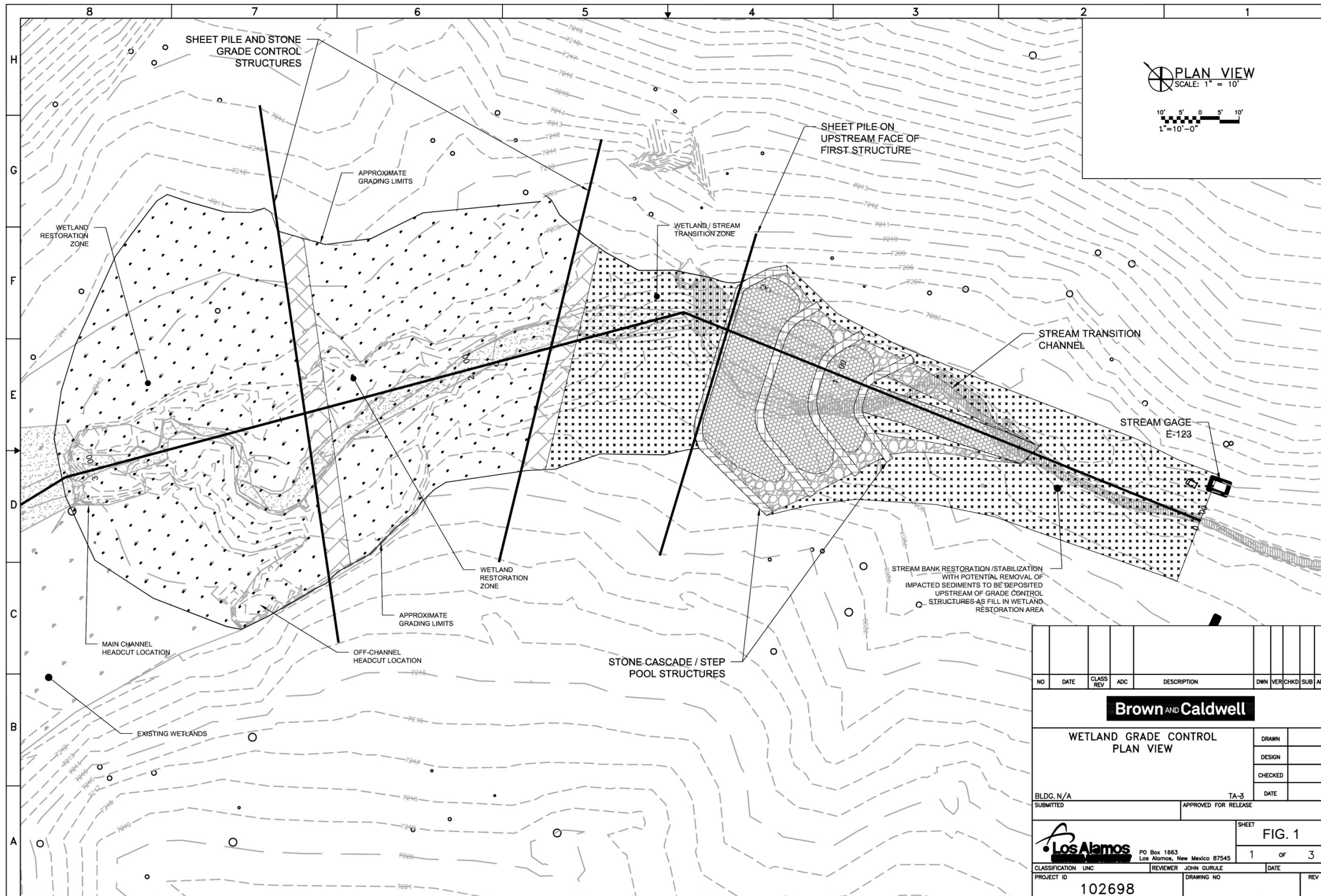
