2016/2017 ANNUAL LONG-TERM MONITORING STATUS REPORT (JULY 2016 THROUGH JUNE 2017)

LOS ALAMOS COUNTY AIRPORT LANDFILL COVER SYSTEM REPLACEMENT
SOLID WASTE MANAGEMENT UNITS 73-001(a,d)
TECHNICAL AREA 73

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prepared for:
Department of Energy
Environmental Management Los Alamos Field Office (EM-LA)
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Revision 0

2016/2017 ANNUAL LONG-TERM MONITORING STATUS REPORT (JULY 2016 THROUGH JUNE 2017)

LOS ALAMOS COUNTY AIRPORT LANDFILL COVER REPLACEMENT

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EXECUTIVE SUMMARY

This report summarizes the first four engineering inspections performed after construction of the Los Alamos County Airport Landfill Cover Replacement and associated facilities (October 2016 to June 2017). The inspections and subsequent reports were performed and completed in accordance with the approved Long-Term Monitoring Plan [Dwyer 2017, NMED 2017]. The remedy tasks were completed and described in the applicable Remedy Completion Reports [Dwyer 2016, Remedy Completion Report *replacement pages* 2017, NMED Approval Letter 2016, and North Wind and Weston 2007].

The remedy elements inspected (as described in Remedy Completion Report [Dwyer 2016]), include the final cover system referred to as an Evapotranspiration (ET) Cover inclusive of water balance and methane monitoring, surface water control features, erosion controls, and site access. Settlement surveys began in October 2017 and will be part of subsequent annual reports. Construction of these remedy tasks began on October 7, 2015 and were successfully installed and completed in accordance with the submitted Work Plan [Dwyer 2015, NMED 2016] by July 1, 2016. Prior remedy elements completed as described in North Wind and Weston (2007) include retaining structures along the eastern perimeter of the airport landfill and the side slopes of the previously completed landfill cover were also inspected and included in the checklists included in Attachment A.

Four inspections were performed following completion of the Remedy (Attachment A). The water balance monitoring of the ET Cover includes data collected continually since its installation (Attachment B). Methane monitoring recorded no methane emissions during each of the four inspections (Attachment C). There were also three inspections performed after significant rainfall events with respective reports on August 5, 23, and 29, 2016 (Attachment D). There was no significant erosion or issues noted in these inspections due to the significant precipitation events.

Vegetation began to emerge on the cover and disturbed areas that were seeded as expected prior to the onset of winter. The vegetation appears to be uniformly emerging across the entire site. The emerging grasses vary from a couple of inches high to about 12-inches. Existing subsurface moisture appears to be the dominant variable related to vegetation height at this time. All methane monitoring locations measured no methane for all inspections performed. Water balance monitoring of the ET Cover revealed no percolation through the cover into the underlying waste. In fact, it appears that moisture is migrating upward from the waste into the cover to date. Matric potential probes (soil suction) were replaced on May 19, 2017 with the most advanced sensors available via Decagon Inc. Settlement survey monuments were installed on August 31, 2017 to measure and quantify any differential settlement. Subsequent inspection and annual reports will contain survey data to quantify settlement (if any). Surface water control features appear to be working as designed with no degradation noted to date. Temporary erosion controls including the erosion control blankets around the perimeter of the ET Cover have degraded past their usefulness but performed as expected during initial establishment of vegetation. Permanent erosion control features including the rock check dams and riprap lined side slope east of the landfill are all in good condition and functioning as designed. There did not appear to be any degradation of the retaining features along the eastern perimeter of the landfill.

The Debris Disposal Area (DDA) cover system appears to be stable at this time with a maturing vegetation cover and no signs of significant degradation or settlement at this time.

All features of the cover systems are currently in good condition and working as designed. There is no recommended maintenance or repairs at this time.

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1.0 INTRODUCTION

The Los Alamos County Airport Landfill Cover Replacement Project [SWMUs 73-001(a) and 73-001(d)] site elements were inspected and monitored in compliance with the approved Long-Term Monitoring Plan for Los Alamos County Landfill Cover Replacement Solid Waste Management Units 73-001(a,d) Technical Area 73 (Dwyer 2017, NMED Approval 2017). The Remedy Completion Report (Dwyer 2016) was approved with modifications on December 22, 2016 (NMED 2016) by the New Mexico Environment Department (NMED). The Long-Term Monitoring Plan was approved on March 30, 2017 (NMED 2017). Generally, landfills regulated under the Resource Conservation and Resource Act (RCRA) are subject to a 30-year post closure monitoring period. However, under §§ 265.117, the time period may be reduced or increased dependent on findings, the integrity of the closure and agreement by applicable officials and regulators.

