Docket No. 2014-1487-MSW
Municipal Solid Waste Permit No. 1312A

APPLICATION OF:	§	**BEFORE THE**
	§	
THE CITY OF FARMERS BRANCH,	§	
CAMELOT LANDFILL TX, LP	§	**TEXAS COMMISSION ON**
MODIFICATION FOR SLURRY	§	
WALL INSTALLATION and	§	
MONITOR WELLS INSTALLATION	§	**ENVIRONMENTAL QUALITY**

REPLY IN SUPPORT OF MOTION TO OVERTURN AND REQUEST FOR STAY

TO THE HONORABLE COMMISSIONERS:

COMES NOW, the City of Carrollton ("Carrollton") and files this Reply in Support of Motion to Overturn the Executive Director's ("ED's") decision to grant the City of Farmers Branch's ("Applicant" or "City of Farmers Branch") application for a modification to authorize the installation of a slurry wall and monitor wells at the Camelot Landfill, located in Denton County, Texas and operating under municipal solid waste Permit Number 1312A.

I. Summary

In their response briefs, the Applicant, ED, and Office of Public Interest Counsel ("OPIC") all claim that a slurry wall will act as a hydraulic barrier to groundwater contamination and provide additional protection of the human health and environment. But the question is not simply whether having a slurry wall is better than not having a slurry wall. The question is whether *this* proposed slurry wall will be an effective barrier to the outward migration of contamination that is occurring along the southern boundary of the Camelot Landfill. Carrollton is deeply concerned about the Applicants' failure to properly address the volatile organic compounds (VOCs) and other hazardous constituents that have been detected in groundwater samples from monitoring wells at the Camelot Landfill and the increasing plume of contamination that has been occurring for almost two decades. Carrollton shares a boundary with the landfill and owns land abutting the landfill.

Carrollton is supportive of appropriate measures to remedy the contamination that has been present at the landfill for almost 20 years. But that does not mean Carrollton is supportive of Applicant's installation of a poorly designed slurry wall that may exacerbate the migration of contamination and increase, rather than decrease, the plume that has migrated outside the waste disposal area of the landfill. Simply put, the Applicant has not provided sufficient technical information to demonstrate that the slurry wall will be an effective control of the existing and ongoing release of hazardous constituents from his landfill. Because the Applicant, ED, and OPIC all fail to address the issues raised by Carrollton in any meaningful way, Carrollton respectfully requests that the Commission grant the Motion to Overturn and send Applicant back to the drawing board to design an appropriate solution to the contamination. In addition, Carrollton requests that the Applicant be directed to pursue the installation of a slurry wall in his pending Major Amendment Application as he has failed to demonstrate that it will serve as an effective corrective action remedy and, thus, cannot proceed as a Modification.[1]

II. Argument

A. Contrary to the ED's assertions Applicant has not complied with the plain language of 30 TAC § 330.409(g)(1)(B).

It is interesting to note at the outset that Applicant did not respond at all to Carrollton's concerns regarding the Applicant's failure to comply with several RCRA corrective action provisions. Only the ED responded to these concerns. In response to this particular issue, the ED states that the "combined existing groundwater monitor wells and groundwater monitoring wells authorized by the issued Modification comply with the requirements of 30 TAC § 330.409."[2] However, this is incorrect. There has been no compliance with this requirement, as Applicant has *not* installed *any* new groundwater monitoring wells along the point of compliance

[1] Carrollton has filed an Appendix in support of Motion to Overturn and this Reply. Documents contained in the Appendix will be referred to as "App. Ex. __." The new documents filed with this Reply supplement the documents filed with the MTO and will be numbered sequentially following the last Exhibit number filed with the MTO.
[2] *See* Executive Director's Response at pp. 3-4.

in accordance with § 330.409(g)(1)B).[3]

Section 330.409(g)(1)(B) provides if a groundwater protection standard has been exceeded as the result of a sampling event that the owner or operator shall notify the ED and appropriate local government in writing and:

> **shall** also … install at least one additional monitoring well between the monitoring well with the statistically significant level and the next adjacent wells along the point of compliance before the next sampling event and sample those wells in accordance with subsection (d)(a) of this section.[4]

As noted by the plain language of the rule, this is not a discretionary requirement. Rather, it is a mandatory requirement.[5]

Our expert, Mr. Stephen D. Phillips, PG, has conducted a review of the groundwater monitor reports filed for this site over time and has developed a series of maps depicting the size and location of the groundwater contamination plume as snapshots in time.[6] For this Reply, Mr. Phillips has identified on those maps the § 330.409(g)(1)(B) required monitoring wells that should have been installed following each sampling result from December 1997 through December 2013.[7] By December of 2013 six (6) additional monitor wells should have been installed and operating had Applicant complied with the provisions of § 330.409(g)(1)(B).[8]

This is not merely an empty error. If Applicant had installed these additional wells and collected data from them over time there would be additional information about the movement and growth of the contamination plume over the course of the past 2 decades.[9] With that information both the Applicant and the ED would have been better informed of the nature and

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[3] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶¶4 and 8.
[4] 30 TAC § 330.409(g)(1)(B). (Emphasis added).
[5] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶6.
[6] This series of maps shows the growth of the contamination plume over the timeframe from December 1997 through December 2013. It is attached to Carrollton's Motion to Overturn and Request for Stay as App. Ex. 33; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶7.
[7] App. Ex. 37, Series of Maps depicting change in size and location of contamination plume with § 330.409(1)(g)(B) wells added; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶7.
[8] For a detailed discussion of the sampling events and additional groundwater monitoring wells that should have been installed pursuant to § 330.409(g)(1)(B), see App. Ex. 36, Supplemental Affidavit of Stephen D. Phillips, PG at ¶8.
[9] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶9.

extent of the contamination and perhaps more knowledgeable about the selection of the best corrective action remedy.[10] In addition, the installation of these additional monitoring wells may well have helped in providing information as to the original source of the contamination and the location of any breach in the landfill liner.[11] This information would have been and still would be invaluable in designing an effective corrective action remedy.[12]

B. Failure to adequately comply with RCRA Corrective Action Measures nullifies the slurry wall from acting as an effective remedy.

The above-described errors compounded with other failings of the Applicant to comply with the groundwater monitoring and corrective action measures of 30 TAC Ch. 330, Subchapter J, as fully described in Carrollton's MTO demonstrate that Applicant has not adequately complied with nor evaluated the plume of contamination along the southern boundary of the Landfill.[13] That plume of contamination is increasing in size and a significant portion of it lies outside the proposed boundary of the slurry wall.[14] As mentioned exhaustively in our Motion to Overturn and Request for Stay, Applicant has not even adequately identified the source of the contamination, stalwartly clinging to the theory that landfill gas is the "cause" of the contamination.[15] While landfill gas may (or may not) be the pathway that carries the contamination out of the landfill, it is not the "source" of the contamination. The source of the contamination within the landfill has never been identified, located or characterized.[16]

Moreover, in its Assessment of Corrective Measures, the Applicant rejected a slurry wall as an alternative remedy claiming that a slurry wall "does nothing to reduce the mass or source

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[10] *Id.*
[11] *Id.*
[12] *Id.*
[13] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶3.
[14] App. Ex. 36, Supplemental Affidavit of Stephen D. Phillips at ¶11; App. Ex. 37, figure 5, showing approximate location of slurry wall.
[15] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶11.
[16] *Id.*

of VOCs and arsenic."[17] If the slurry wall has been rejected by the Applicant as an effective remedy previously, the Applicant must make some kind of demonstration about why it was wrong then and why he now believes it to be the proper remedy which should include a groundwater fate and transport modeling assessment.[18] Applicant suggests that parties to a federal lawsuit have discussed the slurry wall as a potential path to resolving that litigation. However urgent the resolution of that lawsuit may be, it does not excuse the Applicant from complying with the RCRA Corrective Action regulatory requirements.

Applicant has so inadequately failed to comply with the RCRA Correction Action provisions of 30 TAC Ch. 330, Subchapter J that a slurry wall cannot qualify under the record Applicant has created as an effective corrective action remedy.[19] Moreover, new information about the presence of leachate revealed by Applicant in its response brief filed in the proceeding on Carrollton's Motion to Overturn the Applicant's Modification for Leachate Well Installation[20] casts serious doubts about the accuracy of the RCRA Corrective Action process that has been conducted to date.[21] Applicant has provided new information that leachate is present in the pre-Subtitle D area of the landfill. Applicant states that it conducted a pilot project that involved the removal of leachate from the pre-Subtitle D area "using a portable pump temporarily place (*sic*) in various 36-diameter landfill gas collection wells."[22]

The presence of leachate buildup within the pre-Subtitle D area of the landfill comes as a surprise to Carrollton and contradicts statements that the Applicant has made in revisions to the Major Amendment Application as recently as August 22, 2013 wherein Applicant states "[a]

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[17] App. Ex. 23, Assessment of Corrective Measures at p. 12, Supplemental Affidavit of Stephen D. Phillips, PG at ¶12.
[18] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶12.
[19] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶13.
[20] In a parallel action, the Applicant filed a Modification for Leachate Removal Well Installations. That Modification was approved by the Executive Director on September 23, 2014 and is the subject of a Motion to Overturn filed by Carrollton. See TCEQ Docket No. 2014-1639-MSW.
[21] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶14.
[22] See City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, TCEQ Docket No. 2014-1639-MSW, at p. 10; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶14.

review of the construction reports for each [landfill gas extraction well] show that the existing waste fill area is relatively dry."[23] Based on information in the Major Amendment application, the landfill gas extraction wells in the pre-Subtitle D area terminate anywhere from 10 feet, 5 feet, or 3 feet from the bottom of the waste and another set of these wells terminates at the base of the waste.[24] Applicant does not indicate which of these landfill gas extraction wells were used in the pilot study.[25] However, if the Applicant used the wells that terminate 10 feet above the base of the landfill that would indicate that leachate has collected to a level of 10 feet or higher over the base of the landfill.[26] This is a game changer in terms of the RCRA Corrective Action evaluations that have taken place.[27] If indeed leachate has collected to those levels within the landfill, there is a very high probability that leachate is migrating out of the landfill and is the cause of the plume of contamination, not landfill gas.[28]

For this reason alone, the slurry wall Modification should be overturned and Applicant should be directed to return to the proverbial drawing board to take into account leachate buildup within the landfill, re-perform the Assessment of Corrective Measures, and re-evaluate the Selection of Remedy. The Applicant should also be ordered to install the required § 330.409 monitor wells to more thoroughly evaluate the plume of contamination. Finally, Applicant should be required to revise and update his Major Amendment Application to take into account the new information about the leachate buildup in the pre-Subtitle D area.

C. Not every slurry wall will perform as an effective hydraulic barrier.

Applicant, ED and OPIC all contend that the proposed slurry wall will be protective of human health and the environment and will be an effective barrier to groundwater migration.

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[23] *See* App. Ex. 1, Major Amendment at IIIB -9 (rev'd August 22, 2013; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶15.
[24] App. Ex. 1, Major Amendment at Sheet IIIA-A.12A, IIIA-A.20 and IIIA-A.21; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶15.
[25] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶15.
[26] *Id.*
[27] *Id.*
[28] *Id.*

The ED, in particular, cites and relies upon an EPA report entitled "Evaluation of Subsurface Engineered Barriers at Waste Sites" (EPA 542-R-98-005).[29] The ED asserts that EPA's report documents the "use of a slurry wall as an effective hydraulic barrier at waste facilities requiring corrective action"[30] and that EPA's report further states "under well designed and constructed conditions, such vertical barriers perform as designed."[31] This statement though begs the question of whether the slurry wall at issue is "well designed" and whether it will be "constructed under good conditions." As the ED has noted, EPA does not conclude emphatically that every slurry wall will perform as designed only those well designed and constructed slurry walls will do so.

In fact, EPA's report states "[t]he evidence showed that of the 36 sites, 8 had met and 17 *may have met* the performance objectives established by the owner or regulatory agency for that system."[32] The report did note that "[b]ased on data from 25 of the 36 sites studied, subsurface engineered barriers are effective containment systems for the short and middle term, if properly designed and installed."[33] However, it should be noted that the 36 sites analyzed in the EPA report were a select subset from an original list of 162 sites and represented the best monitored and documented sites. Accordingly, based upon the selection criteria, "the sites selected for detailed evaluation [by EPA] are, by definition, not representative of subsurface engineered barrier sites."[34]

The ED also fails to note that "active containment" was the most prevalent of the

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[29] Executive Director's Response to the City of Carrollton's Motion to Overturn and Request for Stay at pp. 5 and 7-8; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶16.
[30] Executive Director's Response to the City of Carrollton's Motion to Overturn and Request for Stay at p 5; App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶16.
[31] Executive Director's Response to the City of Carrollton's Motion to Overturn and Request for Stay at p. 8; App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶16.
[32] App. Ex. 15, "Evaluation of Subsurface Engineered Barriers at Waste Sites" (EPA 542-R-98-005), Executive Summary at p. vii. (Emphasis added); App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶17.
[33] *Id*. at § 6.1 Conclusions, at p.9; App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶17.
[34] *Id*. at § 2.4 Limitations of the Selection Process, at p. 14; App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶17.

containment sites studied in EPA's report.[35] "Active containment includes a vertical subsurface barrier, often a surface horizontal barrier (cap), and some form of groundwater or leachate withdrawal inside the containment to maintain the groundwater elevation at a level lower inside the barrier than outside."[36] The slurry wall proposed by the Applicant is a "passive" containment system because there are no contaminated groundwater removal wells located between the proposed slurry wall and the landfill by which to make it an active system.[37] While Applicant has proposed to install a set of leachate removal wells in the landfill's pre-Subtitle D area by a separate Modification, Applicant has steadfastly asserted that the pre-Subtitle D liner system has not been breached and it is only the landfill gas that has found a path of migration outward. Accordingly, the leachate collection wells Applicant proposes could not be effective in converting this slurry wall into an active system nor act to withdraw groundwater between the landfill and the proposed slurry wall.[38]

Without a dewatering system on the landfill side of the slurry wall, the slurry wall would effectively act as a dam as water builds up behind it.[39] As a result the slurry wall could fail as a remedial action as groundwater could mound behind it and be redirected around the west end of the slurry wall or flow beneath it through the shale, which is laterally fractured.[40] In addition, the contamination that has migrated outside of the landfill will be stranded in the area between the slurry wall and the sidewall liner and there will be no barrier to prevent additional contamination from migrating into that area and subsequently migrating out the west end of the slurry wall.[41]

Applicant attempts to justify the performance of the slurry wall by representing that there have been over 100 borings completed at the site that together with regional and area water well

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[35] *Id*. at § 5.1 Performance Basis, at pp. 80; App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶18.
[36] *Id*. at § 5.1 Performance Basis, at pp. 80; App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶18.
[37] *See* App. Ex. 36, Supplemental Affidavit of Stephen D. Phillips, PG at ¶19.
[38] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶19.
[39] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶20.
[40] App. Ex. 37, 1991 Soil Liner Evaluation Report, at p. 10; App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶20.
[41] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶21.

information "confirm that the Eagle Ford Shale Zone within the landfill permit boundary area is a thick, continuous, and low permeability shale zone."[42] Applicant is incorrect in his evaluation of the site borings.[43] The majority of the borings performed at the landfill site that penetrate the unweathered shale are in the north and central area of the landfill.[44] Along the southern pre-Subtitle D area of the landfill, the borings along that edge merely tag the shale.[45] While Applicant may be correct when he states over 20 borings are located within 100 feet of the slurry wall location,[46] those borings do not demonstrate the thickness or suitability of the Eagle Ford Shale to act as a confining unit in that area.

Applicant mistakenly under-estimates the likelihood of encountering gravel in the trench dug for the slurry wall.[47] Applicant states that "[t]ypically less than one foot of gravelly material is present discontinuously over the Eagle Ford Shale . . . and the gravelly material will be mixed with a bentonite clay matrix throughout the total depth of the slurry wall and not adversely impact the slurry wall."[48] However, this is an average depth and certainly does not take into account any site specific discovery of gravel along the path of the slurry walls.[49] In addition, the Applicant states in the Major Amendment application that the "[a]lluvium is a coarsening downward sequence of clays, sands and gravels" and that there were "former sand and gravel pits … within the proposed permit boundary."[50] The borings along the southern boundary of the landfill show significant gravel above the Eagle Ford, in particular boring MW 28 shows a

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[42] *See* City of Farmers Branch's Response to the City of Carrollton's Motion to Overturn, at p. 13.
[43] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶23.
[44] App Ex. 1, Major Amendment, Figure IIIG-B- *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶22.
[45] App Ex. 1, Major Amendment, Figure IIIG-B- *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶23.
[46] *See* City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at p. 14.
[47] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶24.
[48] *See* City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at p. 15.
[49] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶24.
[50] *See* App. Ex. 1, Major Amendment, Section 9.1 Geology and Soils, pg. I/II-9-1; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶25.

section of gravel approximately 4 feet in depth.[51] Moreover, Applicant has no construction specifications that address the presence of gravel.[52] The presence of gravel along a slurry wall alignment can result in permeable windows from gravel not being adequately extracted from the trench bottom and/or from gravel either segregating in or settling out from the soil-bentonite backfill resulting in higher permeability.[53]

Finally, desiccation of the slurry wall can cause cracks and fissures to form in the unsaturated zone which will create a pathway of migration for landfill gas.[54] Applicant has indicated that the average depth of the slurry wall is expected to be approximately 30 feet.[55] Accordingly, the probable saturation zone of the slurry wall will be within approximately 10 feet of the top of the Eagle Ford Shale.[56] The upper 20 feet of the slurry wall will have a moderate to high plasticity index and will experience volumetric change with seasonal changes in soil moisture content.[57] During times of drought and hot dry conditions soil cracking will likely occur in this unsaturated zone of slurry wall soil-bentonite backfill.[58] If cracking indeed occurs, the slurry wall would be useless for preventing landfill gas migration.[59]

All of the above deficiencies demonstrate a significant potential for substandard performance for *this* slurry wall as a hydraulic barrier as well as significant potential for altering or modifying contamination pathways to actually increase environmental risks. This slurry wall could cause "damming" or "mounding of groundwater behind the slurry wall, a commonly observed consequence, could create a pathway for migration of contamination through

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[51] *See* App. Ex. 1, Major Amendment, Slurry Wall Section A, Drawing A.17, Sheet IIIA-A.17; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶25.
[52] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶25.
[53] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶26.
[54] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶27.
[55] City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at p. 15; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶27.
[56] *See* App. Ex. 1, Major Amendment, 2012 Major Amendment Application, Slurry Wall Sections A and B, Drawings A.17 and A.18, Sheets IIIA-A.17 and A.18; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶27.
[57] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶27.
[58] *Id.*
[59] *Id.*

permeable gravel windows and could easily redirect groundwater particularly around the west end of the slurry wall, all of which could bypass existing monitoring locations and potentially newly proposed monitoring well MW-13R2.

D. Applicant has mischaracterized the declining values of the concentrations of hazardous compounds detected in the monitoring wells.

