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25 July 2011

Ms. Paula Plont
Tennessee Department of Environment and Conservation
Division of Solid Waste Management
2700 Middlebrook Pike, Suite 220
Knoxville, TN 37921

Subject: Letter Report of Findings
Assessment of LCS Performance and Recent Sludge Excavation
Module G, Matlock Bend Landfill
Loudon County, Tennessee

Dear Ms. Plont:

On behalf of the Loudon County Solid Waste Disposal Commission (LCSWDC) and Santek Environmental, Inc. (Santek), Geosyntec Consultants (Geosyntec) prepared this Letter Report of Findings (Report) regarding: (i) an assessment of the leachate collection system (LCS) in Module G; and (ii) a summary of the recent sludge excavation activities at the Matlock Bend Landfill (Matlock Bend), Loudon County, Tennessee. This Report was prepared after several meetings and discussions with the Tennessee Department of Environment and Conservation (TDEC) and Santek regarding activities at the site before and after the 3 November 2010 waste slope failure at Matlock Bend (slope failure), including: (i) a 24 March 2011 on-site meeting at Matlock Bend with representatives of TDEC and Santek; (ii) several site visits by Geosyntec; and (iii) numerous discussions with Santek personnel. The remainder of this Report is organized to include: (i) brief background; (ii) assessment of the LCS performance in Module G; and (iii) summary of sludge excavation activities in Module G.

BACKGROUND

In response to the slope failure, Geosyntec prepared the February 2011 report titled *Assessment Report - Root Cause of the 3 November 2010 Waste Slope Failure and Rehabilitation Recommendations, Matlock Bend Landfill, Loudon County, Tennessee* (Assessment Report) for submittal to LCSWDC, TDEC, and Santek. In its summary regarding the root cause of the slope failure, Geosyntec offered the following opinion regarding the factors that contributed to the slope failure:

> "*…Specifically, Geosyntec believes that the root cause of the failure was due primarily to increased liquid levels in the landfill that were not being effectively conveyed to the LCS. It is anticipated that these liquids were a result of the large amount of sludge that was being placed, mixed, and compacted at the MBL. The sludge-mixed waste was likely wetter and weaker than waste placed in other portions of the landfill and weaker than waste that is typically expected at MSW landfills. Once the waste in the failure area started to creep downhill due to the ongoing waste placement activities, it is likely that the sludge-rich zones started to "smear" along localized planes. This had the effect of further reducing the ability of liquids to vertically percolate to the LCS and tended to result in local zones of weakened waste…..*"

In response to the slope failure, TDEC noted its concern regarding the sludge materials that were disposed at Matlock Bend and recommended that site- and material-specific testing be performed of the materials disposed at Matlock Bend. Reports from the requested testing programs that were performed by Geosyntec were recently provided to TDEC by Santek. In addition, TDEC requested that an independent assessment be performed on the LCS within the failed portion of the landfill, as well as an assessment of the impact of the remaining sludge within the failed portion of the landfill. This Report was prepared to provide TDEC with the requested independent review and assessment.

ASSESSMENT OF LCS IN MODULE G

In the Assessment Report, Geosyntec provided site-specific information regarding not only the root cause of the slope failure but supporting evidence that the slope failure did not impact the liner system (and thus the LCS) in Module G. Specifically, in *Section 6.1 - Summary* of the Assessment Report, Geosyntec reported…. "*Geosyntec does not believe that existing anchor trench or the liner integrity was compromised as a result of the failure, as confirmed by post-failure survey measurements*." Upon review of subsequent survey measurement since submittal of the Assessment Report, Geosyntec believes that these summary observations remain valid. As indicated in e-mail correspondence between Santek and TDEC, Geosyntec will be providing the referenced supplemental survey measurements in a subsequent report. In the Assessment Report, Geosyntec provided calculations and documentation to support the opinion that the slope failure did not extend to a depth that would compromise the liner system. Furthermore, Geosyntec

referenced that the leachate generation rate did not appear to be impacted as a result of the slope failure. Geosyntec opined at that time that if the slope failure had impacted the LCS, the leachate generation rate would significantly reduce relative to the pre-failure leachate generation rates.

As part of this Report, Geosyntec again reviewed the site-specific performance since the slope failure and further concludes that the LCS in Module G was not impacted by the slope failure. The following information regarding: (i) the location of the failure surface; (ii) the visual inspection of the leachate collection riser in Module G; (iii) the leachate generation rates; and (iv) the extensive network of subsurface drains recently installed by Santek all support this opinion.

- Location of the Critical Failure Surface: Although revised stability analyses were not performed as part of this Report, Geosyntec reiterates that the slope stability analysis results coupled with the site survey and monitoring results support the opinion that the failure surface passed over the top of the perimeter berm and not through the berm and/or the liner system. Survey results indicate that the perimeter berm at the lower portion of Module G was not displaced as a result of the slope failure. Geosyntec believes that if the anchor trench and the perimeter berm were not impacted, the structural integrity of the LCS was not adversely impacted by the slope failure.

- Visual Inspection of the Leachate Collection Riser Pipe: As noted in the Assessment Report, a September 2010 report prepared by Atlantic Coast Consulting (ACC) titled *Final Certification Report, Construction Quality Assurance Services, Matlock Bend Landfill, Module G Leachate Drainage Modification, Loudon County, Tennessee* (CQA Report) focused on modifications to the LCS in Module G prior to the slope failure. The location of the modification in proximity to the extent of the slope failure, including the location of a vertical riser pipe, is provided in Figure 1. After the slope failure, the vertical riser was inspected and found to be collapsed as a result of the displaced waste. Santek removed the damaged riser pipe and excavated to the base of the riser pipe, located the components of the LCS that connected to the riser pipe, cleaned the LCS pipes as needed, and confirmed that leachate was flowing unimpeded into the LCS. Santek re-established the base of the vertical riser pipe (see Photograph 1) and placed fresh gravel in the LCS adjacent the riser pipe. Santek then reinstalled the vertical riser pipe in its original location and surrounded the pipe in clean gravel to facilitate drainage to the LCS (see Photograph 2). Visual observations from the top of the riser confirm that

leachate is, in fact, still flowing through the modified portion of the LCS. These observations indicate that the LCS in Module G in the vicinity of the damaged riser pipe remains functional.