The Airport Landfill project consisted of the design and construction of a replacement cover for the asphaltic cover previously installed in 2007 (North Wind and Weston 2007). The new cover system is a vegetated soil cover referred to as an Evapotranspiration (ET) Cover (Dwyer Engineering 2015). Details of the landfill design are found in the construction drawings, specifications, and calculations included in the Remedy Completion Report (Dwyer 2017).

A project file containing records of all inspections, monitoring, and maintenance performed is maintained by Department of Energy (DOE) Environmental Management Los Alamos Field Office (EM-LA). An annual Long-Term Monitoring Report will be prepared and provided to the NMED Secretary prior to February 14, of each subsequent year.

The name, address, and telephone number for the individual to contact during the post-closure period is as follows:

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1.1 BACKGROUND

The Los Alamos County (LAC) airport landfill operated from 1943 to 1973 for the disposal of solid waste consisting of household trash from the Los Alamos town site and office trash from Los Alamos Scientific Laboratory. From 1984 to 1986, wastes were excavated from the western portion of the LAC airport landfill [SWMU 73-001(a), Figure 1] and placed in the debris disposal area (DDA) located east of the landfill [SWMU 73-001(d), Figure 1].

In late 2006 and early 2007, a landfill cover system composed of asphalt and concrete hangar pads allowing for expansion of the airport hangar facilities was installed at the airport landfill in compliance with an approved NMED Work Plan (North Wind 2004) for remediation of this landfill [SWMU 73-001(a), Figure 1]. The final remedy design and completion activities for the landfill and the DDA [SWMU 73-001(d)] were provided in the Remedy Completion Report

(North Wind and Weston 2007). Subsequent inspections of the landfill beginning in 2009 through 2012 identified significant problems with the site and the newly installed asphalt cover system [SWMU 73-001(a)] including differential settlement greater than 2-ft, elevated methane gas, surface cracking, ponding, poor surface drainage, and significant infiltration of water into the underlying waste through cracking in the asphalt cover. The elevated methane measurements at the landfill in 2011 reached 100% of the lower explosive limit (LEL).

The site was evaluated in 2012 (Dwyer 2012) where it was decided the site had severely degraded and required replacement. A Work Plan (Dwyer 2015) to replace the cover system was submitted to the New Mexico Environment Department (NMED) in July 2015 with 'Approval with Modifications' received on August 14, 2015 (NMED 2015). The remedy included removal of the prior placed asphaltic cover and concrete hangar pads, relocation of waste from the far western portion to the remaining footprint within the landfill, placement of a new concrete hangar pad over the western portion where the waste was relocated from, and closure of the landfill with a cover system referred to as an ET Cover. The closure was successfully installed and completed in accordance with the submitted Work Plan (NMED 2015) by July 1, 2016.

