North Country Environmental Services, Inc.

October 13, 2008

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Montpelier, Vermont 05602

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Ms. Karlee Kenison, P.G.
New Hampshire Department of Environmental Services
Waste Management Division
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

RE: North Country Environmental Services, Inc.
Landfill Facility – Bethlehem, New Hampshire
Response to September 10, 2008 NHDES Comment letter

Dear Ms. Kenison:

NCES (North Country Environmental Services, Inc.) is in receipt of Michael Wimsatt's September 10, 2008 correspondence. Section D of that correspondence contained several comments and requests pertaining to groundwater conditions at our site. We understand from our meeting on October 2, 2008 that response to comments relative to groundwater (Section D) should be addressed to you. Accordingly, we have retyped your comments in *italic print* with our responses in **bold print**.

Groundwater Management and Release Detection Permit Issues
There are several instances in which groundwater monitoring conducted under the facility's GWRD Permit (Groundwater Management and Release Detection Permit #GWP-198704033-B-005) has detected volatile organic compounds (VOCs) and bromide above established background concentrations, thus indicating that contaminants have been released. Under the terms and conditions of the GWRD permit, the source of the releases must be determined and the impacts remediated. Although NCES has suggested that releases are the result of leachate spills involving past leachate handling systems and practices, and are not due to an ongoing release(s) from the landfill, there is insufficient information to fully support such a conclusion and some of the available data also appear to be inconsistent with such a conclusion.

Key issues relating to these detections of VOCs and bromide are outlined below:

1. *Remedial Action Plan for Activities Near Well Couplets MW-402 and MW-403*
Volatile organic compounds (VOCs) and bromide continue to be detected at low levels, but above established background concentrations in well MW-402U, and they have historically been detected in MW-403L. Because these wells are located in the vicinity of the existing leachate loading, storage and transfer areas, NCES contends that the contamination is the result of releases from the leachate handling system, including accidental spills and other past handling practices, and is not due to an ongoing release at the landfill. The remedial action work that NCES has proposed to undertake (as summarized below) in the vicinity of MW-402 and MW-403 is based on that assumption,

but until the work is completed and performance expectations are met, the Department is unable to conclude that leachate handling system activities are the sole source of this contamination.

The facility's GWRD Permit required submittal of a scope of work for remedial activities near monitoring well couplets MW-402 and MW-403 and the existing leachate loading areas in order to address the detection of VOCs above established background concentrations, specifically in well MW-402U. See Section Env-Or 703.15 of the New Hampshire Code of Administrative Rules Env-Or 700, GROUNDWATER RELEASE DETECTION PERMITS, for required elements of the requested Corrective Action Plan.

In response to this requirement, on June 8, 2007, NCES submitted a work plan entitled "Work Plan, Remedial Activities of Soil Potentially Impacted By Leachate, Leachate Management Modification and Improvements," prepared by CMA Engineers and dated May 2007. NCES proposed to implement this work plan in conjunction with the proposed Stage IV Phase II landfill construction. However, in correspondence dated July 31, 2007, the Department directed NCES to initiate the work plan independent of the construction of Stage IV Phase II, based on the fact that several VOCs were detected in Well MW-402U in the April 2007 sampling event. In response, on September 19, 2007, NCES submitted an alternative work plan entitled, "Work Plan, Remedial Activities of Soil Potentially Impacted by Leachate, Alternative Leachate Management Modifications and Improvements," prepared by CMA Engineers, and dated September 2007 (Work Plan). On May 28, 2008, when the Department approved the Type II Permit Modification Application for the Leachate Management Improvements, NCES was directed to proceed with the Work Plan.

CMA Engineers has hypothesized that a source of the low level VOCs detected in Well MW-402U could possibly be remnants of leachate accidentally released into the up gradient vadose zone soils when leachate was collected, stored and transferred in underground facilities in this area, and transferred to tank trucks at an above ground facility. The Work Plan calls for delineation of soils that might be impacted by leachate, and excavation and placement of any impacted soils in the landfill. The targeted soils are located adjacent to or below leachate handling, storage and transfer facilities that are scheduled to be removed and replaced with new systems at different locations in accordance with the above cited plans that were approved on May 28, 2008. The Work Plan provides for removal of impacted soil above the water table that could be a source of down gradient groundwater contamination. Performance criteria for soils were discussed, but no performance criteria for groundwater are proposed in the Work Plan. Performance criteria must be established and achieved to demonstrate that the VOCs detected in this area are the result of poor *leachate handling or piping issues and are not from an ongoing release, a liner leak or other potential source.*

We have attached as Exhibit A an engineering report prepared by CMA Engineers, Inc. of Portsmouth, New Hampshire along with a hydrogeological report prepared by Sanborn, Head & Associates, Inc. of Concord, New Hampshire. These reports demonstrate conclusively that the concentrations of bromide and VOCs detected in wells MW-402U and MW-403L could not be the result of a leak in the landfill's containment system.

We propose to sample MW-402U and MW-403L monthly beginning in November 2008 for bromide and VOCs and will continue monthly until two consecutive rounds of sampling confirm that a downward temporal trend in VOC concentrations exist. We also propose to continue with sampling for bromide monthly, until two consecutive rounds of sampling confirm that the bromide levels have dropped to the background level of 0.4 mg/l. At such time, sampling would revert back to the requirements within the current GWRD Permit.

2. Well B-913M
The source of bromide and tetrahydrofuran detected above background concentrations in well B-913M is not well understood. The bromide concentrations in this well significantly increased from 0.32 mg/l in May 2008 to 1.5 mg/L in June 2008. NCES, through its consultant Sanborn, Head & Associates (SHA), has since reported that the July sampling results for this well indicate bromide concentrations have dropped to 0.37 mg/L and that "... based on these findings, the June result for 913M (1.5 mg/L) appears anomalous." Although this may be true, additional sampling is required to demonstrate that the June results were in fact anomalous and do not indicate a release from within the landfill. A formal submission of an analysis of the data is required. In addition, if the concentrations remain elevated, NCES must prepare and submit a Corrective Action Plan in accordance with Env-Or 703.15. The Corrective Action Plan should include proposed performance standards.

Additionally, as noted in SHA's September 28, 2007 Annual Report, the compound tetrahydrofuran has been intermittently detected in well B-913M since the April 2006 sampling round, and an overall increasing trend above background concentrations is suggested by the data. SHA indicates that the most likely source for the VOCs found in this well is the leachate infrastructure. Currently, the GWRD Permit only requires sampling for VOCs in this well in April and November of each year. Under this sampling schedule, it would take considerable time to assess trends and to verify the effectiveness of remedial actions. The Work Plan submitted by NCES in accordance with the GWRD Permit was required to address the presence of VOCs in groundwater in this general area of the site. If the leachate loading area is, in fact, the source for the VOCs and bromide in this well, then completing the remedial work in this area, including relocating and improving the leachate infrastructure and soil removal, should result in a decrease in VOC concentrations in this well, eventually causing them to return to background concentrations. Again, groundwater performance standards must be proposed by NCES and approved by the Department in order for the success of this Corrective/Remedial Action Plan to be measured and evaluated.

Based on the entire history of available data for bromide concentrations in the samples from well B-913M, we continue to believe that the April result of 1.5 mg/l was anomalous. The bromide concentration detected in the most recent groundwater sample from this well (collected on August 25, 2008) is 0.39 mg/l; essentially the same as the July result (0.37 mg/l) noted in your letter.

Regarding the history of detection of the VOC tetrahydrofuran (THF) in the groundwater samples from well B-913M, we note that the THF concentration detected in April 2008 (24.4 ug/l) is lower than the most recent prior two results (April and November 2007). This area is generally downgradient from the leachate management infrastructure to be addressed as part of the current upgrade program. Therefore, we agree with the Department that we should see a decrease in the concentration of THF in well B-913M, and we believe our comments above relative to "performance criteria for groundwater" as noted in our response to Item D.1 are also applicable.

To address comments with regard to the current frequency of VOC sampling/analysis for this well (twice yearly under the site GWRD Permit issued by NHDES in November 2007), we propose to collect groundwater samples from well B-913M, for VOC analysis, on a monthly basis. We would continue with monthly sampling until two consecutive rounds of sampling confirm a downward temporal trend in VOC concentrations. We also propose to sample for bromide monthly until two consecutive rounds of sampling confirm that the bromide levels have dropped to the background level of 0.4 mg/l. We would then revert to the sampling frequency under the current GWRD Permit.

3. Wells B-919U, B-921M, and B-921U

The VOC dichlorodifluoromethane has been detected at concentrations above background in wells B-919U and B-921M. The data from the April 2008 groundwater sampling round indicate that the concentration of this compound is increasing in well B-921M.

In addition, bromide continues to be detected in B-921U above background concentrations. The April 2008 results detected bromide at 1.7 mg/l. SHA's September 28, 2007 Annual Report indicates that the elevated concentrations of bromide in this monitoring well appear to be related to the short-term accidental leachate/storm water releases associated with Stage IV Phase I construction activities. Based on this belief, SHA further states that it anticipates that bromide concentrations at this location will likely decrease in the near future. However, the April 2008 results continue to show bromide at elevated concentrations. Further evaluation of conditions in this area of the site is needed to confirm that there is not an ongoing release.

