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Superfund - HW
Spills - SP
ERP - E
VCP - V
BCP - C

Van De Mark Chemical Co., Inc.

Former Landfill Corrective Measures Study and Landfill Cap Evaluation

Prepared for:

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G2068

November 1995

EXECUTIVE SUMMARY

Van De Mark Chemical Co., Inc. (VDM) owns a landfill which is located between Mill Street and Eighteen Mile Creek, adjacent to their production facilities, in Lockport, New York. The landfill occupies approximately 2.5 acres and is situated on a flat plateau, about 80 feet above the creek. During the period from 1957 to 1982, VDM reportedly disposed of approximately 3300 drums of chemical waste by-products generated from production of silicon tetrachloride ($SiCl_4$) in the landfill.

The landfill was subsequently closed during the summer of 1987 in accordance with a NYSDEC approved closure plan. As part of this closure, a two-foot thick layer of compacted clay with a maximum permeability of 1×10^{-7} cm/sec was installed. The clay was overlain by drainage and topsoil layers. Additionally, a groundwater monitoring program was initiated and a pan-lysimeter installed to monitor performance of the cap.

The landfill is underlain by a thin veneer of soil and rock materials which overlies the bedrock which consists of four primary units. These include the Grimsby, Power Glen, Whirlpool and Queenston formations. The Grimsby has been almost entirely removed under the landfill due to previous quarrying operations at the site. Groundwater flow under the landfill is generally to the south along horizontal bedding planes and joints. Vertical flow in fractures, particularly near the cliff face where the rock is more fractured due to stress relief associated with downcutting of the valley is likely to be increased. Three separate groundwater zones have been identified under the landfill. These three zones include groundwater at the Grimsby (Overburden)/Power Glen, Power Glen/Whirlpool, and Whirlpool/Queenston contacts, respectively. The primary zone of groundwater flow in the vicinity of the landfill is associated with the overburden/Power Glen contact. Groundwater discharge from under the landfill is ultimately to Eighteen Mile Creek. However, since closure of the landfill in 1987, a seep which previously was noted in the cliff face below the landfill has ceased flowing.

As required by their Part 373 Post-Closure permit, VDM has completed a four year investigative monitoring program to assess groundwater quality and performance of the pan-lysimeter following closure of the facility. Analytical data collected during this program in the downgradient monitoring wells has shown that various volatile organic compounds (VOCs) and a few metals have exceeded the "Groundwater Protection Concentrations" (GPCs) established in VDM's post-closure permit. Analytical data for surface water samples collected in Eighteen Mile Creek do not show any exceedances of NYSDEC surface water standards for any site-related contaminants. Infiltration rates recorded in the pan-lysimeter were also higher than the rates predicted by the design calculations.

In response to these conditions, VDM conducted a corrective measures study and evaluation of the landfill cap performance as required by their permit.

As part of the corrective measures study, a qualitative health risk assessment was performed to identify the potential for adverse health effects, if any, from the release of contaminants from the VDM Landfill. In order to provide a conservative assessment of the health risk posed by the site, all the chemicals specified in VDM's post-closure permit were determined to be potential chemicals of concern and retained for evaluation. These compounds included several VOCs and metals.

Based on the health risk assessment, there are two potentially completed exposure pathways identified for the site. The first exposure route is associated with discharge of contaminated groundwater in the cliff face as seeps or overland flow downslope to Eighteen Mile Creek. Considering the lack of observable seeps or overland flow in the cliff face since grading and capping of the site, and the inaccessibility of the cliff (steepness and private property) to recreational trespassers this is likely to be an occasional exposure activity at best. The second exposure route at the site is associated with surface waters in Eighteen Mile Creek which may receive contaminated groundwater from the landfill site. Mass loading calculations indicate that the quantities of VOCs and metals which could potentially reach the creek are so low relative to the assimilative capacity of the creek, that no appreciable adverse impacts or health risks would occur. This is supported by analytical data for surface water samples collected in Eighteen Mile Creek adjacent to the site which show no exceedances of NYSDEC surface water standards for any site-related contaminants. Additionally, due to the limited potential exposure routes and the extremely low mass loading quantities associated with groundwater discharges from the site, there are no apparent ecological risks posed by the site.

In developing and evaluating potential corrective measures which might be implemented at the site, the primary remedial action objective was to control groundwater discharges at the cliff face and/or discharges directly to Eighteen Mile Creek. Four potential corrective measures were developed based on discussions with the NYSDEC. These included 1) no further action; 2) installation of an upgradient low-permeability barrier; 3) installation of a synthetic cap over the existing clay cap; and, 4) installation of a groundwater collection and treatment system.

The overall groundwater flux across the site under present conditions was calculated to be about 0.18 gpm based on the available groundwater elevation data. Groundwater flow from upgradient areas onto the site accounts for about 0.03 gpm whereas infiltration through the existing cap accounts for the remaining 0.15 gpm. Based on computer estimates of infiltration rates at the site, the current infiltration rate represents about an 89% reduction as compared to the estimated infiltration rate (1.5 gpm) which would have existed prior to regrading (i.e., "mounding") of the site and installation of the clay cap in 1987. This reduction in the infiltration rate has undoubtedly resulted in a substantial reduction in the volume of contaminated groundwater currently being generated at the site as compared to earlier periods of operation. Additionally, in regards to groundwater which discharges at or near the cliff face, evaporation may result in some additional reduction in the volume which ultimately reaches Eighteen Mile Creek. Southerly exposure of the cliff face, increased downslope areas and westerly winds may further increase the effects of evaporation rates at the site.

Based on the evaluation of the various corrective measures, the no further action alternative meets the remedial action objective in that based on the present groundwater discharge rate from the site, the mass loadings to Eighteen Mile Creek are so low relative to the assimilative capacity of the creek, that no appreciable adverse impact will occur. This is supported by analytical data for surface waters in Eighteen Mile Creek adjacent to the site which show no exceedances of NYSDEC surface water standards for any site-related contaminants. Consequently, the risk presently posed by the site to human health and the environment is minimal.

It is estimated that installation of an upgradient low-permeability barrier would reduce the total groundwater flux across the site by about 0.03 gpm which represents approximately 15% of the total groundwater flux (0.18 gpm) across the site. However, considering that the groundwater currently flowing onto the site does not contact the wastes directly, and that the present groundwater discharge rate to the cliff face, and ultimately to Eighteen Mile Creek, is so low (without the barrier), that no discernible impacts to the creek have occurred, the site is not considered to present a risk to human health and the environment. Consequently, implementing this measure will not appreciably improve upon existing conditions.

It is estimated that installation of a geomembrane or bentonite-type liner over the existing clay cap would reduce the present infiltration rates by an additional 9 percent as compared to the original infiltration rates prior to regrading of the site and installation of the clay cap. However, considering that the present groundwater discharge rate to the cliff face, and ultimately to Eighteen Mile Creek is so low that no discernible impacts to the creek have occurred the site is not considered to present a risk to human health and the environment. Consequently, implementing this measure will not appreciably improve upon existing conditions.

It is estimated that installation of a groundwater collection system would result in some portion of the groundwater flowing under the site being collected and treated prior to discharge to Eighteen Mile Creek or the nearby sewage treatment plant. However, as with the other alternatives, the site is not considered to present a risk to human health and the environment under existing conditions. Consequently, implementing this measure will not appreciably improve upon existing conditions.

In summary, some of or all of the various corrective measures outlined herein could be implemented at the site to further reduce the amount of groundwater flowing under the site and/or being discharged in the cliff face and ultimately to Eighteen Mile Creek. However, inasmuch as groundwater discharges from the site under existing conditions and potential mass loadings to Eighteen Mile Creek are so low that no discernible impacts to the creek have resulted, and the exposure risks are minimal or non-existent, it is considered unnecessary and unwarranted to undertake any additional corrective measures at this time.

In regards to evaluation of the landfill cap it was concluded that the low-permeability clay layer exhibits geotechnical properties which are very comparable to those obtained during construction and, consequently, can be expected to be performing as originally designed.

In regards to the pan-lysimeter, water levels in the landfill materials and/or shallow bedrock (Power Glen) are below the elevation of the pan lysimeter and bottom of the excavation, and therefore could not be the cause of the higher than expected infiltration rates observed in the pan-lysimeter.

The most probable cause of the increased infiltration rates appears to be groundwater in the sand drainage layer and/or surface water seeping into the area of the pan lysimeter through secondary permeability features as opposed to water infiltrating solely through the low permeability layer.

In summary, it appears that the low-permeability layer in particular, and the landfill cap in general, are functioning as designed. Furthermore, the higher than expected infiltration rates observed in the pan-lysimeter are not indicative of a failure of the capping system, but are more likely the result of other factors associated with the design and/or construction of the pan-lysimeter installation.

Based on evaluation of the existing site conditions and the potential corrective measures, it is recommended that the No Further Action alternative be implemented at the site.

Additionally, in regards to the pan-lysimeter, it is recommended that its use for monitoring performance of the cap should be discontinued due to the likelihood that problems associated with its installation are providing erroneous data.

As required by the post-closure permit a compliance monitoring program for the site should be developed in consultation with the NYSDEC.

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1.0 INTRODUCTION

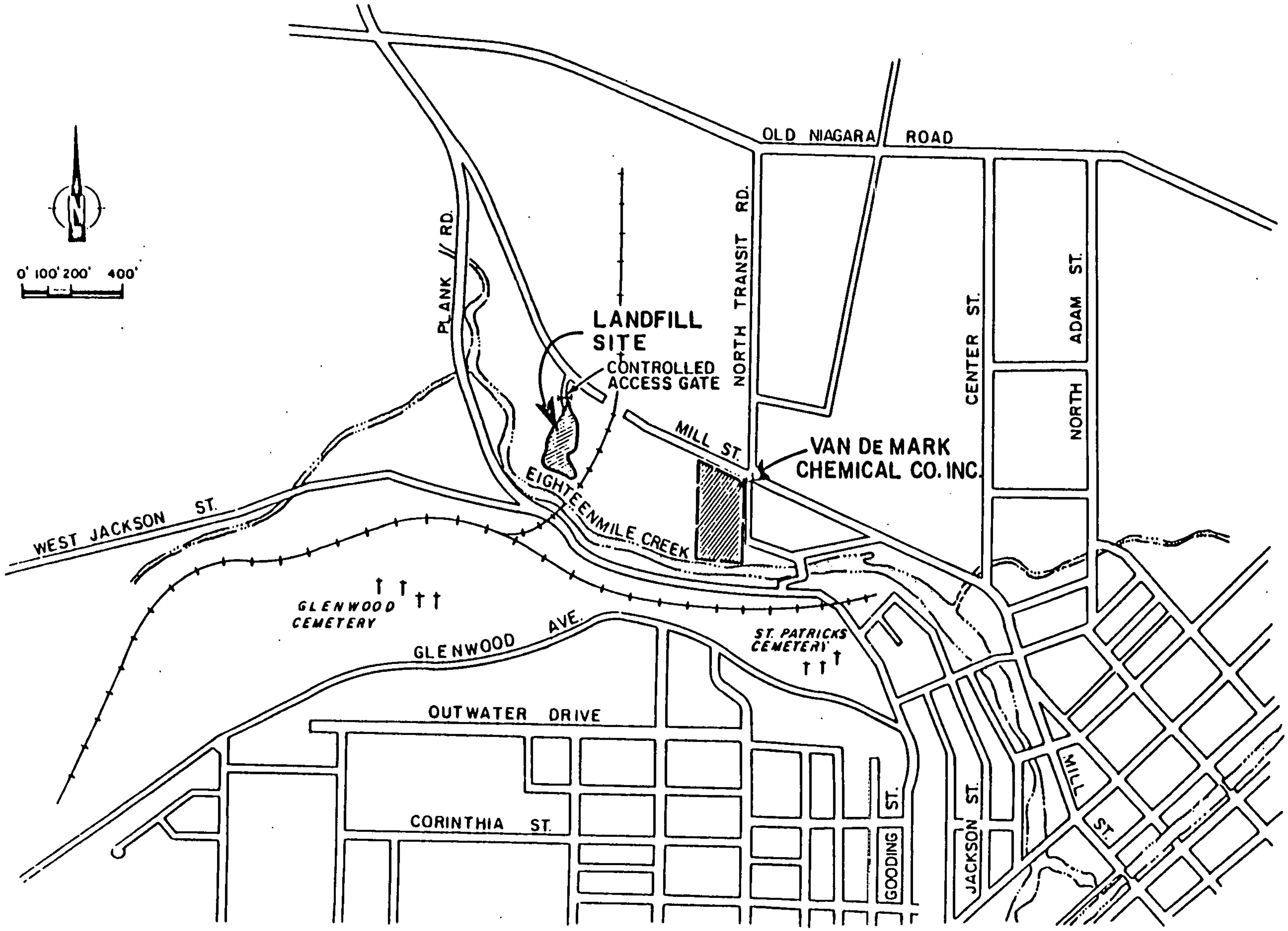
1.1 Background

Van De Mark Chemical Co., Inc. (VDM) owns a landfill which is located between Mill Street and Eighteen Mile Creek, adjacent to their production facilities, in Lockport, New York (Figure 1-1). The landfill occupies approximately 2.5 acres and is situated on a flat plateau, about 80 feet above the creek. During the period from 1957 to 1982, VDM reportedly disposed of chemical waste by-products generated from production of silicon tetrachloride ($SiCl_4$) in the landfill.

Prior to landfilling, the site was utilized as an open-cut quarry for sandstone and limestone. Consequently, the rock of the Grimsby Formation (sandstone) which originally capped the site was removed down to the top of the underlying Power Glen Formation (shale with interbedded dolomite and sandstone). Spoil materials from the mining operation were left in-place over the mined-out areas. This resulted in a layer of soil and rock fragments across the site ranging from about 5 to 13 feet in thickness.

From 1957 to 1979 wastes generated by VDM were disposed in the western half of the site (Figure 1-2). In this portion of the site, landfilling methods consisted of excavating, disposing, and covering of the untreated wastes with the excavated soils. VDM estimates that about 2000 drums of waste were landfilled in this area.