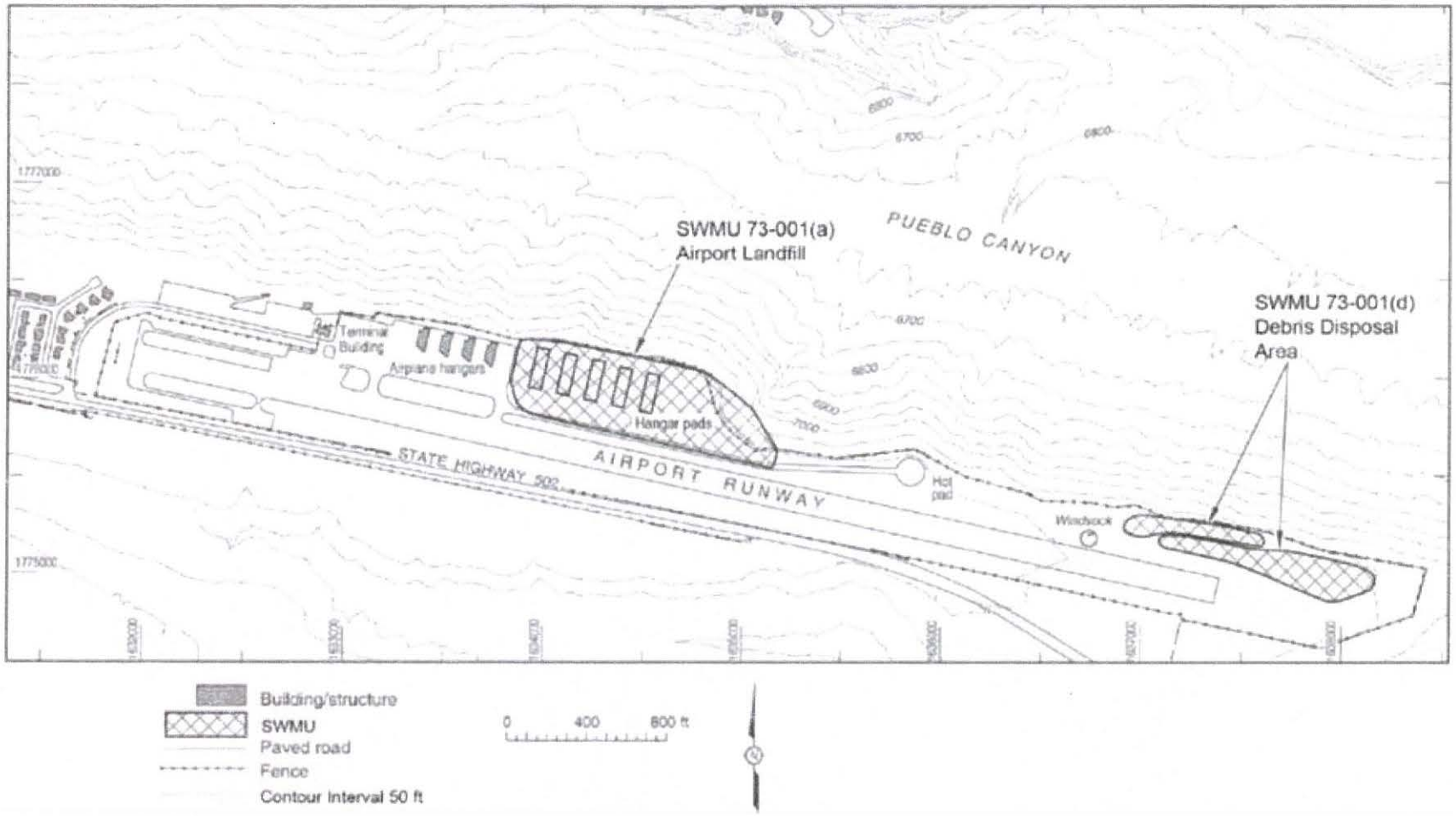


Figure 1. Landfill Locations (LANL 1998)

1.2 PURPOSE

The Los Alamos County Airport Landfill Cover Replacement Project site elements were inspected consistent with the Long-Term Monitoring Plan (Dwyer 2017, NMED Approval 2017). The purpose of the inspections is to identify any areas of the site closure that may require repair to restore the intended functionality of the closure. The landfill cover as well as erosion and sedimentation control measures will be inspected quarterly to assess the general condition of the closure system and identify any maintenance or repair issues that may arise. Water balance and methane monitoring of the cover system are included in these quarterly inspections. Water balance monitoring and cover inspections shall be performed on a quarterly basis for the five-year monitoring period. Should the levels of methane recorded during the initial 2-year monitoring period be below 25% of the lower explosive limit (LEL), then the reported inspections shall be reduced to semi-annual for the next two years. Finally, should the methane levels for these next two years also be below 25% of the LEL, the fifth year reporting inspection will be annual. The NMED shall be provided the results quarterly for the first two years and then reporting periods consistent with the methane monitoring schedule as described above. The moisture measurements are scheduled to be discontinued after the completion of the five-year monitoring period.

In addition to the quarterly inspections, if the site experiences a precipitation event that exceeds 1 inch in any given hour (the 100-year, 1-hour design storm event is 2.17in/hr.); the site shall also be inspected. An annual Long-Term Monitoring Report shall be prepared and submitted to NMED by July 30 of the following year. The annual report shall include all inspection reports and all monitoring performed during that year along with any maintenance and/or repairs performed (if any) and a summary describing the covers performance for the year.

Water balance monitoring is continuous with data downloaded from the data loggers and reported in inspection reports on the agreed upon schedule. There are two water balance monitoring locations (Figure 2). At each water balance monitoring location there are 5 moisture content probes and 5 matric potential (soil suction) probes buried at intervals between 6-inches below ground surface (BGS) and 3.5-ft BGS (Figure 3). The intent of the probes is to monitor moisture movement within the cover profile. Methane is measured once at each monitoring location for each inspection at the time interval as described above. Refer to figure 3 for the methane and water balance monitoring locations. Table 1 summarizes the inspections performed to date and included in this annual report.