Applicant has consistently indicated that the concentrations of hazardous compounds reported in the groundwater are declining.[60] This statement is false and misleading. Based on the Time Series charts provided by the applicant in its Groundwater Reports, there has been an overall increase in compounds in several monitoring wells.[61] For example:

- Sample results for MW-1R, which is one of the applicant's **upgradient** monitoring wells, 1,1-dichcloroethane (DCA) show an overall increase 1996 to 2013.
- Sample results for MW-26 show an overall increase in DCE from 2010 to 2013.
- Sample results for MW-27 show an increase in DCE and a slight increase in DCA while VC has held steady at the GWPS from 2010 to 2013.
- Sample results for MW-9 show an overall increase in DCE from 1998 to 2013.
- Sample results for MW-11 show an increasing trend for DCE from 2000 to 2013.
- Sample results for MW-12 show an increasing trend for DCE from 2000 to 2013.
- Sample results for MW-12A show a slightly increasing trend for DCA and DCE from 2009 to 2013 and remains above the GWPS for DCE.[62]

Applicant has tried to justify any increases in the hazardous compounds seen in its monitoring wells as the degradation of parent products into daughter products such as TCE

[60] City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at pp. 11-12; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶29.
[61] *See* App. Ex. 31, 2013 Annual Groundwater Detection/Assessment Monitoring Report, dated February 2014; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶29.
[62] *See* App. Ex. 31, 2013 Annual Groundwater Detection/Assessment Monitoring Report, dated February 2014, Appendix E, Detection and Assessment Monitoring Statistical Analysis Plots; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶29.

degrading to DCE which in turn degrades into VC.[63] In a September 2012 PowerPoint® presentation to TCEQ Staff, Applicant presented information showing a graphic degradation process.[64] The applicant did not, however, support that degradation process with geochemical data presenting ratios of the amount one compound would degrade into another.[65] In other words, Applicant presented no information regarding whether one quantity of TCE would degrade into more, the same, or lesser amount of DCE. [66] Though this degradation process is a viable process, the concentrations of the parent compound compared to the concentration of the daughter compounds does not substantiate this method as being responsible for the concentrations seen at individual monitoring wells.[67] For instance, in MW-11 the parent compound, TCE, has been in the range of 20 to 30 micrograms per liter (ug/l) from 2004 to 2008.[68] During that same period, the concentration of its daughter compound, DCE, has been near or above 100 ug/l.[69] Since 2008, TCE has declined to a 5 to 10 ug/l range while DCE has continued to be in the near to above the 100 ug/l range.[70] There has been no explanation by the applicant how the daughter compound could possibly have been and remained 5 to 20 times higher than the parent.[71] One would expect to see the daughter (DCE) at a lesser amount and possibly increasing over time as TCE degrades, but never at a higher concentration that the parent compound (TCE) originally was found.[72] Applicant's explanation is simply not viable.[73]

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[63] City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at pp. 11-12; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶3 *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶30.
[64] *See* App. Ex. 29, Camelot Groundwater Monitoring Presentation to TCEQ staff; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶31.
[65] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶31.
[66] *Id.*
[67] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶32.
[68] *See* App, Ex, 31, 2013 Annual Groundwater Detection/Assessment Report, February 2014, Appendix D, Historical Groundwater Tables; *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶32.
[69] *Id.*
[70] *Id.*
[71] *See* App. Ex. 36, Supplemental Affidavit Stephen D. Phillips, PG at ¶33.
[72] *Id.*
[73] *Id.*

III. Conclusion

For all of the above reasons, the additional reasons contained in the City of Carrollton's Motion to Overturn and Request for Stay, and the Affidavit and Supplemental Affidavit of Stephen D. Phillips, PG, the City of Carrollton requests that the application for the modification to allow the installation of the slurry wall and additional monitor wells at the Camelot Landfill be overturned, that the Applicant be required to revise its corrective action evaluations and its Major Amendment Application to take into account new information about the buildup of leachate in the pre-Subtitle D area of the Camelot Landfill, or, in the alternative, requests that the application to install the slurry wall be consolidated into the City of Farmers Branch's pending application for a major amendment for the Camelot Landfill where all of the above issues can be reviewed thoroughly.

Dated: November 25, 2014

Respectfully submitted,

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MODIFICATION FOR SLURRY	**§**	
WALL INSTALLATION and	**§**	
MONITOR WELLS INSTALLATION	**§**	**ENVIRONMENTAL QUALITY**

Appendix for Reply in Support of Motion to Overturn and Request for Stay

Exhibits

36. Supplemental Affidavit of Stephen Phillips, PG.

37. Contaminated Plume Maps, prepared by Stephen Phillips, PG.

38. 1991 Soil and Liner Evaluation Report ("SLER"), City of Farmer's Branch, prepared by Reed Engineering (September 1991).

Docket No. 2014-1487-MSW
Municipal Solid Waste Permit No. 1312A

APPLICATION OF:	§	**BEFORE THE**
	§	
THE CITY OF FARMERS BRANCH,	§	
CAMELOT LANDFILL TX, LP	§	**TEXAS COMMISSION ON**
MODIFICATION FOR SLURRY	§	
WALL INSTALLATION and	§	
MONITOR WELLS INSTALLATION	§	**ENVIRONMENTAL QUALITY**

State of Texas §
§
County of Hopkins §

Supplemental Affidavit of Stephen D. Phillips, PG

Before me, the undersigned Notary Public, on this day personally appeared Stephen D. Phillips, PG, the affiant, a person whose identity is known to me. After I administered an oath to affiant, he testified as follows:

1. My name is Stephen D. Phillips. I am over 21 years of age, of sound mind, and am fully competent to make this affidavit. The facts stated in this affidavit are within my personal knowledge and are true and correct.

2. This Supplemental Affidavit is filed in support of the City of Carrollton's Reply in Support of Motion to Overturn the Permit Modification for Slurry Wall Installation ("Permit Modification") filed by the City of Farmers Branch. It supplements the Affidavit I filed in support of the Motion to Overturn in this matter.

3. My testimony below is organized using the headings for the arguments and numbering system as set forth by the City of Carrollton in its Reply in Support of Motion to Overturn and Requests for Stay.

A. Contrary to the ED's assertions Applicant has not complied with the plain language of 30 TAC § 330.409(g)(1)(B).

4. Applicant has not installed any new groundwater monitoring wells along the point of compliance in accordance with § 330.409(g)(1)(B) during nearly two decades since contaminants have been detected in groundwater sampling events at the point of compliance at the Camelot landfill.[1]

5. 30 TAC § 330.409(g)(1)(B) provides if a groundwater protection standard has been exceeded as the result of a sampling event that the owner or operator shall notify the ED and appropriate local government in writing and:

[1] *See* App. Ex. 37, Series of Maps depicting change in size and location of contamination plume with § 330.409(1)(g)(B) wells added.

EXHIBIT App. Ex. 36

> **shall** also … install at least one additional monitoring well between the monitoring well with the statistically significant level and the next adjacent wells along the point of compliance **before** the next sampling event and sample those wells in accordance with subsection (d)(a) of this section.[2]

6. As noted by the plain language of the rule, this is not a discretionary requirement. Rather, it is a mandatory requirement.

7. I conducted a review of the groundwater monitor reports filed for this site over time and have developed a series of maps depicting a general size and location of the groundwater contamination plume as snapshots in time.[3] For Carrollton's Reply, I have updated those maps to show the § 330.409(g)(1)(B) required monitoring wells that should have been installed following several sampling result from December 1997 through December 2013. That series of Maps is identified as App. Ex. 37.[4]

8. In my review of groundwater monitoring reports filed by the Applicant, I found the following:

- The 1996 and 1997 groundwater samples tested from MW-10 showed contamination above the groundwater protection standard (GWPS) for trichloroethylene (TCE) and vinyl chloride (VC). As a result of this sampling event, two additional monitoring wells should have been located along the (then current) point of compliance (POC) – one between MW-10 and MW-4R; and a second between MW-10 and MW-11.[5] No monitoring well has ever been located between MW-10 and MW-4R or MW-11.
- Beginning in December of 2000 through December 2013, MW-11 showed contamination above the GWPS for TCE. A new monitoring well should have been located between MW-11 and MW-12, but was not.[6]
- In December 2002, MW-12 showed contamination above the GWPS for VC. TCE and cis-1,2-dichloroethylene (DCE) have also been above GWPS in MW-12 during various sampling events from 2003 to 2013. A new monitoring well should have been placed between MW-12 and MW-13R, but was not.[7]
- In 2010 the Applicant began showing a new POC along a new set of monitoring wells about 350 feet downgradient of the original POC.[8]
- Since the change in location of the POC was not commented on by TCEQ, in essence, the Applicant was able to state in its subsequent groundwater reports that there was no contamination at or above GWPS at its POC. It wasn't until November 15, 2012, that TCEQ approved moving the POC to the new set of

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[2] 30 TAC § 330.409(g)(1)(B). (Emphasis added).

[3] This series of maps shows the growth of the contamination plume over the timeframe from December 1997 through December 2013. It is attached to Carrollton's Motion to Overturn and Request for Stay as App. Ex. 33.

[4] *See* App. Ex. 37, Series of Maps depicting change in size and location of contamination plume with § 330.409(1)(g)(B) wells added.

[5] *See* App. Ex. 37, Maps of Contamination Plume, figure 1.

[6] *See* App. Ex. 37, Maps of Contamination Plume, figure 2.

[7] *See* App. Ex. 37, Maps of Contamination Plume, figure 3.

[8] *See* App. Ex. 37, Maps of Contamination Plume, figure 4.

monitoring wells.[9]

- In December 2012 one of the new monitoring wells, MW-26, showed contamination at the GWPS for VC. This monitoring well showed the same level of contamination again in 2013. Two new monitoring wells should have been placed as a result of these sampling events – one between MW-26 and MW-25; and a second between MW-26 and MW-9.[10] Neither monitor well was placed in these locations.
- In summary, by December 2013, six (6) additional monitor wells should have been installed and operating if Applicant had complied with the provisions of § 330.409(g)(1)(B).[11]

9. This is not merely an empty error. If Applicant had installed these additional wells and collected date from them over time there would be additional information about the movement and growth of the contamination plume over the course of the past 2 decades. With that information both the Applicant and the ED would have been better informed of the nature and extent of the contamination and perhaps more knowledgeable about the selection of the best corrective action remedy. In addition, the installation of these additional monitoring wells may well have helped in providing information as to the original source of the contamination and the location of any breach in the landfill liner. This information would have been and still would be invaluable in designing an effective corrective action remedy.

B. Failure to adequately comply with RCRA Corrective Action Measures nullifies the slurry wall from acting as an effective remedy.

10. Based upon my experience, the above-described errors (regarding failings to site monitor wells in accordance with § 330.409(g)(1)(B)) compounded with other failings of the Applicant to comply with the corrective action measures of 30 TAC Ch. 330, Subchapter J, as fully described in Carrollton's MTO demonstrate that Applicant has not adequately complied with nor evaluated the plume of contamination along the southern boundary of the Landfill.

11. That plume of contamination is increasing in size and a significant portion of it lies outside the proposed boundary of the slurry wall.[12] Applicant has not adequately identified the source of the contamination. Throughout the Slurry Wall Modification process, the Applicant retains the position that landfill gas is the "cause" of the contamination. While landfill gas may (or may not) be the pathway that carries the contamination out of the landfill, it is not the "source" of the contamination. The source of the contamination within the landfill has never been identified, located or characterized.

12. In the Assessment of Corrective Measures, the Applicant rejected a slurry wall as an alternative remedy claiming that a slurry wall "does nothing to reduce the mass or source of VOCs and arsenic."[13] If the slurry wall has been rejected by the Applicant as effective remedy previously, the Applicant must make some kind of demonstration about why it was wrong then and why he now believes it to be the proper remedy which should include a groundwater fate and

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[9] *See* App. Ex. 30, TCEQ letter to Camelot (Background Data Evaluation Report) (November 2012).
[10] *See* App. Ex. 37, Maps of Contamination Plume, figure 5.
[11] *Id.*, *See also* App. Ex. 31, Annual Groundwater Detection/Assessment Monitoring Report, 2013, dated February 2014.
[12] *See* App. Ex. 37, Maps of Contamination Plume, figure 5, showing approximate location of slurry wall.
[13] *See* App. Ex. 23, Assessment of Corrective Measures at p. 12.

transport modeling assessment.

13. Applicant has so inadequately failed to comply with the RCRA Correction Action provisions of 30 TAC Ch. 330, Subchapter J that a slurry wall cannot qualify under the record Applicant has created as an effective corrective action remedy.

14. Moreover, new information about the presence of leachate revealed by Applicant in its response brief filed in the proceeding on Carrollton's Motion to Overturn the Applicant's Modification for Leachate Well Installation[14] casts serious doubts about the accuracy of the RCRA Corrective Action process that has been conducted to date. Applicant has provided new information that leachate is present in the pre-Subtitle D area of the landfill. Applicant states that it conducted a pilot project that involved the removal of leachate from the pre-Subtitle D area "using a portable pump temporarily place (*sic*) in various 36-diameter landfill gas collection wells."[15]

15. The presence of leachate buildup within the pre-Subtitle D area of the landfill comes as a surprise to Carrollton and contradicts statements that the Applicant has made in revisions to the Major Amendment Application as recently as August 22, 2013 wherein Applicant states "[a] review of the construction reports for each [landfill gas extraction well] show that the existing waste fill area is relatively dry."[16] Based on information in the Major Amendment application, the landfill gas extraction wells in the pre-Subtitle D area terminate anywhere from 10 feet, 5 feet, or 3 feet from the bottom of the waste and another set of these wells terminates at the base of the waste.[17] Applicant does not indicate which of these landfill gas extraction wells were used in the pilot study. However, if the Applicant used the wells that terminate 10 feet above the base of the landfill that would indicate that leachate has collected to a level of 10 feet or higher over the base of the landfill. This is a game changer in terms of the RCRA Corrective Action evaluations that have taken place. If indeed leachate has collected to those levels within the landfill, there is a very high probability that leachate is migrating out of the landfill and is the cause of the plume of contamination, not landfill gas.

C. Not every slurry wall will perform as an effective hydraulic barrier.

16. The ED cites and relies upon an EPA report entitled "Evaluation of Subsurface Engineered Barriers at Waste Sites" (EPA 542-R-98-005) to justify the use of a slurry wall to as an effective hydraulic barrier at waste facilities requiring corrective action. However, EPA's report states "under well designed and constructed conditions, such vertical barriers perform as designed."[18] EPA does not conclude emphatically that every slurry wall will perform as designed only those well designed and constructed slurry walls will do so.

17. EPA's report states "[t]he evidence showed that of the 36 sites, 8 had met and 17 *may have met* the performance objectives established by the owner or regulatory agency for that

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[14] In a parallel action, the Applicant filed a Modification for Leachate Removal Well Installations. That Modification was approved by the Executive Director on September 23, 2014 and is the subject of a Motion to Overturn filed by Carrollton. See TCEQ Docket No. 2014-1639-MSW.

[15] See City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, TCEQ Docket No. 2014-1639-MSW, at p. 10.

[16] *See* App. Ex. 1, Major Amendment at IIIB -9 (rev'd August 22, 2013).

[17] App. Ex. 1, Major Amendment at Sheet IIIA-A.12A, IIIA-A.20 and IIIA-A.21.

[18] *Id.* at p. 8.

system."[19] The report did note that "[b]ased on data from 25 of the 36 sites studied, subsurface engineered barriers are effective containment systems for the short and middle term, if properly designed and installed."[20] However, it should be noted that the 36 sites analyzed in the EPA report were a select subset from an original list of 162 sites and represented the best monitored and documented sites. Accordingly, based upon the selection criteria, "the sites selected for detailed evaluation [by EPA] are, by definition, not representative of subsurface engineered barrier sites."[21]

18. The ED fails to note that "active containment" was the most prevalent of the containment sites studied in EPA's report.[22] "Active containment includes a vertical subsurface barrier, often a surface horizontal barrier (cap), and some form of groundwater or leachate withdrawal inside the containment to maintain the groundwater elevation at a level lower inside the barrier than outside."[23]

19. The slurry wall proposed by the Applicant is a "passive" containment system because there are no leachate removal wells located between the proposed slurry wall and the landfill by which to make it an active system. While Applicant has proposed to install a set of leachate removal wells in the pre-Subtitle D area by a separate Modification, those leachate collection wells will not be effective in converting this slurry wall into an active system as the Applicant itself claims that the sidewall and bottom liners have not been breached.

20. Without a dewatering system on the landfill side of the slurry wall, the slurry wall would effectively act as a dam as water builds up behind it. It is simply not designed to that capability. As a result the slurry wall could fail as a remedial action as groundwater could mound behind it and be redirected around the west end of the slurry wall or flow beneath it through the shale, which is laterally fractured.[24]

21. In addition, any contamination that has migrated or continues to migrate outside of the landfill will be stranded in the area between the slurry wall and the sidewall liner and the Applicant has not proposed adequate remedial measures to prevent additional contamination from migrating into that area and subsequently migrating out the west end of the slurry wall.

22. Applicant attempts to justify the performance of the slurry wall by representing that there have been over 100 borings completed at the site that together with regional and area water well information "confirm that the Eagle Ford Shale Zone within the landfill permit boundary area is a thick, continuous, and low permeability shale zone."[25]

23. Applicant is incorrect in his evaluation of the site borings. The majority of the borings performed at the landfill site that penetrate the unweathered shale are in the north and central area of the landfill.[26] Along the southern pre-Subtitle D area of the landfill, the borings

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[19] *See* App. Ex. 15,"Evaluation of Subsurface Engineered Barriers at Waste Sites" (EPA 542-R-98-005), Executive Summary at p. vii. (Emphasis added).
[20] *Id.* at § 6.1 Conclusions, at p.91.
[21] *Id.* at § 2.4 Limitations of the Selection Process, at p. 14.
[22] *Id.* at § 5.1 Performance Basis, at pp. 80.
[23] *Id.* at § 5.1 Performance Basis, at pp. 80.
[24] App. Ex. 38, 1991 Soil and Liner Evaluation Report, at p. 10.
[25] *See* City of Farmers Branch's Response to the City of Carrollton's Motion to Overturn, at p. 13.
[26] App Ex. 1, Major Amendment, Figure IIIG-B-2.

along that edge merely tag the shale.[27] While Applicant may be correct when he states over 20 borings are located within 100 feet of the slurry wall location,[28] those borings do not demonstrate the thickness or suitability of the Eagle Ford Shale to act as a confining unit in that area.

24. Applicant mistakenly underestimates the likelihood of encountering gravel in the trench dug for the slurry wall. Applicant merely refers to an average depth of gravel throughout the site when it refers to the fact that "typically less than one foot of gravelly material is present over the Eagle Ford Shale."[29] This is a average depth and does not take into account any site specific discovery of gravel along the path of the slurry wall.

25. In addition, the Applicant states in his own application that the "[a]lluvium is a coarsening downward sequence of clays, sands and gravels" and that there were "former sand and gravel pits ... within the proposed permit boundary."[30] The borings along the southern boundary of the landfill show significant gravel above the Eagle Ford, in particular boring MW 28 shows a section of gravel approximately 4 feet in depth.[31] Moreover, Applicant has no construction specifications that address the presence of gravel.

26. The presence of gravel along a slurry wall alignment can result in permeable windows from gravel not being adequately extracted from the trench bottom and/or from gravel either segregating in or settling out from the soil-bentonite backfill resulting in higher permeability.

27. Desiccation of the slurry wall can cause cracks and fissures to form in the unsaturated zone which will create a pathway of migration for landfill gas. Applicant has indicated that the average depth of the slurry wall is expected to be approximately 30 feet.[32] Accordingly, the probable saturation zone of the slurry wall will be within approximately 10 feet of the top of the Eagle Ford Shale.[33] The upper 20 feet of the slurry wall will have a moderate to high plasticity index and will experience volumetric change with seasonal changes in soil moisture content.[34] During times of drought and hot dry conditions soil cracking will likely occur in this unsaturated zone of slurry wall soil-bentonite backfill. If cracking indeed occurs, the slurry wall would be useless for preventing landfill gas migration.