In June 1977, VDM submitted an engineering report (Whitmore, 1977) and applied for a permit to upgrade the condition of the landfill, and proposed the installation of approximately 5-7 feet of soil fill, regrading, and fencing the site for disposal of waste in dug trenches. In this method, trenches approximately 9 feet wide and 7 feet deep are excavated in the overburden. The length of the trenches varies depending on the number of drums. A six inch layer of 2-inch run of crusher limestone is placed in the bottom of the trenches. The semi-liquid wastes in 55-gallon drums are then placed on the prepared limestone bed. The drums are positioned three across, with 6-inches between drums. The spaces around the drums are backfilled with No. 2 (0-1/2-inch size) crushed limestone to the top of the drums, and a 50-lb bag of finished lime



SOURCE: CONESTOGA-ROVERS & ASSOCIATES, INC. 1984

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SITE LOCATION PLAN

FIGURE 1-1

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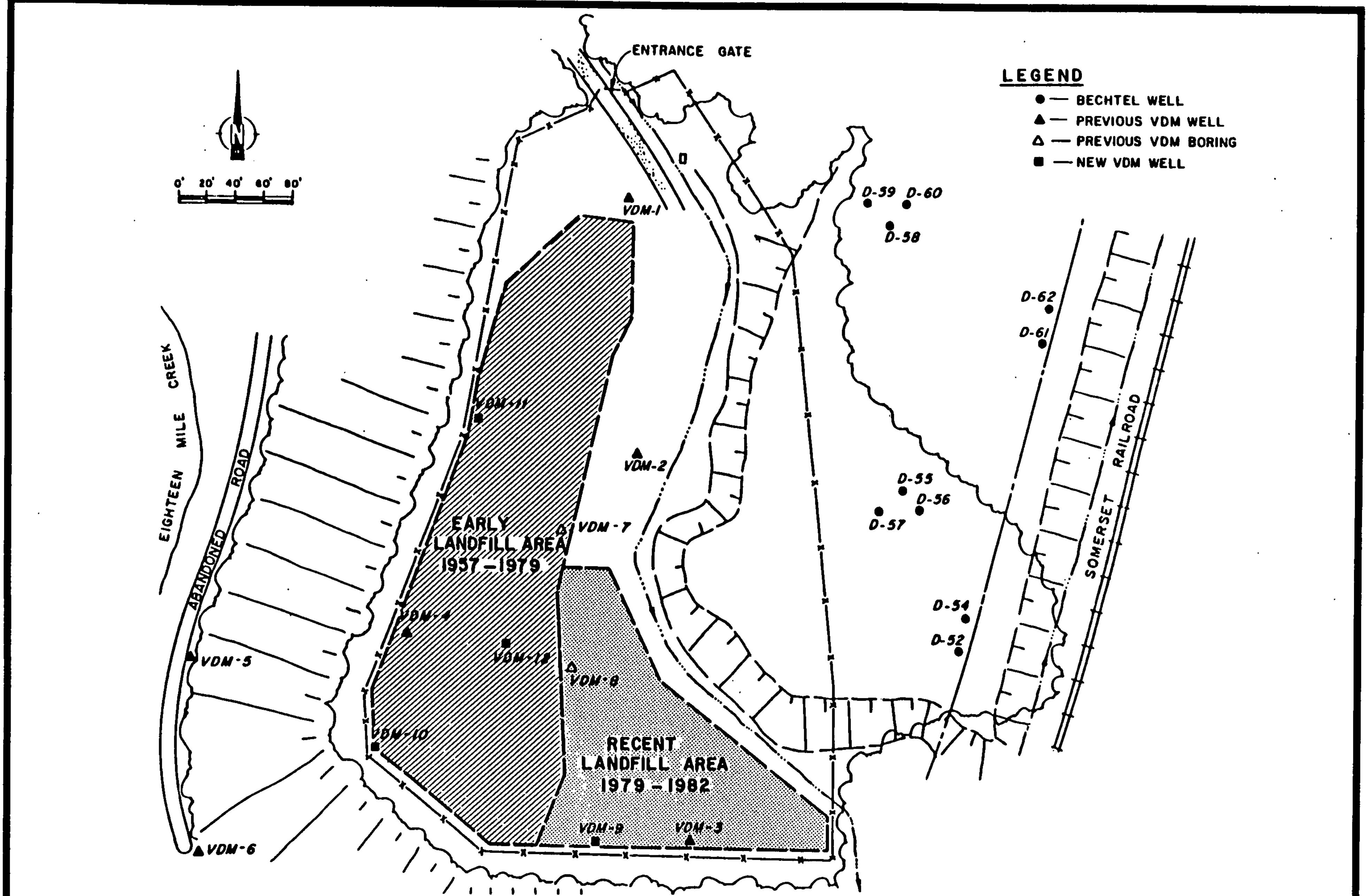

SOURCE: CONESTOGA-ROVERS & ASSOCIATES, INC. 1987

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EARLY AND RECENT LANDFILL AREAS

FIGURE 1-2

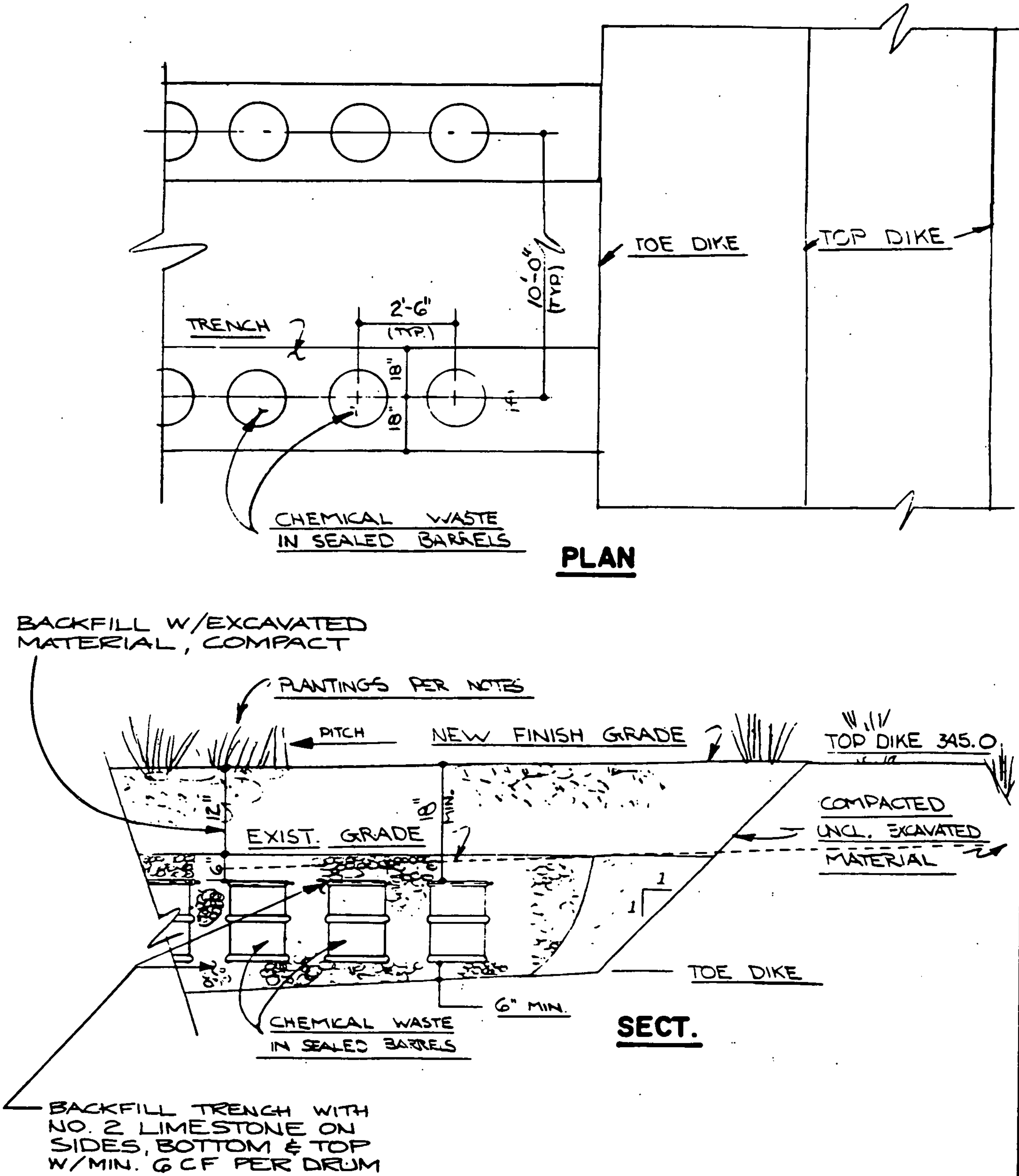
placed on top of each drum. A 6-inch layer of No. 2 crushed limestone is then placed over the lime and drums. This is then covered with 12 inches of excavated material. A hardened steel rod is then pushed vertically into the drums individually through the cover materials. The trench is then backfilled to the original ground surface and the trench location staked and labeled. A typical trench section is presented in Figure 1-3. The overall surface of the site was graded inward such that there was no runoff from the site.

A New York State Department of Environmental Conservation (NYSDEC) permit to operate the eastern portion of the landfill was issued on February 9, 1979 and ran through February 9, 1982. During this period a total of 1307 drums were disposed in the eastern landfill area (Figure 1-2). Following expiration of the permit VDM began disposing pretreated wastes at the Lockport Wastewater Treatment Plant.

As reported by VDM, the wastes consisted of sludges, residues and still bottoms formed as by-products during the commercial production of silicon tetrachloride. The waste materials reportedly consisted of 30 to 70 percent hexachlorodisiloxane, 10 to 50 percent silicon tetrachloride, and 5 to 30 percent carbon and silicon carbide. The hexachlorodisiloxane and silicon tetrachloride decompose into sand (S_iO_2) and hydrochloric acid, Carbon and silicon carbide remain unchanged. The hydrochloric acid reacts with the limestone forming a neutral chloride salt. The owner reported that in 4 to 8 months the only visible remains of the drums are part of the drum rings used to seal the open head drum tops. According to VDM's landfill application, the entire waste mass would eventually become a sand pile with some salt content.

Based on the above discussion, the anticipated leachate produced at the site would be typically acidic and high in chlorides, and would also result in iron leaching from metal present in the landfill and the geologic environment.

The landfill was subsequently closed during the summer of 1987 in accordance with a NYSDEC approved closure plan. As part of this closure, the site was regraded (mounded) to provide positive site drainage and a two-foot thick layer of compacted clay with a maximum permeability of 1×10^{-7} cm/sec was installed. The clay was overlain by drainage and topsoil layers. Additionally, a groundwater monitoring program was initiated using five on-site wells



TRENCH DET.

1/4" = 1'-0"

SOURCE: WILLIAM W. WHITMORE, P.E. CONSULTING ENGINEERS, 1977

URS CONSULTANTS, INC.	WASTE DISPOSAL TRENCHES TYPICAL DETAIL	FIGURE I-3

(VDM-9, -10, -11, -12 and -14), one upgradient well (D-55) and a pan-lysimeter to monitor performance of the cap. VDM-12 has been dry since closure of the landfill was completed.

1.2 Existing Conditions

1.2.1 Geology/Hydrogeology

Several geologic and hydrogeologic studies have been conducted on the site or the immediately adjacent properties to the east (Empire Soils investigation, Inc; Bechtel Civil and Minerals, Inc; and, Woodward Clyde Consultants, Inc.). The relevant data from these reports is summarized in the following sections.

Based on these investigations it was concluded that there are four primary rock units exposed at the site. These include the Grimsby, Power Glen, Whirlpool and Queenston Formations. These sedimentary units are nearly flat lying with bedding striking approximately east-west and dips less then one degree to the south. A generalized stratigraphic column for the site is presented in Table 1-1. A typical geologic cross-section of the site is presented on Figure 1-4.

As indicated in the Bechtel report (Becthel, 1982), the Queenston Formation, is the lowermost formation exposed in the area, and consists of reddish-brown shale with thin interbeds of greenish-gray shale and siltstone. Total thickness of this formation is reported to be 1200 feet. The elevation of the top of the Queenston is about 401 feet msl near 18 Mile Creek and 404 feet msl in the vicinity of Mill Street.

The Whirlpool Formation is a gray to white sandstone. This unit is very hard and fine to medium grained with thin bands of gray shale. In the site area, the Whirlpool Formation outcrops are approximately 11 feet thick. The top of the unit near Eighteen Mile Creek is about elevation 412 feet and about elevation 416 feet near Mill Street.

The Power Glen Formation is a greenish-gray shale and siltstone interbedded with limestone, dolomite, and calcareous sandstone. Thickness of the Power Glen Formation at the

TABLE 1-1

GENERAL STRATIGRAPHIC COLUMN - VDM LANDFILL

System	Series	Group	Formation	Member	Thickness	Description
Silurian	Niagaran	Medina	Grimsby	Zone A	±60'	Sandstone, Siltstone with interbedded Shale: Dark red brown to light green to white sandstone and siltstone with red and green shale interbeds. Sandstone/Siltstone: Thin to medium-bedded, very fine to medium grained, medium hard to very hard, fresh, occasional green mottling, fossiliferous. Shale: Thin bedded to fissile, medium soft, moderately to severaly weathered.
			Power Glen		27.0'	Shale: With interbedded Dolomite and calcareous Sandstone: 60% shale, 40% dolomite and sandstone. Shale: dark gray to green, thin-bedded to fissile, medium soft to soft, microcrystalline, severely weathered. Dolomite and Sandstone: dark gray to green thin-bedded, medium hard, fine-grained, fresh to moderately weathered. Sandstone is cross-bedded.
			Whirlpool		12.0'	Sandstone: White with black speckling (quartz and unknown black mineral), thin-bedded in upper 2', medium-bedded to massive in remainder, fine-grained, hard to very hard, fresh. Cross-bedded, ripple marks.
Ordovician	Cincinnatian	Richmond	Queenston		1200'+	Claystone: Dark reddish-brown with pale green mottling and occasional thin pale green claystone interbeds, medium soft to very soft, clacareous, fresh to completely weathered.

Source: "Closure Plan for Solid Waste Management Facility VAN DE MARK Chemical Company Inc., Lockport, N.Y.", July 1 1982 by William W. Whitmore, Consulting Engineers.

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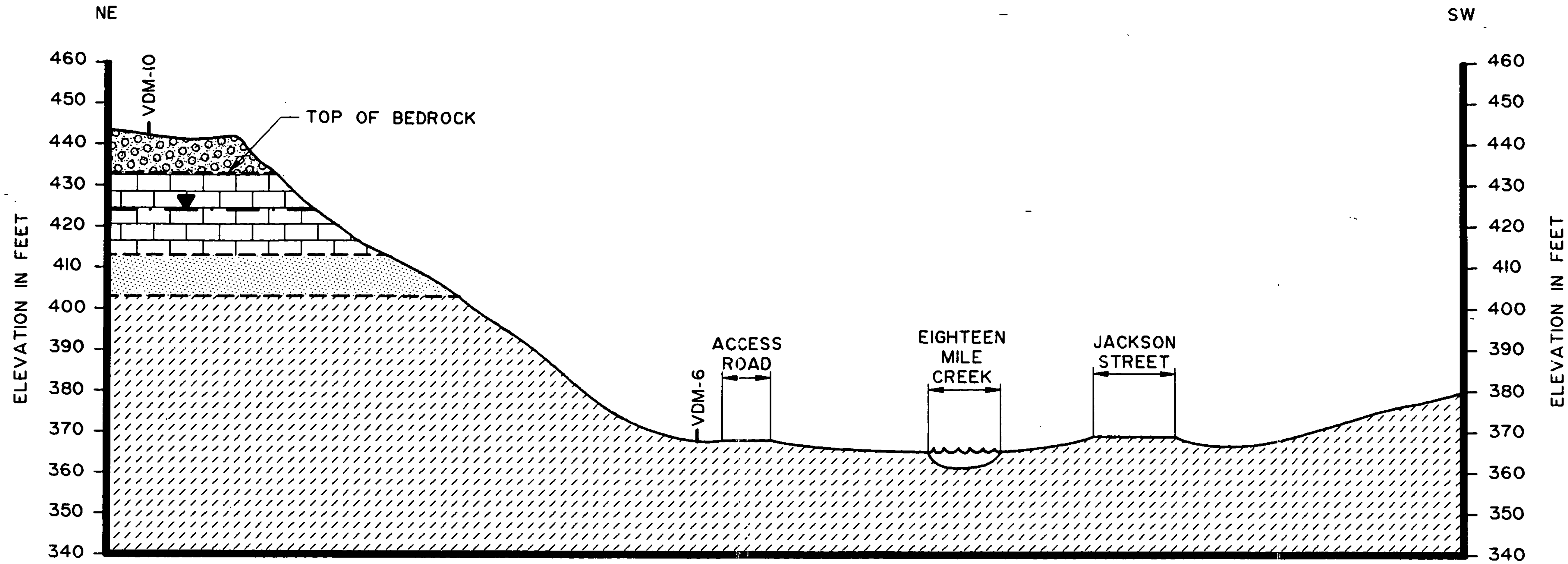

LEGEND

GROUNDWATER SURFACE

LANDFILL/FILL

POWER GLEN FORMATION

WHIRLPOOL FORMATION

QUEENSTON FORMATION

30 0 30

HORIZONTAL & VERTICAL SCALE IN FEET

TYPICAL GEOLOGIC CROSS SECTION

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FIGURE I-4

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site ranges from 20 to 25 feet. The top of the Power Glen generally coincides with the top of rock in the site area due to past quarrying activities, with elevations across the site ranging from about 440 to 432 feet.