- Leachate Generation Rates: Santek provided Geosyntec with records of the leachate generation rates for Matlock Bend commencing January 2004 and running through June 2011 (i.e., current). Results are compiled by Santek monthly and results are presented in Figure 2. Results indicate that the monthly leachate generation rates are highly variable, but also indicate that there are no unusual trends (e.g., spikes or depressions) commencing November 2010. Figure 3 graphically documents the monthly and seasonal variation in leachate generation since records were maintained. The post-slide leachate generation rates are entirely consistent with the historic monthly trends. Finally, Figure 4 provide similar information to that shown in Figure 2, except that the leachate generation rates are normalized to report results in gallons per acre per day (gpad). The values presented in this figure are consistent with the normalized leachate generation rates for operating landfills. This information is believed to provide additional indication that leachate being generated in Module G is eventually getting into the LCS.

- Network of Subsurface Drains in Module G: In the Assessment Report, Geosyntec indicated that the slope failure likely inhibited the vertical migration of leachate from the landfill to the LCS. Numerous leachate (and chronic) leachate breakouts in Module G seem to confirm this position. Results of the leachate generation rates presented previously appear to indicate that although vertical percolation is impeded, leachate eventually gets into the LCS. As part of the rehabilitation measures, Santek installed numerous granular drainage trenches to facilitate migration of leachate to the LCS. The concept of the drainage trenches is that in the event the vertical flow is impeded, the leachate can flow laterally in the waste until it intercepts a drain, after which the leachate flows in the drain towards the LCS. Landfill gas vent pipes are installed periodically along the drains. A drawing showing the approximate location and interconnection of the drainage trenches and the surveyed location of the gas vents is provided in Figure 5. Santek documented the installation of the trenches and gas vents. An example of the field installation activities is presented in the following five photographs:

    - Photograph 3: This shows the excavation of a primary drainage channel looking towards the northwest in the bottom of the cell. The repaired and previously referenced vertical riser pipe is visible in the background.

- Photograph 4: This shows a close-up of the excavated trench. Drainage stone and a gas vent have recently been installed up-gradient of this location as seen in the background.

- Photograph 5: This shows the up-gradient progression of the drainage trenches. An off-road dump truck is visible in the background placing gravel into the trench around a gas vent pipe.

- Photograph 6: This provides an indication of the density of the drainage trenches near the top of the failed area as evidenced by the visible gas vents installed along the length of the trenches.

- Photograph 7: This provides a view of the bottom of the cell showing the gas vents. A stormwater diversion berm was constructed upslope from the vertical riser to minimize infiltration of precipitation into the LCS in the bottom reaches of the cell. This berm is visible in front of the (barely visible) vertical riser pipe.

As will be reported in the next section, when Santek commenced excavation of the sludge in the upper reaches of the failed area, they reported that the waste was noticeably drier than it had been several weeks earlier. This observation coupled with the decreased occurrence of leachate breakouts after installation of the trenches provides additional confirmation that leachate in Module G is finding a pathway to the LCS. Geosyntec believes that the compilation of information presented in this section provides confirmation that the LCS in the portion of cell impacted by the slope failure remains functional.

ASSESSMENT OF SLUDGE EXCAVATION

In the Assessment Report, Geosyntec proposed that measures be taken at the bottom of Module G to buttress the materials involved in the slope failure. Prior to construction of the buttress, Geosyntec recommended that measures be taken to provide subsurface control of leachate in the near-surface wastes. The efforts taken by Santek to install these drains were documented described in the previous section. During construction of the trenches, Santek noticed that the surface in the upper (i.e., southeast) portion of the cell, near the original scarp, continued to settle. A demonstration of this is provided in Figure 6, which shows an isopach of cover soil placed between the approximately six-week time period from 10 February 2011 and 25 March 2011. This figure shows that approximately four to five feet of soil was added to fill the depression and establish positive drainage. TDEC requested that Santek consistently monitor the

area to assess settlement potential and leachate breakouts while final buttress designs were being developed. Upon review of the available disposal and stabilization options and the construction schedule to implement these various options, Santek proposed an alternative strategy. Rather than construct a buttress to stabilize the materials in the failed area, Santek proposed to excavate the waste and sludge materials in this area, as it was believed better to remove the weak waste than to buttress the area. Santek took initiatives to be able to accommodate the excavated sludge and waste materials, estimated to be approximately 5,000 yd^3. Geosyntec concurred with this option and believes that it will ultimately provide a viable and preferable alternative to the originally proposed buttress.

The sludge excavation activities were well documented by Santek. The following series of eleven photographs are referenced as providing this documentation.

- Photograph 8: This shows a view of the depression adjacent the scarp in the background just as the excavation process commenced.

- Photograph 9: This shows a view looking south towards the area of the scarp after the cover soils were removed to reveal the zone/pockets of sludge that will be removed.

- Photograph 10: This also shows a view looking to the east towards the area of the scarp after the cover soils were removed to reveal the zone/pockets of sludge that will be removed.

- Photograph 11: This shows a view of the waste being excavated. Santek reported that once the sludge pockets were removed, the underlying waste was noticeably drier.

- Photograph 12: This shows a view of the drainage trench being excavated up-gradient towards the scarp area. Gravel and gas vents will eventually be installed in this excavated trench.

- Photograph 13: This is an extension of the trench in Photograph 12 towards the south and approaching the scarp area. Santek noted that sludge is being encountered within the alignment of the trench and is being removed.

- Photograph 14: This shows the excavated trench advancing towards the scarp in the southeast portion of the failed area. The sludge pockets were reported to be on the order of eight feet below the ground surface in this area.

- Photograph 15: The excavated trench is now at the northern end of the scarp area. The sludge has been removed and gravel is being placed to promote drainage to the bottom of the cell.

- Photograph 16: This is a view looking towards the north to show the limits of the excavation areas for the scarp and trenches as characterized by the darker colored zones at the base of the sideslopes

- Photograph 17: This is a view looking towards the south at the area after the trenches and gas vents have been installed. Intermediate cover soil is being placed over the excavated and backfilled areas.