28. In my opinion, all of the above deficiencies along with the deficiencies stated in Carrollton's MTO demonstrate a significant potential for substandard performance for *this* slurry wall as a hydraulic barrier as well as significant potential for altering or modifying contamination pathways to actually increase environmental risks. In my opinion, this slurry wall could cause "damming" or "mounding of groundwater behind the slurry wall, a commonly observed consequence, could create a pathway for migration of contamination through permeable gravel windows and additionally could easily redirect groundwater particularly around the west end of the slurry wall, all of which could bypass existing monitoring locations and potentially newly

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[27] *Id.*
[28] *See* City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at p. 14.
[29] *See* City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at p. 15.
[30] *See* App. Ex. 1, Major Amendment, Section 9.1 Geology and Soils, pg. I/II-9-1.
[31] *See* App. Ex. 1, Major Amendment, Slurry Wall Section A, Drawing A.17, Sheet IIIA-A.17
[32] City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at pp. 15.
[33] *See* App. Ex. 1, 2012 Major Amendment, Slurry Wall Sections A and B, Drawings A.17 and A.18, Sheets IIIA-A.17 and A.18.

proposed monitoring well MW-13R2.

D. Applicant has mischaracterized the declining values of the concentrations of hazardous compounds detected in the monitoring wells.

29. Applicant has consistently indicated that the concentrations of hazardous compounds reported in the groundwater are declining.[35] In my opinion, this statement is false and misleading. Based on the Time Series charts provided by the Applicant in its Groundwater Reports, there has been an overall increase in compounds in several monitoring wells.[36] For example:

- Sample results for MW-1R, which is one of the applicant's upgradient monitoring wells, 1,1-dichcloroethane (DCA) show an overall increase from 1996 to 2013.
- Sample results for MW-26 show an overall increase in DCE from 2010 to 2013.
- Sample results for MW-27 show an increase in DCE and a slight increase in DCA while VC has held steady at the GWPS from 2010 to 2013.
- Sample results for MW-9 show an overall increase in DCE from 1998 to 2013.
- Sample results for MW-11 show an increasing trend for DCE from 2000 to 2013.
- Sample results for MW-12 show an increasing trend for DCE from 2000 to 2013.
- Sample results for MW-12A show a slightly increasing trend for DCA and DCE from 2009 to 2013 and remains above the GWPS for DCE.[37]

30. Applicant has tried to justify any increases in the hazardous compounds seen in its monitoring wells as the degradation of parent products into daughter products such as TCE degrading to DCE which in turn degrades into VC.[38] In my opinion, this is also not true.

31. In a September 2012 PowerPoint® presentation to TCEQ Staff, Applicant presented information showing a graphic degradation process.[39] The applicant did not, however, support that degradation process with geochemical data presenting ratios of the amount one compound would degrade into another. In other words, Applicant presented no information regarding whether one quantity of TCE would degrade into more, the same, or lesser amount of DCE.

32. Though this degradation process is a viable process, the concentrations of the parent compound compared to the concentration of the daughter compounds does not substantiate this method as being responsible for the concentrations seen at individual monitoring wells. For instance, in MW-11 the parent compound, TCE, has been in the range of 20 to 30 micrograms per liter (ug/l) from 2004 to 2008.[40] During that same period, the concentration of its daughter compound, DCE, has been near or above 100 ug/l.[41] Since 2008, TCE has declined

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[35] City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at pp. 11-12.
[36] *See* App. Ex. 31, 2013 Annual Groundwater Detection/Assessment Monitoring Report, dated February 2014.
[37] *See* App. Ex. 31, 2013Annual Groundwater Detection/Assessment Monitoring Report, dated February 2014, Detection and Assessment Monitoring Statistical Analysis Plots.
[38] City of Farmers Branch's Response to City of Carrollton's Motion to Overturn, at pp. 11-12.
[39] *See* App. Ex. 29, Camelot Groundwater Monitoring Presentation to TCEQ staff, slide no. 16.
[40] *See* App. Ex. 31, 2013 Annual Groundwater Detection/Assessment Report, dated February 2014, Appendix D, Historical Groundwater Tables.
[41] *Id.*

to a 5 to 10 ug/l range while DCE has continued to be in the near to above the 100 ug/l range.[42]

33. There has been no explanation by the applicant how the daughter compound could possibly have been and remained 5 to 20 times higher than the parent. One would expect to see the daughter (DCE) at a lesser amount and possibly increasing over time as TCE degrades, but never at a higher concentration that the parent compound (TCE) originally was found. In my opinion, Applicant's explanation is simply not viable.

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[42] *Id.*

Stephen Phillips

SUBSCRIBED AND SWORN TO BEFORE ME on November 25, 2014, to certify which witness my hand and official seal.

Notary Public in and for the State of Texas

ZANDRA PEYTON
Notary Public
State of Texas
My Comm. Expires 10-20-2018

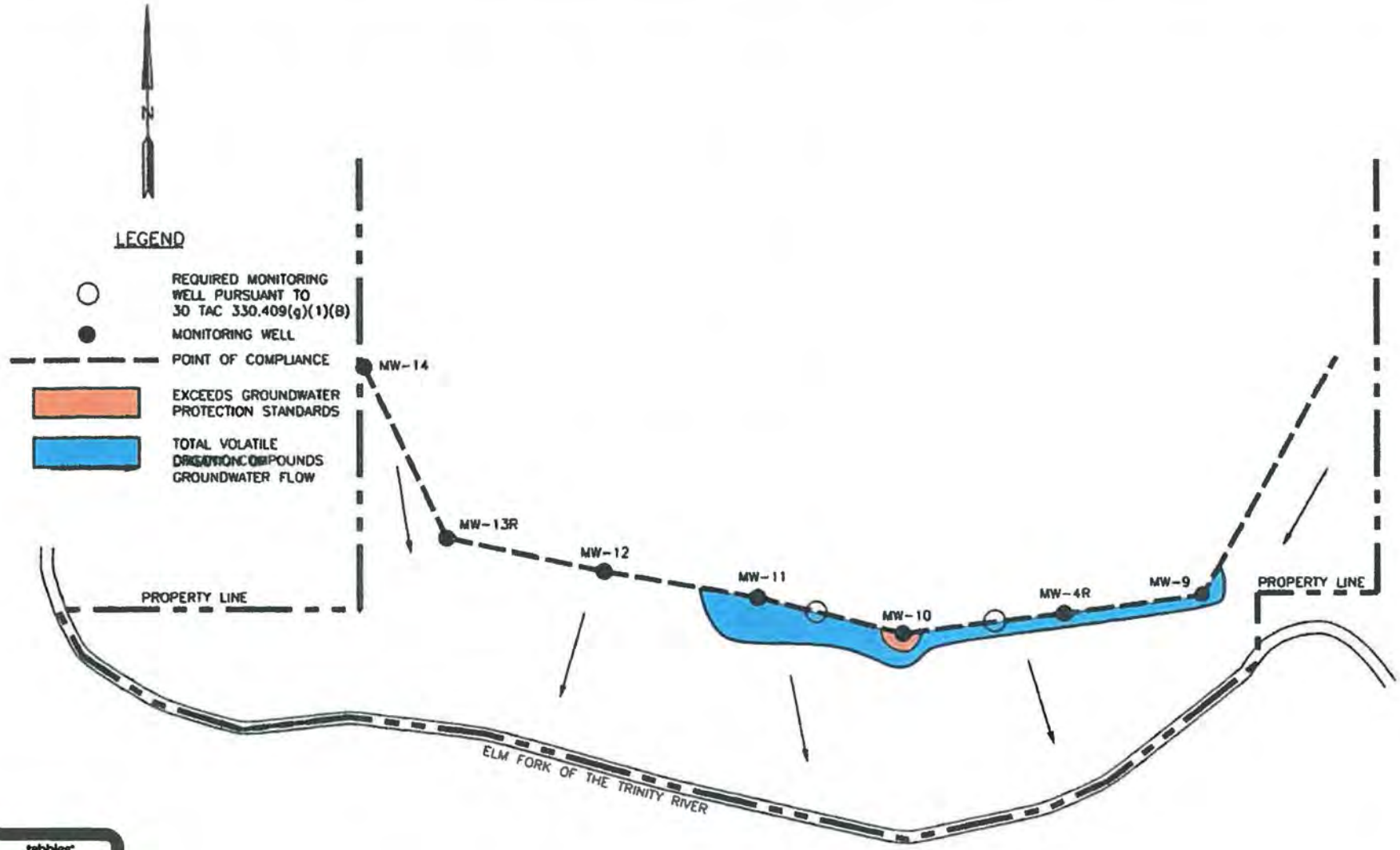


EXHIBIT App. Ex. 37

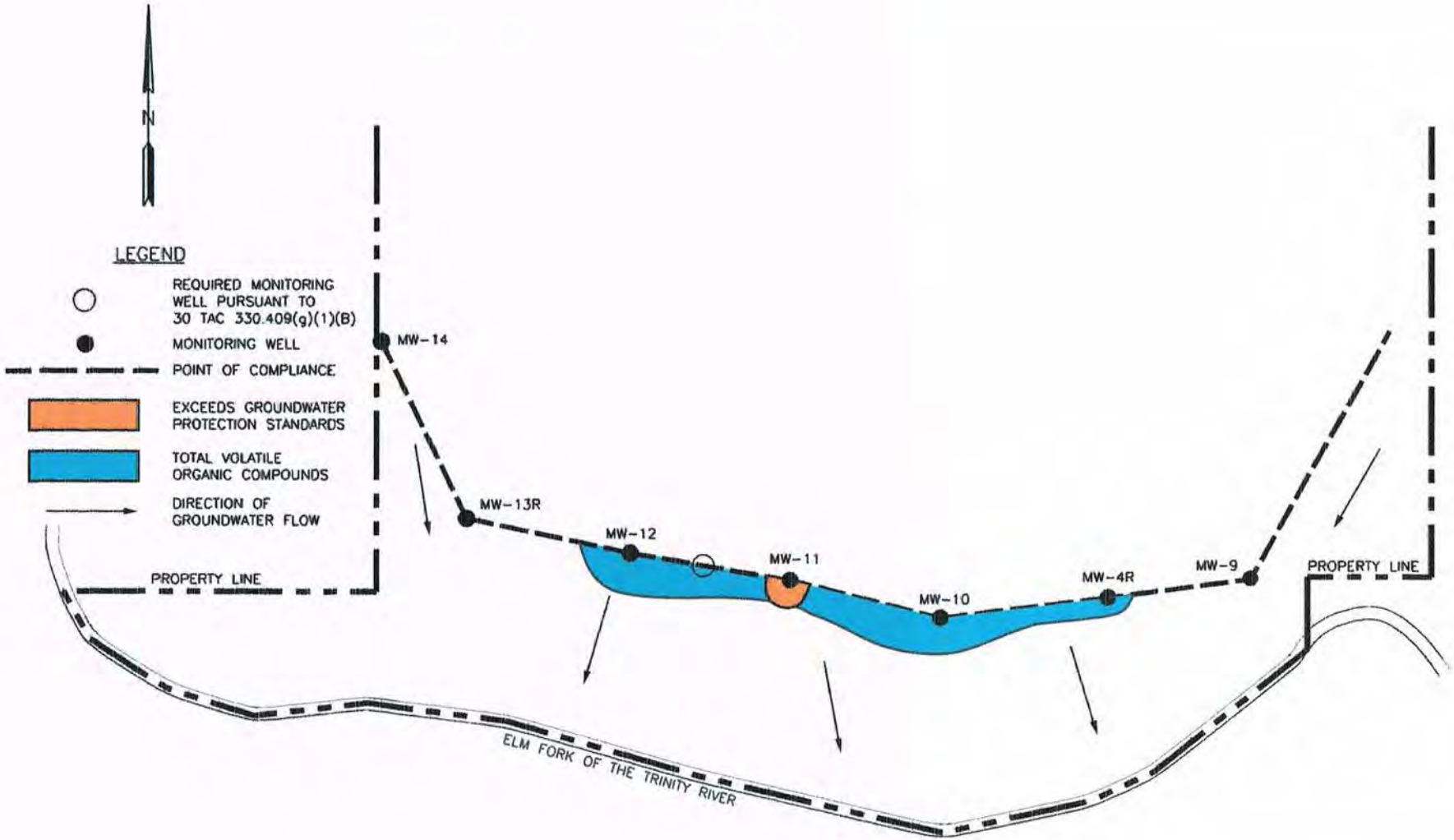
DRAFT - WORK PRODUCT - ATTORNEY PRIVILEGED