The Grimsby Formation includes a lower white to pale-green fine-grained sandstone and an upper reddish-brown sandstone with interbedded siltstone and shale. This unit is exposed in the bluff along the eastern boundary of the site, typically above elevation 440 feet .

Jointing in exposures of bedrock is uniform in orientation and character. Observations from rock cores indicate the joints tend to be open near the bluff and become tighter with increasing depth and distance away from the valley wall. Additionally, vertical stress relief features were noted in the rocks near the valley walls. The frequency of jointing ranges from 3- to 6- foot spacing. Three near-vertical joint sets with orientations of N45W to N70W, N55E to N75E, and N10E to N30E were observed. In addition, horizontal bedding joints are present. Joint openings measured at outcrops near the Van De Mark Landfill ranged from closed to as much as 2 inches.

The rocks underlying the study area appear to have little to no primary (porous) permeability. The occurrence and movement of groundwater is predominantly in the fractures and joints of the rocks. The core from the exploratory holes and the permeability testing indicate that more open jointing tends to occur near the contacts between formations. More open and frequent jointing appears to be present within the Whirlpool and Power Glen Formations in the valley walls adjacent to Eighteen Mile Creek. This is most likely in response to stress relief associated with downcutting of the creek.

Water levels measured in observation wells at the site and surrounding area show that at least four zones of groundwater are present between the ground surface east of the site and the Queenston Formation, and that large differences in water levels are present between the zones. The first zone monitored (Zone 1) is groundwater present in the Grimsby Formation east of the Landfill. Considering that the Grimsby has been excavated in the immediate site area, this zone does not occur. Consequently, it is not considered further in this report.

The second zone (Zone 2) is groundwater at the Grimsby (Overburden)/Power Glen contact. The apparent direction of groundwater movement in this zone is to the south (Figure 1-5).

The third and fourth zones are the groundwaters at the Power Glen/Whirlpool and Whirlpool/Queenston contacts, respectively. The apparent direction of groundwater movement in these zones is also to the south.

As indicated in Table 1-2, the permeability measurements made in the Grimsby and Power Glen Formations range from 2.1 x 10^{-3} to 1.27 x 10^{-6} cm/sec. These measurements are supported by the permeability measurements made from the well purging data. The higher permeabilities measured were from drill holes close to the valley walls, for example, D-53 and D-55 (Figure 1-6). This probably reflects the condition of the jointing. Near the valley, the rock is more jointed and permeable, whereas away from the valley and with depth, the joints become less frequent and tighter. It is probable that the effective permeability of Zone 2 under the northern part of the landfill is less than 10^{-5} cm/sec. Closer to the bluff, the effective permeability may be as high as 10^{-3} cm/sec. Considering this range of permeability and the available hydraulic gradient indicated by the water level measurements shown on Figure 1-5, the rate of flow beneath the landfill will be very small.

The database provided by the Bechtel study identified the primary zone of groundwater flow in the vicinity of the landfill to be the overburden/Power Glen Formation contact. It was also indicated that bedding planes are the major water bearing intervals and routes of water migration. This is supported by the observation (prior to landfill capping) of a seep in the valley wall south of VDM-10, which coincides with the overburden/Power Glen Formation contact zone. It is recognized that some vertical permeability exists, however, it is considered to be small in comparison to the horizontal permeability (one or two orders of magnitude less). Near the valley walls vertical permeability may be more of a factor as a result of the increase in joining and fracturing due to stress relief.

Furthermore, it was concluded based on the geology of the site and various investigations, that groundwater passing under the landfill is ultimately discharged to Eighteen Mile Creek. This

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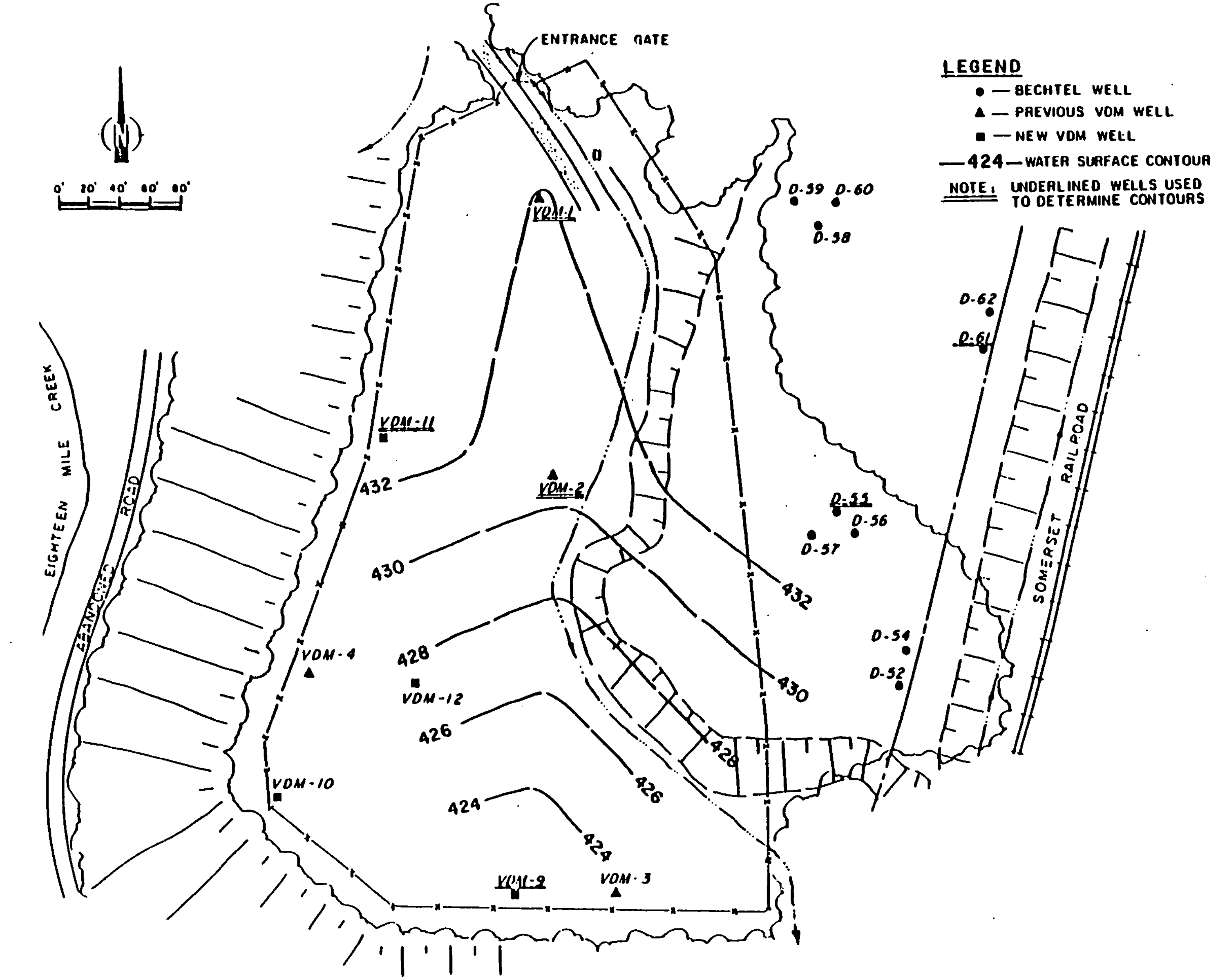

SOURCE: CONESTOGA-ROVERS & ASSOCIATES, INC. 1984

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GRIMSBY/POWER GLEN AQUIFER
WATER SURFACE CONTOURS (PRIOR TO CAPPING)

FIGURE 1-5

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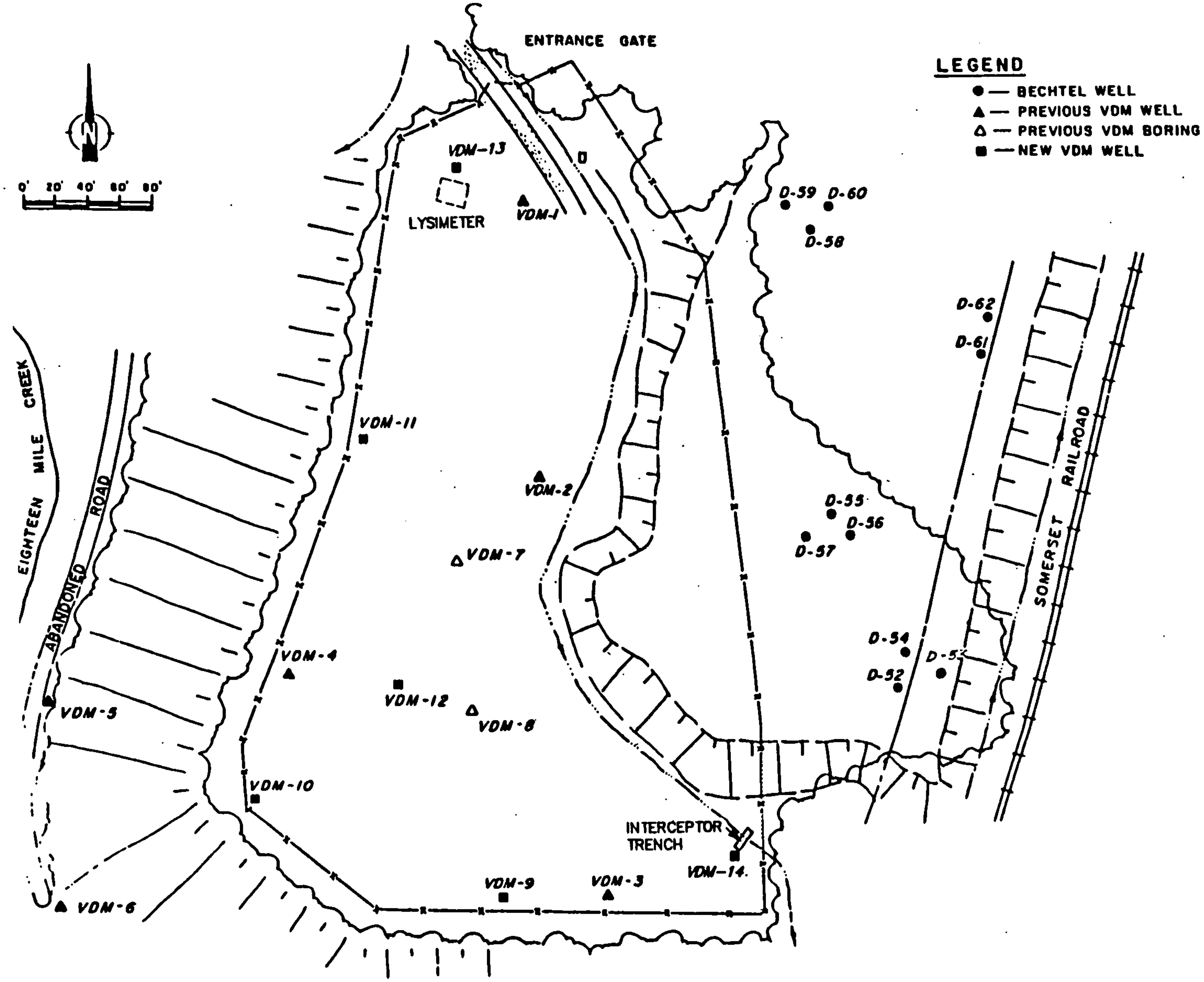

SOURCE: CONESTOGA-ROVERS & ASSOCIATES, INC. 1993

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MONITORING WELL LOCATION PLAN

FIGURE 1-6

is based primarily on the assumption that the base of the aquifer system would be the Queenston Shale.

This is supported both by the geologic and hydrogeologic data for the site. Permeability test data from borings installed in the upper portions of the Queenston (Table 1-2) indicate that permeability is generally very low, being on the order of 4 x 10^{-6} cm/sec or less. In several cases, no measurable water take was observed during testing. In a few instances, higher permeabilities, up to 1 x 10^{-2} cm/sec, were noted. These are presumably associated with discrete fractured or more permeable zones at depth within the Queenston.

Additionally, historical (1981) groundwater measurements taken in monitoring wells VDM-3 and -4 which were installed at the landfill and screened in the Queenston indicated water levels which fluctuated between elevation 362.1 and 373.7 feet, and 405.5 and 406.4 feet, respectively. These levels are both above the water elevation in Eighteen Mile Creek which is about elevation 359 feet. Due to the southerly dip of the bedrock units, it would also be expected that groundwater moving through confined zones within the Queenston would be under artesian pressure which would result in upward hydraulic gradients in the vicinity of the valley/creek. Consequently, water flowing vertically downward from the upper water bearing zones (Zones 2 and 3) will be 1) restricted from further vertical migration when it reaches the Queenston due to the extremely low permeability of this unit, or 2) will merge with the water, flowing along secondary porosity features in the upper portion of the Queenston. In either case, considering that the top of the Queenston is at approximately elevation 401 feet near the creek and groundwater elevations in the upper portion of the Queenston are above the elevation of Eighteen Mile Creek, the groundwater will be directly discharged into Eighteen Mile Creek. Additionally, these geologic/hydrogeologic conditions as described above would prevent groundwater in the site area from migrating beyond Eighteen Mile Creek.

1.2.2 Groundwater Quality

VDM has been monitoring groundwater quality at the landfill site since 1979. Initially samples were collected intermittently from the early monitoring wells at the site (VDM-1 to -8). However, with issuance of the permit for operation of the landfill in 1979, additional wells

(VDM 9-12) were installed, and a routine quarterly monitoring program implemented which continues to date. The wells currently included in the program consist of D-55 (background) and VDM-9, -10, -11, -12, and -14 (Figure 1-6).

The parameters being analyzed include Volatile Organic Compounds (VOCs), Semivolatile Organic Compounds (SVOCs) and Resource Conservation Recovery Act (RCRA) metals. The results of these analysis have been summarized by VDM in a series of tables and graphs and statistically evaluated. Copies of these data are included in Appendix A.

Table 1-3 presents a summary of the average concentrations of the various chemicals detected in the monitoring wells during the two year period following closure of the landfill (1988-1990). A comparison of these values with the groundwater protection concentrations (GPCS) established in VDM's NYSDEC Part 373 post-closure permit (Nov., 1990) indicated that the following chemicals had occasionally exceeded the GPCs: carbon tetrachloride, chloroform, 1,2-dichloroethane, trans-1,2-dichloroethene, methylene chloride, 1,1,2,2-tetrachloroethane, tetrachloroethylene, tetrachloroethene, vinyl chloride, toluene, and phenols. Additionally (total) arsenic, copper, iron, lead and zinc had exceeded the GPCs during this period.