The history of dichlorodifluoromethane (DCDFM) detections in wells B-919U and B-921M is summarized on the attached figure (Exhibit B), which provides a graphical summary of the available VOC sampling results for these wells. These wells are both screened within the stratified-drift unit as observed in this area of the site. As noted in SHA's 2008 Annual Report, DCDFM was also historically detected in former stratified-drift monitoring wells located in the area of what is now the Stage IV / Phase I Landfill, which is upgradient from the area of wells B-919U and B-921M, with respect to groundwater flow. The attached figure also includes the available history of DCDFM concentrations detected in historical groundwater samples collected from three of these latter wells (B-101, MW-804, and MW-805), which were decommissioned, with NHDES approval, prior to construction of the Stage IV / Phase I Landfill.

As indicated on the attached figure, DCDFM concentrations have generally ranged from non-detect to just under about 20 micrograms per liter (ug/l) in the recent samples from wells B-919U and B-921M, which is less than the highest concentrations historically detected in wells B-101, MW-804, and MW-805. DCDFM concentrations reported for these latter three wells had decreased to non-detectable levels for at least several rounds (wells MW-804 and MW-805) or were suggestive of a generally-decreasing temporal trend (B-101) prior to well decommissioning. Based on these conditions, we believe that the presence of DCDFM in groundwater in the area of wells B-919U and B-921M is likely related to the historical occurrence (former unlined landfill) of this compound in groundwater in the areas upgradient from these wells, and thus a result of continued northerly migration with groundwater flow. As observed previously in the historical data for wells MW-804 and MW-805, we expect that future groundwater monitoring results for wells B-919U and B-921M will support a general trend of decreasing DCDFM concentrations in groundwater at these latter locations.

Were the presence of DCDFM in groundwater in this area of the site related to a recent landfill release, we would expect that additional VOCs typically present at higher concentrations in landfill leachate would also have been detected in groundwater. While the available data are limited to two sampling rounds, we note that DCDFM has not been detected in the secondary leachate samples collected from the Stage IV / Phase I Landfill. Copies of the laboratory analytical data reports are attached as Exhibit C.

With regard to the recent history of bromide detection in the groundwater samples from well B-921U, subsequent to the April 2008 result (1.7 mg/l) noted in your letter, additional monthly sampling results for May (1.5 mg/l), June (1.5 mg/l), July (1.3 mg/l), August (1.2 mg/l), and September (1.1 mg/l) indicate a downward trend in bromide concentrations over time for this sampling location (time-series plot attached). This trend is consistent with the construction-related release scenario previously described by SHA in the 2008 Annual Report. We believe this provides further confirmation that there is not an ongoing release from the landfills containment system.

4. Well B-304UR

   The April 2008 sampling data for Well B-304UR indicate bromide is present at a concentration of 0.48 mg/L. This is the highest observed concentration of bromide detected to date at this sampling location. Further evaluation of conditions in this area of the site is needed to confirm that there is not an ongoing release.

   We propose to add well B-304UR to monthly groundwater sampling program for bromide analysis and will continue monthly until two consecutive rounds of sampling confirm that the bromide levels have dropped below background at 0.4 mg/l.

Should you have any questions please do not hesitate to contact us at (802) 223-7221.

Sincerely,

NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.

J. Gay

John Gay, E.I.
Engineering, Permitting Compliance & Construction

Enclosures

c. Town of Bethlehem, NH
Larry Lackey, NCES. (via email, w/o encl.)
Kevin Roy, NCES. (via email, w/o encl.)
David Schmitt, NCES. (via email, w/o encl.)
Bryan Gould, Brown, Olson & Gould
Robert Grillo, CMA Engineers, Inc. / Portsmouth
Paul Rydel, Sanborn, Head & Associates, Inc. / Concord

EXHIBIT A

LINER LEAKAGE ANALYSIS PREPARED BY CMA
AND
HYDROGEOLOGIC ANALYSIS PREPARED BY SHA

SHA
IMPROVING EARTH

CMA ENGINEERS

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October 14, 2008

Mr. John Gay
North Country Environmental Services
3 Pitkin Court
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RE: Liner Leakage Analysis
North Country Environmental Services
Bethlehem, New Hampshire
CMA #656.03 – A

Dear Joe,

In correspondence of September 10, 2008, to North Country Environmental Services, Inc. (NCES), the New Hampshire Department of Environmental Services (DES) suggested that changes to NCES's Corrective Action Plan might be required as a means of demonstrating that there is not a leak in the landfill's liner system. In conjunction with Sanborn, Head & Associates, CMA Engineers, Inc., undertook an evaluation of whether the concentrations of contaminants found in monitoring wells on the site could have been the result of a liner leak. This correspondence reports on the outcome of that evaluation.

A typical lining system schematic for the NCES landfill is provided on Figure 1. The primary liner and leachate collection system consists of 18 inches of drainage sand, underlain by a drainage geocomposite (newer phases) or a drainage net and fabric (older phases), which in turn is underlain by a 60-mil high density polyethylene geomembrane liner. The secondary collection system is essentially a duplicate of the primary system with the same components and drainage capacity except for the flat, base areas of Stage I Phase II and III which do not incorporate drainage net/composite in the secondary collection system.

Overview: Liner Leakage Regulation and Monitoring

Primary and secondary leachate flows are recorded on a daily basis for each landfill phase at the site. Secondary leachate flows are a measure of leakage through the primary liner along with other potential sources of water such as storm water infiltration into the secondary collection system. DES has established a performance criterion of a maximum allowable flow in the secondary collection system of 25 gallons per acre per day (GAD). When flows exceed 25 GAD, NCES is required to investigate the cause of the increased flow and make repairs or operational changes as necessary and appropriate.

The 25 GAD value is a common criterion applied to double-lined landfills in New Hampshire and across the country. The basis for this value is two-fold. First, experience over the past 25 years indicates that landfills containing a liner constructed with care and using rigorous quality control and quality assurance measures should be expected to have secondary leachate flows up to but not exceeding 25 GAD. Second, flows less than 25 GAD result in very low head on the secondary liner as discussed below and, therefore, minute leakage rates since leakage is a function of head. In summary, a landfill with secondary leachate flows of less than 25 GAD is functioning as designed and intended. We are not aware of any landfill in conformance with this performance criterion that is impacting groundwater quality due to leakage through the lining system.

The landfill leachate collection systems are designed to drain large inflows of water. The design criteria for the Stage IV Phase II primary and secondary leachate collection systems include hypothetical storm and waste filling scenarios that would result in leachate flows in the 25,000 GAD range, using appropriate design reduction factors and factors of safety, while maintaining a maximum head on the liner of less than 0.25 inches. It is apparent therefore that flows of less than 25 GAD in the secondary system will result in very low heads on the liner and insignificant amounts of leakage.

Table 1 includes a summary of monthly leachate flow data from the NCES site. Flow data is provided for a twelve year period (1995 through 2007) for each landfill phase (eight total). The secondary flow rates over this period have averaged between about 9 and 19 GAD, depending on the landfill phase being considered. These values are consistent with secondary flow rates that we are aware of at other double-lined landfills in the state.

The secondary flow rates at the NCES facility, however, do not entirely represent leakage through the primary liner. The monthly data show several periods of time when secondary flows increased dramatically, up to several hundred GAD in some instances, followed by a return to lower normal levels of less than 10 GAD. Four of these periods in recent years are highlighted on Table 1. In each of these instances, the spike in secondary flow was investigated by NCES and found to be the result of clean storm water inflows into the secondary collection systems due to damage or construction activities. After appropriate repairs were completed, the secondary flows returned to their normal low level in each instance.

One of the primary functions of the secondary collection system is use flow data to directly monitor the performance of the primary liner on a near continuous basis. When a spike in secondary flow is observed, NCES reviews operations and construction activities that occurred in the area of increased flows, investigates the cause, and makes appropriate repairs. The site record of responding to secondary flow data demonstrates that NCES is effectively and successfully managing the system that most directly ensures the performance of the landfill liners is as designed and intended. In short, the liner monitoring system is working at this site.

Leakage Estimate Method and Procedures

We estimated leakage through the liners using procedures and equations provided in a paper entitled "Rates of Leakage Through Landfill Liners," by Bonaparte, Giroud, and Grosse, published in the proceedings of the Geosynthetics '89 Conference held in San Diego, California. The paper provides the following two equations that are relevant to the NCES landfill:

For leakage through a geomembrane liner alone:

$Q = C_B\, a\, (2gh)^{0.5}$ where: Q = flow through a given hole in m^3/s
C_B = a constant 0.6
a = area of one hole in geomembrane in m^2
g = gravity, 9.8 m/s^2
h = head on the liner in m

And for leakage through a composite soil/geomembrane:

$Q = 1.15\, a^{0.1}\, h^{0.9}\, k_s$ where: Q = flow through a given hole in m^3/s
a = area of one hole in geomembrane in m^2
h = head on liner in m
k_s = hydraulic conductivity of the underlying soil in m/s

The first equation applies to the primary liner where leakage is governed by the size of the hole and the relatively permeable soil (drainage sand) that underlies the liner. The second equation applies to the secondary liner where leakage through the liner is restricted by the moderately low permeability of the underlying screened glacial till layer. For the purposes of these calculations, we have assumed a hydraulic conductivity of $1X10^{-4}$ meters per second for the drainage sand and $1X10^{-7}$ meters per second for the screened and compacted till layer. We conservatively assumed poor contact between the geomembrane and screened till layer for the second equation. Given the weight of the refuse, the length of time it has been in place, and the plastic nature of the geomembrane, good contact between the geomembrane and till would be a reasonable assumption. Assuming poor contact results in leakage estimates over five times greater than with good contact.