CITY OF FARMERS BRANCH
CAMELOT LANDFILL
LEWISVILLE, TEXAS

VOLATILE ORGANIC COMPOUNDS
GROUNDWATER PLUME
DECEMBER 1997

PS Phillips Environmental

DRAWN: GPP	SCALE: 1" = 500' (approx.)	DATE: 09/24/2014
CHECKED: SDP	APPROVED: SDP	FIG. 1



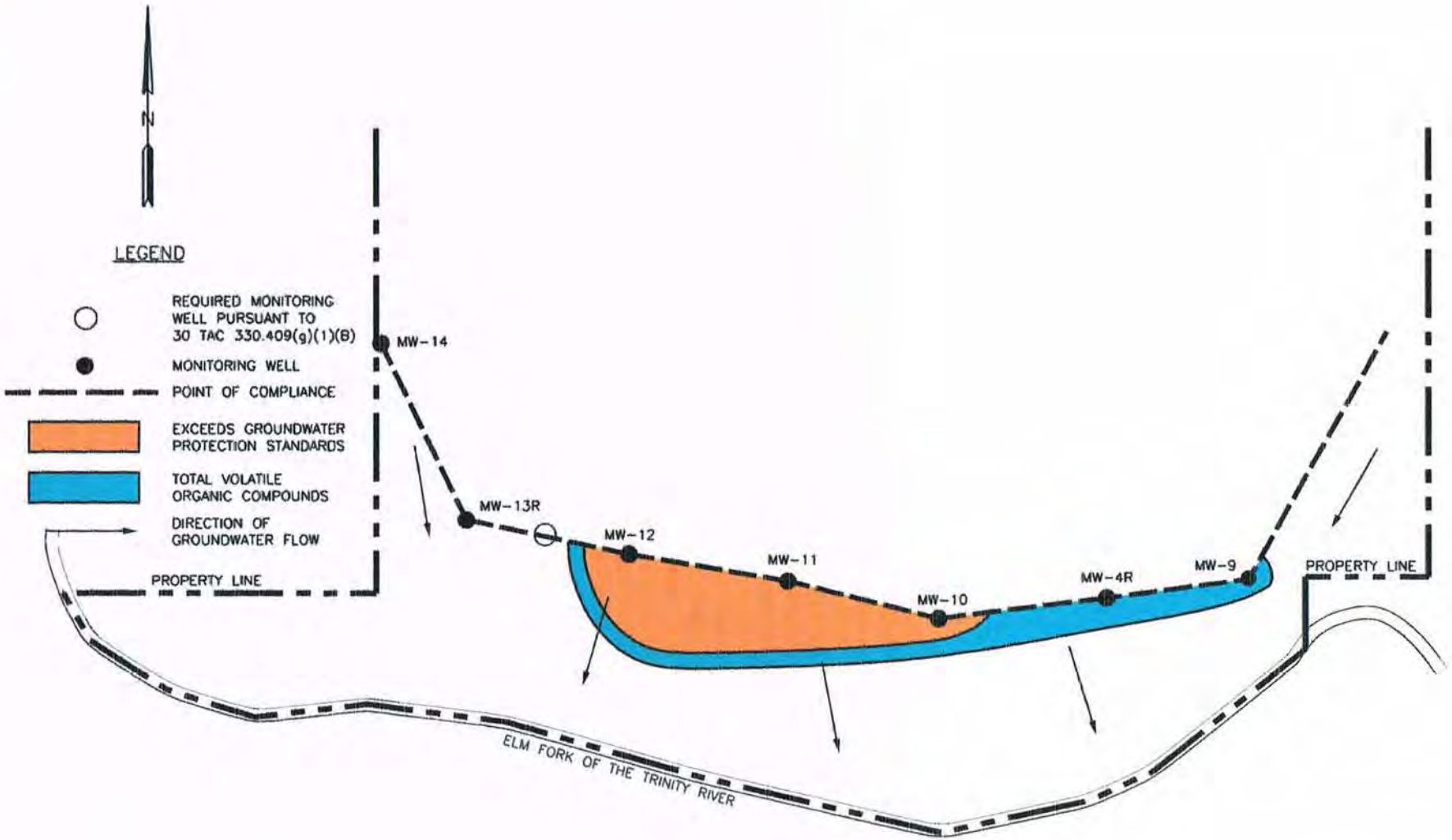
CITY OF FARMERS BRANCH
CAMELOT LANDFILL
LEWISVILLE, TEXAS

VOLATILE ORGANIC COMPOUNDS
GROUNDWATER PLUME
DECEMBER 2000

PS Phillips Environmental

DRAWN: GPP	SCALE: 1" = 500' (approx.)	DATE: 09/24/2014
CHECKED: SDP	APPROVED: SDP	FIG. 2

DRAFT - WORK PROCUCT - ATTORNEY PRIVILEGED



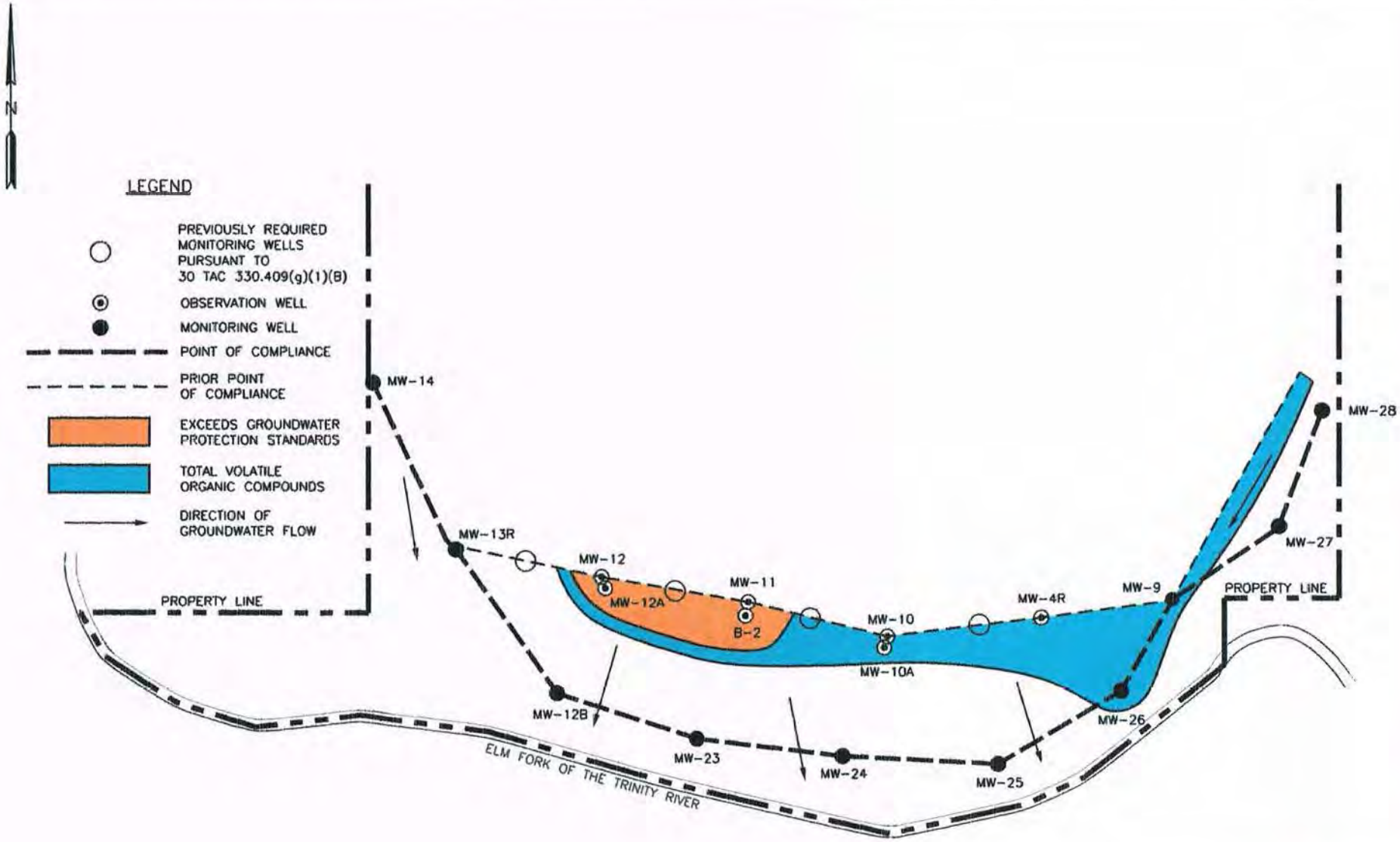
CITY OF FARMERS BRANCH
CAMELOT LANDFILL
LEWISVILLE, TEXAS

VOLATILE ORGANIC COMPOUNDS
GROUNDWATER PLUME
JUNE 2005

PS Phillips Environmental

DRAWN: GPP	SCALE: 1" = 500' (approx.)	DATE: 09/24/2014
CHECKED: SDP	APPROVED: SDP	FIG. 3

DRAFT - WORK PRODUCT - ATTORNEY PRIVILEGED



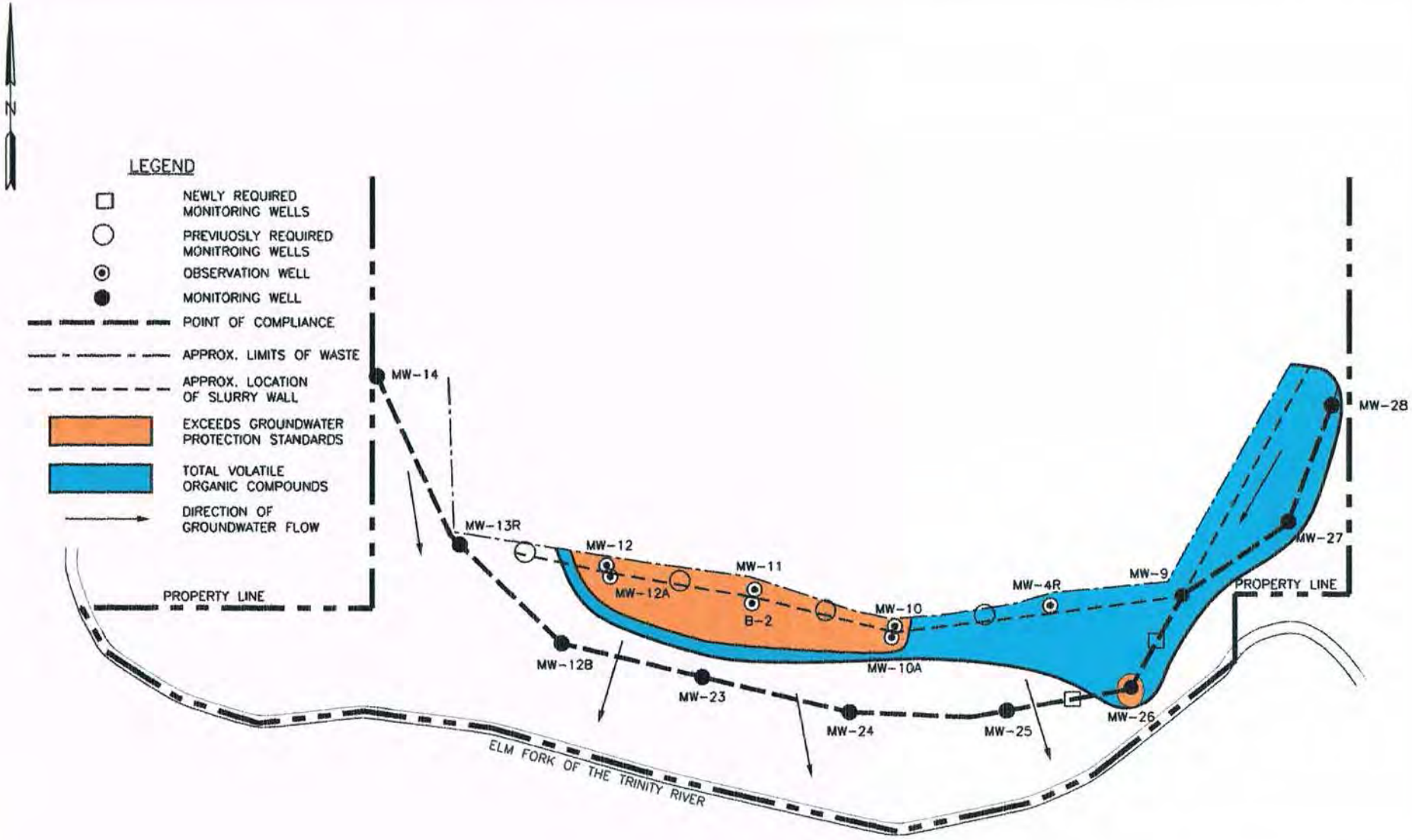
CITY OF FARMERS BRANCH
CAMELOT LANDFILL
LEWISVILLE, TEXAS

VOLATILE ORGANIC COMPOUNDS
GROUNDWATER PLUME
JUNE 2010

PS Phillips Environmental

DRAWN: GPP	SCALE: 1" = 500' (approx.)	DATE: 09/24/2014
CHECKED: SDP	APPROVED: SDP	FIG. 4

DRAFT - WORK PRODUCT - ATTORNEY PRIVILEGED



CITY OF FARMERS BRANCH
CAMELOT LANDFILL
LEWISVILLE, TEXAS

VOLATILE ORGANIC COMPOUNDS
GROUNDWATER PLUME
DECEMBER 2013

PS Phillips Environmental

DRAWN: GPP	SCALE: 1" = 500' (approx.)	DATE: 09/24/2014
CHECKED: SDP	APPROVED: SDP	FIG. 5

DRAFT – WORK PRODUCT– ATTORNEY PRIVILEGED

reed engineering

PROJECT NO. 136.5
SEPTEMBER, 1991

SOIL AND LINER EVALUATION REPORT
CITY OF FARMERS BRANCH
PERMIT NO. 1312-A
DENTON COUNTY, TEXAS

Presented To:
CITY OF FARMERS BRANCH
FARMERS BRANCH, TEXAS

EXHIBIT
App. Ex. 38

GEOTECHNICAL CONSULTANTS

TEXAS DEPARTMENT OF HEALTH
MUNICIPAL SOLID WASTE LANDFILL SITE
SOIL AND LINER EVALUATION REPORT

********** READ THESE INSTRUCTIONS BEFORE COMPLETING THIS FORM ********

This form is to be completed by a registered professional engineer or a professional geologist as further defined in Part G of this questionnaire. Note documentation required.

The purpose of the soil evaluation requirement is to assure that groundwater, as defined in the Texas Department of Health's "Municipal Solid Waste Management Regulations" (MSWMR), is protected from contamination resulting from the land disposal or storage of municipal solid waste. This soil evaluation is required to provide an opportunity for a professional geotechnically trained individual to inspect the trench or area and to document that in situ soils and/or constructed soil liners meet the Department's regulatory requirements prior to filling operations. This evaluation is in addition to soils data obtained to meet permitting requirements. For this reason, prior geotechnical data in itself shall not be considered a substitute for laboratory soils testing necessary to provide proper documentation and subsequent verification of the soil conditions of each trench or disposal area prior to solid waste disposal.

Data and information required in this questionnaire are to provide the basis of the evaluation made by the engineer or geologist. This report is to be supplemented with field test data in the form of soil density reports and depth checks to support the quality control of a constructed soil liner. The amount of quality control testing shall be outlined in the required Soil and Liner Quality Control Plan that has been agreed upon by the permit holder and this Department prior to undertaking the construction of any liner or section of liner.

Attach additional sheets as needed, and on each sheet identify the appropriate Part and Paragraph number for each reference.

****

PART A SITE IDENTIFICATION

Permittee City of Farmers Branch
Permit/Application No. 1312-A Operational Classification Type I - Municipal
County Denton

PART B GENERAL INFORMATION

1. Did you, during the preparation of this report, review the permit issued for this site? Yes Does the permit require liners? Yes

2. Does the engineering data in support of the permit, indicate the need or probable need for a liner or partial liner at any location within this disposal site? Yes If so, what kinds of liners were expected?

X bottom area liners ___ periphery boundary liners
X sidewall liners ___ other (explain) _____

* Sidewall liner addressed by liner reports dated November, 1988 (Rone), May, 1989, and October, 1990, with letters confirming integrity dated September, 1991.

PART C LOCATIONS AND/OR DESCRIPTION OF AREAS CURRENTLY BEING EVALUATED

1. Attach to this report a copy of the original sectorized fill layout plan showing the areas or sectors of the landfill site currently being evaluated and noting areas previously filled. If a copy of the original plan or map is not available or is determined to be inaccurate, then prepare and attach an updated site layout map that identifies the areas already filled, those currently receiving waste material, and the area or areas now being evaluated. The required grid system must be shown on this drawing.

2. On a sketch or drawing of the area or areas actually being evaluated, indicate the following:

   a. Location and pertinent identifying information relating to all soil borings, core samples, observation trenches, and in situ soil tests that were collected or conducted to accomplish this evaluation;

   b. Boundary lines distinguishing the bottom and sidewall areas of the trenches or fill areas being evaluated; and

   c. Location and proper designation of constructed liners.

PART D SOIL EVALUATIONS CONDUCTED DURING CURRENT STUDY

1. Describe concisely on attached sheets the field and laboratory activities performed by yourself and/or your staff to accomplish this evaluation. Please indicate the methods used to determine sampling locations, actual sampling procedures, and analytical methods that were followed. Any assumptions you made in setting up the field and laboratory portions of the current study must also be discussed.
See Attachment 1 for description and Attachments 2 and 3 for plan.

2. Your observations of the disposal excavation trench or area pertaining to this evaluation:

   a. Trench, sector, or area identification or number See Attachments 2 and 3.

   b. Excavation depth 30± ft., length at top of excavation 480 & 650 ft., width at top of excavation 530 & 740 ft., and side slopes 3H : 1V

c. Were any sand lenses noted in evaluated area? None
If so, have they been lined? _____

d. Were any cracks or fissures noted in the evaluated area? Yes
If so, have they been lined? See Attachment 1.

e. The soils tested for this report should be those which in the evaluator's estimation will prove inadequate for groundwater protection in the area under investigation and in addition, all soils in the questionable range as outlined in 325.122 of the Department's MSWMR must be tested.

What percentage of all soils in the evaluated area do these tests represent? 100 %

f. Based on this evaluation or prior soils testing was all, part or none of the evaluated area lined? See Attachment 1.

g. Dates you actually visited site: January 31, 1991, February 1, 1991, March 28, 1991, March 29, 1991, July 22, 24, 30, & 31, 1991, August 1, 2, 5, 8, 21, 26, 1991, and September 3, 1991.
NOTE: On-site visits should be as numerous as necessary to adequately evaluate and test the liner as it is compacted or otherwise constructed.

3. Provide separate summaries below and on the next page for the soil tests listed for both the sidewall areas and bottom areas under evaluation. This may be eliminated if lining is obviously necessary.

IN SITU SIDEWALL AREAS

Test Locations Must Be Noted on the Sketch Required by Part C, Paragraph 2 and are Identified as Follows: _____

Number Done	Tests Conducted on Sidewalls	Range of Values (where appropriate)
_____	Soil Classification (USC)	_____
_____	Fraction Passing No. 200 Sieve (%)	_____
_____	Moisture Content (%)	_____
_____	Liquid Limit (Minus No. 40 Sieve)	_____
_____	Plasticity Index (Minus No. 40 Sieve)	_____
_____	Dry Density	_____
_____	Coef. of Permeability (cm/sec)	_____
	Method Used to Determine Permeability	_____

If present, to what horizontal distance do acceptable soils exist? _____

IN SITU BOTTOM AREAS

Test Locations Must Be Noted on the Sketch Required by Part C, Paragraph 2 and are Identified as Follows: See Attachment 1 for narrative and Attachments 2, 3, and 5 for plan locations.

Number Done	Tests Conducted on Bottom	Range of Values (where appropriate)
25	Soil Classification (USC)	CH
25	Fraction Passing No. 200 Sieve (%)	65 - 93
	Moisture Content (%)	
25	Liquid Limit (Minus No. 40 Sieve)	41 - 77
25	Plasticity Index (Minus No. 40 Sieve)	20 - 52
	Dry Density	
7 Lab + 40 In-Situ	Coef. of Permeability (cm/sec)	1.56E-8 to 9.57E-10 cm/sec
	Method Used to Determine Permeability	See Narrative

If present, to what depth do acceptable soils exist? 200+ feet below the landfill.

NOTE: These soils tests shall follow test procedures as per 325.122 of the Department's MSWMR.

PART E EVALUATION RESULTS

1. STATUS OF IN SITU SOILS

a. Based on tests results of soil samples taken from the sidewalls and/or bottom of the evaluated trench or disposal area, or presence of joints, fractures or bedding, is a constructed liner needed to meet the requirements of the MSWMR? Yes - A partial constructed liner was needed to fill in an existing sump. See Attachment 1 for narrative.

b. If no, what is the basis for your decision relative to both soil quality and depth of acceptable soils? Exposed materials consist of unweathered clay shale of the Eagle Ford Group. There were no open joints or fissures exposed in the bottom. Borings for verification of thickness indicate no change in materials throughout the in-situ liner thickness. The stratum is estimated to be some 200+ feet thick.

2. STATUS OF INSTALLED LINERS

A professional engineer or geologist or a member of his staff qualified by training and experience (see Part G) shall monitor liner construction, but the final evaluation must be made by the aforementioned engineer or geologist with the documented geotechnical experience.

a. Does a Soil and Liner Quality Control Plan exist? Yes

b. Was this plan followed? Yes

c. If not followed, why? _____

d. Was the liner construction completed prior to your final field investigation? Yes

e. Attach all field test and laboratory test data concerning soil liner construction. These data must include liner thickness verifications.

3. PROTECTIVE COVER

Is the protective cover in place on the surface of the constructed liner or evaluated in situ soil? Yes

4. EVALUATION OR LINER BOUNDARY MARKERS

Are these markers in place at the time of this report submittal? Yes

PART F PLANS CONCERNING FUTURE EVALUATIONS

1. On what date do you anticipate the Soil and Liner Evaluation Report for the next trench or area will be submitted? July, 1992

2. Note any expected difference in soils characteristics or site topography (particularly in the area of the site that is to be evaluated next) that might necessitate the use of different procedures and techniques when performing future soil and liner studies and determinations. _____

NOTE: If any changes are anticipated in disposal methods, site development procedures or soil and liner evaluation procedures prior approval is required by the Department's MSWMR before any such procedures or methods are implemented. Appropriate revisions to the Site Development Plan and/or Soil and Liner Quality Control Plan must be submitted for the Department's review.

PART G SIGNATURE OF REGISTERED PROFESSIONAL ENGINEER OR PROFESSIONAL GEOLOGIST

********** NOTE FOR ENGINEER OR GEOLOGIST SIGNING THIS FORM ********** **

The Department's MSWMR (325.122(b)(3)(E)(ii)) require that "All field sampling and testing, both during construction and after completion of lining as well as verification of in situ soils, shall be performed by a registered professional engineer experienced in geotechnical engineering or a geologist having a college degree in geology with no less than four years experience in engineering geology, or under their direct supervision." To assure compliance with disciplinary rule DR 3.1 of the Board Rule of Practice and Procedure promulgated under authority of the Texas Engineering Practice Act and Section 3 of the Code of Ethics of the American Institute of Professional Geologists, the Department requires the engineer or geologist signing this form to verify this education and/or experience by filing with the Bureau of Solid Waste Management (BSWM) a brief resume of his or her education and experience in geotechnical engineering and testing. If the engineer or geologist does not have such a resume on file with the BSWM, it must accompany this evaluation or the evaluation will be considered incomplete.

****

AFFIX SEAL BELOW

9/23/91

STATE OF TEXAS
RONALD F. REED
48174
REGISTERED PROFESSIONAL ENGINEER

(signature)

Ronald F. Reed
(typed or printed name)

Principal Engineer
(title)

REED ENGINEERING GROUP
(firm)

09-23-91
(Date)

2424 Stutz Drive, Suite 400
Dallas, Texas 75235 (214) 350-5600
(address and phone #)

IMPORTANT: 1. Attach narrative required by Paragraph D-1 and any other sections which need additional explanation or discussion.

2. Attach the annotated site map, drawing or sketch which is clearly understandable as required by Part C.

PART II SIGNATURE OF PERMITTEE

I hereby certify that I have read and I fully understand the findings contained in this evaluation report. I further understand, provided this report is accepted by the Texas Department of Health, the use of any trench or area not covered by this document or another such document is a violation of the Texas Department of Health's MSWHR and I will not allow the use of this trench or area until I receive written notification of the acceptance of this document or at least 14 days have elapsed since the Department received this document or other arrangements are made with the BSWM in advance.

Pete Pistole
(signature)

PeTe PisTole
(typed or printed name)

Sanitation Supt.
(title)

City of Farmers Branch
(f etc.)

IMPORTANT: Three signed copies of this form and all attachments (drawings, comments, etc.) must be provided to the Department.

10/9/91
(Date)

PO Box 8190,
Farmers Branch, Texas 75381-9010
(address and phone #)

IN-SITU BOTTOM LINER EVALUATION REPORT
CITY OF FARMERS BRANCH
PERMIT NO. 1312-A
DENTON COUNTY, TEXAS

The Soil and Liner Evaluation Report (SLER) certifies a bottom in-situ and constructed liner section. The approximate area in relationship to the landfill is shown on Attachment 2. The specific area is shown on Attachment 3. The area is approximately 317,000 square feet in plan dimension and is defined approximately by Grid Line A to the south, a line 250 feet north of Grid Line B, Station 19+00 to the east, and 11+62 to the west. The in-situ liner section is approximately 267,000 square feet in plan dimension. The constructed section is approximately 50,000 square feet in plan dimension.

Investigation of the integrity of the in-situ bottom liner section has included 52 depth confirmation borings, 18 soil classification tests, determination of in-situ permeability at 8 locations by use of a two-stage test method developed by Boutwell (reference ASCE, Journal of Geotechnical Engineering, Vol. 115, No. 9, September, 1989, pp. 1205 - 1226) and visual confirmation of the integrity of the liner surface.