As required by their post-closure permit, VDM conducted a four year investigative monitoring program (Nov., 1990 to Nov., 1994) to monitor performance of the landfill cap. The data from this program is summarized in the tables prepared by VDM (Appendix A) and is represented by the last 16 data points for each well.

Based on a review of the data during this period (Appendix A) it would appear that many VOC and metal concentrations have been reduced relative to the pre-capping levels. However, some VOCs and metals concentrations have increased somewhat during this period. This is most likely due to changes in the quantities of water infiltrating through the cap and paths followed by the infiltrating water following capping. Decreases in the volume of flow through a source of contamination can result in increases in "observed" contaminant concentrations due to the decreases in dilution associated with the lower flows. Similarly, decreases in flow volumes may reduce the flow rates, thereby increasing the contact time between the water and the contaminant source, and consequently, the observed contaminant concentrations. Changes in the flow paths

TABLE 1-3

Average Groundwater Concentrations
VanDeMark Landfill

Monitoring Wells

Constituent	GPC	VDM-9	VDM-10	VDM-11	VDM-14	D-55
Carbon Tetrachloride	5	11.6	1.0	14.4	5.2	1.0
Chloroform	8	117.2	148.0	67	43.1	1.0
Chloromethane	5	2.6	3.3	2.3	4.5	1.9
1,2-Dichloroethane	5	10.2	8.6	3.2	4.1	1.0
Trans-1,2-Dichloroethene	5	9.0	1.2	1.4	3.1	1.0
Methylene Chloride	5	33.2	7.6	5.2	6.4	1.5
1,1,2,2-Tetrachloroethane	5	136.2	2.5	84.4	85.1	1.1
Tetrachloroethene	5	22.9	1.0	34.2	17.3	1.0
Trichloroethene	5	20.3	1.4	4.8	63.1	1.0
Vinyl Chloride	2	1.3	1.2	1.4	1.3	1.3
Toluene	5	1.5	41.2	1.0	1.0	1.0
Phenols	1	41	81.2	18.8	12.1	9.6
Arsenic	25	24.1	19.2	27.8	10.8	10.6
Chromium	50	39.3	30.8	45.5	2779	20.8
Copper	200	2561	2820	1757	47.6	108.3
Iron	300	4E+5	51550	43590	2E+5	4972
Lead	25	362.7	141.5	118.8	124.6	98.2
Mercury	2	0.7	0.8	0.6	0.5	0.5
Zinc	300	2086	2715	2698	587	113.7

SOURCE: NYSDEC Post-Closure Permit

associated with reduced infiltration may result in changes with respect to which contaminant sources are contacted by the infiltrating groundwater. These changes would be reflected in corresponding changes in the observed contaminant concentrations in the downgradient monitoring wells. A summary of the chemicals which were detected more than once during this period at concentrations exceeding the GPCs is presented below.

VDM-9 - Exceedances for: Chloroform, 1,2-dichloroethane, Trans-1,2-dichloroethene, methylene chloride, 1,1,2,2-tetrachloroethane, tetrachloroethene, trichloroethene vinyl chloride, phenols, arsenic, chromium, copper, mercury, and zinc.

VDM-10 - Exceedances for: Chloroform, 1,2-dichloroethane, methylene chloride, toluene. 1,1,2,2-tetrachloroethane, vinyl chloride, phenols, chromium, copper, zinc.

VDM-11 - Exceedances for: tetrachlorethane, chloroform, 1,1,2,2-tetrachloroethane, vinyl chloride, phenols, copper, and zinc.

VDM-12 - This well has been dry since capping of the landfill was completed.

VDM-14 - Interceptor trench - Exceedances for: carbon tetrachloride, chloroform, trans-1,2-dichloroethene, 1,1,2.2-Tetrachloroethane, tetrachloroethene, trichloroethene, vinyl chloride, phenols, chromium, and zinc.

D-55 - Exceedances for: No exceedances

1.2.3 Surface Water Quality

Surface water samples were collected from upstream and downstream locations in Eighteen Mile Creek (Figure 1-7) during the period of May 12, 1986 to February 15, 1989. No impacts on the creek were observed during this period, and the NYSDEC agreed to discontinuing any further monitoring. The analytical data for these samples is contained in Appendix B.

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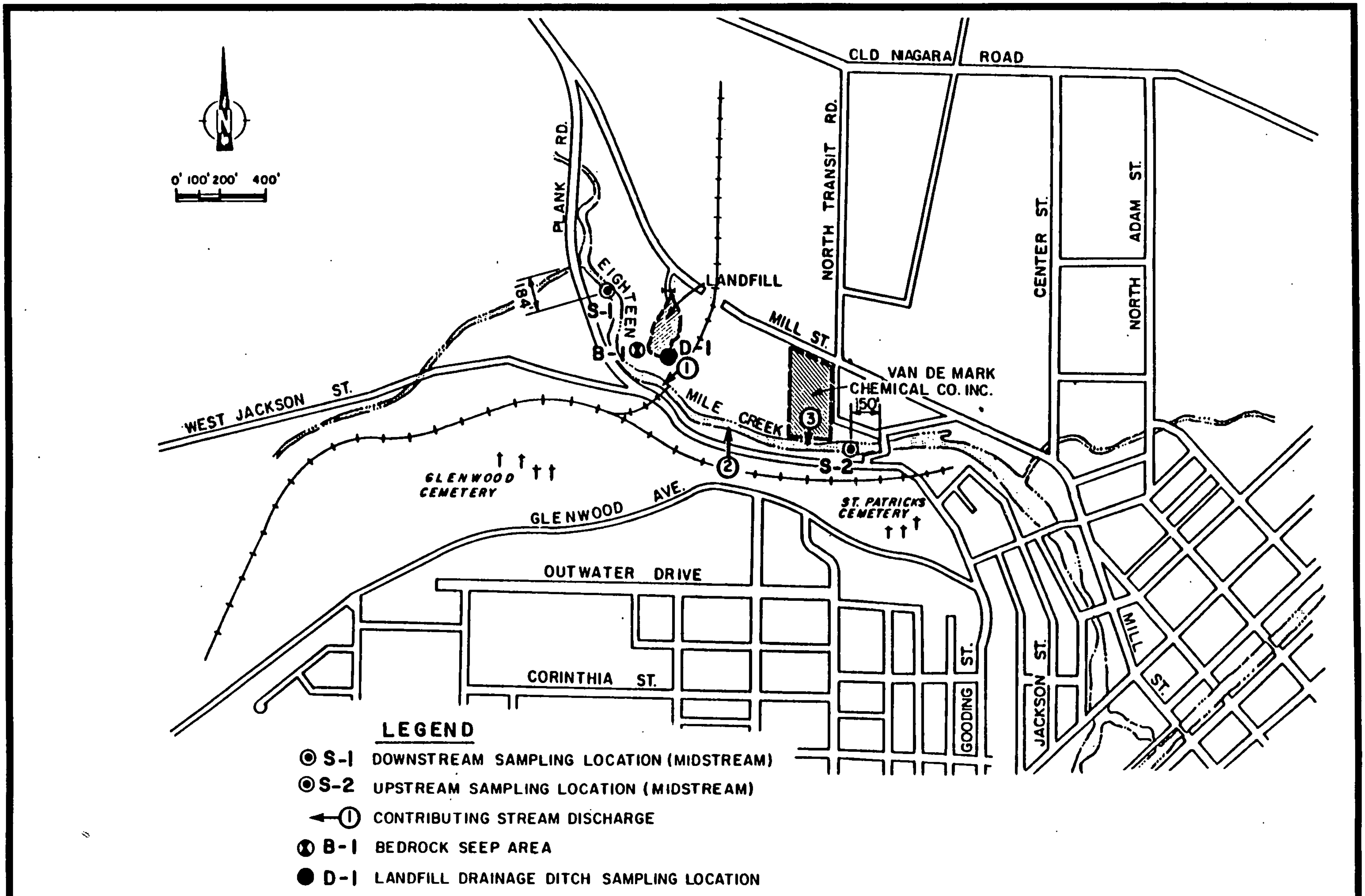


SOURCE: CONESTOGA-ROVERS & ASSOCIATES, INC. 1987

URS CONSULTANTS, INC.

EIGHTEEN MILE CREEK SAMPLE LOCATIONS

FIGURE 1-7

1.2.4 Pan-lysimeter

As required by their post-closure permit VDM has utilized the pan-lysimeter to monitor performance of the clay cap. Table 1-4 indicates the rates at which water recharges to the pan-lysimeter. These rates are higher than anticipated based on design calculations.

1.3 Purpose

As specified in their permit, VDM is required to conduct a corrective measures study (CMS) to evaluate various corrective measures which may be implemented at the site, and to assess the current condition and performance of the clay cap relative to the pan-lysimeter data.

1.4 Objective

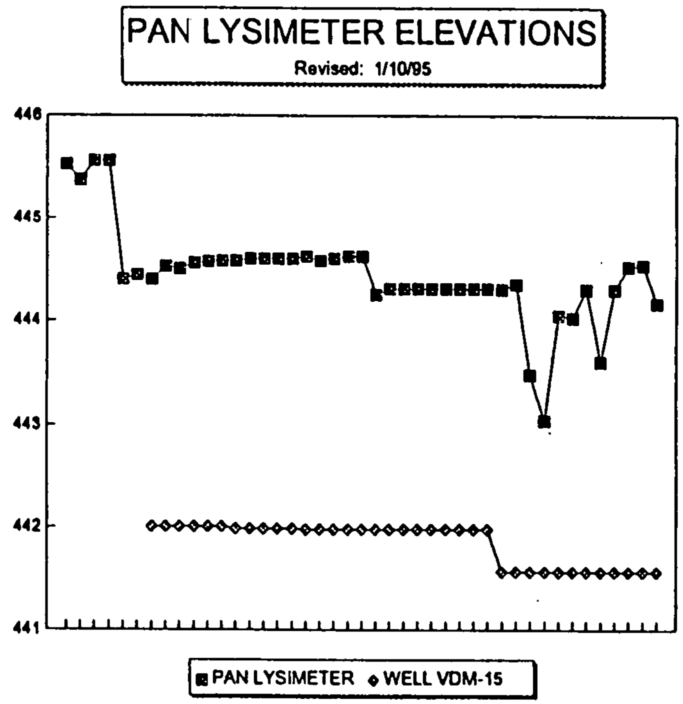
The objective of the CMS is to evaluate various corrective measure strategies that are technologically feasible, reliable, and which effectively minimize risks to human health and the environment.

In regards to the clay cap assessment, the objective is to collect sufficient data to verify whether or not the cap is performing as per design specifications, and/or whether the pan-lysimeter is providing erroneous data.

TABLE 1-4

PAN LYSIMETER WATER ELEVATION READINGS
VANDEMARK LANDFILL - LOCKPORT, NY
REVISED: 1/10/95...(file data/123w/pan)

	PAN LYSIMETER		WELL VDM - 15		
		453.27		450.57	water pumped out
DATE	DEPTH	ELEVATION	DEPTH	ELEVATION	of the Panlysimeter
5/14/93	7.75	445.52			
5/19/93	7.9	445.37			
5/27/93	7.71	445.56			
6/8/93	7.71	445.56			
7/8/93	8.875	444.395			
8/30/93	8.83	444.44			
2/10/94	8.875	444.395	8.56	442.01	
2/18/94	8.75	444.52	8.56	442.01	
3/24/94	8.77	444.5	8.56	442.01	
3/30/94	8.71	444.56	8.56	442.01	
4/15/94	8.7	444.57	8.56	442.01	
4/22/94	8.69	444.58	8.56	442.01	
4/27/94	8.69	444.58	8.58	441.99	
5/4/94	8.67	444.6	8.58	441.99	
5/13/94	8.67	444.6	8.58	441.99	
5/18/94	8.67	444.6	8.58	441.99	
5/25/94	8.67	444.6	8.58	441.99	
6/3/94	8.65	444.62	8.59	441.98	
6/9/94	8.69	444.58	8.59	441.98	
6/16/94	8.67	444.6	8.59	441.98	
6/24/94	8.65	444.62	8.59	441.98	
6/29/94	8.65	444.62	8.59	441.98	
7/1/94	9.02	444.25	8.59	441.98	
7/7/94	8.96	444.31	8.59	441.98	
7/13/94	8.96	444.31	8.59	441.98	
7/20/94	8.96	444.31	8.59	441.98	
7/29/94	8.96	444.31	8.59	441.98	
8/3/93	8.96	444.31	8.59	441.98	
8/12/94	8.96	444.31	8.59	441.98	
8/23/94	8.96	444.31	8.59	441.98	
8/30/94	8.96	444.31	8.59	441.98	
10/17/94	8.97	444.3	9	441.57	10 gal
10/20/94	8.92	444.35	9	441.57	2.5 gal / 3 days
10/25/94	9.79	443.48	9	441.57	2.5 gal / 4 days
11/3/94	10.22	443.05	9	441.57	0 gal / 7 days
11/10/94	9.22	444.05	9	441.57	
11/11/94	9.24	444.03	9	441.57	2 gal / 8 days
11/16/94	8.97	444.3	9	441.57	2.5 gal/5 days
12/2/94	9.66	443.61	9	441.57	3 gal/16 days
12/16/94	8.97	444.3	9	441.57	3.5 gal/15 days
12/27	8.75	444.52	9	441.57	2.5 gal / 8 days
1/3/95	8.73	444.54	9	441.57	1.75 gal / 8 days
1/10/95	9.1	444.17	9	441.57	could not pump - pump broke



SOURCE: VanDeMark Chemical Ltd. (April 1995)

2.0 BASELINE HEALTH RISK ASSESSMENT

This section presents a preliminary identification of the potential for adverse health effects, if any, from the release of contaminants from the VDM Landfill. The Qualitative Health Risk Assessment (HRA) uses data and information collected during the various investigations conducted previously at the site and from the ongoing groundwater monitoring program.

At present, the analytical data is limited to groundwater samples only. This data has been summarized and statistically evaluated by VDM as required by the post closure permit. The data utilized in this HRA is contained in Appendix A. The analytical data contained in the previous reports and summary tables prepared by VDM and provided to URS were utilized "as-is". No data validation or other QA/QC review were performed. Potentially irregular data values have been noted by URS, in Appendix A, but not modified.

2.1 Identification of Potential Chemicals of Concern

In order to provide a conservative assessment of the health risk poses by the site, all the chemicals specified in VDM's post-closure permit (Table 2-1) were determined to be potential chemicals of concern and retained for further evaluation.

2.2 Potential Exposure Pathways

Exposure pathways describe the movement of contaminants from sources (e.g. chemicals in soil) to exposure points where receptors (potentially exposed populations) may come in contact with the contaminants. This movement usually involves release of contaminants from the source to an intermediate transport medium (e.g. groundwater) between source and receptor point.