Table 1. Cover Inspections Performed

Monitoring Period	Inspection No.	Date
Year 1, Quarter 1 (Jul-Sep)	Inspection 1	October 18, 2016
Year 1, Quarter 2 (Oct-Dec)	Inspection 2	December 19, 2016
Year 1, Quarter 3 (Jan-Mar)	Inspection 3	March 31, 2017
Year 1, Quarter 4 (Apr-Jun)	Inspection 4	June 7, 2017
***Quarterly inspections generally performed in March, June, September and December of each year		

2.0 SCOPE OF ACTIVITIES

This report summarizes the inspection of the following elements of the Closure at the Airport Landfill:

- Evapotranspiration Cover System including water balance monitoring;
- Storm water control system;
- Airport Fencing;
- Retaining walls;
- Erosion and Sedimentation Control Measures;
- Site access;
- Methane monitoring; and
- Site after significant precipitation event inspections.

The completed inspection checklists along with applicable photos are provided in Attachment A. A summary of the water balance monitoring performed to date is provided in Attachment B. Methane monitoring is provided in Attachment C. Reports after significant precipitation events are provided in Attachment D.

2.1 EVAPOTRANSPIRATION COVER AND DEBRIS DISPOSAL AREA MONITORING

The installed ET Cover system as described in the Remedy Completion Report (Dwyer 2016) is inspected quarterly as described in Section 1.2. The monitoring activities are intended to verify the continued acceptable performance and identity any problems. Additionally, the formerly closed debris disposal area (DDA) cover system is also monitored visually to identify any potential issues that may arise. Details of the DDA closure are summarized in the Remedy Completion Report (North Wind and Weston 2007).

3.0 SUMMARY OF PERFORMANCE MONITORING RESULTS

The following subsections describe the specific elements inspected with a summary for each element. The inspection checklists with pictures are contained in Attachment A. The water balance monitoring results for the ET Cover is contained in Attachment B. The methane monitoring results field notes are contained in Attachment C. There was no methane measured in any inspection to date. Finally, the reports after a significant precipitation event are contained in Attachment D. There were no issues or problems identified as a result of significant precipitation events.

3.1 ET COVER

The general integrity of the ET Cover system was inspected. The top slope and side slopes of the landfill were examined for degradation of the cover system, such as erosion (as evidenced by rilling or gullying), quality and quantity of vegetation establishment, areas of subsidence, biointrusion, cracking, slope instability, and wet areas. The cover system including side slopes was found to be in excellent condition with no signs of degradation. There was no erosion, differential settlement resulting in ponding, biointrusion, surface cracking, or other issues identified.

There were no maintenance or repair issues identified. If any maintenance or repair issues were identified in an inspection; they would be identified in the applicable inspection report with accompanying photos and repaired as soon as weather permits. If any repairs requiring additional fill were identified, fill from an approved borrow source would be used meeting requirements set forth for cover soil in the Technical Specifications, Section 02200 (Earthwork) of in the Remedy Completion Report (Dwyer 2016).

Vegetation in seeded areas including the cover system was inspected for success based on type of vegetation, approximate surface coverage based on visual observation and size of native vegetation seeded during the cover installation. The vegetation began to emerge shortly after seeding and continued to grow until it went into winter dormancy. The vegetation is predominantly composed of seeded native grasses and ranges in height from a few inches to about a foot. The coverage is uniform across the entire landfill. The varied height of the grass is assumed to be the result of existing moisture within the landfill migrating upward. Grasses are taller in areas that were wetter, while the grass in the drier areas has relied predominantly on precipitation for its growth to date. Because parts of the landfill were very wet as a result of concentrated infiltration with the prior cover system, this variance in vegetation height is expected to last for awhile until the vegetation matures. The vegetation was monitored for continued robustness to ensure there are no unintended stresses on it such as stress due to landfill gas. No unusual plant distress was identified that would indicate this to date. Should future problems with vegetation be identified during the inspections, the problem will be noted along with a recommended repair or further evaluation recommendations.

3.1.1 WATER BALANCE MONITORING

Water balance monitoring data of the ET Cover was downloaded on a quarterly basis. The data is continual from the time of installation. This monitoring includes water content and soil

suction within the cover profile at varied depths. Each location has five water content probes and five soil suction probes installed within the profile to measure the respective parameters on a continual basis (Figure 3). Matric potential probes (soil suction) were replaced on May 19, 2017 with the most advanced sensors available via Decagon Inc. The first set of sensors were less accurate, the second generation sensor is advertised to be more accurate in drier soils such as those expected at the site. The multiple probes within each location allows for monitoring of moisture movement within the cover profile. There are two locations within the cover system instrumented (Figure 2). The two locations provide south and north slope differences as well as duplication in case of instrumentation or software errors. Each set of probes are connected to on-site data loggers that compiles the data to be downloaded. The summary and analysis of the data is submitted with this report (Attachment B).