- Photograph 18: This provides a view of the former scarp area after sludge excavation and final contour grading. Survey monuments have been installed on this regraded surface.

The final demonstration of the success of the sludge excavation activities will be the survey records in the area of the scarp where the depression represented a chronic challenge to Santek. Preliminary results, however, are encouraging, as shown in Figure 7. Since completion of the waste excavation activities, the vertical settlements in this area have reduced significantly.

Geosyntec concurs with the Santek decision to excavate the sludge zones from the scarp area. It appears that this effort was successful and that as a result, it will not be necessary to construct a dedicated buttress to stabilize these wastes. The combination of waste excavation and the gravel-filled drainage trenches appears to have stabilized the waste in the failed area. The purpose of this Report was to provide documentation of these activities. A subsequent report will be provided to present the results of the ongoing survey measurements.

CLOSURE

Geosyntec trusts that the information presented in this Report provide TDEC with the requisite documentation regarding the performance of the LCS in Module G as well as the sludge excavation activities initiated by Santek in the upper reaches of the failed area. On behalf of the LCSWDC and Santek, Geosyntec requests TDEC's concurrence with the findings presented in this Report. Upon review of this information, should TDEC have any questions or require additional information, please do not hesitate to contact Geosyntec.

Sincerely,

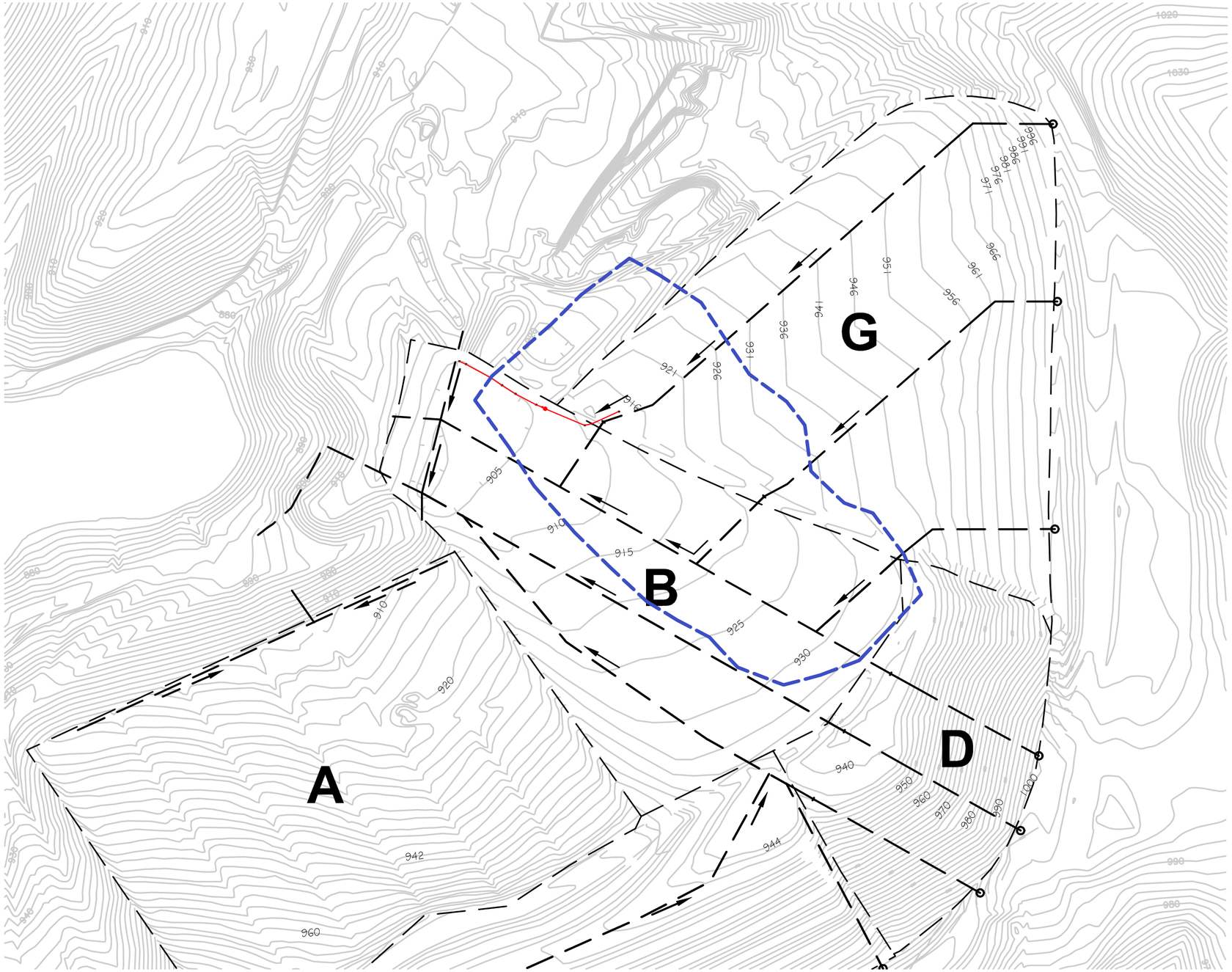
Robert C. Bachus, Ph.D., P.E.
Principal

Attachments: Figures
Photograph Log

Copies to: Matt Dillard, Levi Higdon, Ron Vail, Rob Burnette – Santek Environmental
Steve Field – Loudon County Solid Waste Disposal Commission

FIGURES

MATLOCK BEND LANDFILL
LEACHATE COLLECTION SYSTEM DESIGN AND MODIFICATION



N

LEGEND

- SLIDE LIMITS
- LEACHATE FLOW DIRECTION
- LOCATION OF SEPTEMBER 2010 LCS MODIFICATION BY ACC, INCLUDING LOCATION OF VERTICAL PIPE RISER

0 150' 300'

SCALE IN FEET

Geosyntec consultants

KENNESAW, GA

DATE:	Jul–11	SCALE:	1"=150'
PROJECT NO.	GG4773	FILE NO.	4773F010
DOCUMENT NO.	–	FIGURE NO.	1

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Figure 2
Monthly (and Average) Leachate Generation Rates
Matlock Bend Landfill