Investigation of the constructed portion of the liner included full-time observation and testing of compacted density and moisture, and sampling and testing of soils for liquid and plastic limit determinations, percent passing the number 200 sieve, and permeability.

The evaluation was conducted in phases. The initial phase consisted of borings to confirm liner thickness and obtain samples for laboratory tests. A total of 36 borings were conducted during this phase. The approximate location of the borings are shown on Attachment 3. Each boring was drilled to a minimum depth of four feet and backfilled with bentonite grout at completion.

Samples of the in-situ bottom liner obtained during the drilling process were visually classified and subjected to liquid and plastic determinations, and percent passing the 200 sieve. A total of 18 samples were tested. Test results are summarized on Attachment 4.

Due to the difficulties involved with performing representative laboratory permeability tests, in-situ tests were proposed. The method recommended and agreed on with Texas Department of Health (TDH) consisted of the two-stage bore hole conductivity test developed by Boutwell. The procedure required construction of eight clusters or groups of piezometers labeled G-1 through G-8. Each group consisted of five individual piezometers, Numbers 1 through 5. Piezometers 1 through 4 were constructed to measure

vertical permeability at depths of 1, 2, 3 and 4 feet below top of shale. Piezometer 5 was constructed to evaluate a combination of vertical and horizontal permeability at a depth of one to four feet. The location and designation of the piezometer groups are shown on Attachment 5. The locations were field-surveyed by representatives of the City of Farmers Branch. The top of the shale surface was also surveyed for elevation. Idealized sections of the bottom discharge and side discharged piezometers are shown on Attachment 6.

Piezometers were installed the latter part of July, filled with water and observed through the first week of September. Water level observations and calculated hydraulic conductivity are provided for each group on Attachments 7 through 15. Calculations of the Stage I Hydraulic Conductivity (k_1) and Stage II Conductivity (k_2) were performed for each time interval in accordance with the appropriate Hvorslev equation. Copies of the equations used for k_1 and k_2 are shown on Attachment 15.

Calculation of horizontal and vertical permeability requires determination of a ratio "m". The value of "m" is determined based on ratios of k_2/k_1 and the length-to-diameter (L/D) ratio of the Stage II piezometer. The curve used for the specific L/D ratio (6) was calculated and is shown on Attachment 16. The value of k_1 was obtained by averaging the values of k_1 for the one-foot through four-foot determinations. Horizontal and vertical permeabilities (k_h and k_v) were then calculated by multiplying or dividing k_1 by m. The k_2/k_1 ratio, m, k_h and k_v

values are provided on Attachments 7 through 14, and are summarized on Attachment 17.

At the completion of the final readings, the piezometers were pulled and the holes backfilled with bentonite grout.

A portion of the bottom liner had been excavated along the south side of the subject area as a sump to collect rainfall. Relatively high horizontal permeabilities were obtained in the vicinity of Group G-1. The high permeability was obtained at the four-foot depth. City personnel were directed to excavate the in-situ shale liner in the area of G-1 to a depth of four feet so that visual inspection could be performed. A disturbed bentonite seam was noted at the four-foot depth. The area around G-1 and the sump were excavated to fresh shale, and a bottom liner constructed. The specific area excavated and liner constructed is shown on Attachment 18. The area encompasses approximately 50,000 square feet.

Clay soils were placed in lifts and compacted to a minimum of 95 percent of Standard Proctor (ASTM D-698) at or above optimum moisture. A total of 15 field density tests were performed on the liner (approximately 5 per 12-inch thickness). Three density tests were performed on the liner cover. Test results are summarized on Attachment 19. Copies of the optimum moisture/maximum density curves (Standard Proctor Curves) are shown on Attachments 20 and 21.

The compacted liner thickness was verified at completion by elevation survey from a temporary benchmark (base of piezometer G-4-5).

Seven samples (two from each 12-foot thickness plus one from the soil cover) of the fill soil were obtained by use of a three-inch diameter drive tube and tested for Atterberg Limits and Percent Passing a No. 200 Sieve. Sample numbers correlate to test number locations shown on Attachment 19. Test results are summarized on Attachment 22. The seven samples were also subject to laboratory falling head permeability tests. Test results are summarized on Attachments 23 through 26.

At the completion of testing of the in-situ and compacted liner, the in-situ liner cover (top one foot) was stripped so that the top of the liner could be inspected. The liner was inspected by the writer. The stripped shale was replaced for use as cover.

Based on the in-situ bore hole permeability results, and the testing on the recompacted section, the bottom liner meets or exceeds a permeability of 1.0E-7 cm/sec.

NOTICE

REGARDING DOCUMENT QUALITY

THE QUALITY OF THE FOLLOWING DOCUMENTS IS SUCH THAT ALL OR PORTIONS OF THE MICROFILMED IMAGE MAY BE DIFFICULT TO READ OR ILLEGIBLE.

Microfilming Target
RMD 207 (August 1987)
Replaces form No. 58-8500.008
Texas State Library
State Records Center

Reproduction of this form at the agency level is authorized.

NORTH

September, 1990

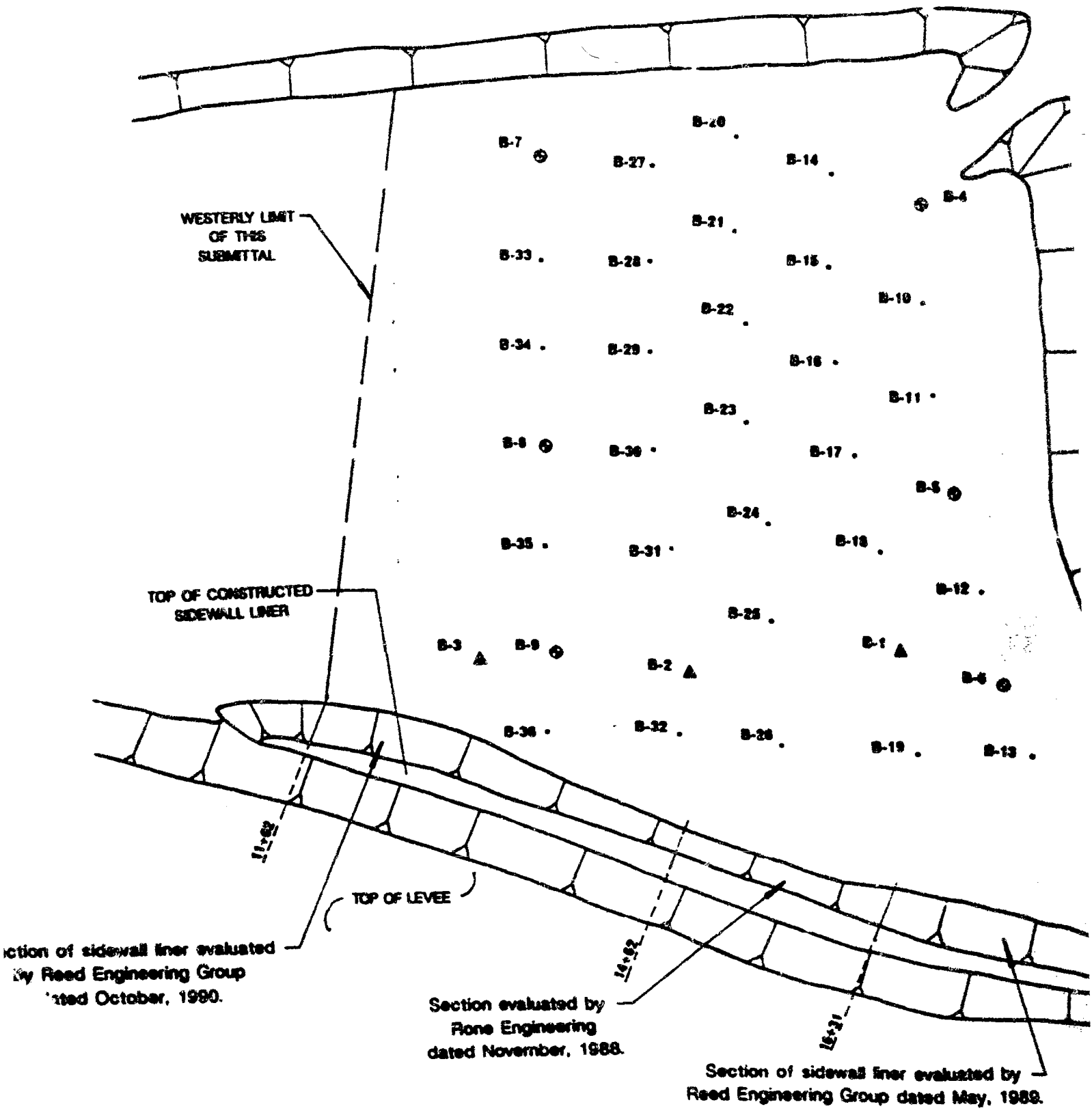
Aerial Photograph

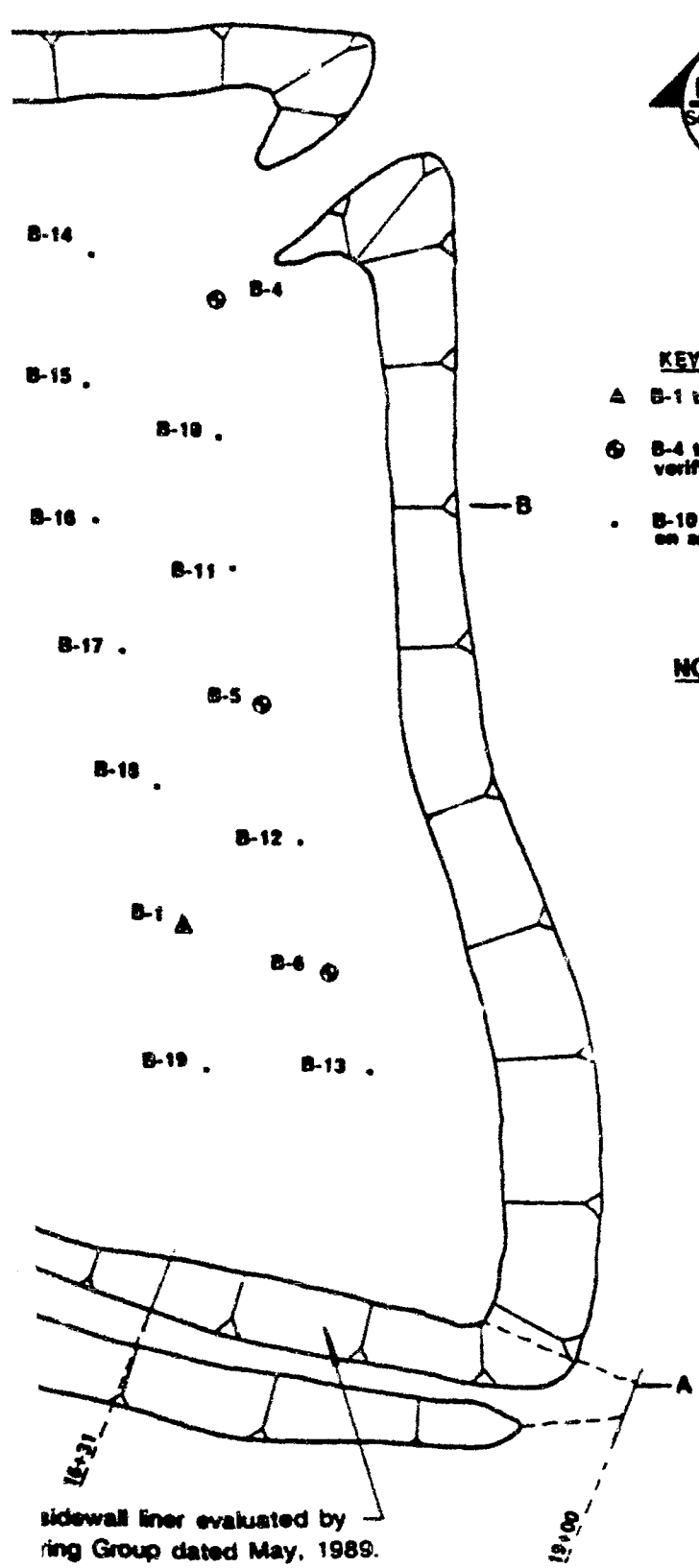
City of Farmers Branch Landfill

Permit 1312-A

Denton County, Texas

Attachment 2


WESTERLY LIMIT OF THIS SUBMITTAL
TOP OF CONSTRUCTED SIDEWALL LINER
TOP OF LEVEE
ction of sidewall liner evaluated
Ky Reed Engineering Group
ated October, 1990.
Section evaluated by
Rone Engineering
dated November, 1988.
Section of sidewall liner evaluated by
Reed Engineering Group dated May, 1989.
B-7
B-27
B-14
B-4
B-21
B-33
B-28
B-15
B-10
B-22
B-34
B-29
B-16
B-11
B-23
B-30
B-17
B-5
B-24
B-35
B-31
B-18
B-12
B-25
B-3
B-9
B-2
B-1
B-6
B-36
B-32
B-26
B-19
B-13



NORTH
Scale: 1"=100'

KEY to BORING SYMBOLS

- ▲ B-1 thru B-3, in situ Permeability & thickness verification
- ⊕ B-4 thru B-9 for sampling & depth verification purposes
- • B-10 thru B-36 for thickness verification on approx. 75' centers

NOTES:

1. Additional borings performed for thickness verification as shown on Attachment 5.
2. Plan based on aerial photograph taken in September 1990.