The principal factors that control the magnitude of leakage through the primary and secondary liners are the head on each liner and the composite nature of the secondary liner. As shown in Table 1, the primary liner on average drains about 10 to 50 times more leachate than the secondary liner. With more flow to drain, the head on and therefore leakage through the primary liner will be significantly greater than it will be through the secondary liner. Furthermore, the primary liner is underlain by permeable drainage sand that readily transmits flow through any defect or damage in the primary liner. The secondary liner is underlain by less permeable glacial till soils that block or retard flow through a hole in the secondary liner and promote lateral flow in the drainage layer above the liner.

We conducted the leakage analyses on those landfill phases located upgradient of the impacted wells. As shown on Figure 2, Stage I Phases 2, 3, and 4 are located upgradient of wells MW-402U, MW-403L, and B-913M. Stage IV Phase I and Stage II Phases I and II are located upgradient of wells B-921M, B-919U, and B-304-U.

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We used the procedures outlined below to calculate leakage from each landfill phase located upgradient of the impacted wells. (A summary of the calculations is presented in Table 2.)

- Calculate the average head on the primary liner in each phase. We used the actual average primary leachate flows from Table 1, a hydraulic conductivity of the drainage net/composite of 0.29 m/sec, and one half of the typical cell drainage length to represent average head conditions. We calculated the total flow along the drainage path using actual flow data and the flow capacity of the drainage net along the drainage path using Darcy's law, then divided the actual flow by the flow capacity and multiplied by the drainage net thickness to obtain head on the liner.

- Calculate hole size and frequency in the primary liner using the actual secondary flow data and the first equation for the "geomembrane alone" case. As discussed above, the secondary flows include a large component of clean storm water. We conservatively assumed, however, that all of the secondary flow is attributed to leakage which results in larger calculated hole sizes. Since flow and head on the liner are known, we can back calculate the area of the hole. Although the drainage sand underlying the hole has a high permeability, it is not permeable enough to transmit all of the water through a typical hole without having a larger wetted area beneath the hole to transmit the flow. We therefore used Darcy's law to calculate the wetted area of sand that would be needed to transmit all of the flow and used that value as the hole size. This technique typically increased the calculated hole size by a factor in the range of 50.

- Assume the same hole size/frequency in the secondary liner as was calculated for the primary liner. This is reasonable since the secondary liner was constructed by the same liner crew using the same equipment and materials, at the same time, and subject to the same quality control/assurance protocols as the primary liner. This assumption is conservative in that the primary liner is more vulnerable to damage caused by landfill operations since it is exposed at the surface whereas the secondary liner is beneath and protected by the primary liner.

- Calculate the average head on the secondary liner using actual secondary flow data and the procedure described above for the primary liner, and account for the lack of drainage net on the flat base areas of Stage I Phases II and III. In these areas secondary flow is drained by drainage sand alone. The drainage sand is not as transmissive as the drainage net, resulting in higher heads on the liner than in areas with the drainage net. The landfill areas without drainage net are shown on Figure 3.

- Calculate the leakage through the secondary liner using the second equation for composite soil/geomembrane liners.

Each of the phases evaluated for leakage has a collection sump where the leachate collects and is pumped out of the landfill. Heads on the liner in the sump areas are higher than in other areas by design to allow for the operation of the pumping system. Each of these sump areas has extra lining systems (four total instead of two) to prevent leakage and other measures to protect the liners. Our analysis assumes that any leakage through the primary liner is on the floor of the landfill and not in the sump area. Given the known secondary flow rates and a higher head on the liner in the sump area, a leak in the sump area would necessarily result in a calculated hole size that is smaller than that calculated for the floor area which is subject to much lower heads. We therefore believe our analysis is conservative in this respect.

Results and Conclusions

The results of calculations are shown on Figure 4 and in Table 2. The secondary liner and overall landfill leakage rates range from 0.00014 to 0.00035 gallons per phase per day for those four phases that incorporate drainage net/composite in the secondary base areas. The landfill leakage rate ranges from 0.15 to 0.25 gallons per phase per day in those phases where drainage sand alone is incorporated in the secondary base areas. The calculated leakage rates are quite low, and as discussed in the accompanying hydrogeologic analyses, leakage from the landfill has not impacted water quality at the site monitoring wells.

We have made several assumptions in completing these calculations. We believe the assumptions made in our calculations are reasonable and conservative. While other assumptions could be made that would change the results of the calculations, we do not believe that any reasonable assumptions could result in substantial leakage from the landfill due to the documented secondary flows and the known properties of the double liner design. As stated earlier, we are not aware of any double-lined landfill with secondary flows less than 25 GAD that is measurably impacting groundwater quality due to liner leakage. These positive landfill performances are the result of the low heads and leakage potential associated with such low secondary flow rates, and at this site a composite secondary liner that additionally reduces leakage potential.

Please contact us if you have any comments or questions.

Very truly yours,
CMA ENGINEERS, INC.

Robert J. Grillo, P.E.
Project Manager

RJG/amh

cc: Kevin Roy, NCES

Enclosures: Tables 1 & 2
Figures 1 - 4

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Table 1 - Primary and Secondary Leachate Flows