Based on the type of contaminants detected and the physical setting of the site, there are a number of different pathways whereby contaminants could be released to the environment. These pathways include:

TABLE 2-1

Exceedance Concentrations
VanDeMark Landfill

Constituent	Monitoring Point			
	VDM-9	VDM-10	VDM-11	VDM-14
Carbon Tetrachloride	30	10	30	30
Chloroform	200	200	200	100
Chloromethane	20	20	20	20
1,2-Dichloroethane	30	30	30	30
Trans-1,2-Dichloroethene	40	10	10	10
Methylene Chloride	70	30	30	30
1,1,2,2-Tetrachloroethane	200	20	120	100
Tetrachloroethene	65	20	100	65
Trichloroethene	50	20	30	30
Vinyl Chloride	15	15	15	15
Toluene	20	60	20	20
Phenols	60	100	60	60
Arsenic	60	60	70	60
Chromium	60	80	60	8500
Copper	4000	9500	4000	300
Lead	500	500	500	500
Mercury	5	5	5	5
Zinc	5000	4000	4000	1000

Notes:

1. All Values in ug/l (ppb)
2. Source - VDM'S NYSDEC Part 373 Post Closure Permit (Nov, 1990)

- Direct releases through the cap to air due to volatilization of contaminants or generation of gases from degradation or decomposition;

- Resuspension to air along with surface dust;

- Leaching of chemicals from landfill waste materials and soils to groundwater under the site with migration to off-site groundwater, surface water or deeper water-bearing zones.

2.3 Contaminant Migration Potential

This section assesses the potential for releases of chemicals to the environment along each of the pathways identified above. Factors to be considered include the concentrations of the chemicals, physio-chemical properties of the chemicals (i.e. solubility, mobility, adsorption), media impacted, location at the site (i.e. exposure to air or water), climatic conditions (i.e. precipitation, wind, temperature), and groundwater flow/gradients.

2.3.1 Releases to Air

As indicated in Section 2.1 a number of VOCs have been identified as chemicals of concern at the site. These chemicals all have high vapor pressures and high diffusion coefficients which allow them to volatilize easily and diffuse readily through soil. Therefore, all of these could be of potential concern for direct emission to the air.

No data is available on the concentration of the VOCs in the landfill materials/soils. However, it is likely that prior to capping, VOCs in the near surface soils were emitted to the air, migrated along other pathways, or have degraded. Additionally, since regrading of the site and installation of the low permeability cap over the landfill, the potential for emission of any remaining VOCs has been significantly reduced. The VOCs at depth in the landfill and soils could potentially result in emissions to the air if they were disturbed through excavation or other activities which would bring them to the surface.

The other mode for chemicals to be released to the air is by re-suspension along with dust. This would include metals and organic compounds which exist as both free particles and adsorbed onto soil grains in the surface soils and at depth. Considering that the entire landfill has been regraded and covered with several feet of clean soils and a low permeability cap, the potential for resuspension of chemically contaminated particles is extremely low.

2.3.2 Migration to Groundwater

Historical data indicate that organic compounds (silicon tetrachloride and hexachlorodisiloxane) and metals were disposed in the landfill. As noted, these organic compounds react with water, lime/limestone and degrade to sand (SiO_2), salts, hydrochloric acid, and a variety of VOCs depending on the completeness of the reactions. The potential for these constituents to migrate to the groundwater is dependent upon the amount of water infiltrating through the landfill cap to the waste material and the physio-chemical properties of the individual chemicals. These include solubility, mobility, volatility, viscosity, adsorption characteristics, and molecular weight.

In most cases, VOCs are highly mobile, moving through soil by advection and dispersion along with groundwater. Metals are generally less mobile and exhibit low solubilities in water. However, these solubilities are most likely increased at the site due to the low pH (acidity) of the groundwater.

As indicated by the groundwater monitoring well data, there are a limited number of VOCs and metals which were detected, generally at low concentrations. It should be noted that the metals concentration represent "total" metals, and not "soluble" metals. The metals concentrations can be highly influenced by the amount of suspended particles in the samples, and consequently, may not be truly representative of the actual metals concentrations leaching to groundwater.

In regards to the deeper water bearing zones (Zones 3 and 4), these waters are not in direct contact with the contaminated soils/wastes. These deeper zones are generally isolated from the contaminated soils/wastes by intervening, low-permeability rock formations.

In summary, the potential for contaminants (VOCs) to migrate from the contaminated soils and wastes at the site to the groundwater flowing under the landfill is considered to be high. For the most part, the metals have low solubilities, although the low pH of the groundwater may increase the potential for leaching.

2.3.3 Migration to Off-site Groundwater/Surface Water/Deeper Water-Bearing Zones

As discussed in Section 1.2.1 - Site Geology/Hydrogeology, flow within the shallow aquifer (Zone 2) beneath the site is to the south and/or southwest toward Eighteen Mile Creek. Near the cliff face a portion of the groundwater flows downward through vertical fractures in the rock units until it reaches the top of the Queenston shale and is re-directed horizontally to the cliff face or mixes with groundwater in the upper portion of the Queenston and flows towards Eighteen Mile Creek. Ultimately, all the groundwater flowing under the site discharges at the cliff face or directly to Eighteen Mile Creek along with groundwater from the Queenston as discussed previously. Groundwater discharged at the cliff face:

- Evaporates to the atmosphere; or
- Flows overland down the slope and into Eighteen Mile Creek. (It is to be noted that no overland flow of groundwater has been observed in the exposed portions of the cliff face, since capping of the landfill, although some flow may occur in those portions of the cliff which are covered by rock talus and/or loose soil.)

In regards to migration of contaminants from the shallow aquifer to the deeper water - bearing zones, the previous investigations have shown that these zones are hydraulically separated by the intervening low-permeability rock units, and are not in direct contact with each other. It may be postulated that a certain amount of vertical downward flow occurs from the upper to lower units due to the high vertical hydraulic gradients which exist between the zones. However, horizontal flow (toward the cliff face) along bedding planes and horizontal joints/fractures is most likely as much as two orders of magnitude higher than the vertical flow. Evidence of horizontal flow with discharge at the cliff face is provided by the observation of a seep in the cliff face at the approximate overburden/Power Glen contact prior to capping of the landfill. The seep has not been noted since capping was completed in 1988. This appears to be due to a decrease in infiltration into the landfill due to placement of the low permeability cap.

The low pH (acidic) of the groundwater under the site may also result in solutioning along joints, fractures and bedding planes within the horizontal limestone/dolomite units (Power Glen), thereby increasing the permeability of these units still further. Additionally, should any contaminants migrate vertically to the lower zones, they still will be discharged at the cliff face as discussed below.

Based on existing site conditions there is some potential for mixing of waters from the three zones in the area at, or very near, the cliff face. As indicated previously, the rock units in the immediate vicinity of the cliff face are more fractured and contain vertical stress relief fractures which may cut across formation boundaries. Consequently, as waters moving horizontally in each of the three zones intersect this fractured area, they will flow (unconfined) vertically downward until they reach the upper portion of the low-permeability Queenston shale.

Due to the unconfined nature of the groundwater flow in this zone, there is little if any possibility that hydraulic heads would develop that would result in contaminant migration from the fractured area into the lower zones. However, there is some potential for contaminants to migrate into the lower zones by diffusion, although this is considered very unlikely. It is more probable that mixing of water from the lower units with contaminated water from the upper zone will help reduce the concentrations of the contaminants.

As discussed in Section 1.2.1, the waters reaching the upper portion of the Queenston will 1) be restricted from further vertical migration due to the extremely low permeability of this unit or 2) flow with the water moving through the upper portion of the Queenston. In either case, considering that the top of the Queenston is at approximately elevation 401 feet near the creek and, groundwater elevations in the upper portion of the Queenston are above the water elevation of Eighteen Mile Creek, the groundwater will be discharged to the cliff face and/or directly into Eighteen Mile Creek.

Additionally, due to the southerly dip of the bedrock units, it would also be expected that groundwater moving through confined zones within the Queenston would be under artesian pressure. This would result in upward vertical hydraulic gradients in the vicinity of the valley/creek. Consequently, any groundwater from the upper zones which migrates into the upper portion of the Queenston will be discharged to the cliff face and/or directly into Eighteen Mile Creek. As a result of the hydrogeologic conditions in the vicinity of the creek, it is not possible for any contaminants to migrate beyond the creek.

Based on the existing geologic/hydrogeologic conditions discussed above, the primary potential transport scenario at the site is for contaminants to be discharged to surface water in Eighteen Mile Creek. However, due to the decrease in infiltration to the landfill as a result of regrading and capping the site, the seep which previously existed in the cliff face has ceased flowing. It is possible that some seeps may occur in the lower portions of the cliff, but not be visible due to the rock talus covering the slope in these areas.

As discussed in sections 4.3.2 and 4.3.3 the overall flow beneath the landfill prior to regrading of the site and installation of the clay cap was estimated at approximately 804,500 gal/yr. Following regrading and capping of the site this flow was reduced to about 92,000 gal/yr, a reduction of almost 89 percent.

Additionally, relative to Eighteen Mile Creek, the minimum flow immediately adjacent to the site is 30 cfs during the winter (without canal contributions), with an average flow during summer months of 69.3 cfs. (These figures were reported to the NYSDEC by the City of Lockport WWTP.) This equates to a winter flow of 19.4 mgd and a summer flow of 44.8 mgd. By comparison, the estimated flow from the site (92,000 gal/yr) equates to 0.000252 mgd. Consequently, the ratio of flow in the creek as compared to site flow ranges from 77,000:1 during the winter to 178,000:1 during the summer.

In addition, the mass loading of chemicals which may reach Eighteen Mile Creek due to discharge of contaminated groundwater in the cliff face was estimated. This was done for both pre-grading/capping and post-grading/capping conditions. The mass loadings for each chemical were calculated by multiplying the average concentration of the chemical as measured in VDM-9,

-10, and -11 (Appendix A) by the overall volume of flow. The result of these calculations are summarized in Table 2-2. As indicated, the estimated total organic loading has been reduced from 4.061 lbs/yr to 0.207 lbs/yr and total metals loading has been reduced from 35.057 lbs/yr to 3.691 lbs/yr. These represent reductions of approximately 95 and 89 percent respectively, as a result of regrading/capping the landfill.

Additionally, based on the minimum flow rates in Eighteen Mile Creek and the mass loading numbers, the impact from the total organics is calculated to be less than 0.004 ~~3~~ ug/L per day, whereas from total metals the impact would be less than 0.063 ug/L per day. Based on the above discussion, it is obvious that the assimilative capacity of Eighteen Mile Creek, even during periods of low flow, is such that no discernible impact will result from discharges of contaminated groundwater from the landfill.

This conclusion is supported by the analytical data (Appendix B) which was collected from both upstream and downstream locations in Eighteen Mile Creek during the period of May 1986 to February 1989 (prior to and immediately after capping) which did not show any exceedances of NYSDEC surface water standards for any site-related contaminants. Based on the sampling results the NYSDEC allowed VDM to discontinue any further monitoring of the creek due to the lack of any observable impacts.

This assessment is considered to be conservative in that it assumes that 100 percent of the contaminants detected in the groundwater at each well are being discharged directly to Eighteen Mile Creek. This does not allow for any volatilization of the VOCs or precipitation or attenuation of the metals which may occur during transport from the site to Eighteen Mile Creek. These factors would be expected to significantly reduce the actual mass loading to the creek.

2.3.4 Migration Off-Site in Surface Water

Considering that the entire landfill has been capped, there is no potential for surface waters to be contaminated by direct contact with any of the waste materials. Additionally, there have been no known leachate breakouts anywhere on the above-grade portions of the landfill. As noted previously, a seep did exist in the cliff face below the landfill, however, this seep has

TABLE 2-2
MASS LOADING ANALYSIS
VANDEMARK LANDFILL

PARAMETER	BEFORE						AFTER					
	VDM9 MEAN CON-CENTRATION BEFORE CAP ug/L	VDM10 MEAN CON-CENTRATION BEFORE CAP ug/L	VDM11 MEAN CON-CENTRATION BEFORE CAP ug/L	AVERAGE MEAN CON-CENTRATION BEFORE CAP ug/L	FLOW BEFORE CAP gal/year	MASS (1) LOADING BEFORE CAP lbs/year	VDM9 MEAN CON-CENTRATION AFTER CAP ug/L	VDM10 MEAN CON-CENTRATION AFTER CAP ug/L	VDM11 MEAN CON-CENTRATION AFTER CAP ug/L	AVERAGE MEAN CON-CENTRATION AFTER CAP ug/L	FLOW AFTER CAP gal/year	MASS LOADING AFTER CAP lbs/year
Carbon Tetrachloride	12.71	3.2	24.76	13.56	804500	0.091	6.02	3.08	6.37	5.16	92000	0.004
Chloroform	195.57	85.94	84.62	122.04	804500	0.819	95.5	95.84	35.15	75.50	92000	0.058
Chloromethane	3.86	5.13	5	4.66	804500	0.031	3.3	2.49	2.83	2.87	92000	0.002
1,2-Dichloroethane	12.8	5.6	4.68	7.69	804500	0.052	12.52	9.06	2.61	8.06	92000	0.006
Trans-1,2-Dichloroethane	14	3.54	4.2	7.25	804500	0.049	48.64	1.9	6.16	18.90	92000	0.015
Methylene Chloride	124.14	29.37	40.82	64.78	804500	0.435	33.06	8.76	5.58	15.80	92000	0.012
1,1,2,2-Tetrachloroethene	229.4	4	32.64	88.68	804500	0.595	92.03	2.68	35.59	43.43	92000	0.033
Tetrachloroethene	77.4	3.2	97.94	59.51	804500	0.399	109.88	2.01	31.81	47.90	92000	0.037
Trichloroethene	70.8	3.78	13.62	29.40	804500	0.197	23.22	1.99	4.3	9.84	92000	0.008
Vinyl Chloride	4.2	3.53	4.2	3.98	804500	0.027	2.71	2.53	2.83	2.69	92000	0.002
Toluene	--	65.47	--	65.47	804500	0.439	2.65	65.47	1.78	23.30	92000	0.018
Phenols	151.67	232.38	30.14	138.06	804500	0.927	11.07	30.03	7.95	16.35	92000	0.013
Arsenic	128	19.2	42.6	63.27	804500	0.425	21.6	27.51	11.48	20.20	92000	0.016
Chromium	271.14	25.27	166.5	154.30	804500	1.036	39.82	41.05	27.21	36.03	92000	0.028
Copper	4264.86	328.33	1291.67	1961.62	804500	13.165	2668.82	3677.94	727.97	2358.24	92000	1.810
Lead	540	119.26	206.33	288.53	804500	1.936	179.22	78.44	40.75	99.47	92000	0.076
Mercury	2.4	2.1	1.4	1.97	804500	0.013	1.25	0.92	0.75	0.97	92000	0.001
Zinc	4626.67	1326.92	2308.33	2753.97	804500	18.483	2714.54	2962.19	1206.55	2294.43	92000	1.761

TOTAL ORGANIC LOADING BEFORE CAP	4.061	lbs/year
TOTAL METAL LOADING BEFORE CAP	35.057	lbs/year
TOTAL ORGANIC LOADING AFTER CAP	0.207	lbs/year
TOTAL METAL LOADING AFTER CAP	3.691	lbs/year
PERCENT ORGANIC REDUCTION	94.901%	
PERCENT METAL REDUCTION	89.471%	

1.) Mass Loading = Concentration x flow x conversion factor

m = C x F x cf

Where: m = mass loading in lbs/year

F = Flow in gal/year

C = Parameter concentration

cf = Conversion factor of 8.342E-09

not been observed since regrading and capping of the site. Consequently, no impacts related to surface water contamination would be expected from the flow of surface water from the site to downgradient areas.