Area of Subject Bottom L

City of Farmers Branch La

Permit 1312-A

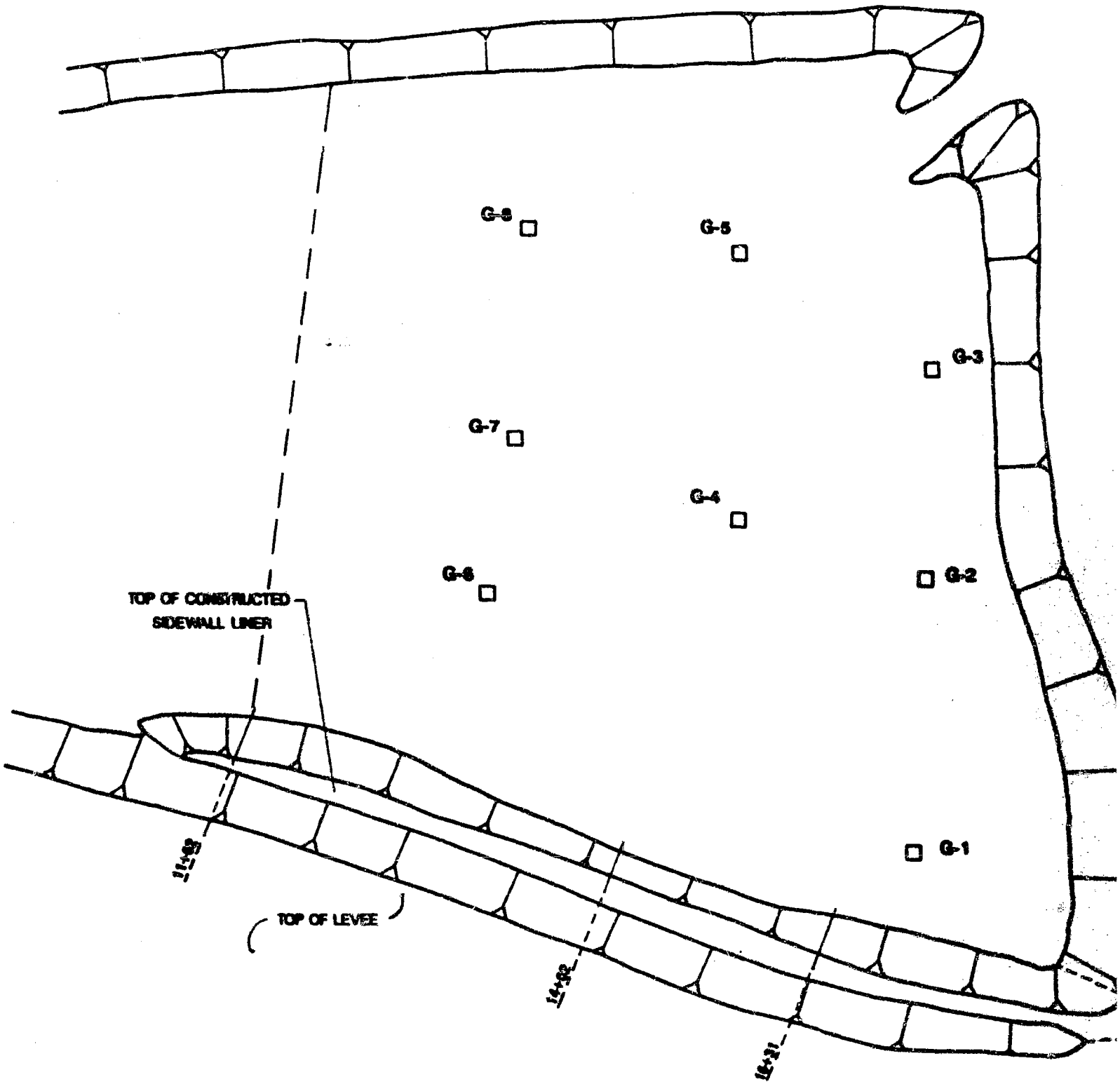
Denton County, Texa

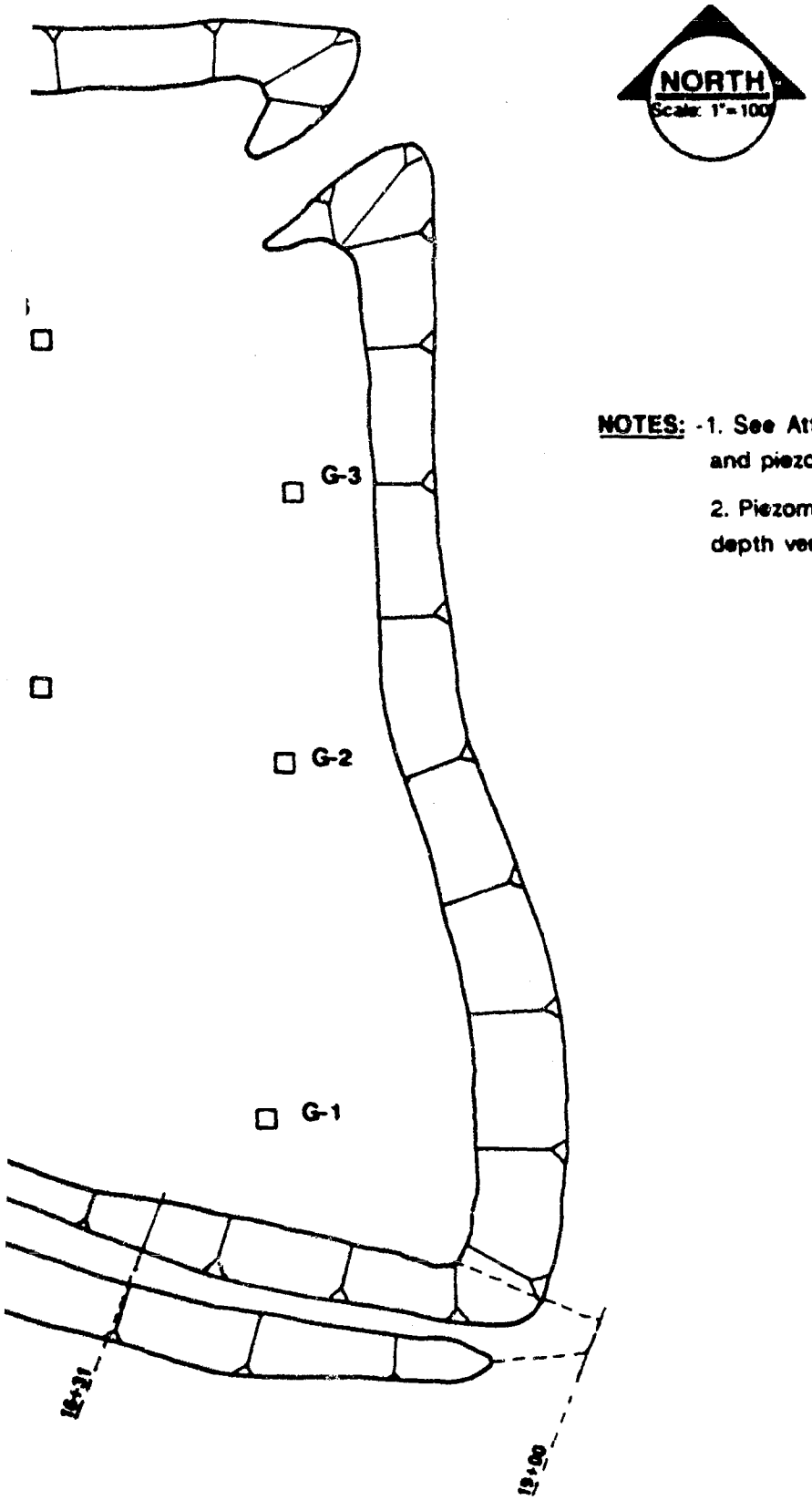
Attachment 3

SOIL AND LINER EVALUATION REPORT
CITY OF FARMERS BRANCH
PERMIT NO. 1312-A
DENTON COUNTY, TEXAS

Summary of Laboratory Data

Boring No.	Depth (feet)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (PI)	Percent Passing No. 200 Sieve
B-1	1.0 - 2.0	48	23	25	89
	2.0 - 3.0	44	21	23	83
	3.0 - 4.0	43	19	24	84
B-2	1.0 - 2.0	42	22	20	65
	2.0 - 3.0	53	25	28	70
	3.0 - 4.0	46	23	23	77
B-3	1.5 - 2.0	44	23	21	76
	2.0 - 3.0	48	23	25	71
	3.0 - 4.0	43	23	20	81
B-4	1.0 - 2.0	46	26	20	71
	2.0 - 3.0	41	21	20	73
	3.0 - 4.0	43	21	22	67
B-5	1.0 - 2.0	48	25	23	68
	2.0 - 3.0	44	24	20	78
	3.0 - 4.0	52	24	28	65
B-6	1.0 - 2.0	55	26	29	65
	2.0 - 3.0	51	25	26	87
	3.0 - 4.0	55	27	28	76


G-8
G-5
G-3
G-7
G-4
G-6
G-2
G-1
TOP OF CONSTRUCTED
SIDEWALL LINER
TOP OF LEVEE



NOTES: -1. See Attachment 6 for layout of individual piezometers and piezometer sections.

2. Piezometers 4 and 5 in each group also serve for depth verification.

Location of Boutw
Piezometer Group

Farmers Branch Lan

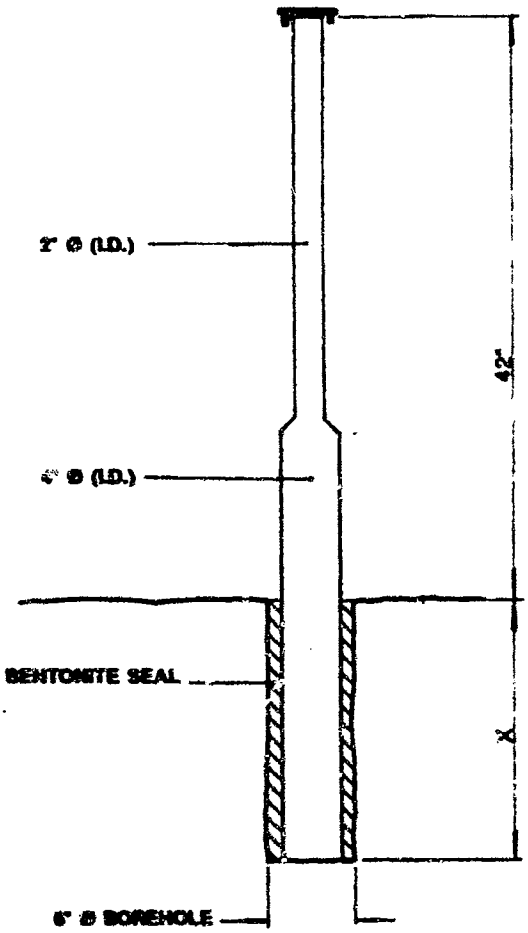
Permit 1312-A

Denton County, Tex

Attachment 5

Typical Section of Piezometers 1 thru 4

Scale: 1"=1'-0"

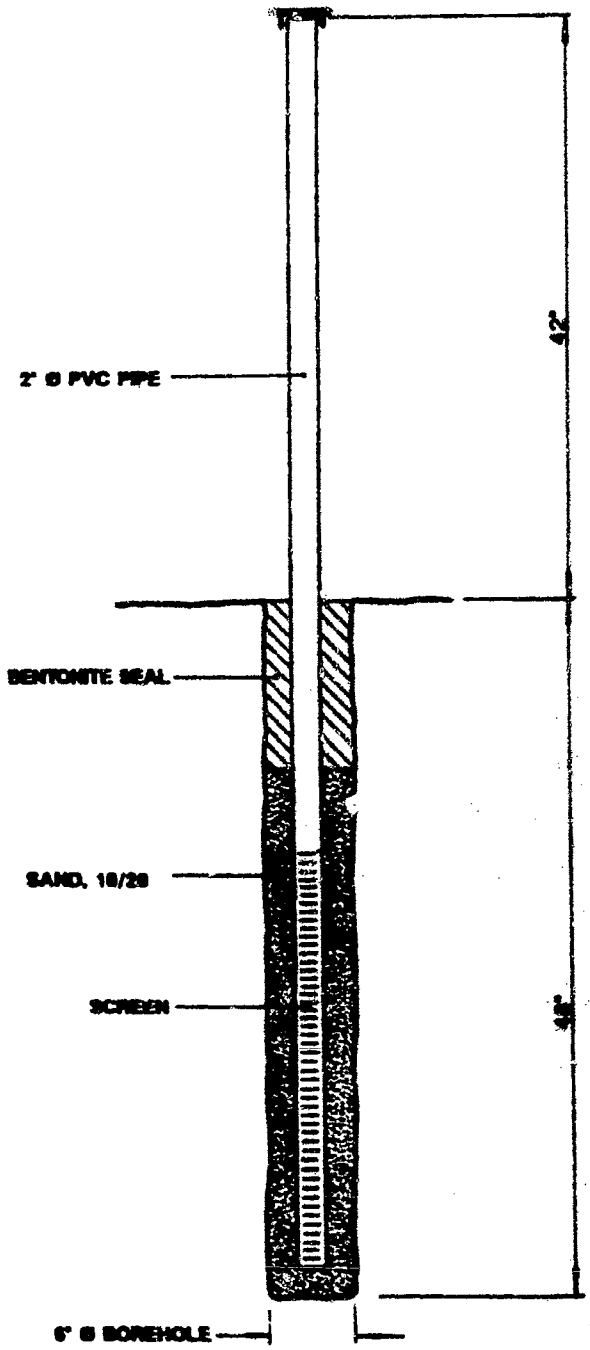


BELOW GRADE DIMENSION

	X (ft)
PIEZ. 1	12"
PIEZ. 2	24"
PIEZ. 3	48"
PIEZ. 4	36"

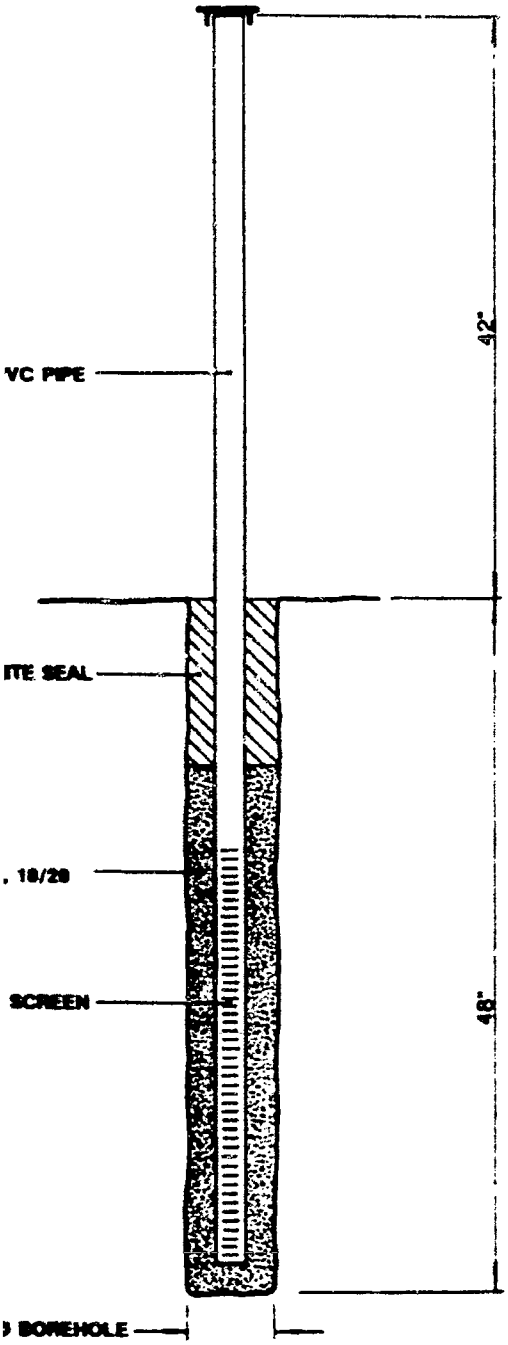
Typical Section of Piezometer 5

Scale: 1"=1'-0"



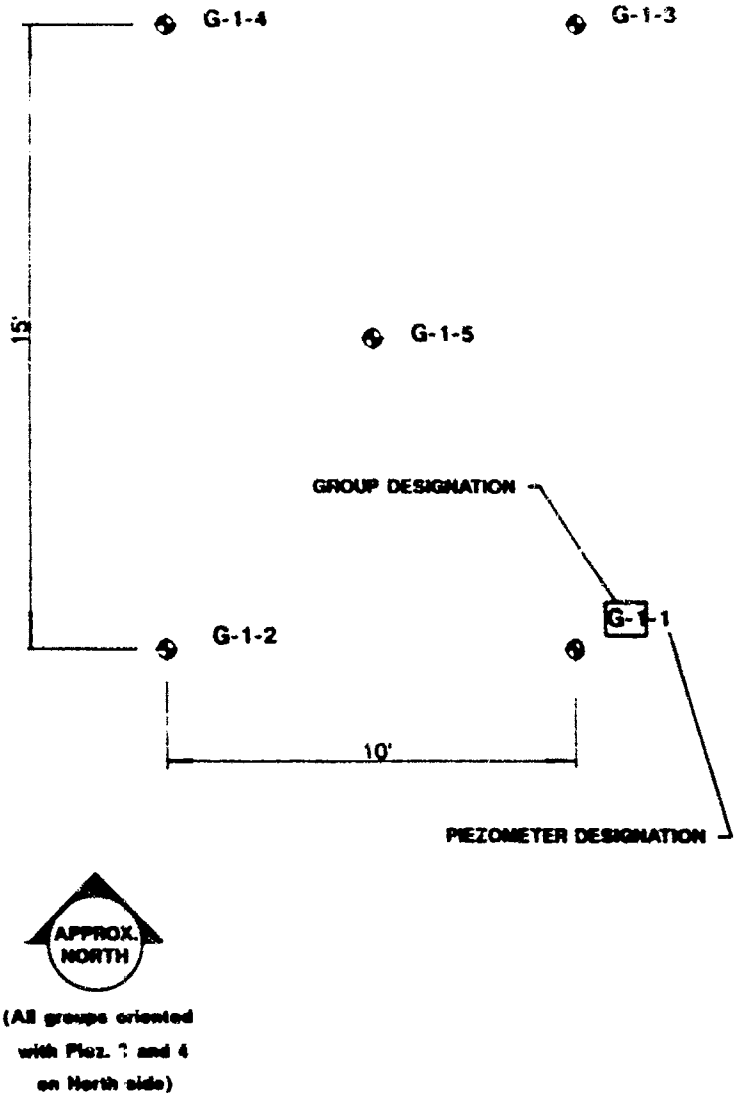
Typical Section of Piezometer 5

Scale: 1"=1'-0"



Typical Piezometer Group

Scale: 1"=4'



Piezometer Details

City of Farmers Branch Landfill

Permit 1312-A

Denton Co., Texas

Attachment 6

Summary of Permeability for Group G – 1

See Attachment 5 for location of Group

City of Farmer's Branch
Camelot Landfill
Permit No. 1312 – A

	G – 1 – 1			G – 1 – 2			G – 1 – 3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30 – Jul	11:31 AM	0.38		11:33 AM	0.31		11:34 AM	0.41	
30 – Jul	12:32 PM	0.53	5.78E – 07	12:34 PM	0.44	3.78E – 07	12:35 PM	0.59	4.15E – 07
31 – Jul	08:50 AM	3.91	6.47E – 07	08:50 AM	2.59	3.32E – 07	08:52 AM	5.91	6.09E – 07
31 – Jul	01:50 PM	4.41	4.04E – 07	01:51 PM	3.00	2.58E – 07	01:52 PM	6.94	4.97E – 07
01 – Aug	09:57 AM	6.72	4.78E – 07	09:58 AM	4.34	2.16E – 07	09:59 AM	11.06	5.10E – 07
02 – Aug	01:48 PM	9.06	3.68E – 07	01:49 PM	5.41	1.2[illegible]E – 07	01:51 PM	15.00	3.70E – 07
	01:48 PM	0.22	REFILL				01:51 PM	0.16	REFILL
05 – Aug	12:32 PM	5.78	3.11E – 07	12:33 PM	6.69	6.09E – 08	12:35 PM	12.25	4.12E – 07
				12:33 PM	0.34	REFILL	12:35 PM	0.16	REFILL

	G – 1 – 4			G – 1 – 5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30 – Jul	11:36 AM	0.34				
30 – Jul	12:36 PM	N.C.	–			
31 – Jul	08:52 AM	0.88	1.12E – 07	08:55 AM	53.00	3.65E – 06
31 – Jul	01:53 PM	0.91	1.63E – 08	01:55 PM	55.50	6.89E – 07
01 – Aug	10:00 AM	1.44	6.93E – 08	10:02 AM	61.38	5.34E – 07
02 – Aug	01:52 PM	1.97	5.03E – 08	01:54 PM	71.75	3.29E – 06
05 – Aug	12:36 PM	3.38	5.32E – 08	12:37 PM	78.13	1.48E – 07

Group Abandoned – Area excavated and liner constructed

NOTE: 1. N.C. indicates no change in reading after last measurement

Attachment 7

Summary of Permeability for Group G-2

See Attachment 5 for location of Group

City of Farmer's Branch
Camelot Landfill
Permit No. 1312-A

G-2-1				G-2-2			G-2-3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30-Jul	11:42 AM	0.25		11:43 AM	0.50		11:44 AM	0.25	
30-Jul	12:47 PM	0.31	2.16E-07	12:48 PM	N.C. (1)	-	12:49 PM	1.34	2.28E-06
31-Jul	08:57 AM	1.13	1.52E-07	08:58 AM	0.94	1.43E-07	08:59 AM	9.[illegible]3	9.80E-07
31-Jul	01:58 PM	1.25	9.51E-08	01:59 PM	0.97	1.93E-08	02:01 PM	15.66	5.17E-07
							02:01 PM	0.22	[illegible]
01-Aug	10:04 AM	1.94	1.32E-07	10:04 AM	1.28	4.83E-08	10:05 AM	8.50	9.73E-07
02-Aug	01:57 PM	2.69	1.05E-07	01:57 PM	1.50	2.45E-08	01:59 PM	14.88	5.88E-07
							01:59 PM	0.22	[illegible]
05-Aug	12:39 PM	4.72	1.15E-07	12:40 PM	2.19	3.05E-08	12:41 PM	17.28	6.01E-07
							12:41 PM	0.22	[illegible]
08-Aug	11:37 AM	6.69	1.16E-07	11:38 AM	2.66	2.09E-08	11:39 AM	15.56	5.32E-07
03-Sep	09:07 AM	17.50	8.41E-08	09:08 AM	7.06	3.34E-08	09:09 AM	26.44	5.12E-08

G-2-4				G-2-5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30-Jul	11:45 AM	0.41		11:46 AM	0.38	
30-Jul	12:49 PM	0.44	7.61E-08	12:50 PM	1.00	3.01E-07
31-Jul	[illegible]:59 AM	0.66	2.82E-08	09:00 AM	6.97	1.06E-07
31-Jul	02:02 PM	0.68	1.23E-08	02:03 PM	8.00	[illegible]3E-08
				02:04 PM	0.34	[illegible]
01-Aug	10:06 AM	0.75	9.10E-09	10:07 AM	5.19	8.53E-08
02-Aug	02:00 PM	0.81	5.85E-09	02:01 PM	10.44	7.16E-08
				02:01 PM	0.25	[illegible]
05-Aug	12:42 PM	1.53	2.67E-08	12:43 PM	12.50	6.47E-08
				12:43 PM	0.22	[illegible]
08-Aug	11:40 AM	2.25	2.68E-08	11:41 AM	11.38	5.81E-08
03-Sep	09:10 AM	7.56	2.36E-08	09:12 AM	60.00	6.36E-08

Piezometer	Elevation at Ground Surface
G-2-1	434.34
G-2-2	434.20
G-2-3	434.46
G-2-4	434.45
G-2-5	434.62

k2/k1	1.4
Coefficient m	1.7
(obtained from Plate 1)	
Horizontal Permeability	7.75E-08 cm/sec
Vertical Permeability	2.68E-08 cm/sec

NOTE: 1. N.C. indicates no change in reading after last measurement

Attachment 8

Summary of Permeability for Group G-3

See Attachment 5 for location of Group

City of Farmer's Branch
Cowboy Landfill
Permit No. 1312-A

G-3-1				G-3-2			G-3-3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30-Jul	11:48 AM	0.25		11:48 AM	0.34		11:49 AM	0.31	
30-Jul	12:51 PM	N.C.(1)	-	12:52 PM	0.38	8.99E-08	12:52 PM	0.34	6.69E-08
31-Jul	09:02 AM	0.72	1.34E-07	09:03 AM	0.56	2.86E-08	09:03 AM	0.91	6.28E-08
31-Jul	02:08 PM	N.C.	-	02:08 PM	0.58	1.06E-08	02:09 PM	0.91	0.00E+00
01-Aug	10:09 AM	1.13	2.12E-07	10:10 AM	0.69	1.65E-08	10:11 AM	1.44	6.02E-08
02-Aug	02:03 PM	1.31	2.57E-08	02:04 PM	0.72	3.46E-09	02:05 PM	1.91	3.83E-08
05-Aug	12:45 PM	2.03	3.91E-08	12:45 PM	1.06	1.51E-08	12:45 PM	3.28	4.49E-08
08-Aug	11:44 AM	2.53	2.74E-08	11:45 AM	1.13	2.73E-09	11:46 AM	4.25	3.19E-08
03-Sep	09:16 AM	38.31	3.85E-07	09:16 AM	4.00	1.47E-08	09:18 AM	10.84	2.59E-08