		Stage I								Stage II					Stage III		Stage IV	
		Phase I (6.6Ac)		Phase II (3.8Ac)		Phase III (3.5Ac)		Phase IV (3.7Ac)		Phase I (1.7Ac)		Phase II		Phases I and II	Phase I		Phase I	
		Primary G/Ac/D	Secondary G/Ac/D	Primary G/Ac/D	Secondary G/Ac/D	Primary G/Ac/D	Secondary G/Ac/D	Primary G/Ac/D	Secondary G/Ac/D	Primary G/Ac/D	Secondary G/Ac/D	Primary G/Ac/D	Secondary G/Ac/D	Primary G/Ac/D	Primary G/Ac/D	Secondary G/Ac/D	Primary G/Ac/D	Secondary G/Ac/D
1995	Jan-95	227	0.00	379	0.00	336	2.17	298	0.00	-	-	-	-	-	-	-	-	-
	Feb-95	193	0.00	280	0.07	316	0.90	284	0.19	-	-	-	-	-	-	-	-	-
	Mar-95	234	0.00	364	0.02	379	5.22	771	0.02	-	-	-	-	-	-	-	-	-
	Apr-95	224	0.00	295	0.00	337	1.36	319	0.00	-	-	-	-	-	-	-	-	-
	May-95	242	0.00	330	0.00	329	0.82	249	0.00	-	-	-	-	-	-	-	-	-
	Jun-95	227	0.00	357	0.00	266	0.33	187	0.00	-	-	-	-	-	-	-	-	-
	Jul-95	165	0.00	277	0.00	236	0.30	146	0.00	-	-	-	-	-	-	-	-	-
	Aug-95	203	0.00	308	0.02	348	0.25	169	0.07	-	-	-	-	-	-	-	-	-
	Sep-95	172	0.00	280	0.00	278	6.89	141	0.00	-	-	-	-	-	-	-	-	-
	Oct-95	519	15.11	276	16.97	244	14.86	116	15.85	-	-	-	-	-	-	-	-	-
	Nov-95	1050	12.88	667	1.77	363	0.00	245	0.00	-	-	-	-	-	-	-	-	-
	Dec-95	327	7.32	323	0.53	328	4.06	185	5.75	-	-	-	-	-	-	-	-	-
1996	Jan-96	789	60.16	608	0.00	378	4.60	218	0.00	-	-	-	-	-	-	-	-	-
	Feb-96	723	6.84	540	1.82	394	8.46	277	13.90	-	-	-	-	-	-	-	-	-
	Mar-96	477	3.82	386	1.22	392	3.99	112	3.41	-	-	-	-	-	-	-	-	-
	Apr-96	1185	2.80	773	17.73	548	16.78	585	20.48	-	-	-	-	-	-	-	-	-
	May-96	1253	1.86	1072	12.80	607	9.40	705	0.00	-	-	-	-	-	-	-	-	-
	Jun-96	322	8.89	942	1.93	437	1.81	335	3.00	1627	61.70	-	-	1627	-	-	-	-
	Jul-96	606	8.04	769	0.94	569	8.54	264	0.00	4374	72.60	-	-	4374	-	-	-	-
	Aug-96	378	4.92	582	1.04	382	14.25	459	0.00	1106	22.20	-	-	1106	-	-	-	-
	Sep-96	221	3.64	298	0.00	306	3.48	85	0.00	424	14.80	-	-	424	-	-	-	-
	Oct-96	378	6.16	470	0.00	402	4.33	461	0.00	1986	16.80	-	-	1986	-	-	-	-
	Nov-96	416	4.51	833	0.00	434	4.39	864	0.00	791	14.94	-	-	791	-	-	-	-
	Dec-96	711	8.80	1092	7.84	669	34.26	1716	14.96	1318	9.94	-	-	1318	-	-	-	-
1997	Jan-97	576	1.05	686	0.66	782	8.87	782	0.00	760	10.37	-	-	760	-	-	-	-
	Feb-97	378	0.00	448	0.75	597	14.43	219	0.00	345	3.76	-	-	345	-	-	-	-
	Mar-97	390	0.00	603	0.00	389	0.00	247	12.34	382	0.00	-	-	382	-	-	-	-
	Apr-97	454	0.00	604	0.00	682	4.26	706	0.00	460	5.77	-	-	460	-	-	-	-
	May-97	671	0.46	1132	0.00	846	5.14	1211	0.00	480	1.74	-	-	480	-	-	-	-
	Jun-97	349	0.00	692	0.00	481	0.00	519	0.00	298	6.47	-	-	298	-	-	-	-
	Jul-97	140	0.00	619	0.00	427	0.87	401	0.00	404	5.14	-	-	404	-	-	-	-
	Aug-97	5	0.00	439	18.85	579	39.01	346	49.99	194	1.92	-	-	194	-	-	-	-
	Sep-97	150	8.73	614	9.42	261	58.11	403	66.80	204	0.48	-	-	204	-	-	-	-
	Oct-97	788	88.44	559	18.14	492	20.86	217	32.88	179	1.83	-	-	179	-	-	-	-
	Nov-97	236	7.23	338	23.97	257	140.31	186	220.04	432	7.23	-	-	432	-	-	-	-
	Dec-97	261	0.00	335	1.26	343	60.97	91	20.17	273	4.38	-	-	273	-	-	-	-
1998	Jan-98	290	0.00	365	84.82	294	249.87	84	113.30	1078	0.26	-	-	1078	-	-	-	-
	Feb-98	249	0.00	339	0.00	255	20.34	76	5.23	372	0.48	-	-	372	-	-	-	-
	Mar-98	273	0.00	324	43.47	308	39.54	72	12.00	763	38.28	-	-	763	-	-	-	-
	Apr-98	266	0.00	306	10.81	335	78.11	69	27.21	648	6.32	-	-	648	-	-	-	-
	May-98	217	0.00	250	0.00	143	33.86	71	0.00	265	2.21	-	-	265	-	-	-	-
	Jun-98	202	0.00	328	8.91	211	49.25	57	29.30	375	7.26	-	-	376	-	-	-	-
	Jul-98	221	0.00	272	26.58	285	73.51	38	20.66	388	4.46	-	-	388	-	-	-	-
	Aug-98	242	0.00	283	10.81	242	18.12	60	14.00	178	2.01	-	-	178	-	-	-	-
	Sep-98	179	4.71	259	12.18	39	23.06	44	11.10	217	11.89	-	-	217	-	-	-	-
	Oct-98	226	0.20	218	3.20	189	7.10	81	3.60	201	10.40	-	-	201	-	-	-	-
	Nov-98	208	0.00	250	6.20	213	4.80	56	3.00	392	5.80	-	-	392	-	-	-	-
	Dec-98	218	0.00	268	20.40	259	7.80	46	3.80	314	2.20	-	-	314	-	-	-	-
1999	Jan-99	185	0.00	190	40.90	313	7.20	46	1.28	287	0.67	-	-	287	-	-	-	-
	Feb-99	193	0.00	215	4.46	285	25.44	45	0.00	181	1.86	-	-	181	-	-	-	-
	Mar-99	215	0.00	215	3.69	213	24.23	47	12.82	546	1.26	-	-	546	-	-	-	-
	Apr-99	190	0.00	205	9.09	191	41.07	87	2.62	191	2.06	796	48.88	987	-	-	-	-
	May-99	204	0.00	220	0.00	167	11.79	44	3.32	161	5.62	264	24.74	425	-	-	-	-
	Jun-99	181	0.00	202	0.00	354	11.29	47	0.60	182	0.00	298	42.14	480	-	-	-	-
	Jul-99	197	0.00	194	14.78	182	6.24	49	0.00	291	0.31	276	0.23	567	-	-	-	-
	Aug-99	199	0.00	166	0.00	180	11.66	60	16.89	194	6.29	153	25.20	347	-	-	-	-
	Sep-99	262	0.00	196	11.46	218	11.41	50	1.00	591	1.35	560	0.87	1151	-	-	-	-
	Oct-99	211	0.00	242	1.82	138	18.38	28	4.82	421	9.86	543	15.06	964	-	-	-	-
	Nov-99	175	0.00	204	16.30	163	9.63	68	10.59	494	12.30	770	6.46	1264	-	-	-	-
	Dec-99	161	0.00	372	38.80	273	17.38	50	1.11	217	1.72	546	6.30	762	-	-	-	-
2000	Jan-00	177.96	0.00	170.47	4.89	164.02	8.96	69.65	6.00	256.82	0.16	615.15	8.24	860.07	-	-	-	-
	Feb-00	172.58	0.00	236.56	2.86	185.69	13.39	41.39	6.82	325.71	0.40	291.44	8.03	617.15	-	-	-	-
	Mar-00	170.61	0.00	209.90	18.71	145.28	8.74	83.42	4.64	443.63	0.50	789.01	8.41	1232.05	-	-	-	-
	Apr-00	286.58	2.83	333.76	162.81	261.14	100.76	176.87	44.89	0	0.72	0	8.49	0	-	-	-	-
	May-00	366.84	0.00	301.81	170.80	286.44	66.29	34.99	4.32	0	1.13	0	0.66	0	-	-	-	-
	Jun-00	280.85	0.00	226.46	33.82	170.04	14.57	47.12	0.00	0	0.79	0	0.34	0	-	-	-	-
	Jul-00	228.86	0.00	177.20	6.81	133.87	12.77	39.63	0.76	0	0.59	0	0.23	0	-	-	-	-
	Aug-00	204.28	0.00	180.90	0.00	211.06	17.16	46.11	0.80	0	0.64	0	0.31	0	-	-	-	-
	Sep-00	218.68	0.00	160.63	6.21	169.63	0.00	41.84	0.00	0	0.56	0	0.28	0	-	-	-	-
	Oct-00	234.76	0.10	211.32	5.50	191.32	18.60	81.23	4.29	0	3.71	0	0.46	0	-	-	-	-
	Nov-00	330.03	2.30	193.01	0.00	143.47	6.60	47.96	7.82	0	1.06	0	0.48	0	-	-	-	-
	Dec-00	345.29	0.00	181.14	39.66	140.97	18.89	30.82	0.00	0	0.40	0	0.15	0	-	-	-	-
2001	Jan-01	294.01	0.00	179.36	0.45	136.77	0.79	30.37	7.93	201.17	-	201.17	-	201.17	1301.823	-	-	-
	Feb-01	329.62	0.00	145.76	0.00	132.99	17.77	41.82	1.96	196.74	-	196.74	-	196.74	1507.145	-	-	-
	Mar-01	398.31	0.00	130.25	0.98	140.31	18.22	33.89	1.83	309.28	-	309.28	-	309.28	1346.65	-	-	-
	Apr-01	479.42	0.80	512.29	223.41	347.39	149.29	169.01	73.00	653.83	-	653.83	-	653.83	4079.785	-	-	-
	May-01	423.79	4.28	281.19	64.00	140.70	45.78	45.22	22.86	395.00	-	395.00	-	395.00	708.0655	-	-	-
	Jun-01	281.22	0.00	268.86	16.69	174.27	12.49	71.15	6.97	296.25	-	296.25	-	296.25	831.3608	-	-	-
	Jul-01	251.04	0.00	186.80	0.00	133.62	10.17	33.84	2.72	186.21	-	186.21	-	186.21	395.2948	-	-	-
	Aug-01	236.21	0.80	160.80	0.80	114.11	8.74	32.82	0.00	152.99	-	152.99	-	152.99	326.219	-	-	-