Monitoring Equipment at each location (2 locations) includes:

- 5 each – 5TM water content probes by Decagon Devices Inc.
- 5 each – MPS-2 water potential probes by Decagon Devices, Inc.
- 2 each – EM50 data loggers by Decagon Devices Inc.

Currently, the moisture within the deeper portions of the cover appears to be coming from beneath the cover. The landfill was relatively wet due to concentrated infiltration from the prior cover system. This moisture is moving upward from the waste into the cover and then evaporated or transpired via the established vegetation. Thus there appears to be a net negative flux to date; i.e. drying of the landfill. This is expected given the wet condition of the landfilled waste due to the concentrated infiltration combined with the inability of that infiltrated water to be removed via ET while the asphalt cover was in place.

The water content probes allow for examination of water movement within the cover profile. The soil suction probes measure the matric potential in the soil and also relate it to wetting fronts. The combination of the probes can allow for an in situ determination of the moisture characteristic curve for the cover profile that can in turn be used to calculate flux.

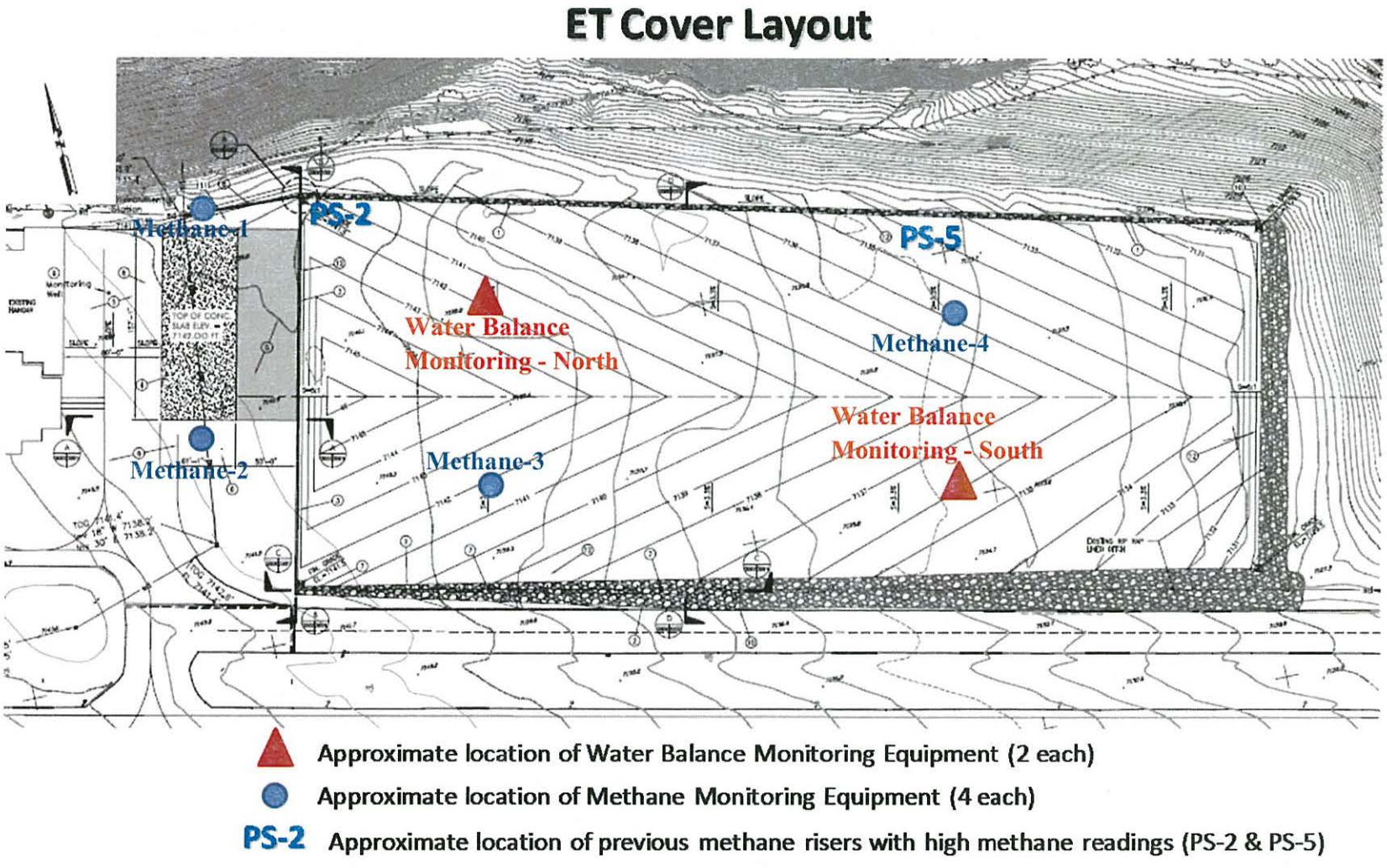


Figure 2. Instrumentation Locations

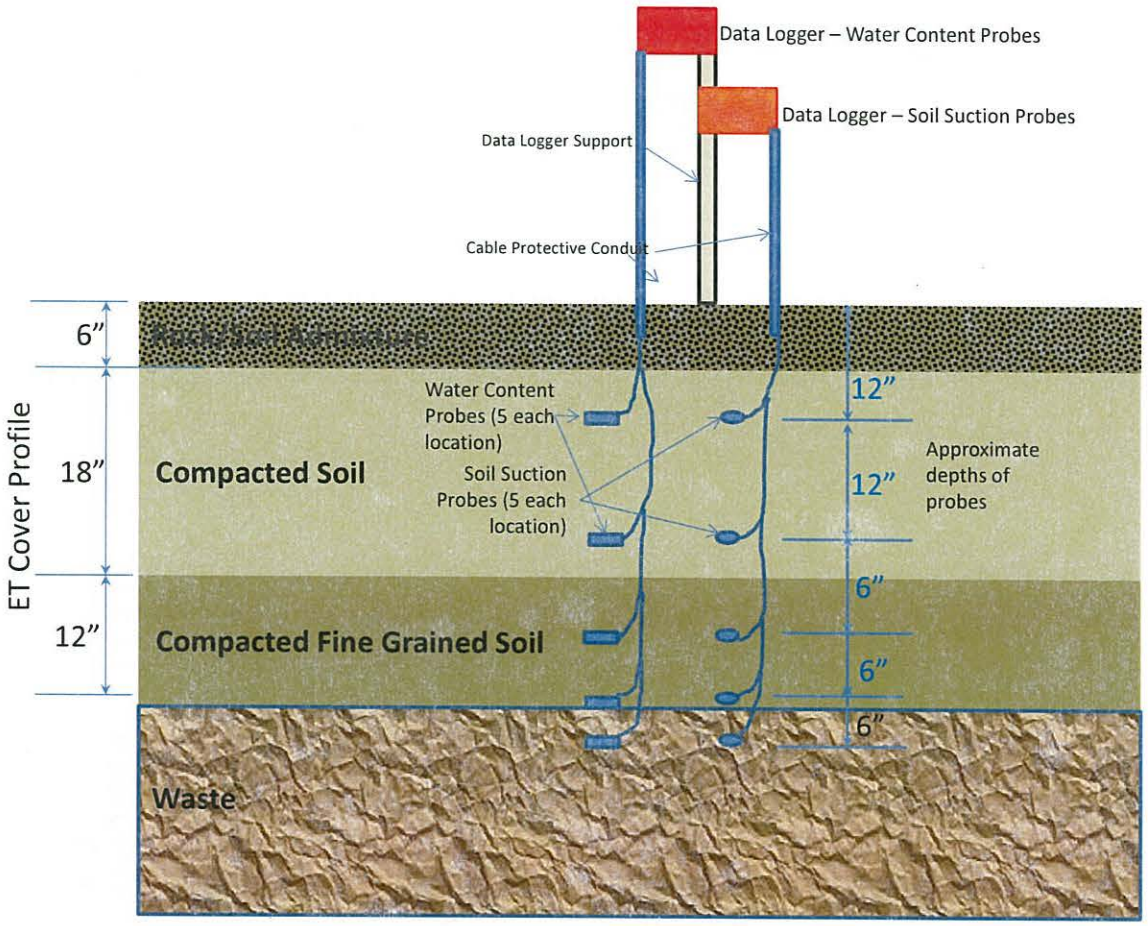


Figure 3. Water Balance Instrumentation

3.1.2 METHANE MONITORING

Methane monitoring is performed at four locations (Figure 2). The methane monitoring consists of a single instantaneous measurement via a single read calibrated instrument at each monitoring location for each inspection. The measurement units are made in % of LEL. Methane #1 is located to measure any methane from an area where waste was removed from waste left in place just west of the monitoring location near the airport hangar. There was a vertical polyethylene liner placed between the waste and clean area where the new hangar pad was installed. This liner is intended to stop the potential lateral migration of methane gas from the landfill toward the airport hangars. Methane #2 is located in a clean area intended to identify if any methane has migrated from the landfill toward the hangars. Methane # 4 is located on the landfill with the base of the standpipe inserted into waste to measure methane within the landfill. It