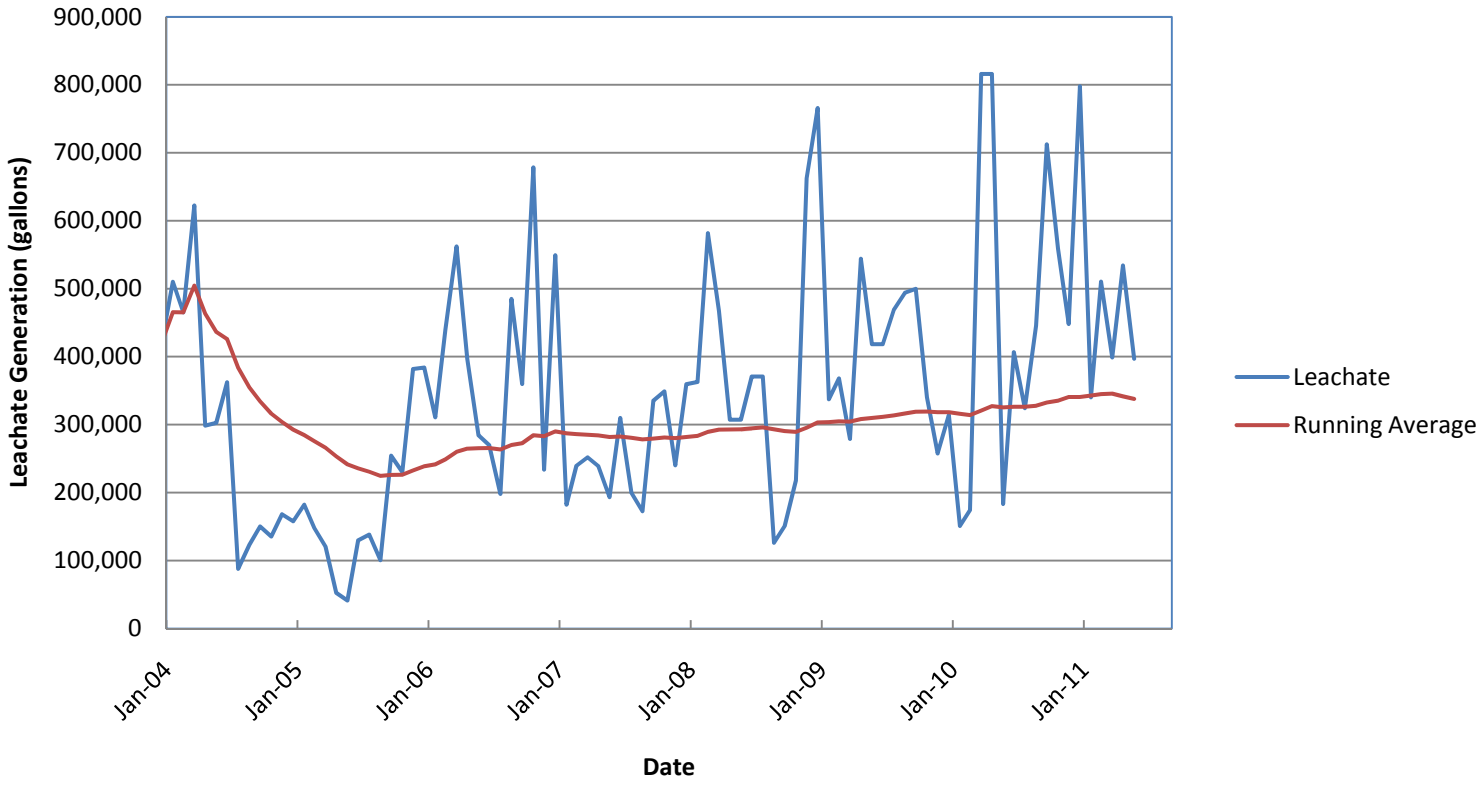


Figure 3
Comparison of Monthly Leachate