	Sep-01	218.73	0.00	149.30	8.51	116.80	7.09	24.75	0.00	75.92	-	75.92	-	75.92	350.181	-	-	-
	Oct-01	215.35	0.80	177.27	0.00	183.56	6.18	64.84	0.80	316.21	-	316.21	-	316.21	265.593	-	-	-
	Nov-01	207.00	0.00	138.66	0.00	117.42	12.54	17.23	6.13	217.89	-	217.89	-	217.89	314.9608	-	-	-
	Dec-01	240.49	0.00	120.49	0.10	77.59	12.81	31.54	4.04	247.92	-	247.92	-	247.92	247.7768	-	-	-
2002	Jan-02	276	0.00	211.62	26.09	153.81	18.09	37.09	4.65	410.97	0.91	410.97	12.87	410.97	995.46	4.59	-	-
	Feb-02	279	0.00	226.07	42.16	156.40	39.25	43.69	26.96	536.57	0.40	536.57	0.16	536.57	1435.45	2.64	-	-
	Mar-02	288	0.00	342.76	197.72	158.76	39.07	104.14	23.09	593.10	3.30	593.10	0.40	593.10	2343.04	3.90	-	-
	Apr-02	248	0.00	301.67	83.86	37.78	49.40	24.43	38.77	326.23	8.70	326.23	26.18	326.23	1814.71	6.35	-	-
	May-02	261	0.00	209.97	118.38	133.01	61.39	68.02	51.06	397.46	4.91	397.46	0.98	397.46	914.33	4.76	-	-
	Jun-02	266	0.00	336.01	76.32	100.48	33.41	21.86	3.25	434.43	8.19	434.43	120.00	434.43	1137.73	3.89	-	-
	Jul-02	271	0.47	210.87	19.89	132.76	28.30	66.05	34.49	561.45	0.38	561.45	8.18	561.45	702.56	2.92	-	-
	Aug-02	241	0.00	187.39	12.32	77.86	14.59	110.36	6.50	466.63	0.31	466.63	0.30	466.63	356.85	2.80	-	-
	Sep-02	227	0.00	180.62	5.30	38.06	2.59	0.00	0.86	179.15	2.56	179.15	0.05	179.15	321.61	0.81	-	-
	Oct-02	231	0.00	197.28	0.32	79.28	1.84	82.27	5.67	196.16	0.79	196.16	6.11	196.16	321.87	0.12	-	-
	Nov-02	232	0.00	183.37	0.00	60.64	21.32	50.28	23.22	253.80	7.79	253.80	9.00	253.80	513.81	0.03	-	-
	Dec-02	225	0.00	140.67	0.00	83.07	18.36	30.89	6.86	216.85	1.47	216.85	0.02	216.85	468.17	0.82	-	-
2004	Jan-04	343.83	0.00	118.45	17.44	27.09	0.00	25.15	0.00	326.34	20.88	326.34	0.16	326.34	77.38	3.26	-	-
	Feb-04	298.14	0.00	312.90	0.00	160.14	0.80	164.14	0.00	1023.75	6.92	1023.75	0.22	1023.75	400.16	2.84	-	-
	Mar-04	269.15	0.00	197.30	6.22	71.91	2.17	42.89	0.81	1131.72	4.15	1131.72	0.07	1131.72	548.75	1.99	-	-
	Apr-04	211.73	0.00	167.12	0.56	78.64	8.03	68.09	0.00	1150.55	7.35	1150.55	0.11	1150.55	639.03	2.21	-	-
	May-04	248.49	0.00	128.13	14.67	56.41	6.31	37.80	0.80	1046.61	15.36	1046.61	0.01	1046.61	408.16	3.01	-	-
	Jun-04	74.86	0.00	194.60	0.00	87.50	10.13	66.50	0.00	1011.85	3.94	1011.85	0.00	1011.85	396.28	28.51	-	-
	Jul-04	28.58	0.00	84.09	0.00	40.13	22.06	84.83	0.00	785.34	11.02	785.34	135.26	785.34	613.44	48.77	-	-
	Aug-04	64.00	0.00	273.23	0.00	165.19	14.83	87.87	0.00	1333.49	4.47	1333.49	266.77	1333.49	472.75	271.67	-	-
	Sep-04	43.06	0.00	192.27	0.02	61.99	4.87	83.34	0.00	500.74	2.86	500.74	404.22	500.74	367.44	337.39	-	-
	Oct-04	216.21	0.50	180.36	4.26	84.00	6.40	60.86	0.00	342.81	0.84	342.81	50.46	342.81	81.04	49.28	-	-
	Nov-04	311.08	0.50	134.16	0.64	44.62	0.00	62.44	0.00	429.54	6.22	429.54	41.85	429.54	490.40	36.76	-	-
	Dec-04	271.71	0.30	177.66	14.73	41.96	1.97	47.85	0.00	814.38	17.12	814.38	61.81	814.38	1082.81	26.31	-	-
2005	Jan-05	270.02	0.30	180.66	4.89	62.83	0.00	92.94	0.00	1188.04	6.43	1188.04	110.81	1188.04	809.89	21.33	-	-
	Feb-05	262.78	0.30	120.29	1.16	43.42	1.63	-4.78	0.00	1019.11	0.00	1019.11	47.80	1019.11	414.49	2.64	-	-
	Mar-05	142.35	0.80	31.49	0.58	30.21	21.57	60.83	0.00	802.49	0.50	802.49	46.89	802.49	838.09	16.76	-	-
	Apr-05	242.23	0.00	346.49	13.47	226.48	1.46	91.29	0.00	1502.00	0.00	1502.00	112.81	1502.00	1293.89	11.84	-	-
	May-05	457.61	0.00	1900.46	0.42	76.70	0.06	280.84	0.00	3791.38	0.00	3791.38	66.36	3791.38	1202.37	13.93	-	-
	Jun-05	166.21	0.00	256.12	0.06	56.08	0.00	19.84	0.00	1464.99	0.00	1464.99	24.63	1464.99	729.00	15.26	-	-
	Jul-05	110.52	0.00	207.42	0.00	34.75	0.00	-0.78	0.00	1901.26	0.00	1901.26	50.89	1901.26	702.19	13.49	-	-
	Aug-05	181.72	0.00	248.70	0.00	196.30	0.02	0.06	0.00	1451.53	0.00	1451.53	13.92	1451.53	494.82	13.35	-	-
	Sep-05	138.99	0.00	176.33	10.48	123.87	6.40	211.80	0.00	1126.51	0.01	1126.51	0.36	1126.51	276.23	14.82	-	-
	Oct-05	166.63	0.00	341.57	4.05	74.79	3.69	196.62	0.50	1234.94	0.00	1234.94	32.30	1234.94	463.69	0.74	-	-
	Nov-05	458.71	0.00	563.29	0.64	480.38	0.00	664.29	0.00	869.46	0.00	869.46	20.69	869.46	302.38	4.03	-	-
	Dec-05	201.44	0.00	258.27	0.00	4.22	0.00	119.86	0.00	718.90	0.00	718.90	13.85	718.90	44.35	6.35	-	-
2006	Jan-06	258.10	0.00	344.19	42.89	67.74	27.56	94.86	0.00	1411.86	0.00	1411.86	66.06	1411.86	512.90	16.41	-	-
	Feb-06	282.78	0.00	210.87	26.71	16.30	31.77	70.14	0.00	1149.26	0.30	1149.26	23.59	1149.26	414.49	2.84	-	-
	Mar-06	142.36	0.00	240.94	2.30	-8.10	16.20	72.89	0.00	932.26	80.30	932.26	60.04	932.29	749.23	9.90	-	-
	Apr-06	242.29	0.00	346.49	1.29	226.48	13.53	91.29	0.00	1502.00	16.67	1502.00	22.69	1502.00	718.49	4.85	-	-
	May-06	457.51	1.35	277.56	6.40	42.90	17.31	118.17	0.00	651.39	0.81	651.39	61.84	651.39	200.68	5.86	-	-
	Jun-06	263.05	11.32	278.50	11.36	76.38	8.03	98.31	75.79	758.65	0.00	758.65	0.01	758.65	731.55	3.91	-	-
	Jul-06	289.20	14.70	219.86	2.17	130.94	17.00	195.17	79.38	1571.54	0.00	1571.54	1.96	1571.54	556.30	5.52	-	-
	Aug-06	218.46	14.76	210.86	3.78	167.36	3.09	77.89	91.89	918.66	0.00	918.66	0.04	918.66	1068.87	5.92	-	-
	Sep-06	196.97	2.02	173.60	0.48	172.80	18.80	165.44	46.89	933.54	0.00	933.54	0.00	933.54	634.82	6.56	-	-
	Oct-06	304.68	0.00	144.72	0.00	32.23	0.00	67.89	0.00	744.72	0.00	744.72	0.00	744.72	620.00	0.00	-	-
	Nov-06	-	0	-	0.00	-	0.00	-	0.00	-	0	-	0	-	-	0	-	-
	Dec-06	-	0	-	0.00	-	0.00	-	0.00	-	0	-	0	-	-	0	-	-
2007	Jan-07	356.96	91.82	183.82	4.26	18.85	30.31	116.30	17.71	-	-	-	-	-	661.17	5.28	1136.16	25.90
	Feb-07	206.10	20.62	242.90	0.08	6.67	18.81	60.66	76.87	-	-	-	-	-	578.19	5.00	422.16	7.25
	Mar-07	300.39	60.67	269.88	34.15	38.84	30.28	64.12	80.09	-	-	-	-	-	564.24	4.87	966.52	13.85
	Apr-07	388.46	106.88	258.82	32.01	29.39	36.13	61.88	81.49	-	-	-	-	-	634.41	2.36	1058.27	18.40
	May-07	237.85	17.75	234.06	3.00	60.80	30.87	84.00	4.89	-	-	-	-	-	490.33	4.07	581.59	7.52
	Jun-07	270.39	18.81	190.73	1.81	23.94	19.59	10.97	0.00	-	-	-	-	-	440.00	4.77	483.17	7.07
	Jul-07	280.44	7.84	210.77	1.50	17.11	21.12	35.41	2.39	-	-	-	-	-	380.16	1.76	362.71	4.97
	Aug-07	220.40	8.32	191.48	5.79	38.47	17.06	48.29	3.40	-	-	-	-	-	300.94	6.35	308.86	3.55
	Sep-07	196.02	6.09	147.16	0.89	82.14	16.71	67.59	3.45	-	-	-	-	-	281.33	0.41	293.55	2.67
	Oct-07	192.43	8.46	169.48	3.45	41.22	19.90	38.40	6.30	-	-	-	-	-	301.84	2.39	361.91	1.87
	Nov-07	223.48	4.81	194.28	4.64	26.82	26.47	30.91	5.06	-	-	-	-	-	291.09	2.82	406.72	11.23
	Dec-07	192.96	3.63	174.59	11.89	73.09	23.36	30.21	6.20	-	-	-	-	-	306.92	4.17	461.43	7.16
	Average	293.24	4.92	310.65	14.53	208.84	18.99	152.85	12.32	635.17	6.47	655.41	30.75	686.86	678.23	16.97	678.74	9.10