is located near PS5 (prior methane monitoring location with removed asphaltic cover system) where methane readings were consistently elevated prior to the removal of the asphalt cover and replacement with the ET Cover. Methane #3 is located within the measurement zone for the prior methane measuring location (PS2) which also consistently received high methane measurements. Each location includes a vertical riser installed into the underlying waste that

rises above ground level where measurements are made. The methane was measured at the exit point of each methane riser on the established periodic basis to quantify methane release from the landfill. To date, all measurements have been zero. Refer to Attachment C.

If combustible gas level measurements exceed 25% of the LEL in any riser near the airport hangar pad, or 100% of the LEL at the risers on the landfill, the owner or operator shall:

- Immediately take all necessary steps to ensure protection of public health, welfare and the environment and notify the NMED;
- Within seven days of detection, record the methane gas levels detected and a description of the steps taken to protect public health, welfare and the environment and report them to NMED.

3.1.3 BIOINTRUSION MONITORING

As part of each inspection, the ET Cover surface was visually monitored for animal or insect burrowing. To date, there is no biointrusion in the ET Cover. There were a few animal burrows identified on the side slopes. The number (6) and size (less than 3-inches in diameter) of the burrows identified is within expected tolerances based on my experience and does not pose significant risk to the performance of the side slope cover system.

The ET Cover surface layer is composed of a mixture of 25% rock to 75% soil by volume that discourages burrowing, but does not prevent it. The Federal Aviation Administration (FAA) requires nearby fields including this landfill surface to be mowed to ensure that vegetation is less than a foot tall. To date, no mowing of the cover system has been performed. The mowing is to be performed under the direction of the LAC Airport and has multiple advantages for the cover system. Its purpose is to disrupt the landscape required for burrowing animals to effectively survive. The taller vegetation acts as a canopy to hide the smaller animals from predators such as