Generation Rates
Matlock Bend Landfill

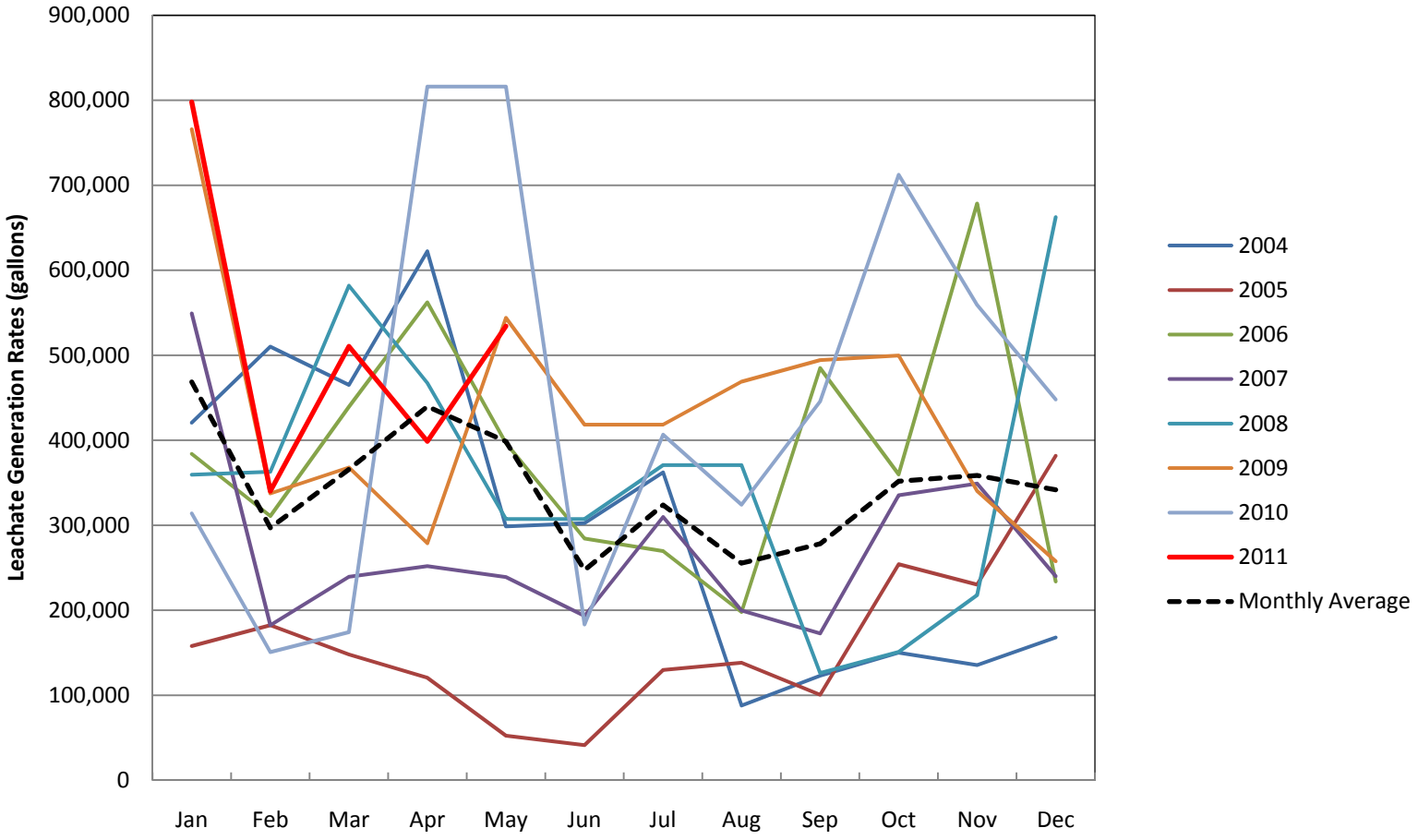