Average Stage II Secondary Flows	18.62

Phase IV-I Construction

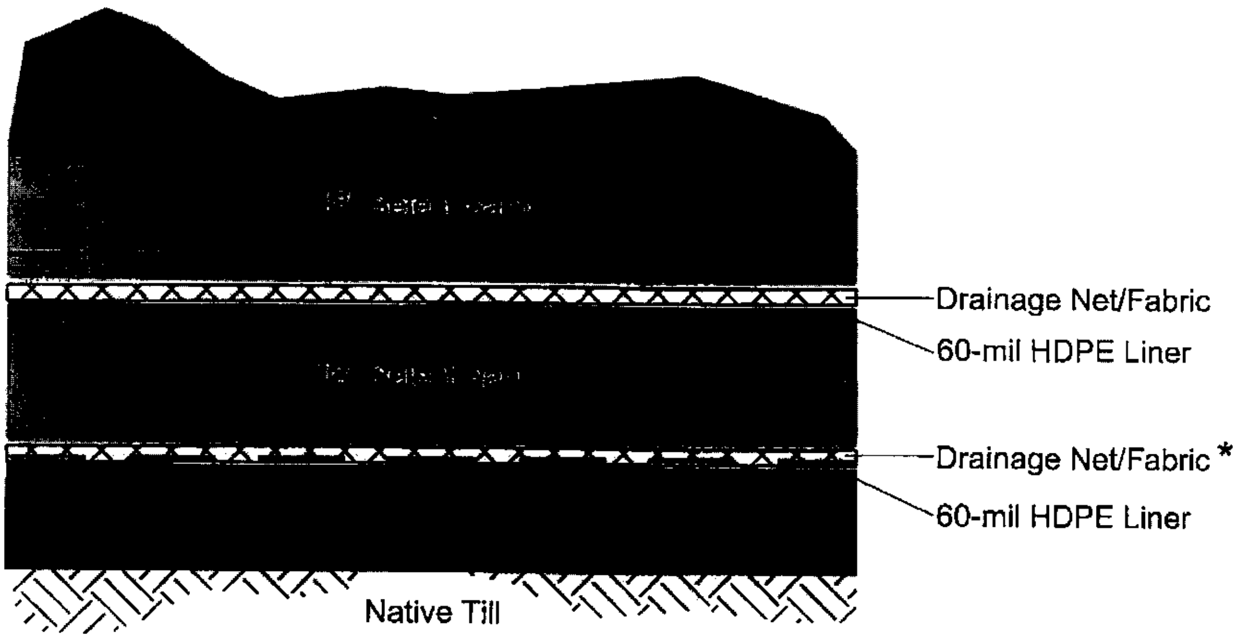
Cap Downchute

Zig Zag

CMA ENGINEERS, Inc.	Project:	North Country Environmental Services, Inc.
Civil/Environmental Engineers	Project No:	656
35 Bow Street	Date:	September 2008
Portsmouth, NH 03801	Calc. By:	MLB
	Chkd. By:	RJG

Table 2:
Liner Leachate Calculations

Phase	Primary Flow	Primary Flow	m^3/sec per	Max. Head (m)	Flow through 1 cm^2 hole	Wetted area	Gallons/hole/day	Secondary Flow	Holes/Phase	Total area of Holes	Secondary Flow	Secondary Flow	Material	m^3/sec per	Max. Head	Flow Through Wetted Area	% (Net/Sand)	Flow Through Wetted Area
	(GAD)	m^3/ft^2/sec	Drainage Length		(m^3/sec)	(m^2)		(GAD)		(m^2)	(GAD)	m^3/ft^2/sec		Drainage Length	(m)	per Phase (gal/day)		per Phase (gal/day)
I-4	152.85	1.53767E-10	1.41465E-08	4.06509E-06	5.35568E-07	0.00536	12.22	12.32	1.0	0.00540	12.32	1.23939E-11	Net	1.14024E-09	3.277E-07	0.000150		
I-3	208.54	2.09791E-10	1.99301E-08	5.72704E-06	6.35689E-07	0.00636	14.51	19.0	1.3	0.00833	19.0	1.91139E-11	Net	1.75848E-09	5.053E-07	0.000225	55	0.25
													Sand	1.56734E-09	0.00261	0.495280	45	
I-2	310.05	3.11909E-10	2.37051E-08	6.81181E-06	6.93283E-07	0.00693	15.82	14.53	0.92	0.00637	14.53	1.46171E-11	Net	1.1109E-09	3.192E-07	0.000150	61	0.15
													Sand	8.62411E-10	0.00144	0.291818	39	
II-1&2	686.86	6.90979E-10	9.60461E-08	2.75994E-05	1.3955E-06	0.01395	31.85	18.6	0.58	0.00815	18.6	1.87115E-11	Net	2.6009E-09	7.474E-07	0.000342		
IV-1	578.74	5.8221E-10	6.34609E-08	1.82359E-05	1.13434E-06	0.01134	25.89	9.10	0.35	0.00399	9.10	9.15457E-12	Net	9.97848E-10	2.867E-07	0.000143		



* Drainage Geocomposite Is Absent In The Basal Areas Of Stage I, Phases II & III

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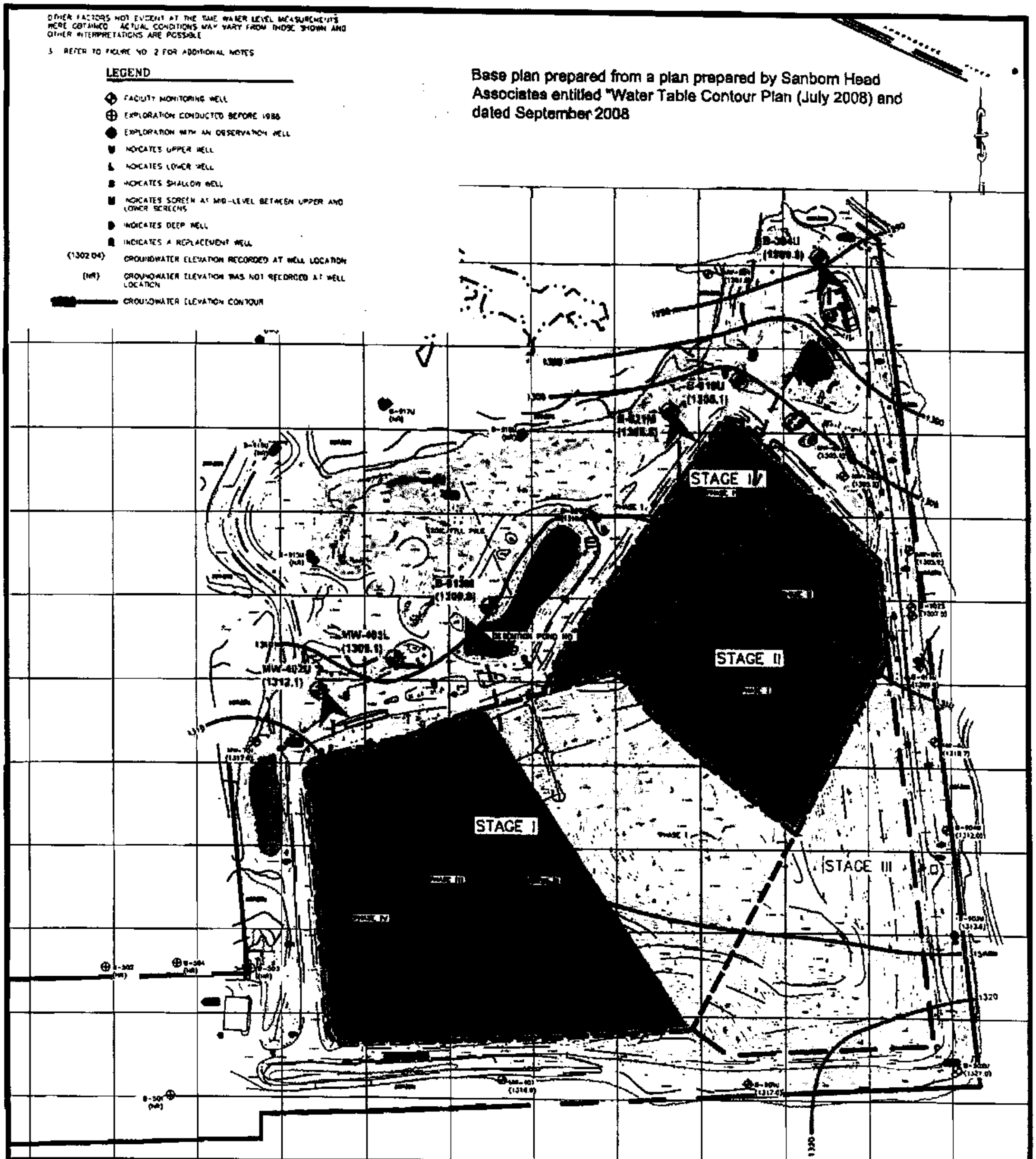
Bethlehem, NH