coyotes and birds. The FAA requires the mowing and thus discouragement of smaller burrowing animals because the presence of predators is a safety hazard, by attracting the predators within the airport. A second advantage of the mowing is that it encourages the establishment of thinner and shallower rooting vegetation such as grasses and discourages the establishment of deeper, woody rooted plants including trees. The large woody roots of trees can provide preferential flow paths through soil covers. Significant burrowing will be reported in the attached inspection checklist as well as to the LAC Airport manager. Any animal burrows larger than 3-inches in diameter will be reported. These large burrow holes will also be filled as soon as possible with soil, meeting the cover soil specifications contained in the Technical Specifications, Section 02200 (Earthwork) of the Remedy Completion Report (Dwyer 2016).

3.2 STORM WATER CONTROL SYSTEMS

The storm water control systems including perimeter ditches and existing drainage controls are in proper working condition with no degradation noted to date. Each inspection will satisfy the required annual storm water control system inspections as described in the approved Storm Water Pollution Prevention Plan (SWPPP) (CTI 2015). The visual inspection looked for evidence of, or the potential for, degradation of and /or pollutants entering the storm water

conveyance system. Discharge locations were inspected to determine whether erosion controls are effective in preventing significant impact to Pueblo Canyon.

The general integrity of the landfill drainage channels and culverts were inspected. No degradation or problems were identified. The channels and the transition of the channels to the arroyo were inspected for evidence of degradation, erosion, subsidence, sediment accumulation, undercutting, obstructions, slope instability and other disturbances to the channels. No degradation or problems were identified.

If any of the issues are observed to be significant by the Inspection Engineer (New Mexico Professional Engineer), they are to be repaired as soon as weather permits. Repairs (if any) requiring additional material such as riprap or soil shall use locally available materials that meet the design technical specifications contained in the Remedy Completion Report (Dwyer 2016).