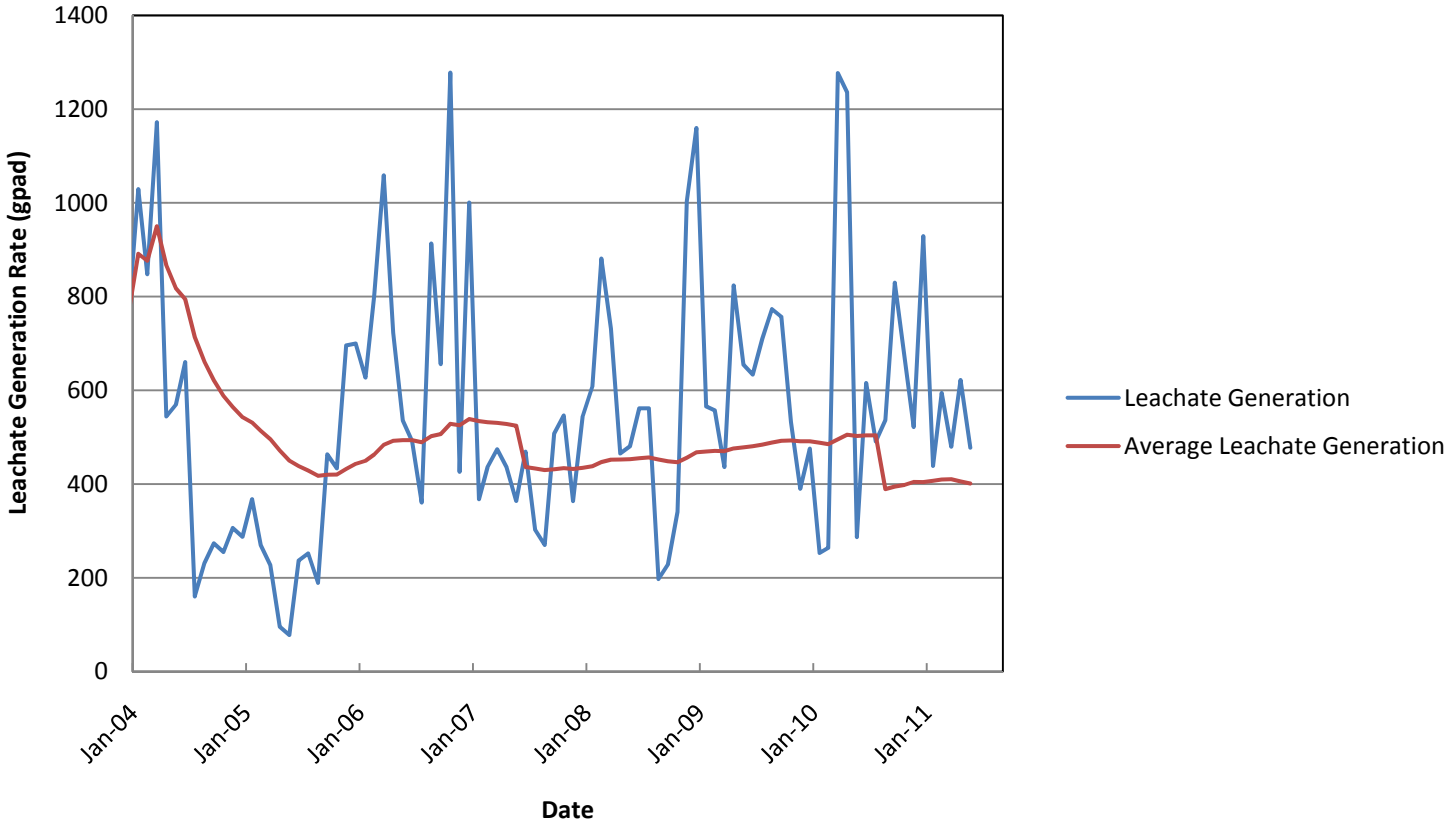
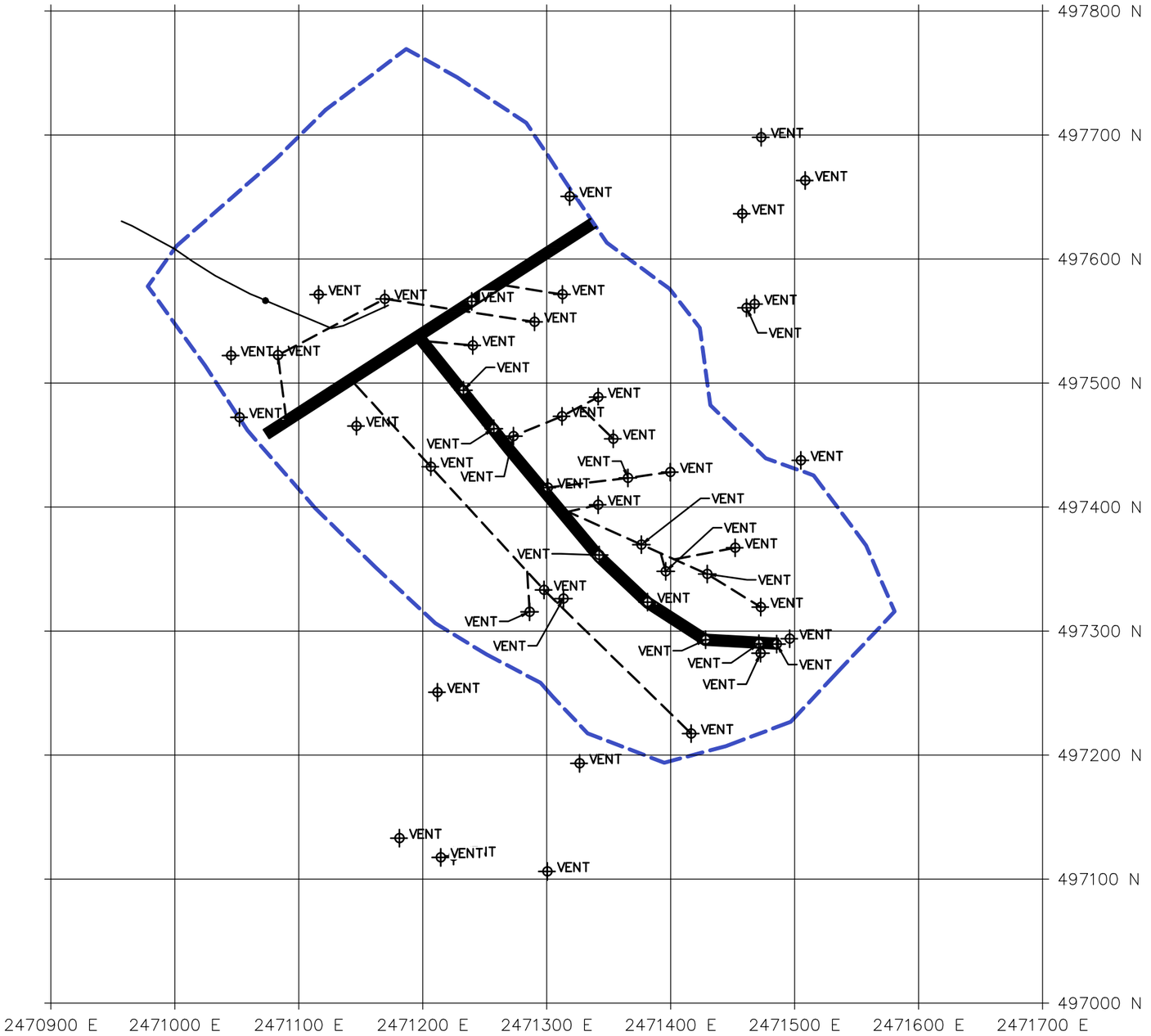