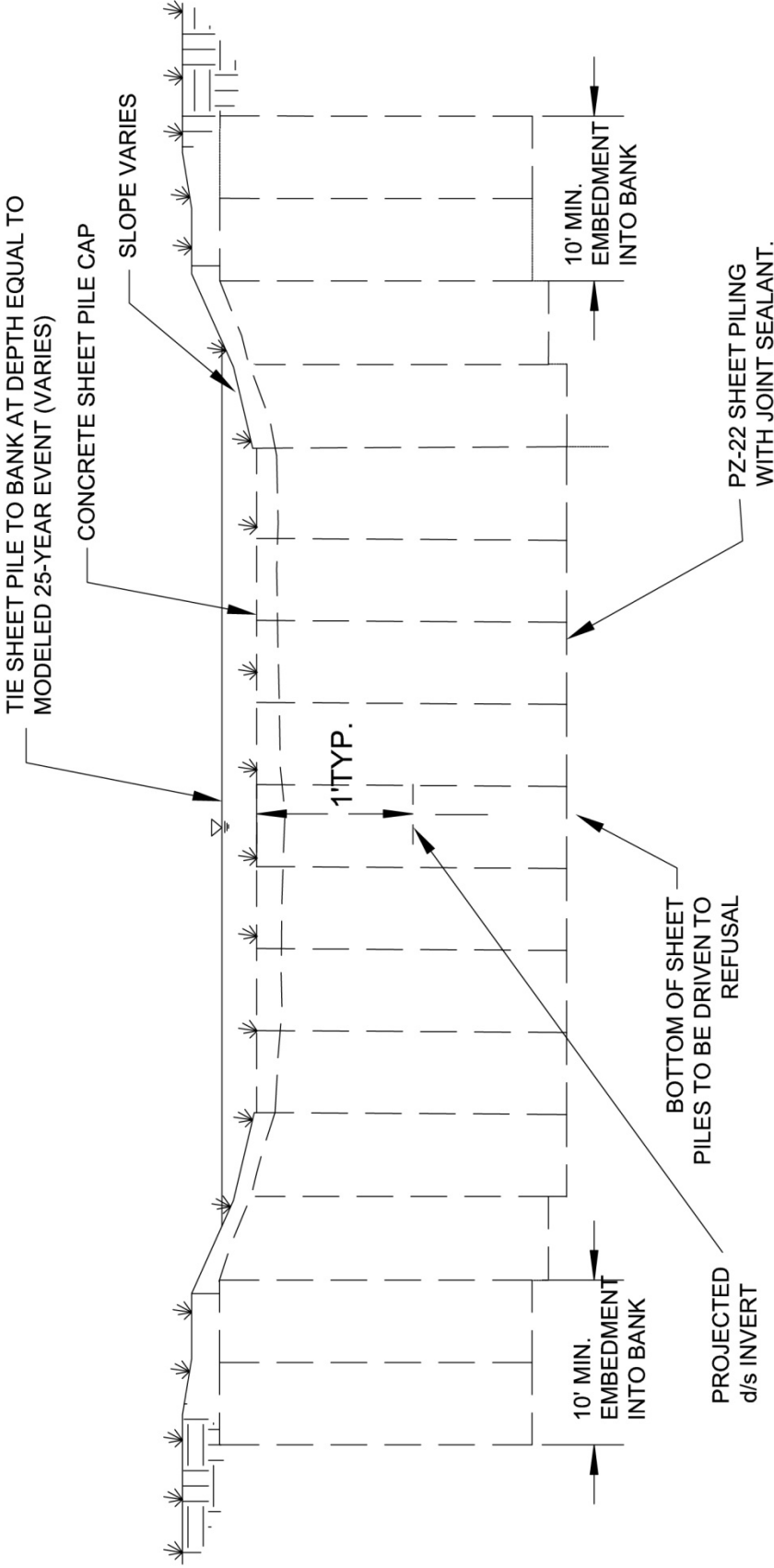