3.3 FENCING

Fencing at the site is composed of perimeter fencing around the airport. The integrity of all fencing adjacent to the landfill and eastern retaining wall structures was inspected. There were no deficiencies identified. This length of fencing was inspected for any damage, including but not limited to: bent posts, loose posts, broken links or wire, and damaged gates. Any damage noted shall be noted in the inspection report and repaired as soon as weather permits.

3.4 RETAINING WALLS

Visual inspections were performed for both the concrete and mechanically stabilized earth (MSE) walls. Inspections evaluate the visual condition of the retaining structures and note any degradation. No deficiencies were noted. Inspections include identifying the existence and extent of any cracks that may exist in the concrete wall. Inspections also look for any distortion in the wall due o such things as unexpected settlement or soil piping. No issues were identified in this set of inspections.

Digital photos shall be taken of any cracking or degradation noted in the concrete wall. Measurements of the location and depth of the crack(s) (if any) shall be determined and documented in the inspection report. Documentation will be submitted of the location (if any) of any issues identified along with digital photos of the extent of damage or movement and included in the inspection report. Any soil erosion or other evidence of water damage in the vicinity of retaining walls shall be documented in the inspection report with recommended repair(s) or maintenance.

3.5 EROSION AND SEDIMENT CONTROL

Condition of temporary erosion measures was inspected for its integrity and usefulness during the time period they are deemed essential (about one year). Temporary erosion controls include erosion matting around the perimeter of the ET Cover system at the base of the slope. This temporary erosion material has degraded to the point where it is no longer useful. It served its purpose in allowing for the establishment of vegetation along the perimeter of the cover system.

Condition of permanent erosion control measures was inspected. This included the drainage channels, rock check dams, terraces, and rip rap protecting the areas around the retaining structures along the eastern portion of the landfill. There was no damage or degradation noted to date. If any degradation or damage is noted in future inspections, they shall be noted in the inspection reports along with recommended repair or maintenance for each occurrence. These reports or maintenance items are to be performed as soon as weather permits.

Condition of perimeter drains/berms, culverts, and drop inlets were inspected for presence of sediments, breaches in berms, presence of vegetation or debris, etc. No sediment or issues were identified to date. Sediments, vegetation, or debris retarding storm water runoff shall be reported to the appropriate Los Alamos County and DOE personnel and then removed as needed (if identified).

3.6 SITE ACCESS

A permanent road dedicated to the landfill does not exist. However, access to continued monitoring is granted by the Los Alamos County. Access to the site through the locked gate is adequate and provides for desired isolation of the site. Access shall be made available by the Los Alamos County for any maintenance or repairs required, as noted during the inspections. Prior notice must be given to the Los Alamos County Airport manager before any maintenance or work is performed.

3.7 DEBRIS DISPOSAL AREA COVER SYSTEM

The DDA cover system is an earthen cover located east of the ET Cover (Figure 1). It is approximately 5 acres in size and consists of a 12-inch thick soil cover seeded with native vegetation. This work was completed prior to 2007 and is described in North Wind and Weston (2007). The cover appeared in good condition with no signs of ponding or vegetation distress. Vegetation is generally mature on the site and is mowed to comply with the maximum height of vegetation allowed per the FAA (about 12-inches).

4.0 CONCLUSIONS AND RECOMMENDATIONS

The Los Alamos County Airport Landfill Cover Replacement and associated facilities are in excellent condition and performing as designed. Methane measurements have all been zero to date. The ET Cover is in excellent condition with no signs of erosion while vegetation is emerging as expected. There was no sign of significant differential settlement. Future reports will contain survey data that quantifies any ongoing settlement. There was not significant biointrusion in the cover systems. The water balance data, although there is not enough data to date to establish significant trends, appears to demonstrate that existing moisture within the landfill is moving upward while the cover prevents percolation - thus there is a negative net flux to date (drying of the landfill). Storm water controls are effective at controlling surface runoff from the site and efficiently routing it off site though designated release points. The site access is effectively controlled by the airport fencing and locked access.

There are no recommended maintenance or repair items at this time. The next annual report will be submitted to NMED by July 30, 2018 and every July thereafter as long as monitoring is required.

5.0 REFERENCES

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6.0 ACRONYMS

BGS	below ground surface
DDA	Debris Disposal Area
DOE	Department of Energy
EM-LA	Environmental Management, Los Alamos Field Office
ET	Evapotranspiration
FAA	Federal Aviation Administration
LAC	Los Alamos County
LEL	Lower Explosive Limit
MSE	mechanically stabilized earth
NMED	New Mexico Environment Department
RCRA	Resource Conservation and Recovery Act
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan

ATTACHMENTS