Figure 4
Normalized (and Average) Leachate Generation
Matlock Bend Landfill



MATLOCK BEND LANDFILL
LOCATION OF GAS VENTS AND SUBSURFACE GRAVEL DRAINS



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LEGEND

- SLIDE LIMITS
- VENT — EXISTING GAS VENTS
- GAS VENT PRIMARY 6FT (W) x 8FT (D) DRAINAGE CHANNEL
- GAS VENT LATERAL DRAINAGE TRENCH

0 100' 200'

SCALE IN FEET

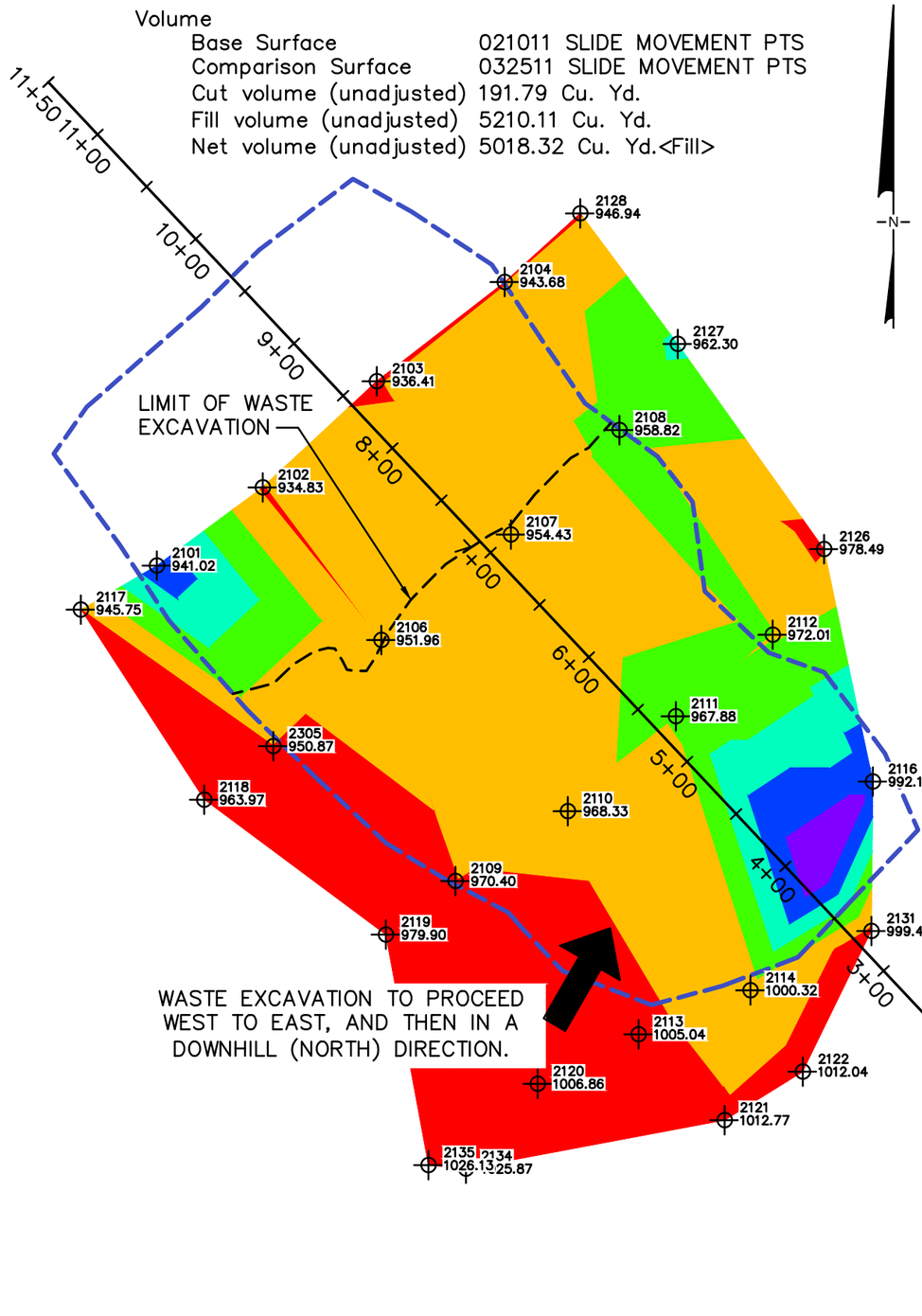
Geosyntec consultants

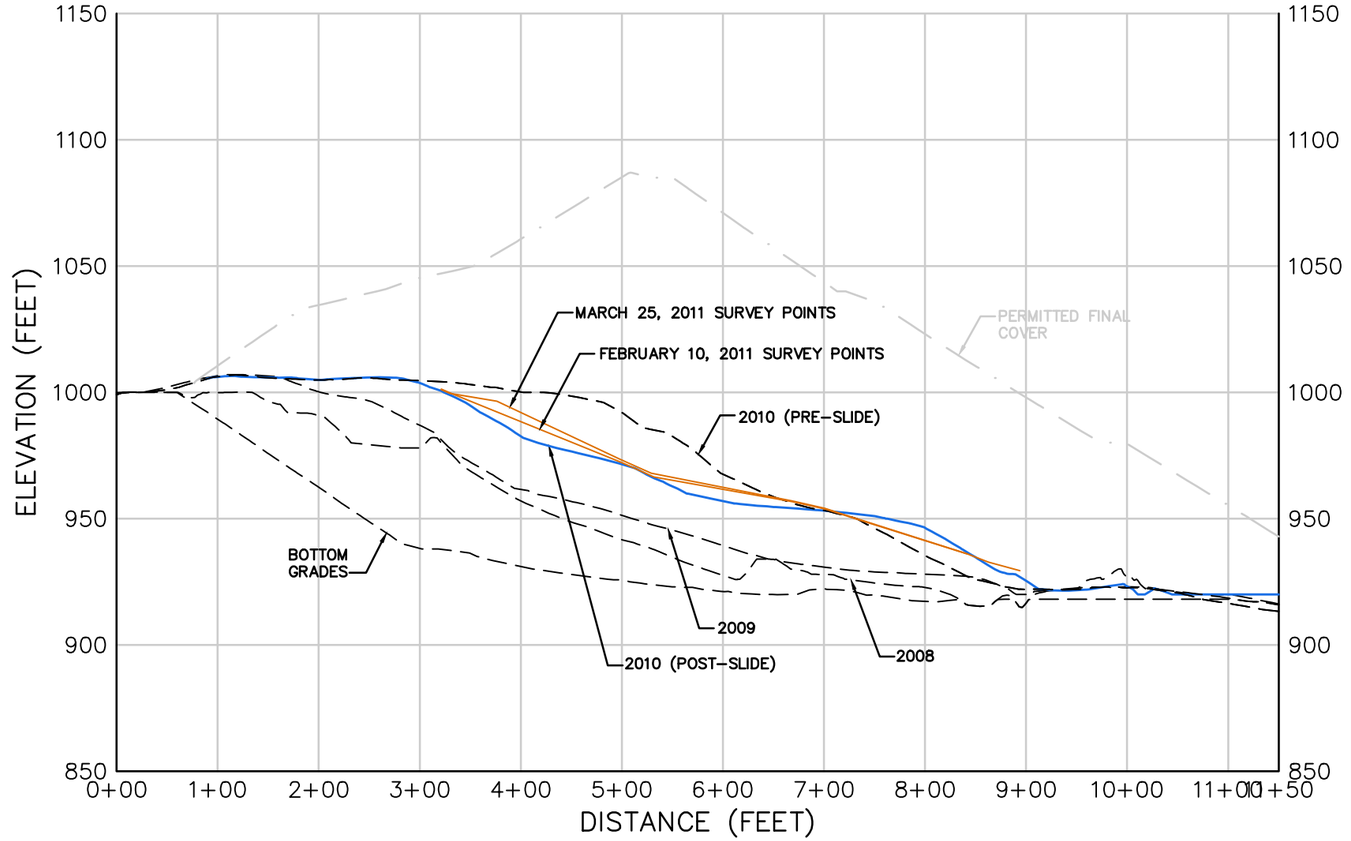
KENNESAW, GA

DATE:	Jul-11	SCALE:	1"=100'
PROJECT NO.	GG4773	FILE NO.	4773F009
DOCUMENT NO.	–	FIGURE NO.	5

L:\CADD\L\LOUDON COUNTY LANDFILL\MODIFICATION\4773F009

FIGURE 1
MATLOCK BEND LANDFILL - SITE LAYOUT





Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-0.307	0.000	
2	0.000	1.000	
3	1.000	2.000	
4	2.000	3.000	
5	3.000	4.000	
6	4.000	5.000	

LEGEND

SLIDE LIMITS

2121 1012.77 SLIDE MOVEMENT POINTS

0 100' 200'