G-3-4				G-3-5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30-Jul	11:50 AM	0.28		11:51 AM	0.50	
30-Jul	12:53 PM	0.31	7.72E-08	12:54 PM	0.75	8.15E-08
31-Jul	09:04 AM	0.37	7.39E-09	09:05 AM	2.88	3.66E-08
31-Jul	02:10 PM	0.39	1.02E-08	02:10 PM	3.00	8.69E-09
01-Aug	10:11 AM	0.47	1.02E-08	10:12 AM	4.34	2.40E-08
02-Aug	02:06 PM	0.53	5.70E-09	02:06 PM	5.53	1.55E-08
05-Aug	12:46 PM	0.69	5.80E-09	12:47 PM	7.81	1.21E-08
				12:47 PM	0.22	[illegible]
08-Aug	11:47 AM	0.72	1.15E-09	11:48 AM	2.34	1.03E-08
03-Sep	09:19 AM	3.22	1.07E-08	09:21 AM	26.91	1.71E-08

Piezometer	Elevation at Ground Surface
G-3-1	435.72
G-3-2	436.04
G-3-3	436.05
G-3-4	436.20
G-3-5	436.10

k2/k1	0.7
Coefficient m (obtained from Plate 1)	0.5
Horizontal Permeability	7.58E-09 cm/sec
Vertical Permeability	3.29E-08 cm/sec

NOTE: 1. N.C. indicates no change in reading after last measurement

Summary of Permeability for Group G–4

See Attachment 5 for location of Group

City of Farmer's Branch
Camelot Landfill
Permit No. 1312–A

G–4–1				G–4–2			G–4–3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30–Jul	11:58 AM	0.22		11:59 AM	0.34		12:00 PM	0.31	
30–Jul	01:00 PM	0.25	1.13E–07	01:00 PM	N.C.	–	01:01 PM	N.C.	–
31–Jul	09:15 AM	0.69	8.13E–08	09:16 AM	0.59	8.99E–08	09:16 AM	0.63	6.93E–08
31–Jul	02:22 PM	N.C.(1)	–	02:22 PM	0.63	2.19E–08	02:23 PM	0.69	2.87E–08
01–Aug	10:22 AM	1.22	2.30E–07	10:23 AM	0.78	2.33E–08	10:24 AM	0.91	2.44E–08
02–Aug	02:19 PM	1.63	5.57E–08	02:20 PM	0.84	6.91E–09	02:20 PM	1.03	1.01E–08
05–Aug	12:57 PM	2.94	7.24E–08	12:58 PM	1.16	1.37E–08	12:58 PM	1.38	1.10E–08
08–Aug	11:59 AM	4.38	8.10E–08	12:00 PM	1.38	9.59E–09	12:01 PM	1.44	2.00E–09
03–Sep	09:36 AM	13.81	6.84E–08	09:36 AM	5.06	1.90E–08	09:37 AM	5.06	1.35E–08

G–4–4				G–4–5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30–Jul	12:00 PM	0.28		12:01 PM	0.47	
30–Jul	01:02 PM	N.C.	–	01:03 PM	0.78	03E–07
31–Jul	09:17 AM	0.50	6.40E–08	09:18 AM	5.41	8.10E–08
31–Jul	02:23 PM	0.58	4.08E–08	02:24 PM	6.44	7.47E–08
01–Aug	10:24 AM	0.88	3.84E–08	10:26 AM	10.19	7.18E–08
02–Aug	02:21 PM	1.13	2.34E–08	02:22 PM	14.31	6.04E–08
				02:22 PM	0.16	refill
05–Aug	12:58 PM	2.00	3.27E–08	12:59 PM	11.28	5.82E–08
				01:00 PM	0.25	refill
08–Aug	12:02 PM	2.72	2.69E–08	12:03 PM	10.91	5.53E–08
03–Sep	09:38 AM	8.16	2.43E–08	09:40 AM	60.25	6.48E–08

Piezometer	Elevation at Ground Surface
G–4–1	435.02
G–4–2	434.95
G–4–3	435.23
G–4–4	435.21
G–4–5	435.00

k2/k1	2.1
Coefficient m (obtained from Plate 1)	3.0
Horizontal Permeability	9.24E–08 cm/sec
Vertical Permeability	1.06E–08 cm/sec

NOTE. 1. N.C. indicates no change in reading after last measurement

Attachment 10

Summary of Permeability for Group G – 5

See Attachment 5 for location of Group

City of Farmer's Branch
Camelot Landfill
Permit No. 1312-A

	G-5-1			G-5-2			G-5-3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30-Jul	12:03 PM	0.63		12:04 PM	0.31		12:05 PM	0.47	
30-Jul	01:05 PM	2.91	8.52E-06	01:05 PM	N.C.(1)	-	01:06 PM	N.C.	-
31-Jul	09:22 AM	20.44	4.18E-06	09:23 AM	0.47	7.08E-08	09:24 AM	0.75	8.31E-08
31-Jul	02:28 PM	27.94	3.06E-06	02:30 PM	0.49	1.28E-08	02:30 PM	0.79	1.77E-08
	02:29 PM	0.34	[illegible]						
01-Aug	10:30 AM	14.41	3.06E-06	10:30 AM	0.59	1.60E-08	10:31 AM	0.91	1.31E-08
02-Aug	02:27 PM	24.69	2.17E-06	02:29 PM	0.63	3.99E-09	02:30 PM	0.97	5.05E-09
	02:28 PM	0.31	[illegible]						
05-Aug	01:02 PM	26.06	1.87E-06	01:03 PM	0.84	9.35E-09	01:04 PM	1.41	1.41E-08
	01:03 PM	0.25	[illegible]						
08-Aug	12:07 PM	23.19	1.58E-06	12:08 PM	0.91	2.72E-09	12:09 PM	1.69	9.01E-09
03-Sep	09:44 AM	46.56	4.61E-07	09:45 AM	4.22	1.69E-08	09:46 AM	5.13	1.29E-08

	G-5-4			G-5-5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30-Jul	12:05 PM	0.31		12:06 PM	0.34	
30-Jul	01:06 PM	N.C.	-	01:07 PM	N.C.	-
31-Jul	09:25 AM	0.44	5.58E-08	09:26 AM	1.38	2.32E-08
31-Jul	02:31 PM	0.45	6.37E-09	02:32 PM	N.C.	-
01-Aug	10:32 AM	0.47	2.43E-09	10:33 AM	2.16	3.71E-08
02-Aug	02:30 PM	0.52	4.76E-09	02:31 PM	2.75	7.45E-09
05-Aug	01:06 PM	0.66	5.03E-09	01:05 PM	4.09	6.78E-09
08-Aug	12:10 PM	0.75	3.44E-09	12:11 PM	5.19	5.58E-09
03-Sep	09:47 AM	2.81	8.77E-09	09:48 AM	14.25	5.73E-09

Piezometer	Elevation at Ground Surface
G-5-1	436.70
G-5-2	436.73
G-5-3	436.95
G-5-4	437.00
G-5-5	436.92

k2/k1	0.4
Coefficient m (obtained from Plate 1)	0.1
Horizontal Permeability	1.67E-09 cm/sec
Vertical Permeability	9.89E-08 cm/sec

NOTE: 1. N.C. indicates no change in reading after last measurement

Summary of Permeability for Group G-6

See Attachment 5 for location of Group

City of Farmer's Branch
Camelot Landfill
Permit No.1312-A

G-6-1				G-6-2			G-6-3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30-Jul	12:08 PM	0.44		12:09 PM	0.38		12:10 PM	0.44	
30-Jul	01:13 PM	N.C.(1)	-	01:14 PM	N.C.	-	01:14 PM	0.47	6.59E-08
31-Jul	09:28 AM	0.72	1.33E-07	09:29 AM	0.69	1.04E-07	09:29 AM	0.66	2.09E-08
31-Jul	02:35 PM	0.77	3.79E-08	02:35 PM	0.73	2.57E-08	02:36 PM	0.69	1.49E-08
01-Aug	10:35 AM	0.97	3.77E-08	10:36 AM	0.88	2.24E-08	10:36 AM	0.81	1.38E-08
02-Aug	02:33 PM	1.09	1.70E-08	02:33 PM	0.94	6.92E-09	02:34 PM	0.84	2.53E-09
05-Aug	01:07 PM	1.72	3.39E-09	01:07 PM	1.19	1.10E-08	01:08 PM	1.00	5.81E-09
08-Aug	12:15 PM	2.13	2.21E-08	12:16 PM	N.C.	-	12:17 PM	1.21	6.69E-09

G-6-4				G-6-5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30-Jul	12:10 PM	0.41		12:11 PM	0.50	
30-Jul	01:15 PM	N.C.	-	01:16 PM	2.00	4.78E-07
31-Jul	09:30 AM	0.44	5.60E-08	09:31 AM	14.50	2.37E-07
31-Jul	02:36 PM	N.C.	-	02:38 PM	16.69	1.85E-07
				02:39 PM	0.16	[illegible]
01-Aug	10:37 AM	0.45	5.82E-08	10:38 AM	9.78	1.76E-07
02-Aug	02:34 PM	0.47	1.86E-09	02:36 PM	17.75	1.20E-07
				02:36 PM	0.06	[illegible]
05-Aug	01:08 PM	0.50	1.11E-09	01:09 PM	18.00	9.91E-08
				01:09 PM	0.28	[illegible]
08-Aug	12:18 PM	0.56	1.46E-09	12:19 PM	16.25	8.641-08

Piezometer	Elevation at Ground Surface
G-6-1	434.20
G-6-2	434.02
G-6-3	434.32
G-6-4	434.20
G-6-5	434.15

k2/k1	8.4
Coefficient m	18.0
(obtained from Plate 1)	
Horizontal Permeability	1.86E-07 cm/sec
Vertical Permeability	5.73E-10 cm/sec

NOTE: 1. N.C. indicates no change in reading after last measurement

Summary of Permeability for Group G-7

See Attachment 5 for location of Group

City of Farmer's Branch
Camelot Landfill
Permit No. 1312-A

G-7-1				G-7-2			G-7-3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30-Jul	12:12 PM	0.34		12:13 PM	0.53		12:13 PM	0.44	
30-Jul	01:17 PM	0.38	1.08E-07	01:18 PM	1.88	3.86E-06	01:18 PM	N.C.(1)	-
31-Jul	09:33 AM	0.54	3.48E-08	09:35 AM	19.94	3.29E-06	09:36 AM	0.59	6.57E-08
31-Jul	02:42 PM	0.59	2.01E-08	02:43 PM	23.13	2.81E-06	02:45 PM	0.62	1.15E-08
				02:44 PM	0.25	[illegible]			
01-Aug	10:39 AM	0.69	1.85E-08	10:41 AM	17.88	3.15E-06	10:42 AM	0.72	3.12E-08
02-Aug	02:38 PM	0.78	1.27E-08	02:40 PM	29.56	2.80E-06	02:42 PM	0.75	2.52E-09
				02:41 PM	0.19	[illegible]			
05-Aug	01:11 PM	1.00	1.18E-08	01:12 PM	30.19	1.74E-06	01:14 PM	1.00	8.01E-09
				01:12 PM	0.22	[illegible]			
08-Aug	12:22 PM	1.31	1.67E-08	12:23 PM	29.78	1.69E-06	12:24 PM	1.03	9.94E-10
03-Sep	09:50 AM	3.44	1.33E-08	10:01 AM	30.28	5.67E-08	10:01 AM	2.63	5.86E-09

G-7-4				G-7-5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30-Jul	12:14 PM	0.44		12:15 PM	0.59	
30-Jul	01:19 PM	N.C.	-	01:20 PM	1.06	1.48E-07
31-Jul	09:36 AM	0.56	7.19E-08	09:38 AM	7.75	1.19E-07
31-Jul	02:46 PM	0.58	8.81E-09	02:47 PM	9.00	9.52E-08
				02:47 PM	0.25	[illegible]
01-Aug	10:42 AM	0.66	9.96E-09	10:43 AM	6.00	1.02E-07
02-Aug	02:42 PM	0.74	7.80E-09	02:43 PM	12.16	8.54E-08
				02:44 PM	0.22	[illegible]
05-Aug	01:14 PM	0.94	7.31E-09	01:15 PM	14.75	7.83E-08
				01:15 PM	0.31	[illegible]
08-Aug	12:25 PM	1.00	2.30E-09	12:26 PM	13.59	7.03E-08
03-Sep	10:02 AM	2.50	6.30E-09	10:03 AM	45.81	3.15E-08

Piezometer	Elevation at Ground Surface
G-7-1	435.52
G-7-2	435.37
G-7-3	435.61
G-7-4	435.50
G-7-5	435.50

k2/k1	1.2
Coefficient m	1.2
(obtained from Plate 1)	
Horizontal Permeability	3.37E-08 cm/sec
Vertical Permeability	2.34E-08 cm/sec

NOTE: 1. N.C. indicates no change in reading after last measurement

Summary of Permeability for Group G-8

See Attachment 5 for location of Group

City of Farmer's Branch
Camelot Landfill
Permit No. 1312-A

G-8-1				G-8-2			G-8-3		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k1 (cm/sec)
30-Jul	12:16 PM	0.19		12:17 PM	0.34		12:18 PM	0.34	
30-Jul	01:21 PM	0.25	2.16E-07	01:22 PM	N.C.(1)	-	01:22 PM	0.41	1.32E-07
31-Jul	09:40 AM	0.53	6.94E-08	09:40 AM	0.53	8.02E-08	09:41 AM	1.06	7.29E-08
31-Jul	02:50 PM	0.69	4.75E-08	02:50 PM	0.56	1.71E-08	02:51 PM	1.09	1.37E-08
01-Aug	10:45 AM	0.94	4.71E-08	10:46 AM	0.69	1.97E-08	10:47 AM	1.78	7.85E-08
02-Aug	02:46 PM	1.06	1.70E-08	02:46 PM	0.78	1.03E-08	02:47 PM	2.47	5.63E-08
05-Aug	01:16 PM	1.69	3.39E-08	01:17 PM	1.16	1.65E-08	01:18 PM	4.00	5.04E-08
08-Aug	12:28 PM	2.06	2.04E-08	12:29 PM	1.34	8.20E-09	12:30 PM	5.34	4.46E-08
03-Sep	10:06 AM	6.56	2.94E-08	10:07 AM	3.44	1.07E-08	10:08 AM	9.09	1.47E-08

G-8-4				G-8-5		
DATE	TIME	HEIGHT (inches)	k1 (cm/sec)	TIME	HEIGHT (inches)	k2 (cm/sec)
30-Jul	12:19 PM	0.53		12:20 PM	0.50	
30-Jul	01:23 PM	N.C.	-	01:23 PM	0.66	5.09E-08
31-Jul	09:42 AM	0.69	8.70E-08	09:43 AM	2.31	2.82E-08
31-Jul	02:52 PM	0.71	1.14E-08	02:52 PM	2.41	6.30E-09
01-Aug	10:47 AM	0.81	1.34E-08	10:48 AM	3.64	1.83E-08
02-Aug	02:47 PM	0.91	8.75E-09	02:48 PM	4.19	9.59E-09
05-Aug	01:18 PM	1.34	1.63E-08	01:19 PM	5.88	8.73E-09
08-Aug	12:31 PM	1.63	1.04E-08	12:32 PM	7.00	5.88E-09
03-Sep	10:09 AM	4.78	1.37E-08	10:10 AM	23.50	1.15E-08

Parameter	Elevation at Ground Surface
G-8-1	436.50
G-8-2	436.50
G-8-3	435.90
G-8-4	436.90
G-8-5	436.71

k2/k1	0.7
Coefficient m (obtained from Plate 1)	0.5
Horizontal Permeability	8.21E-09 cm/sec
Vertical Permeability	3.56E-08 cm/sec

NOTE: 1 N.C. indicates no change in reading after last measurement

SOIL AND LINER EVALUATION REPORT
CITY OF FARMERS BRANCH
PERMIT NO. 1312-A
DENTON COUNTY, TEXAS
(continued)

$k_1 = \pi d^2/(11D\ \Delta t)*\ln(H_1/H_2)$

where:

d = diameter of pipe at opening = 5.08 cm

D = diameter of pipe at ground level = 10.16 cm

Δt = change in time between readings

H_2 = height of water above bottom of casing at time of second reading

H_1 = height of water above bottom of casing at time of first reading

$k_2 = A/B*\ln(H_1/H_2)$

where:

$A = d^2\{\ln[L/D + \sqrt{1+(L/D)^2}]\}$

$B = 8D(L/D)\ \Delta t\{1-0.562\exp[-1.57(L/D)]\}$

where:

L = depth of boring below casing = 91.44 cm

D = diameter of boring = 15.24 cm

Reference: Daniel, David E. (1989), "In Situ Hydraulic Conductivity Tests for Compacted Clay." J. Geotech. Engrg., ASCE, 115(9), 1205-1226.