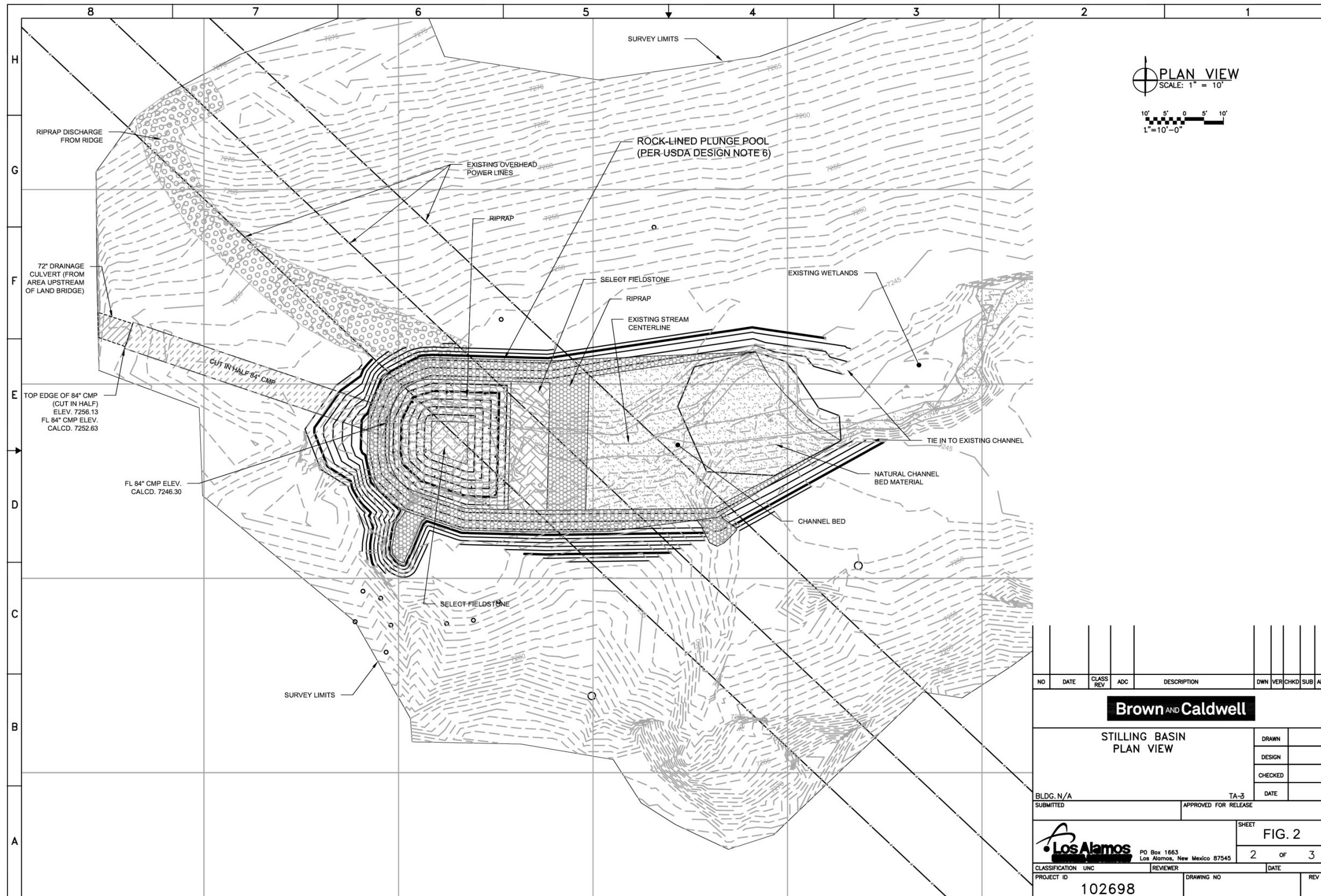
Figure 2.2-2 Grade-control structure plan view