2.4 Identification of Potential Exposure Routes

Human Health Risk

Exposure routes describe the modes of contact with and intake of contaminated media and contaminants at exposure points. Typical human exposure routes include inhalation, ingestion and dermal contact. Exposures related to direct contact with the on-site soils and inhalation of contaminants in ambient air are not possible at the site due to the presence of the cap. Groundwater exposure is not assumed to be a viable pathway based on the hydrology of the site and the fact that no current users of groundwater for potable and/or industrial purposes exist. Additionally, due to the physical setting and hydrogeology of the site, it is not possible for future users to install a supply well in any of the three water bearing zones downgradient of the site. It is also to be noted that property up to Eighteen Mile Creek in this area is owned by VDM.

Exposure to surface water could occur during wading or other recreational trespass activities, though this would be an intermittent exposure activity. Additionally, whereas there is some potential of contaminated groundwater from the site reaching Eighteen Mile Creek, no site-related contaminants have been shown to exist in Eighteen Mile Creek at concentrations exceeding NYSDEC surface water standards.

The other identified exposure route at the site is associated with discharge of contaminated groundwater in the cliff face as seeps or overland flow downslope to the creek. In this scenario there is the possibility for trespassers to come into contact with groundwater and/or inhale volatilizing contaminants. It is to be noted that the cliff face has been inspected periodically since closure and capping of the landfill and there have been no observable seeps or overland flow in the exposed portions of the cliff below the landfill during this period. Considering the lack of observable seeps and the inaccessibility of the cliff (steepness and private property), this route of exposure is highly unlikely and extremely rare at best.

Ecological Risk Assessment

There are only a limited number of possible exposure routes for ecological receptors. Terrestrial plants on the cliff face and at the base of the slope may be exposed to contaminants in soil and/or groundwater by root uptake. To date there have been no indications of stressed vegetation in either of these areas. Terrestrial animals may be exposed by dermal uptake of contaminants in seeps or overland flow; ingestion of contaminated water/seeps, plants and animals; and inhalation of VOCs. Based on the site setting and hydrogeology, these would likely be intermittent exposures. In regards to aquatic plants and animals in Eighteen Mile Creek, there have been no contaminants detected at concentrations above the NYSDEC surface water standards. Additionally, based on the calculation of potential mass loadings to Eighteen Mile Creek presented in previous sections, it appears that the loadings are so low that there would be no discernible impact in the surface water of Eighteen Mile Creek. This is supported by the surface water monitoring data that has been collected adjacent to the site.

Conclusion

Based on the above-discussions, it would appear that there are two potentially completed exposure pathways for the site whereby contaminants in the landfill and/or groundwater could be transported to areas where humans or environmental receptors can come in contact with them. Both these pathways would likely only be completed on an intermittent basis, and it has been shown that the risk to human health and the environment in both cases is minimal or non-existent.

3.0 LANDFILL CAP EVALUATION

As indicated previously a pan-lysimeter was installed beneath the clay cap during closure activities at the site in 1987 to monitor the effectiveness of the clay cap in preventing surface water infiltration.

Water levels are measured in VDM-13, the monitoring pipe for the pan-lysimeter, and VDM-1, a piezometer installed in the fill near the pan-lysimeter, during the quarterly monitoring program. The specifications for the pan-lysimeter indicate that an accumulation of 38.73 gallons over a 180-day time period (.215 gal/day) is approximately equal to an infiltration rate of 1×10^{-7} cm/sec. Higher rates of accumulation would indicate infiltration rates exceeding the design specification for the clay cap.

As indicated on Table 3-1, the volumes of water accumulated in the pan-lysimeter exceed the anticipated infiltration rates of 0.215 gal/day. Consequently, as required by the post-closure permit, VDM is to perform an evaluation of the landfill cap to determine its present condition relative to the design specifications. To accomplish this a program was developed which consisted of collection of samples of the clay cap, geotechnical lab testing and a review of the construction data for the pan-lysimeter. The results of the evaluation are presented in the following sections.

3.1 Field Sampling

On January 10, 1995, four undisturbed samples of the existing low-permeability clay layer were collected for geotechnical analysis. These samples were collected at the approximate locations shown on Figure 3-1. As indicated, three samples (ST-1, -2 and -3) were obtained from the general cap area, whereas the fourth (ST-4) was obtained directly above the pan-lysimeter. At the time of sampling, the temperature was about 25° F and there was 4 to 6 inches of snow on the ground. However, the cap materials were not frozen.

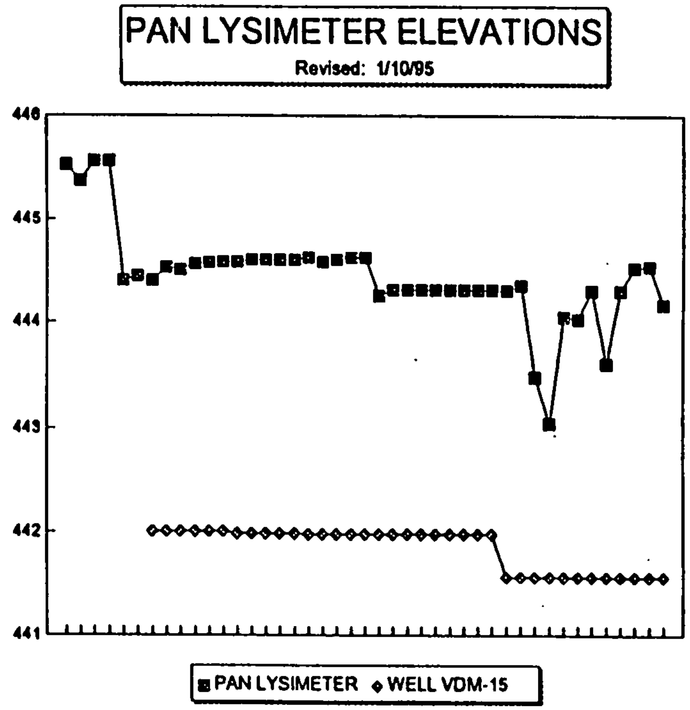
The sample collection process involved drilling through the topsoil (6 inches), barrier protection layer (15 inches) and sand drainage layer (3 inches) to expose the top of the low

TABLE 3-1

PAN LYSIMETER WATER ELEVATION READINGS
VANDEMARK LANDFILL - LOCKPORT, NY

REVISED: 1/10/95...(file data/123w/pan)

	PAN LYSIMETER		WELL VDM - 15		
		453.27		450.57	water pumped out
DATE	DEPTH	ELEVATION	DEPTH	ELEVATION	of the Panlysimeter
5/14/93	7.75	445.52			
5/19/93	7.9	445.37			
5/27/93	7.71	445.56			
6/8/93	7.71	445.56			
7/8/93	8.875	444.395			
8/30/93	8.83	444.44			
2/10/94	8.875	444.395	8.56	442.01	
2/18/94	8.75	444.52	8.56	442.01	
3/24/94	8.77	444.5	8.56	442.01	
3/30/94	8.71	444.56	8.56	442.01	
4/15/94	8.7	444.57	8.56	442.01	
4/22/94	8.69	444.58	8.56	442.01	
4/27/94	8.69	444.58	8.58	441.99	
5/4/94	8.67	444.6	8.58	441.99	
5/13/94	8.67	444.6	8.58	441.99	
5/18/94	8.67	444.6	8.58	441.99	
5/25/94	8.67	444.6	8.58	441.99	
6/3/94	8.65	444.62	8.59	441.98	
6/9/94	8.69	444.58	8.59	441.98	
6/16/94	8.67	444.6	8.59	441.98	
6/24/94	8.65	444.62	8.59	441.98	
6/29/94	8.65	444.62	8.59	441.98	
7/1/94	9.02	444.25	8.59	441.98	
7/7/94	8.96	444.31	8.59	441.98	
7/13/94	8.96	444.31	8.59	441.98	
7/20/94	8.96	444.31	8.59	441.98	
7/29/94	8.96	444.31	8.59	441.98	
8/3/93	8.96	444.31	8.59	441.98	
8/12/94	8.96	444.31	8.59	441.98	
8/23/94	8.96	444.31	8.59	441.98	
8/30/94	8.96	444.31	8.59	441.98	
10/17/94	8.97	444.3	9	441.57	10 gal
10/20/94	8.92	444.35	9	441.57	2.5 gal / 3 days
10/25/94	9.79	443.48	9	441.57	2.5 gal / 4 days
11/3/94	10.22	443.05	9	441.57	0 gal / 7 days
11/10/94	9.22	444.05	9	441.57	
11/11/94	9.24	444.03	9	441.57	2 gal / 8 days
11/16/94	8.97	444.3	9	441.57	2.5 gal/5 days
12/2/94	9.66	443.61	9	441.57	3 gal/16 days
12/16/94	8.97	444.3	9	441.57	3.5 gal/15 days
12/27	8.75	444.52	9	441.57	2.5 gal / 8 days
1/3/95	8.73	444.54	9	441.57	1.75 gal / 8 days
1/10/95	9.1	444.17	9	441.57	could not pump - pump broke



SOURCE: VanDeMark Chemical Ltd. (April 1995)

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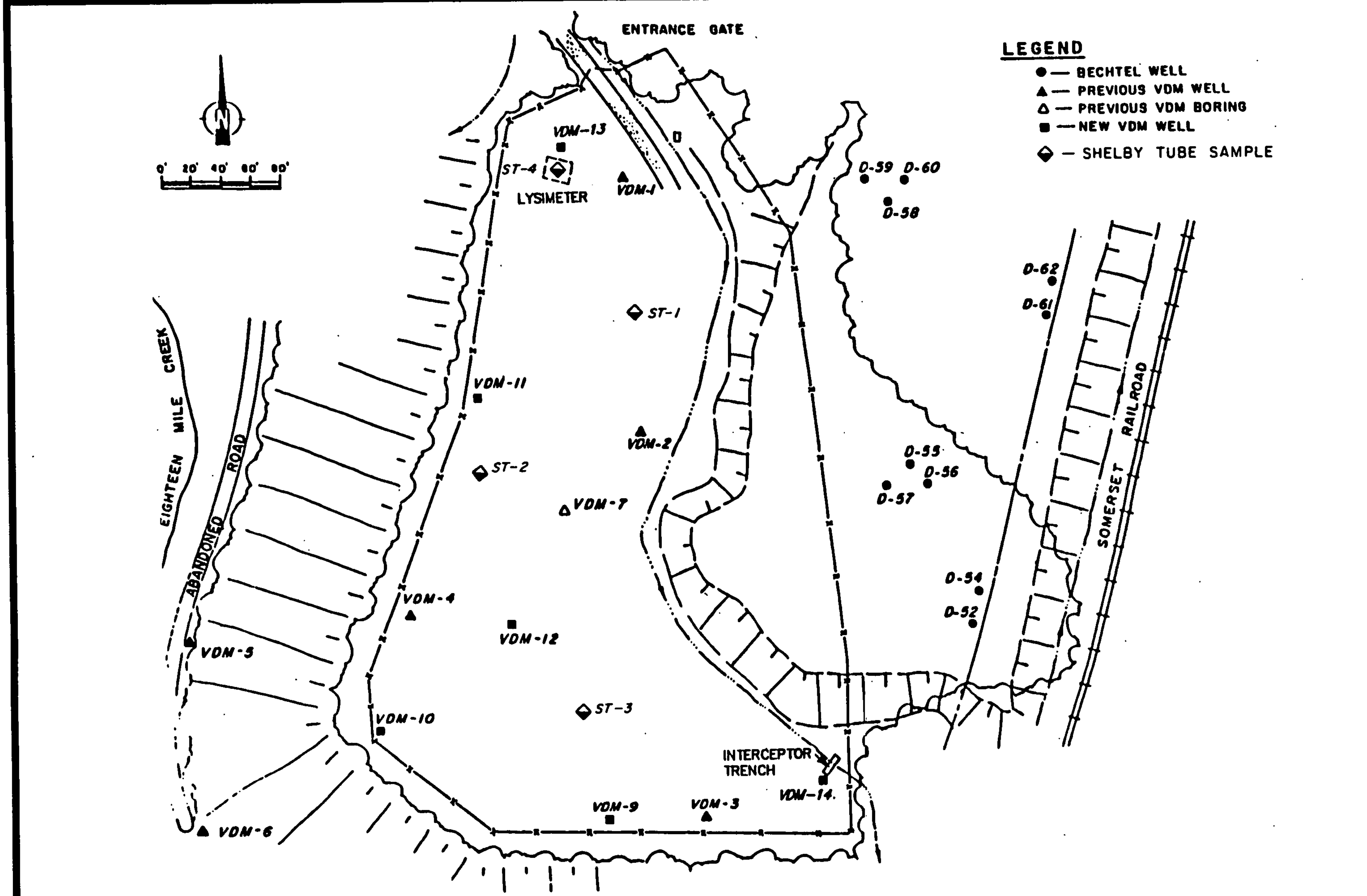

SOURCE: BASEMAP - CONESTOGA-ROVERS & ASSOCIATES, INC. 1993; SHELBY TUBE SAMPLE LOCATIONS - URS CONSULTANTS, INC. 1995

URS CONSULTANTS, INC.	LANDFILL CAP - SHELBY TUBE SAMPLE LOCATIONS	FIGURE 3-1

permeability clay layer. The holes were advanced with an ATV-mounted CME-55 drilling rig utilizing 4¼-inch hollow stem augers. The augers were advanced initially to a depth of two feet below ground surface. The cuttings were removed from around the collar of the hole and the augers withdrawn. The borehole was then cleaned out by hand to remove any loose material and expose the top of clay. The holes were advanced, as necessary, by hand to the top of the clay if deeper than two feet.

Once the hole was clean, a 3-inch diameter by 30-inch long Shelby tube equipped with a drive head was placed by hand into the borehole with the Shelby tube resting firmly on the bottom of the hole. The tube was then pushed with the drill rig a total of 26-inches to ensure a sample of the entire thickness of the low-permeability layer was obtained. The sample over the pan-lysimeter was only pushed 18 inches to ensure the clay layer was not fully penetrated. The tubes were allowed to stand for 10 minutes after they were pushed, and then rotated by hand with a pipe wrench and extracted from the hole. The length of sample recovered was measured and plastic caps were placed over the ends of the tube and securely taped in placed. The tubes were labeled and stored in an upright position until the end of the day when they were transported to the geotechnical lab which is located about 5 miles from the site.

The borehole was subsequently backfilled with bentonite pellets to within about 6 inches of the ground surface. The pellets were hydrated with potable water, and the remainder of the hole backfilled with the drill cuttings to the ground surface.

The locations of the boreholes were determined by taping the distance to the existing wells on-site. The samples were submitted to Glynn Geotechnical Engineering in Lockport, NY for determination of natural moisture content, insitu density and permeability. Additionally, the samples were visually inspected for the presence of desiccation cracks and logged as to the type of material. The laboratory reports are contained in Appendix D.

3.2 Laboratory Results

All four samples were described as medium-brown silty clay. Natural moisture contents were fairly consistent and varied from a low of 18.8 percent in ST-1 to a high of 21.9 percent at ST-4. Insitu densities were also fairly consistent, ranging from 108.3 to 114.4 PCF (dry densities). The permeabilities, which ranged from 1.1 to 5.4 x 10^{-8} cm/sec were all well below the acceptable design limit of 1 x 10^{-7} cm/sec.