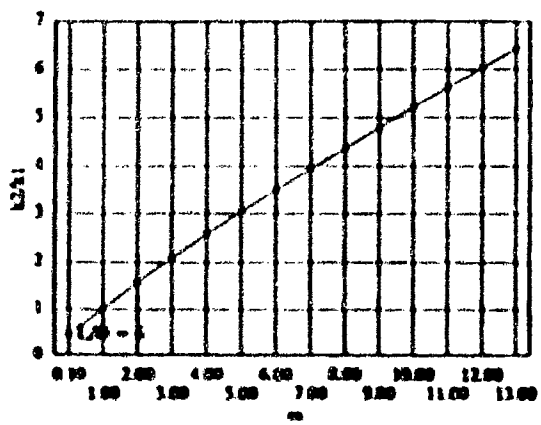
SOIL AND LINER EVALUATION REPORT
CITY OF FARMERS BRANCH
PERMIT NO. 1312-A
DENTON COUNTY, TEXAS

Calculation of Permeability

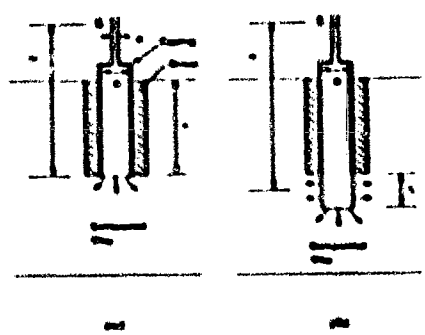
$k_h = m*k_1$

$k_v = (1/m)*k_1$

where: $m = f(k_1, k_2)$, taken from FIGURE 1



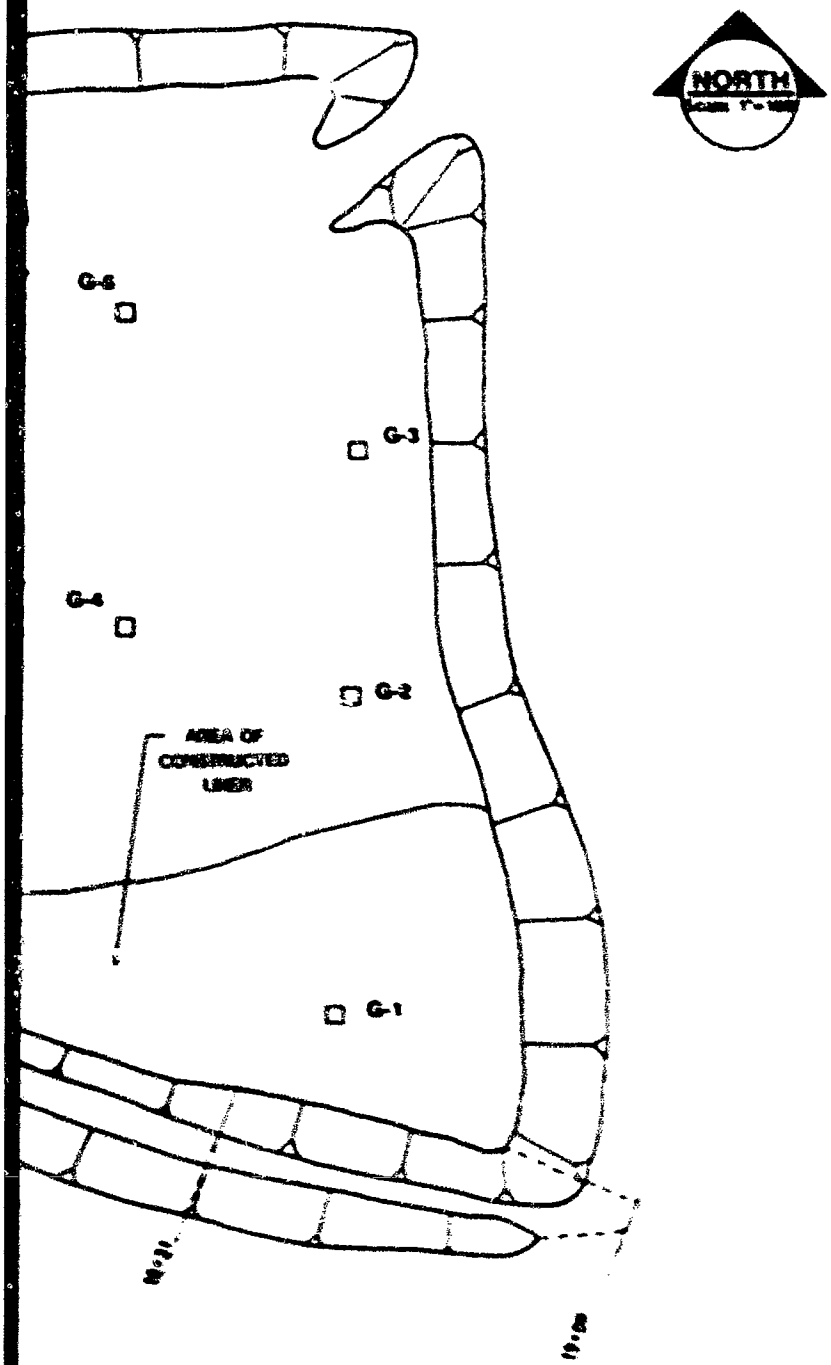
Configuration of test shown in FIGURE 2.



SUMMARY OF FINAL PERMEABILITIES

Group No.	Average k1	k2	k2/k1	m	Vertical Permeability	Horizontal Permeability
G-2	4.56E-08	6.36E-08	1.40	1.70	2.68E-08	7.75E-08
G-3	1.58E-08	1.03E-08	0.65	0.48	3.29E-08	7.58E-09
G-4	3.13E-08	6.48E-08	2.07	2.95	1.06E-08	9.24E-08
G-5	1.29E-08	5.73E-09	0.45	0.13	9.89E-08	1.67E-09
G-6	1.03E-08	8.64E-08	8.38	18.00	5.73E-10	1.86E-07
G-7	2.81E-08	3.15E-08	1.12	1.20	2.34E-08	3.37E-08
G-8	1.71E-08	1.15E-08	0.67	0.48	3.56E-08	8.21E-09

G-8
G-5
G-2
G-7
G-4
G-6
G-3
TOP OF CONSTRUCTED SIDEWALL LINER
AREA OF CONSTRUCTED LINER
G-1
TOP OF LEVEE



Area of Constructed Liner

Farmers Branch Landfill

Permit 1312-A

Denton County, Texas

Attachment 18

SOIL AND LINER EVALUATION REPORT
PERMIT NO. 1312-A
DENTON COUNTY, TEXAS

Summary of In-Place Density Tests

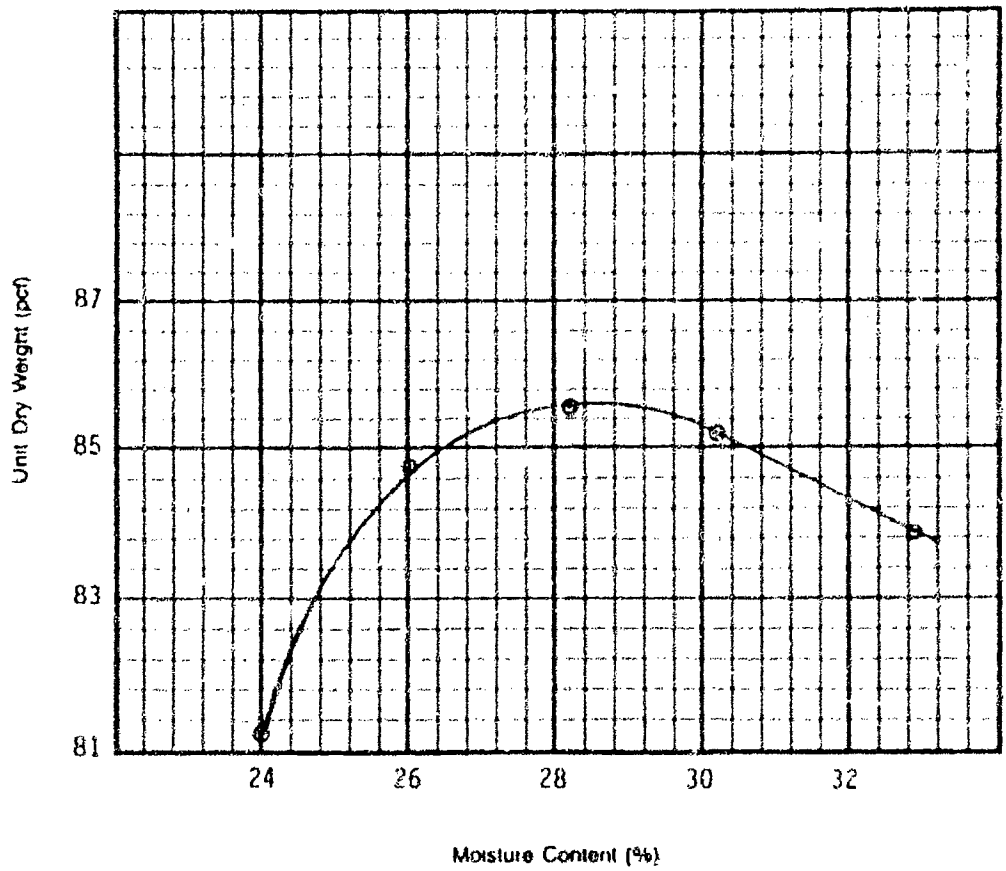
Date	Test No.	Location(1)	Lift No.(2)	Depth (feet)(2)	In-Situ Density (pcf)	In-Situ Moisture (%)	Curve No.	Percent Compaction
08-21-91	1	85'N,150'W	1	3.8	89.0	31.9	1/2	97.6
	2	85'N,375'W	1	3.8	91.2	30.1	1/2	100.0
	3	80'N,200'W	2	3.6	92.3	27.4	2	95.4
	4	80'N,400'W	2	3.3	87.2	32.8	1/2	95.9
	5	90'N,195'W	2	3.0	94.5	28.4	2	97.6
	6	90'N,350'W	3	2.5	96.0	24.8	2	99.2
08-22-91	7	90'N,260'W	3	2.5	84.1	29.1	1	98.3
	8	80'N,100'W	4	2.5	83.8	28.8	1	97.9
	9	80'N,370'W	4	2.0	95.0	27.7	2	98.1
08-23-91	10	80'N,320'W	4	2.0	95.2	26.4	2	98.3
	11	150'N,200'W	5	1.4	87.7	30.9	1/2	96.5
	12	80'N, 80'W	5	1.3	93.1	29.5	2	96.2
	13	80'N,360'W	5	1.5	92.0	28.9	2	95.0
08-26-91	14	20'N,370'W	6	1.0	93.0	30.1	2	96.1
	15	20'N,175'W	6	1.0	92.9	29.0	2	96.0
	16	90'N,250'W	6	0.0	94.2	29.3	2	97.1
	17	30'N,125'W	7	0.0	90.9	31.6	1/2	100.0
	18	30'N,385'W	7	0.0	89.1	32.0	1/2	98.0

Footnotes:

(1) All measurements relative to A-18+00, southwest corner of the excavation.

(2) Lift numbers and depth to surface tested obtained by elevation survey from known point.

(3) Three-inch diameter push tube samples taken at Test Location Numbers 2, 4, 7, 10, 13, 16 and 18. Liquid and Plastic Limit determinations and Percent Passing 200 Sieve shown on Attachment 22.



Standard Proctor Compaction Test No. 1

25 blows per each of 3 layers, with 5.5 pound hammer

and 12 inch drop using 4 inch diameter mold

Test performed on minus #4 sieve size material

Boring No. — Location Camelot Landfill

Hebron, Texas

Depth · Sample No.

Classification Dark brown and very dark gray clay (CH)

Liquid Limit 78 %

Plastic Limit 27 %

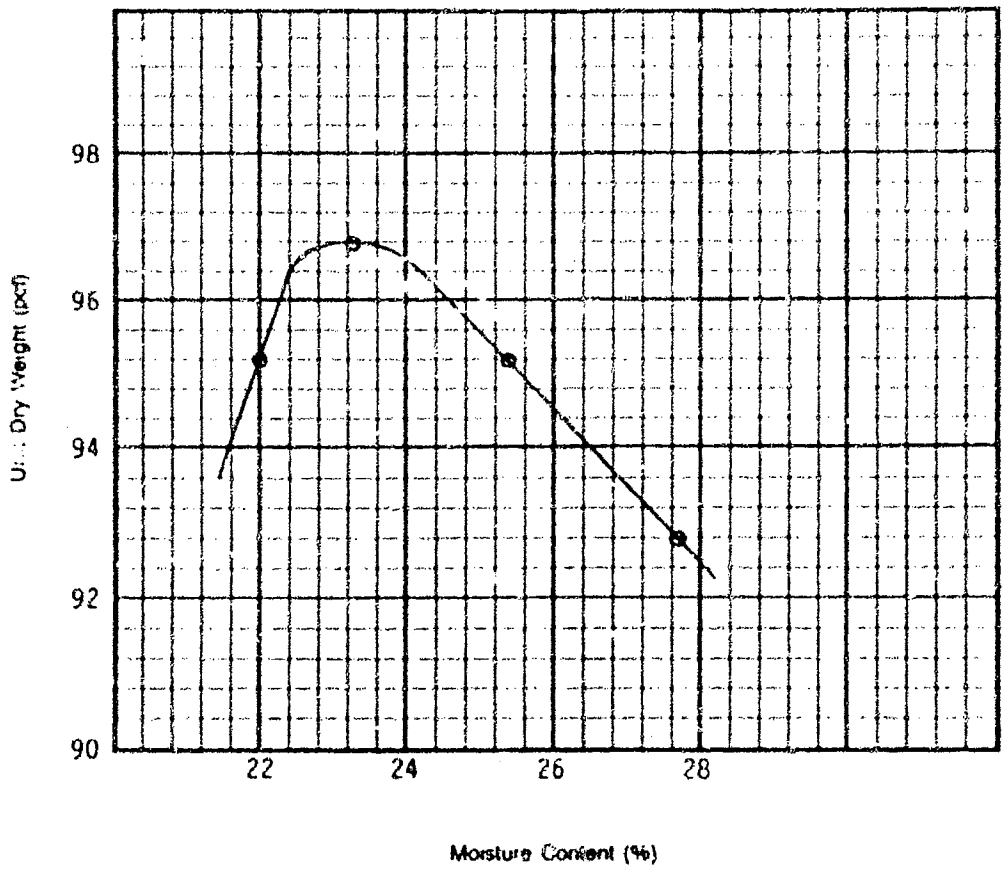
Plasticity Index 51

Maximum Unit Dry Weight 85.6 pcf

Optimum Moisture Content 28.2 %

OPTIMUM MOISTURE DENSITY CURVE

Attachment 20



Standard Proctor Compaction Test No. 2

25 blows per each of 3 layers, with 5.5 pound hammer

and 12 inch drop using 4 inch diameter mold

Test performed on minus #4 sieve size material

Boring No. — Location Camelot Landfill

Hebron, Texas

Depth - Sample No.

Classification Very dark gray clay w/trace of sand and fine gravel

Liquid Limit ____ %

Plastic Limit ____ %

Plasticity Index ____

Maximum Unit Dry Weight 96.8 pcf

Optimum Moisture Content 23.5 %

OPTIMUM MOISTURE DENSITY CURVE

Attachment 21

SOIL AND LINER EVALUATION REPORT
CITY OF FARMERS BRANCH
PERMIT NO. 1312-A
DENTON COUNTY, TEXAS

Summary of Laboratory Data

Sample No.	Depth (feet)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (PI)	Percent Passing No. 200 Sieve
2	3.8	77	25	52	93
4	3.3	63	26	37	91
7	2.5	56	22	34	84
10	2.0	56	24	32	87
13	1.5	61	26	35	89
16	1.0	54	22	32	79
18	0.0	63	26	37	88

Note: Sample number indicates test number shown on Attachment 19.

FALLING HEAD LAB PERMEABILITY TEST

Job No.: 136.5

Sample No.: 2

Sample Height (cm) = 7.23

Height of 0.0 ML (cm) = 72.50

Height of Outflow Port (cm) = 6.50

Filled to 0.0 ML @ 10:59 AM Date: 24-Aug-91

Date	Time	Water Level (ml)	Water Level (cm)	Permeability (cm/sec)
24-Aug-91	10:58 AM	0.00	72.50	----------
26-Aug-91	07:06 AM	2.80	70.90	$6.17E^{-08}$
26-Aug-91	04:34 PM	2.81	70.80	$5.21E^{-10}$
27-Aug-91	06:50 AM	3.00	70.60	$1.35E^{-08}$
27-Aug-91	09 05 AM	3.01	70.61	$2.20E^{-09}$

Job No.: 136.5

Sample No.: 4

Sample Height (cm) = 7.41

Height of 0.0 ML (cm) = 77.40

Height of Outflow Port (cm) = 10.60

Filled to 0.0 ML @ 10:13 AM Date: 24-Aug-91

Date	Time	Water Level (ml)	Water Level (cm)	Permeability (cm/sec)
24-Aug-91	10:13 AM	0.00	77.40	----------
26-Aug-91	07:06 AM	4.20	74.80	$9.29E^{-08}$
26-Aug-91	04:34 PM	4.40	74.70	$2.14E^{-08}$
27-Aug-91	06:50 AM	4.70	74.50	$2.14E^{-08}$
27-Aug-91	08:50 AM	4.80	74.51	$5.09E^{-08}$

FALLING HEAD LAB PERMEABILITY TEST

Job No.: 136.5

Sample No.: 7

Sample Height (cm) = 7.14

Height of 0.0 ML (cm) = 72.50

Height of Outflow Port (cm) = 6.40

Filled to 0.0 ML @ 12:43 PM Date: 27-Aug-91

Date	Time	Water Level (ml)	Water Level (cm)	Permeability (cm/sec)
27-Aug-91	12:43 PM	0.00	72.50	----------
27-Aug-91	05:55 PM	0.60	72.20	$1.10E^{-07}$
28-Aug-91	01:43 PM	1.60	71.50	$4.84E^{-08}$
28-Aug-91	04:10 PM	1.60	71.50	N.C.
29-Aug-91	07:30 AM	2.00	71.20	$2.52E^{-08}$
30-Aug-91	07:45 AM	2.60	70.90	$2.40E^{-08}$

Job No.: 136.5

Sample No.: 10

Sample Height (cm) = 6.66

Height of 0.0 ML (cm) = 77.40

Height of Outflow Port (cm) = 12.70

Filled to 0.0 ML @ 01:17 PM Date: 27-Aug-91

Date	Time	Water Level (ml)	Water Level (cm)	Permeability (cm/sec)
27-Aug-91	01:17 PM	0.00	77.40	----------
27-Aug-91	05:55 PM	6.10	73.60	$1.23E^{-07}$
28-Aug-91	01:42 PM	7.10	73.10	$4.87E^{-08}$
28-Aug-91	04:10 PM	7.20	73.20	$3.92E^{-08}$
29-Aug-91	07:30 AM	7.60	72.70	$2.53E^{-08}$
30-Aug-91	07:45 AM	8.00	72.50	$1.61E^{-08}$

FALLING HEAD LAB PERMEABILITY TEST

Job No.: 136.5

Sample No.: 13

Sample Height (cm) = 7.08

Height of 0.0 ML (cm) = 74.50

Height of Outflow Port (cm) = 11.40

Filled to 0.0 ML @ 09:05 AM Date: 30-Aug-91

Date	Time	Water Level (ml)	Water Level (cm)	Permeability (cm/sec)
30-Aug-91	09:05 AM	0.00	74.50	----------
30-Aug-91	12:55 PM	7.30	70.30	$1.94E^{-06}$
30-Aug-91	03:35 PM	7.40	70.00	$3.97E^{-08}$
03-Sep-91	06:45 AM	9.50	68.80	$2.58E^{-08}$

Job No.: 136.5

Sample No.: 16

Sample Height (cm) = 7.06

Height of 0.0 ML (cm) = 68.50

Height of Outflow Port (cm) = 6.40

Filled to 0.0 ML @ 09:36 AM Date: 30-Aug-91

Date	Time	Water Level (ml)	Water Level (cm)	Permeability (cm/sec)
30-Aug-91	09:36 AM	0.00	68.50	----------
30-Aug-91	12:55 PM	0.40	68.10	$1.21E^{-07}$
30-Aug-91	03:35 PM	0.40	68.11	-
03-Sep-91	06:45 AM	2.80	66.60	$2.80E^{-08}$

FALLING HEAD LAB PERMEABILITY TEST

Job No.: 136.5

Sample No.: 18

Sample Height (cm) = 7.13

Height of 0.0 ML (cm) = 72.80

Height of Outflow Port (cm) = 11.20

Filled to 0.0 ML @ 01:37 PM Date: 03-Sep-91

Date	Time	Water Level (ml)	Water Level (cm)	Permeability (cm/sec)
03-Sep-91	01:37 PM	0.00	72.80	----------
04-Sep-91	07:34 AM	1.80	71.70	$1.03E^{-07}$
04-Sep-91	03:50 PM	2.40	71.50	$7.52E^{-08}$
05-Sep-91	08:16 AM	2.80	71.10	$2.53E^{-08}$
05-Sep-91	04:44 PM	3.20	71.00	$4.94E^{-08}$
06-Sep-91	09:20 AM	3.80	70.50	$3.80E^{-08}$
07-Sep-91	12:00 PM	4.10	70.30	$1.19E^{-08}$