TYPICAL SHEET PILE SECTION

NOT TO SCALE

Figure 4.1-1 Typical sheet pile section



NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	VER	CHKD	SUB	APP
Brown and Caldwell									
STILLING BASIN PLAN VIEW								DRAWN	
								DESIGN	
								CHECKED	
								DATE	
BLDG. N/A					TA-3				
SUBMITTED					APPROVED FOR RELEASE				
SHEET								FIG. 2	
Los Alamos								2 OF 3	
PO Box 1663 Los Alamos, New Mexico 87545								DATE	
CLASSIFICATION UNC					REVIEWER		DATE		REV
PROJECT ID					DRAWING NO				
102698									

Figure 5.1-1 Stilling basin plan view

Table 6.0-1
Alluvial Groundwater Sampling and Analysis Plan for Sandia Wetland Stabilization Monitoring

Suite	Frequency	Comment
EES Metals ^a (filtered)	Quarterly	Includes redox sensitive metals Fe, Mn, Cr, As
EES Anions ^b (filtered)	Quarterly	Includes redox sensitive anions sulfate and nitrate; nitrate is a wetland vegetation nutrient
Sulfide (filtered)	Quarterly	Redox indicator (reduction of sulfate)
alkalinity/pH (unfiltered)	Quarterly	Organic matter degradation
Ammonia (filtered)	Quarterly	Indicator of organic matter degradation; wetland vegetation nutrient
TOC ^c (unfiltered)	Annually	Organic matter degradation
DOC ^d (filtered)	Annually	Organic matter degradation
Cr(VI) (filtered)	Annually	Indicator of Cr(III) oxidizing to Cr(VI)
$\delta^{15}\text{N}$ ammonia (filtered)	Quarterly	Indicator of nitrogen sources and redox-related transformations
$\delta^{15}\text{N}/\delta^{18}\text{O}$ nitrate (filtered)	Quarterly	Indicator of denitrification (redox process) and nitrogen sources
$\delta^{18}\text{O}/\delta\text{D}$ water (filtered)	Quarterly	Indicator of outfall discharge versus snowmelt and stormwater runoff

^a EES metals refers to metals analyses conducted at the Laboratory's Earth and Environmental Sciences (EES) analytical laboratory, and consists of the following suite: Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cs, Cu, Fe, K, Li, Mg, Mn, Na, Ni, Pb, Rb, Se, Si, Sr, Ti, Tl, U, V, Zn, Hg, Mo, Sb, Sn, Th.

^b EES anions refers to anion analyses conducted at the Laboratory's EES analytical laboratory, and consists of the following suite: Br, F, Cl, NO₂, NO₃, PO₄, SO₄, C₂O₄H₂ (oxalic acid).

^c TOC = Total organic carbon.

^d DOC = Dissolved organic carbon.

**Table 6.0-2
Sampling Sequence for Collection of Stormwater Samples at E121, E122, and E123**

	Start Time (min) 12-Bottle Sampler	Analytical Suites 12-Bottle Sampler	Start Time (min) 24-Bottle Sampler	Analytical Suites 24-Bottle Sampler
1	Peak + 10	PCB congener (UF ^a)	Trigger + 0	Suspended sediment
2	Peak + 10	TAL ^b metals (UF)	Trigger + 5	Suspended sediment
3	Peak + 10	PAH ^c	Trigger + 10	Suspended sediment
4	Peak + 10	SVOC ^d	Trigger + 15	Suspended sediment
5	Peak + 50	PCB congener (UF)	Trigger + 20	Suspended sediment
6	Peak + 50	TAL metals (UF)	Trigger + 25	Suspended sediment
7	Peak + 50	PAH	Trigger + 30	Suspended sediment
8	Peak + 50	SVOC	Trigger + 50	Suspended sediment
9	Peak + 90	PCB congener (UF)	Trigger + 70	Suspended sediment
10	Peak + 90	TAL metals (UF)	Trigger + 90	Suspended sediment
11	Peak + 90	PAH	Trigger + 110	Suspended sediment
12	Peak + 90	SVOC	Trigger + 130	Suspended sediment
13	n/a ^e	n/a	Trigger + 150	Suspended sediment
14	n/a	n/a	Trigger + 170	Suspended sediment
15	n/a	n/a	Trigger + 190	Suspended sediment
16	n/a	n/a	Trigger + 210	Suspended sediment
17	n/a	n/a	Trigger + 230	Suspended sediment
18	n/a	n/a	Trigger + 250	Suspended sediment
19	n/a	n/a	Trigger + 270	Suspended sediment
20	n/a	n/a	Trigger + 290	Suspended sediment
21	n/a	n/	Trigger + 310	Suspended sediment
22	n/a	n/a	Trigger + 330	Suspended sediment
23	n/a	n/a	Trigger + 350	Suspended sediment
24	n/a	n/a	Trigger + 370	Suspended sediment

^a UF = Unfiltered.

^b TAL = Target analyte list.

^c PAH = Polycyclic aromatic hydrocarbon.

^d SVOC = Semivolatile organic compound.

^e n/a = Not applicable.