These results were compared with the QC results obtained during construction for samples of the low-permeability layer. As shown on Figure 3-2, the current sampling locations do not correspond directly to any of the previous permeability test locations. Consequently, the test results were compared with the permeability values for all samples collected during construction of the clay cap (Table 3-2). This comparison indicates that the permeabilities for the four new samples are comparable to the permeabilities obtained during construction. In the same manner, the natural moisture contents and dry densities of the new samples are generally similar to the moisture/density values shown in Table 3-2 for the earlier samples, although samples ST-1, 3 and 4 have slightly higher densities (0.5 to 3 PCF) and sample ST-4 has a slightly higher moisture content (approx. 2%).

3.3 Potential Causes of Increased Infiltration

Based on the geotechnical data for the four Shelby tubes and comparisons with the QC data for the low-permeability layer obtained during construction, it is concluded that there have been no significant changes in the moisture/densities or permeabilities of the low permeability layer which would result in increased rates of infiltration. More specifically, the low permeability layer immediately overlying the pan-lysimeter exhibits a density of 111.5 PCF @ 21.9 percent moisture and a permeability of 2.4 x 10^{-8} cm/sec. These values are considered to be comparable to values at other locations in the cap, and well within the acceptable design limitations.

It was therefore necessary to look at other possible explanations for the higher than expected infiltration to the pan-lysimeter. To do this, initially, the construction records and photographs were reviewed to see if any features or possible explanations could be identified to explain the increased infiltration.

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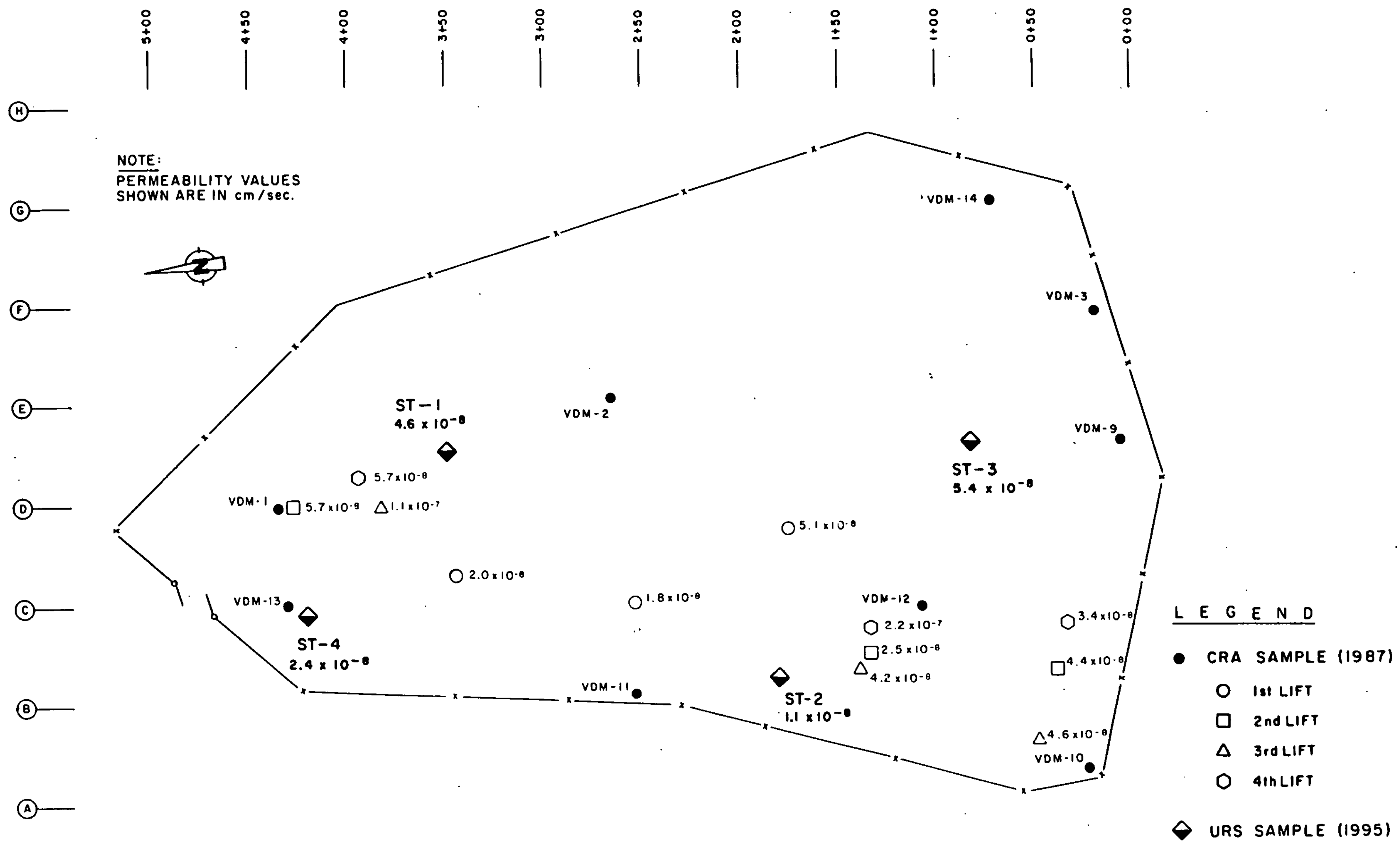

PERMEABILITY CYLINDER SAMPLING LOCATIONS

SOURCE: BASEMAP - CONESTOGA-ROVERS & ASSOCIATES, INC. 1987; SHELBY TUBE SAMPLE LOCATIONS - URS CONSULTANTS, INC. 1995

URS CONSULTANTS, INC.

LANDFILL CAP - PERMEABILITY TEST RESULTS

FIGURE 3-2

TABLE 3-2

SUMMARY OF CLAY TEST RESULTS

Sample No.	Permeability Rate $x10^{-7}$ cm/sec	Cylinder Dry Density	Moisture Content	Percent Compaction	Atterberg Liquid Limit	Atterberg Plastic Limit
Test Pad	0.729	108.6	19.5	94.8	37	23
Test Pad	0.221	108.9	20.1	95.1	39	22
Test Pad	0.471	107.3	19.3	93.7	--	--
1B	0.176	110.2	16.5	96.2	43	22
2B	0.510	105.7	19.5	92.3	37	20
3A	0.200	107.8	15.8	94.1	39	20
4A	0.440	110.7	17.7	96.7	38	20
5B	0.248	108.7	18.5	94.9	34	19
6A	0.569	109.2	19.8	95.4	36	17
7A	0.461	110.5	14.9	96.5	45	24
8B	0.418	109.8	17.0	95.9	36	19
9A	1.09	105.0	18.2	91.7	48	26
10B	0.336	103.2	15.6	90.1	38	19
11B	2.201	101.9	18.2	89.0	38	20
11R2	4.96	102.4	13.3	89.4	32	19
12A	0.574	108.5	17.9	94.8	48	25
Bag #2	4.12	107.1	19.1	93.5	35	18
Avg. 1-12	0.60	107.6	----	----	--	--

SOURCE: "Record of Closure Activites" - Conestoga-Rovers & Associates (Novemeber 1987)

Based on this review the following possible elements, either singly or in combination, were identified which may be responsible for the increased infiltration to the pan-lysimeter.

- As noted previously, groundwater elevations in the landfill materials (437 feet) and Power Glen Formation (432 feet) are well below the elevation of the pan-lysimeter (444.56 feet) or base of the excavation (approx. 443 feet). Consequently, it is not likely that groundwater either in the landfill materials, or bedrock is capable of affecting the levels measured in the pan- lysimeter This is further supported by the fact that well VDM-15, which was installed adjacent to the pan-lysimeter to specifically monitor groundwater levels in the fill materials, has gone dry (<elevation 441.57 feet) as of January 1995. This would indicate that water levels in the surrounding natural materials are well below the bottom of the pan-lysimeter or even the excavation. Consequently, (assuming VDM-15 is functioning properly) the source of the increased infiltration must be the result of other causes.

- Based on the well installation diagrams for VDM-15 (Figure 3-3), it appears that the sandpack/screen is installed from just below the bottom of clay layer to about 3 feet below the level of the perforated plate in the pan-lysimeter box. The well is also installed outside the limits of the excavation for the pan-lysimeter, in virgin soils. Water level measurements in VDM-15 from February 10, 1994 to January 10, 1995 (Table 3-1) indicate that water levels gradually decreased from elevation 442.01 feet until the well went dry in January 1995. This would tend to indicate that the clay cap is functioning properly, and the water level in the landfill area is gradually being lowered due to decreased infiltration as a result of the capping; or the well is not functioning properly; or, the zone in which the well is screened is extremely tight (low permeability) and/or essentially dry.

- As indicated in the landfill closure report (CRA, 1987), the pan lysimeter was bedded on a one-foot thick layer of #1B stone. The construction photos indicate this stone was hand-placed from a stockpile on the ground surface adjacent to the excavation area. Additionally, the stone blanketed portions of the slopes/side

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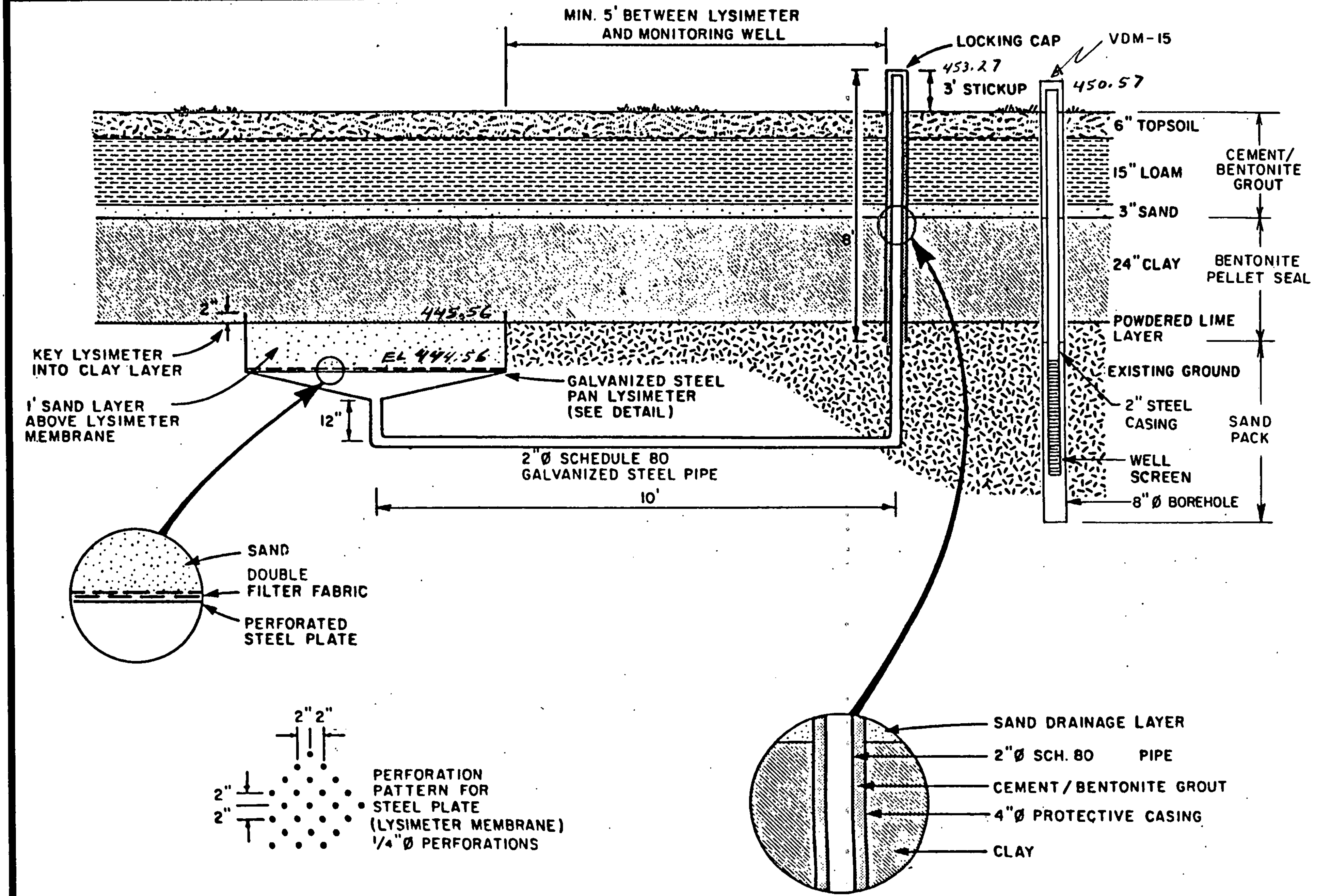

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PAN-LYSIMETER SYSTEM TYPICAL DETAIL

FIGURE 3-3

walls of the excavation from the bottom (below pan-lysimeter) to the ground surface (top of clay layer). If this stone was not properly cleaned up prior to backfilling of the excavation, it may provide a potential seepage pathway for water in the sand drainage layer to flow into the area immediately around the pan-lysimeter.

- As indicated in the construction photos, the zone between the stone bedding layer and the top of the pan-lysimeter box (12 inches) was backfilled with loose materials consisting of chunks and pieces of clay. The closure report indicates this layer was subsequently compacted by hand with a hydraulic jumping jack. Once backfilled, the entire area over the pan lysimeter was capped by two feet of clay in 6-inch lifts. The first two lifts were hand compacted using a Bomag Compactor and the hydraulic jumping jack. The sheepsfoot roller was used for the third and final lifts.

  Due to the hand compaction methods utilized for the backfill around the pan lysimeter and the "chunky" nature of the backfill material, it is quite probable that this material was not fully compacted, and that the void spaces between chunks were not entirely eliminated. The same may be true, to a lesser degree, of the first two 6-inch lifts of clay. The report also indicates that the initial backfill and first lift were not wetted during compaction. This would tend to increase the probability that the voids between chunks were not eliminated.

  Over the years since the lysimeter was installed, the materials in these two zones will have consolidated and settled further due to natural processes. This could potentially result in the formation of "gaps" or more open zones forming along the contacts between the two zones, which could provide pathways for groundwater to reach the pan-lysimeter.

- The steel riser pipe for the pan-lysimeter which extends through the cap to the surface may provide another potential pathway for groundwater or surface water infiltration. The pan-lysimeter construction detail sheet (Figure 3-3) indicates that the 2-inch riser pipe is protected by a 4-inch diameter protective casing, and that the annular space between the riser pipe and protective casing is filled with cement/bentonite grout. The protective casing extends from the ground surface to just below the bottom of the low-permeability clay layer. There are no seepage collars or other measures employed on the casing to prevent groundwater or surface water from migrating down along the outside of the casing into the area around the lysimeter. There is a high degree of probability that openings have developed between the casing and surrounding soils as a result of freeze/thaw action and shrinkage of the soils due to drying of the soils during extremely hot and/or dry periods. The fact that the protective casing is steel further increases the temperature related effects, due to the higher thermal conductivity of the steel. This may result in freezing and drying of the soils to greater depths immediately around the protective casing.

If the soils dried out and shrinkage (desiccation) cracks developed along the pipe down into, or through, the low-permeability layer, it is possible that sand from the 3-inch thick drainage layer may have fallen into the area around the casing where it penetrates the low-permeability layer. As the area becomes re-wetted and the clays swell, the sand would prevent the clay from sealing around the pipe, and provide a pathway for surface water, groundwater, or more probably water in the drainage layer to migrate into the area around the lysimeter. Repeated drying cycles would tend to increase the amount of sand infilling around the pipe and consequently the amount of water inflow.