NCES Landfill Leakage Analysis

Figure 1 *- Liner System Schematic*



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NCES Landfill Leakage Analysis

Figure 2 *- Groundwater Flow Directions*

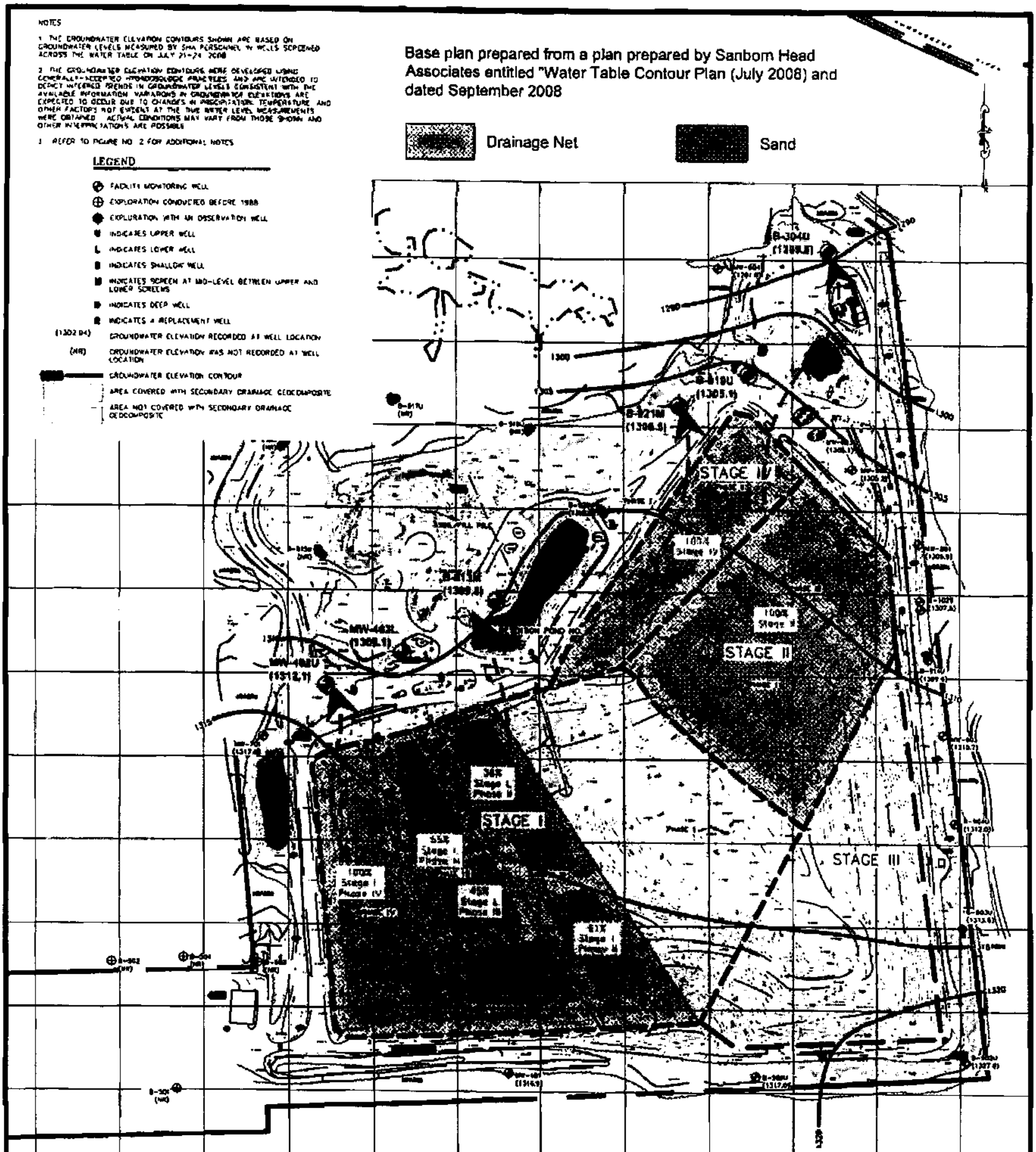

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***Figure 3** - Secondary Leachate Collection Systems*

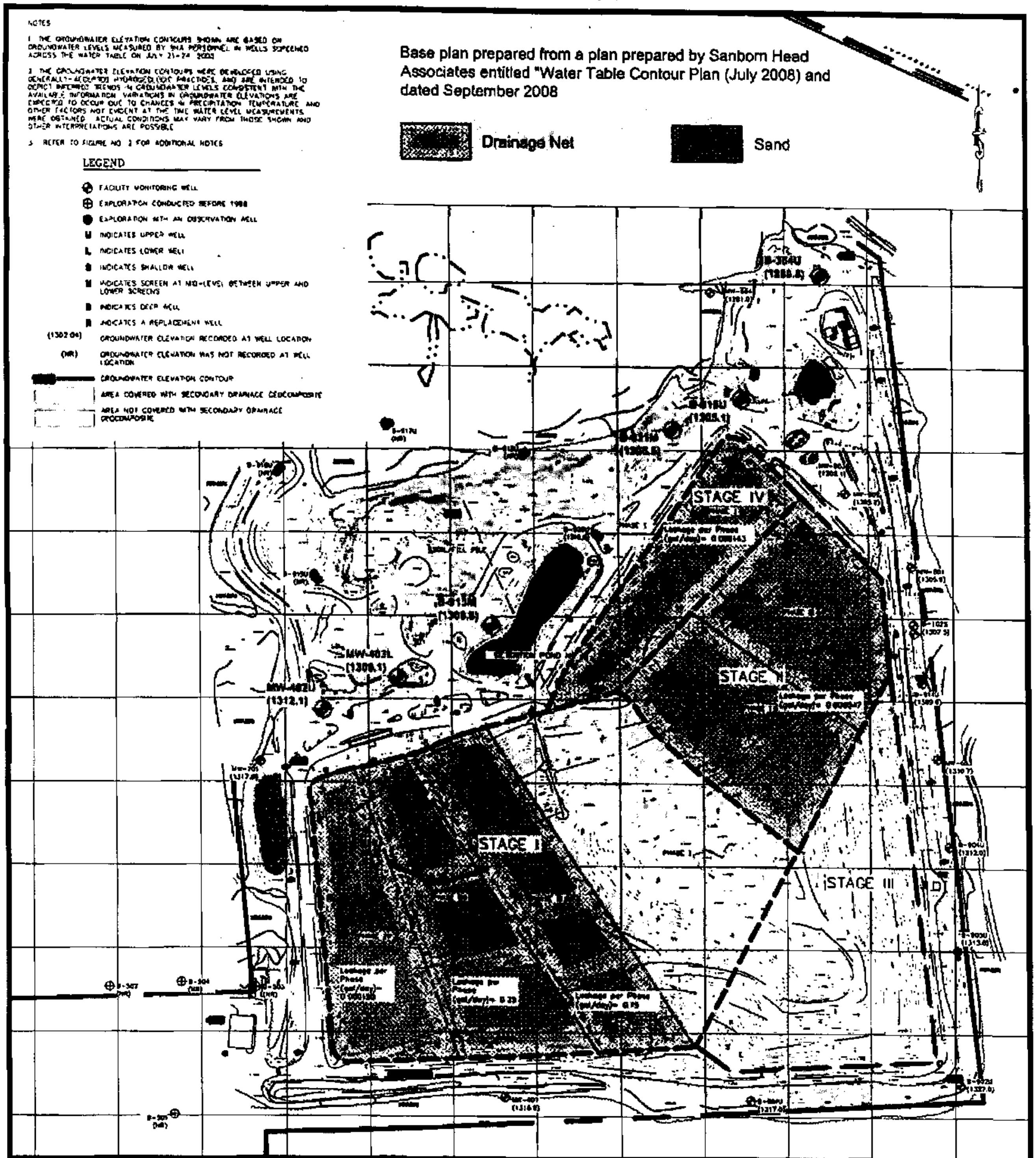

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***Figure 4** - Calculated Leakage Rates by Phase*

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IMPROVING EARTH

MEMORANDUM

To: Joe Gay, NCES

From: Paul Rydel

File: 1003.06

Date: October 17, 2008

Re: Analysis of Site Hydrogeologic Conditions Relative to VOC Detections in Groundwater Samples from Well MW-402U

As requested, Sanborn, Head & Associates, Inc. (SHA) prepared this memorandum to document our findings with regard to our review of site hydrogeologic conditions in the area proximate to monitoring well MW-402U, which has yielded groundwater samples in which VOCs have been reported. This review considered data and information previously provided to the New Hampshire Department of Environmental Services (NHDES), in SHA's 2008 Annual Report[1] and 2002 hydro study[2] prepared in support of the NCES Stage IV Landfill. Our findings are presented below.