SCALE IN FEET

Geosyntec consultants

KENNESAW, GA

DATE:	Jul-11	SCALE:	1"=100'
PROJECT NO.	GG4773	FILE NO.	4773F007
DOCUMENT NO.	-	FIGURE NO.	6

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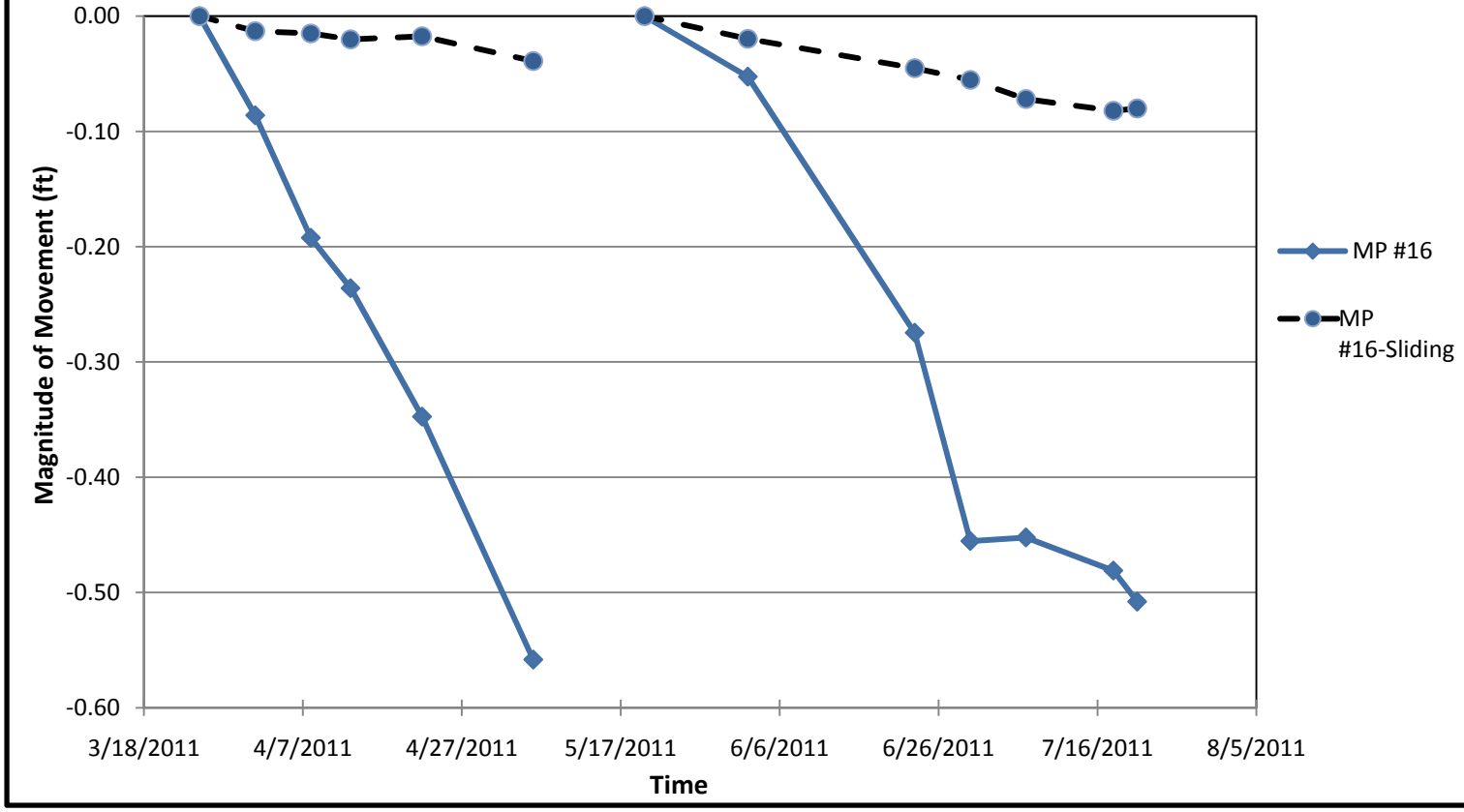
Figure 7
Excavated Depression
Matlock Bend Landfill



ATTACHMENT

PHOTOGRAPH LOG

Geosyntec consultants

PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 1: Condition of base of vertical rizer pipe in the LCS at bottom of Module G

Photograph 2: New vertical rizer pipe and gravel in the LCS at bottom of Module G

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 3: Excavated Drainage Trench looking towards bottom of Module G. (Note the repaired vertical rizer near bottom of cell)

Photograph 4: Close-Up of excavated drainage trench showing liquid in bottom of trench, gravel that has been recently placed, and an installed gas vent.

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 5: Down-gradient progression of gravel placed in trench adjacent to gas vent and surface completion of trench to minimize direct percolation of surface water.

Photograph 6: Indication of the density of drains and gas vents in upper reaches of Module G.

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 7: Indication of drains and gas vents in lower reaches of Module G and stormwater diversion berm near base of cell.

Photograph 8: Area where depression repeatedly appeared prior to commencement of excavation. Notice that gas vents and drains had been previously installed in area to be excavated.

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 9: View looking South of formerly depressed area after soil cover removed to expose waste and sludge.

Photograph 10: View looking East of formerly depressed area after cover soil was removed to expose waste and sludge.

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 11: View of waste being excavated. Santek reported that once sludge was removed (See Photograph 9 and 10), the underlying waste was relatively dry.

Photograph 12: Excavation of drainage trench from existing drainage trench towards the excavated (and now covered) area where sludge pockets were encountered.

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 13: Excavated trench progressing towards scarp area. Note that sludge is being encountered in this area.

Photograph 14: Excavated trench continuing to advance southeast and approaching the scarp area. The sludge layers are reported to be approximately 8-ft deep in this area which is then underlain by relatively dry waste.

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 15: Excavated trench near the edge of the former scarp area. Gravel is placed in the trench to promote drainage to bottom of cell.

Photograph 16: View looking North showing extent of over-excavation in scarp and trenches.

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PHOTOGRAPH LOG

PROJECT NAME: MATLOCK BEND LANDFILL	PROJECT NO.: GG4773
CLIENT.:	FILE NAME:

Photograph 17: View looking South to show installed drains/gas vents and placement of intermediate cover in excavation areas.

Photograph 18: View of former scarp area upon completion of excavation and regrading.