Previous investigations at the site have established that the site overburden stratigraphy consists of three primary units. In descending order from the ground surface downward, these include:

- the Upper Till Unit, consisting of a poorly-sorted mixture of fine to medium sand and silt with moderate amounts of coarse-grained material and lesser amounts of clay;
- the Stratified Drift Unit, comprised of a relatively thick and heterogeneous sequence of stratified silt and fine sand (generally well sorted), commonly interfingered with "till-like" submembers; and,
- the Lower Till Unit, which is comprised chiefly of sand and gravel with lesser amounts of silt;

A number of explorations have been drilled to bedrock at the site, and have encountered the bedrock surface at depths greater than 100 feet (below the ground surface). The site monitoring well network has been developed to include locations screened within selected

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1 "2008 Summary of Water Quality Monitoring" (dated September 30, 2008), prepared by SHA on behalf of NCES.
2 "Hydrogeologic Study – Proposed Phase IV Expansion" (dated January 25, 2002), prepared by SHA on behalf of NCES.

intervals of the overburden stratigraphic units described above; principally the Upper Till and Stratified Drift Units, as the uppermost water-bearing units.

Monitoring well MW-402U is screened in the Upper Till Unit, and is located in an area that is generally downgradient from the westernmost portions of the Stage I lined landfill (i.e., Stage I Phases 3 and 4), and Detention Pond No. 2. As indicated on the July 2008 groundwater elevation contour plan provided with SHA's 2008 Annual Report, groundwater flow in the Upper Till Unit in this area of the site is generally toward the north or northeast, and is influenced by groundwater mounding associated with Detention Pond No. 2. These conditions are comparable to those indicated in SHA's 2002 report. Flow directions in the underlying Stratified Drift Unit in this area of the site are also to the north or northeast, as previously reported in the 2002 study.

Based on comparison of groundwater elevations measured in well MW-402U, and an adjacent well (MW-402LR) screened in the underlying Stratified Drift Unit, a consistent downward vertical gradient has been observed between the Upper Till and Stratified Drift Units in this area of the site. The observed vertical gradient is on the order of four times the horizontal gradient within the Upper Till Unit. This finding indicates that lateral groundwater flow in the Upper Till in this area of the site is limited, with groundwater occurring within the Upper Till principally "draining" to, or recharging, the underlying Stratified Drift. Thus, the Stratified Drift Unit is the principal groundwater flow unit in this area of the site, such that a potential release associated with the lined Stage I landfill upgradient of MW-402U would migrate with groundwater flow, and primarily impact groundwater quality in the Stratified Drift unit.

Well MW-402L and its 2004 replacement MW-402LR have been routinely sampled for VOCs since at least 1995. During this period of water quality monitoring, VOCs (MEK at 10 ug/l in 1996) were detected only one time in the groundwater samples collected from these wells. These data are consistent with the premise that the Stage I landfill liner system is functioning as intended.

The level of dilution that would be expected based on estimated groundwater flow rates in the Stratified Drift Unit was assessed as follows. The volume of groundwater flow within the Stratified Drift Unit in the area upgradient of well MW-402LR was estimated based on Darcy's Law and the hydrogeologic parameters developed previously as part of SHA's 2002 hydro study. This approach is summarized as follows:

$$Q = KAi$$

Where;

Q = groundwater discharge (L^3/T);
K = saturated hydraulic conductivity (or "permeability") (L/T);
A = cross-sectional area through which flow occurs (L^2); and,
i = hydraulic gradient (L/L).

Using the hydrogeologic parameters documented previously in the 2002 report, a permeability value of 6 ft/day was selected as generally representative of the Stratified Drift Unit in this area of the site. This value was selected based on consideration of the textural description of the Stratified Drift Unit materials penetrated at MW-402L (generally sand and gravel with some to trace silt content), and the geometric mean permeability for the Stratified Drift Unit (coarser-grained deposits) presented in the 2002 report.

The cross-sectional area through which groundwater flow occurs (A) was determined based on the saturated thickness of the Stratified Drift Unit in the area of MW-402U (about 35 feet [Section A-A' of the 2002 report]) multiplied by a horizontal distance (100 feet) approximating the width of the Stage I / Phase I landfill cell perpendicular to the prevailing groundwater flow direction. Similarly, the lateral hydraulic gradient within the Stratified Drift Unit (0.012 ft/ft) was estimated based on the groundwater elevation contour plan for this unit provided in the 2002 report. Substitution of these values into Darcy's Law yields:

$Q = KAi;$
$Q = (6 \text{ ft/day}) ([35 \text{ ft}] [100 \text{ ft}]) (0.012 \text{ ft/ft});$
$Q = 252 \text{ ft}^3\text{/day}$

Applying the unit conversion of 7.48 gallons per ft^3 yields a daily groundwater discharge through the Stratified Drift Unit of approximately 1,885 gallons (i.e., expressed in units of gallons per day [GPD]). Given the dilutive effect of this daily discharge when compared to the results of the secondary leachate collection system flow and liner leakage analysis documented in the accompanying report prepared by CMA Engineers, it is unlikely that releases of leachate from the liner system as described in the attached CMA report would result in detectable levels of VOCs in the downgradient wells.

As discussed above, there is a strong downward component to the groundwater flow direction in the Upper Till Unit to the north of the landfill. The history of VOC detections in the groundwater samples from Upper Till Unit well MW-402U (summary data plot attached) are thus consistent with a shallow, local VOC source proximate to the monitoring well (i.e., the previously-reported leachate releases associated with the leachate load-out building), and not a release from the landfill liner system.

PLR/TMW/RSS/JAC:plr

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EXHIBIT B

DICHLORODIFLUOROMETHANE (DCDFM) DETECTIONS SUMMARY (WELLS B-101, B-919U, B-921M, MW-804, AND MW-805)

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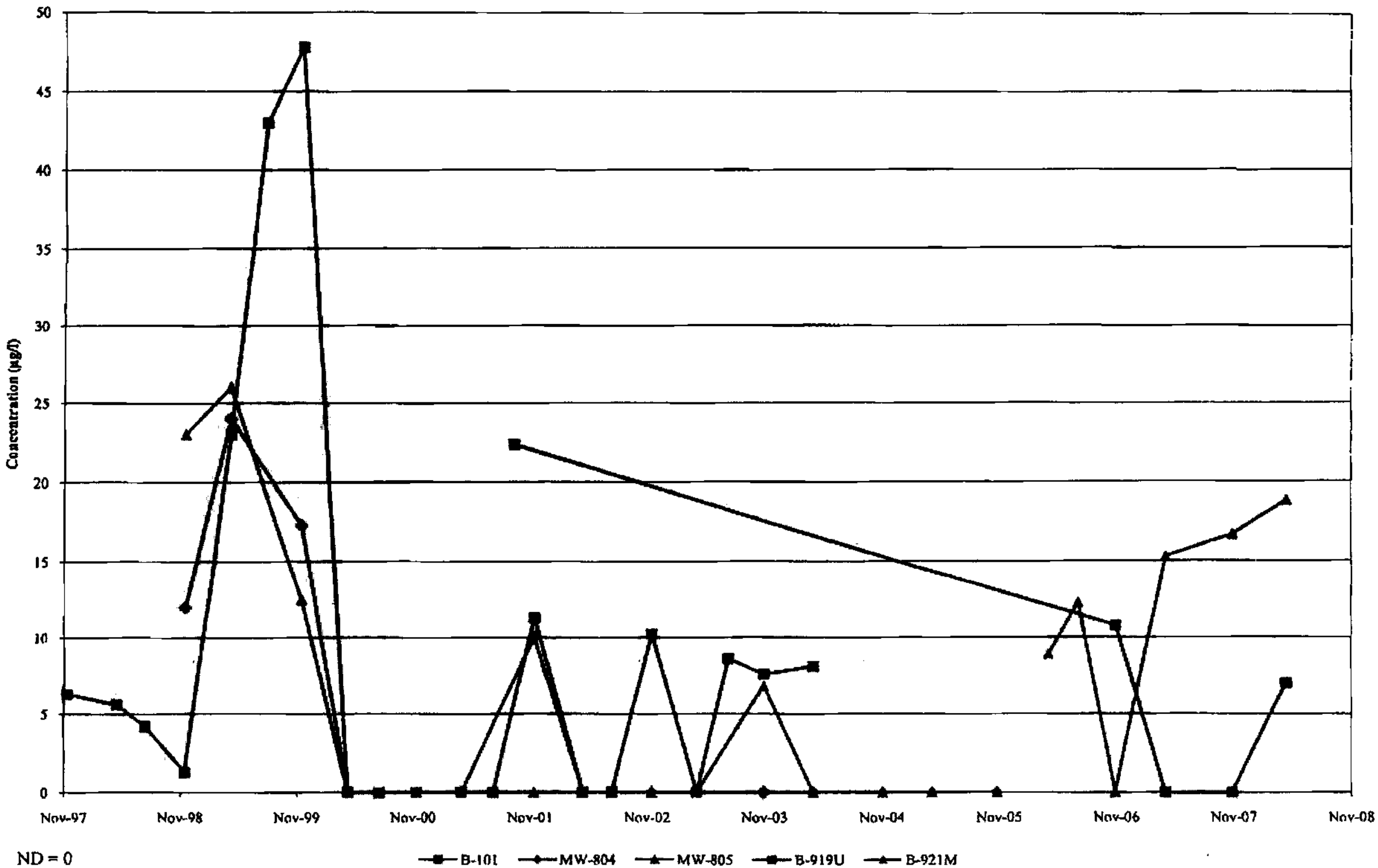
Dichlorodifluoromethane in Select Wells
NCES Landfill
Bethlehem, New Hampshire



ND = 0

EXHIBIT C

LABORATORY ANALYTICAL RESULTS
LEACHATE SAMPLING

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