- Likewise, desiccation cracks also may have developed in the barrier protection layer and/or low-permeability layer overlying the pan lysimeter during extremely dry periods (e.g. Summer 1991). These cracks would also fill with sand from the drainage layer which would prevent hem from closing fully when the clays become re-wetted.

These desiccation cracks would provide preferential pathways for surface waters or water in the sand drainage layer to infiltrate directly to the pan-lysimeter.

Although no desiccation cracks were noted during the visual examination of the Shelby tube samples, the possibility still exists that they are present.

- As noted in the Record of Closure Activities Report (CRA, 1987), the edges of the excavation were "regraded" to ensure adequate bonding between the pre-existing clay cover and the newly constructed cover over the lysimeter. It is unclear whether this regrading consisted of sloping, benching, or some other process. It is possible, no matter what mechanism was used, that bonding along this interface may not have been complete, and that this contact zone provides a preferential pathway for migration of groundwater in the sand drainage layer through the clay layer and into the zone around the pan-lysimeter.

- Other potential factors include leakage through the joints in the steel riser pipe which were reportedly welded and visually inspected, but never tested for tightness. Additionally, as indicated by VDM, the waste materials generate hydrochloric acid when exposed to water. This could potentially result in a very corrosive groundwater in areas where it is not neutralized by the powdered lime and/or limestone. This would be particularly true in areas of the early landfill where it is unclear whether any lime/limestone was used in the disposal process. The pan-lysimeter does not appear to be directly located within the limits of the early landfill (Figure 1-2). However, it does appear to be located just outside those limits. Consequently, it is possible that soil and groundwater conditions in the area of the lysimeter could be corrosive and result in deterioration of the pan-lysimeter and riser pipes.

4.0 CORRECTIVE MEASURES EVALUATION

4.1 Introduction

This section of the report presents a discussion of the remedial action objectives for the various media at the site, outlines the potential corrective measures which might be implemented at the site, and evaluates the measures as to their implementability and effectiveness in meeting the remedial action objectives.

4.2 Remedial Action Objectives

Remedial Action Objectives, which are medium-specific, are established to protect human health and the environment. The development of the remedial action objectives is based on the human health risk assessment (HRA), ecological risk assessment, and a comparison of contaminant concentrations detected in onsite media with chemical-specific SCGs, since these are the basis for measuring the potential impact of the landfill on human health and the environment. Medium-specific remedial objectives for the VDM site are presented below:

Soil/Fill

The HRA indicated that there is no risk associated with soils/fill at the site. The landfill has been capped with a low permeability cap, thereby eliminating the potential for dermal contact, inhalation or ingestion. Additionally, the site is fenced on two sides and bounded by extremely steep slopes on the other two sides which restricts the potential for recreational trespassers. The only onsite activities at present consist of periodic monitoring which limits the potential exposure to workers. Therefore, there are no remedial action objectives developed for soil/fill at the site.

Surface Waters

Analytical data from samples collected in Eighteen Mile Creek indicate there are no exceedances of NYSDEC Standards, Criteria or Guidances (SCGs). Consequently, there is no potential health risk associated with surface waters and no remedial action objectives have been developed.

Sediment

No samples of the sediments from Eighteen Mile Creek have been collected and analyzed. However, there was a groundwater seep observed in the cliff face below the landfill prior to regrading and capping of the landfill. Overland flow down the slope from this seep could potentially have transported contaminants directly into the surface waters of Eighteen Mile Creek. Considering this seep has been not been observed since regrading/capping of the landfill was completed, there are no exceedances of SCGs in the surface waters of the creek, the VOCs detected in groundwater at the site tend to volatize or evaporate very rapidly in moving water or upon exposure to the atmosphere, and the VOCs have very low adsorption potential, it is not anticipated that the sediments are contaminated with VOCs.

In regards to metals, there is some potential that soluble metals transported in groundwater from the site may be discharged into Eighteen Mile Creek where they are transported downstream or precipitated out. No sediment samples have been collected in Eighteen Mile Creek adjacent to the site. However, a limited number of samples were obtained by the NYSDEC Division of Water in 1988, 1989 and 1990 in portions of Eighteen Mile Creek beginning approximately one mile downstream of the site and continuing to the mouth of the creek at Olcott. These samples indicated a wide range of metals concentrations in the sediment. Consequently, based on the extremely low calculated mass loading for metals from the site, it is assumed that no appreciable impact to sediment in the creek has, or will, occur. Therefore, there are no remedial action objectives developed for sediments.

Groundwater

Groundwater is not used as a potable supply source in the vicinity of the site. The geologic/hydrogeologic setting prevents installation of downgradient wells and VDM owns the property up to the creek in the downgradient areas. Prior to cap construction, contaminated groundwater had been observed intermittently seeping from the cliff face below the landfill and flowing downslope towards Eighteen Mile Creek. No seeps or discharges have been observed since capping, although there could potentially be intermittent seeps which are obscured by the talus accumulations on the slope.

There is a potential current and future risk to recreational trespassers from dermal contact and inhalation of vapors if contaminated groundwater seeps in the cliff face below the landfill occur. Surface flow of contaminated groundwater has been eliminated due to capping of the landfill, although there is some potential for seeps to occur in those portions of the cliff which are obscured by talus accumulations on the slope.

For the protection of human health and the environment, the following remedial action objective has been developed for groundwater:

- Control groundwater discharges in the cliff face and/or discharges directly to Eighteen Mile Creek.

Air

The only reported gaseous emissions from the landfill are associated with the initial placement and subsequent puncturing of the drums. The existing cap will prevent any current or future emissions unless it is disturbed. Consequently, there is no health risk posed by air emissions from the site, and no remedial action objectives have been developed for air.

4.3 Potential Corrective Measures

Based on the existing site conditions and discussions with NYSDEC, a limited number of potential corrective measures have been identified which are to be evaluated during this study. These include:

1) No further action;
2) Installation of an upgradient low-permeability barrier;
3) Installation of a synthetic cap over the existing clay cap; and

4) Installation of a groundwater collection and treatment system.

These corrective measures address the remedial action objective which is to control groundwater discharges by either reducing infiltration, preventing inflow, or collecting downgradient. The corrective measures are described in the following sections, and evaluated as to their technical implementability and effectiveness in achieving the remedial action objective.

4.3.1 No Further Action

In this scenario, the site would be left in its present condition with continuation of the existing post closure groundwater monitoring and maintenance programs as outlined in the closure plan.

This alternative is easily implemented since there is no construction, and has no additional cost associated with it.

This corrective measure meets the remedial action objective of controlling groundwater discharges inasmuch as there are no visible seeps and/or discharges of contaminated groundwater in the cliff face below the landfill now.

4.3.2 Upgradient Low-Permeability Barrier

This corrective measure involves the installation of a low-permeability barrier along the upgradient perimeter of the landfill to reduce the amount of groundwater flow into the landfill. The barrier would be installed to the depth required to ensure that groundwater does not contact the waste placed at the site. This barrier would extend from the northern end of the landfill (near VDM-1) along the eastern boundary to the southeastern corner of the landfill (near VDM-14), a distance of about 560 feet. The barrier itself could be constructed of compacted clay, bentonite slurry, cement grout, sheet piling and/or geosynthetic membranes depending on the required depth and type of materials to be penetrated. Considering that groundwater is first encountered in the bedrock underlying the site, the low permeability barrier would also have to be installed into the bedrock.

Based on the available information, it appears that groundwater flow is generally from the north-northeast to the south-southwest across the site. Groundwater elevations along the upgradient boundaries as measured in monitoring wells VDM-1 and -2 are typically 431 to 432 feet. These measurements are consistent with groundwater elevations measured in well D-55, which is installed east of the site and screened across the Grimsby/Power Glen contact, which vary from 432 to 434 feet. At the southern, or downstream edge of the site, water levels typically are at or below elevation 422 feet. Table 4-1 and Figure 4-1 present a summary of groundwater elevations.

As indicated on Figure 4-2, the top of rock ranges in elevation from about 440 feet at the northern end of the site (near VDM-1) to 430 feet along the southern edge of the site (near VDM-3). In regards to waste disposal at the site, there is very limited information available as to how deep the trenches were excavated into the overburden and/or bedrock. This is particularly true for the early landfill area. In the early landfill area, it has been assumed that the trenches were most likely extended through the overburden materials to the top of bedrock, or possibly a short distance (one or two feet) into the bedrock. Based on typical cross-sections presented in the construction plans prepared by Whitmore (1977) for the new disposal area, it appears that some of the trenches extended into the bedrock. These same drawings also indicate that the base elevation for these disposal trenches does not go below Elev. 438 feet, even in areas where the bedrock is lower.

In summary, the bottom of waste on site is assumed to range from about elevation 430 to 440 feet at the northern end to 428 to 430 feet at the extreme southern edge.

Based on the above discussion, it would appear that the existing water levels measured in the bedrock (Power Glen) immediately underlying the waste, are currently and historically below the base of any wastes disposed on site. Consequently, the groundwater flowing across the site does not come into direct contact with any of the onsite waste materials. Additionally, groundwater levels in the bedrock have remained relatively constant throughout the history of the site, and it is not expected that any significant changes in elevations (increases) will occur in the future.

TABLE 4-1

Groundwater Elevations
(feet AMSL)
VanDeMark Chemical Ltd.
Lockport, New York

Date	VDM-9	VDM-10	VDM-11	VDM-14	D-55
Jan-84	421.62	413.42	431.45	NI	433.70
Mar-84	421.86	413.07	431.42	NI	433.51
May-86	NM	NM	NM	NI	433.51
Jan-87	421.91	414.54	433.19	NI	434.71
Jun-87	422.32	414.17	431.92	NI	432.79
Sep-87	421.26	413.25	431.46	NI	432.36
Nov-87	421.98	413.25	431.64	436.46	433.16
Mar-88	422.06	413.87	434.20	436.98	433.71
Jun-88	421.97	411.60	431.08	435.73	432.61
Aug-88	422.04	412.04	431.00	435.57	432.80
Nov-88	422.84	413.73	432.76	431.56*	432.06
Feb-89	421.74	412.57	432.43	436.28	433.05
May-89	421.95	412.98	431.31	436.21	433.17
Sep-89	421.79	411.93	433.00	436.37	432.61
Jan-90	422.16	413.61	431.85	436.58	433.15
Jun-90	421.49	423.98	430.76*	435.11	432.67
Sep-90	421.49	411.82	430.93	435.19	432.54
Dec-90	421.91	413.82	434.43	437.29	434.26
Mar-91	422.01	413.73	431.97	436.56	433.42
Jun-91	421.54	411.87	430.65	435.21	432.46
Oct-91	422.00	410.90	429.80	434.87	432.46
Dec-91	421.58	412.27	430.14	435.53	432.71
Mar-92	423.00	413.81	433.55	436.60	433.58
Jun-92	421.94	413.87	431.21	436.60	432.81
Sep-92	422.46	412.67	431.74	436.34	432.94
Dec-92	424.17	413.61	433.47	437.48	434.21
Mar-93	424.66	414.59	434.91	437.91	434.84

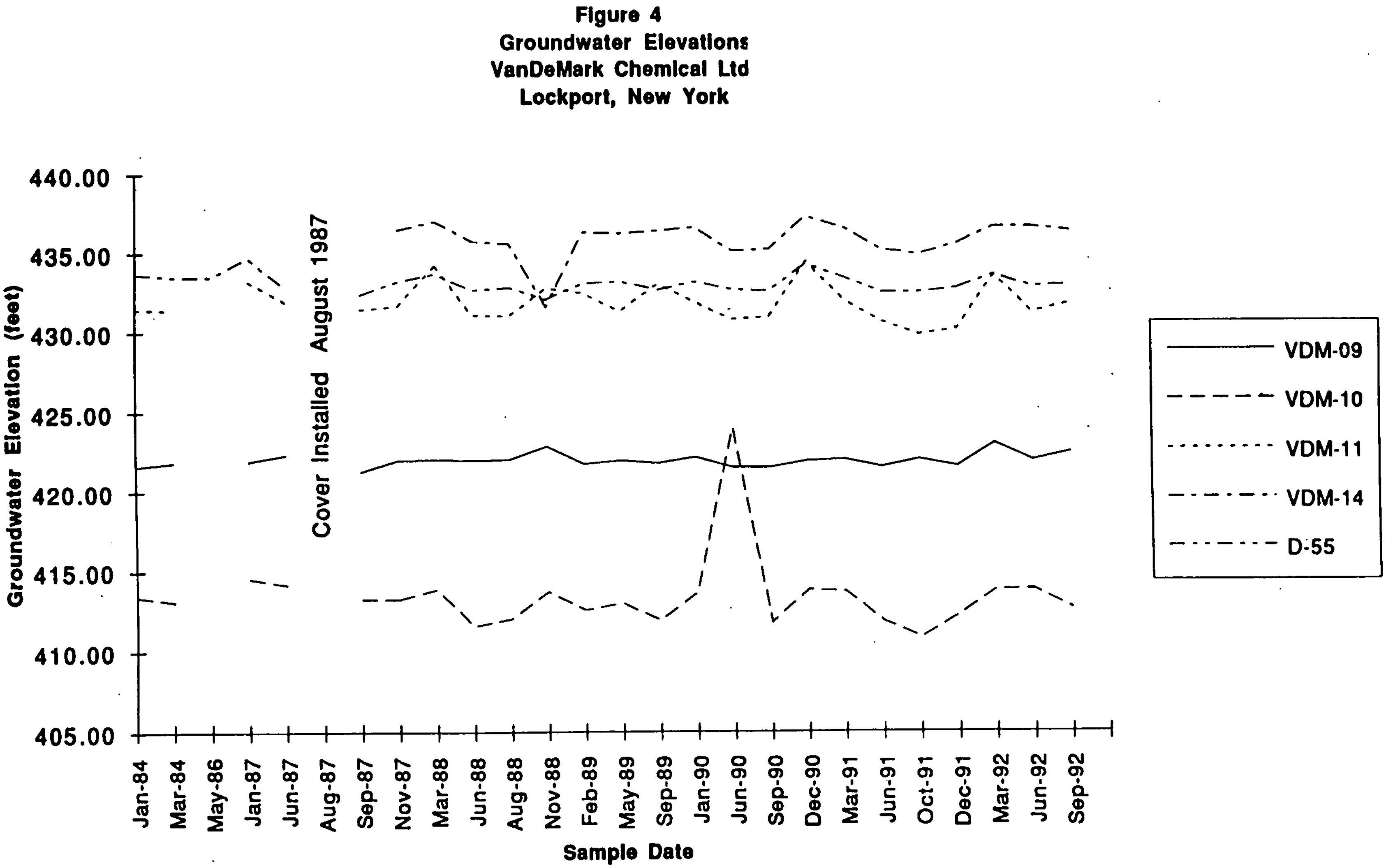
Notes:

* Potential erroneous or erratic reading.
NI= Not Installed
NM= Not Measured
Landfill cover installed in August 1987.
AMSL= Above Mean Sea Level

SOURCE: Conestoga-Rovers & Associates (April 1993)

AH-7652F

J:\35395\CAD\ I=I 4/21/95-I KAH



SOURCE: VANDEMARK 1993

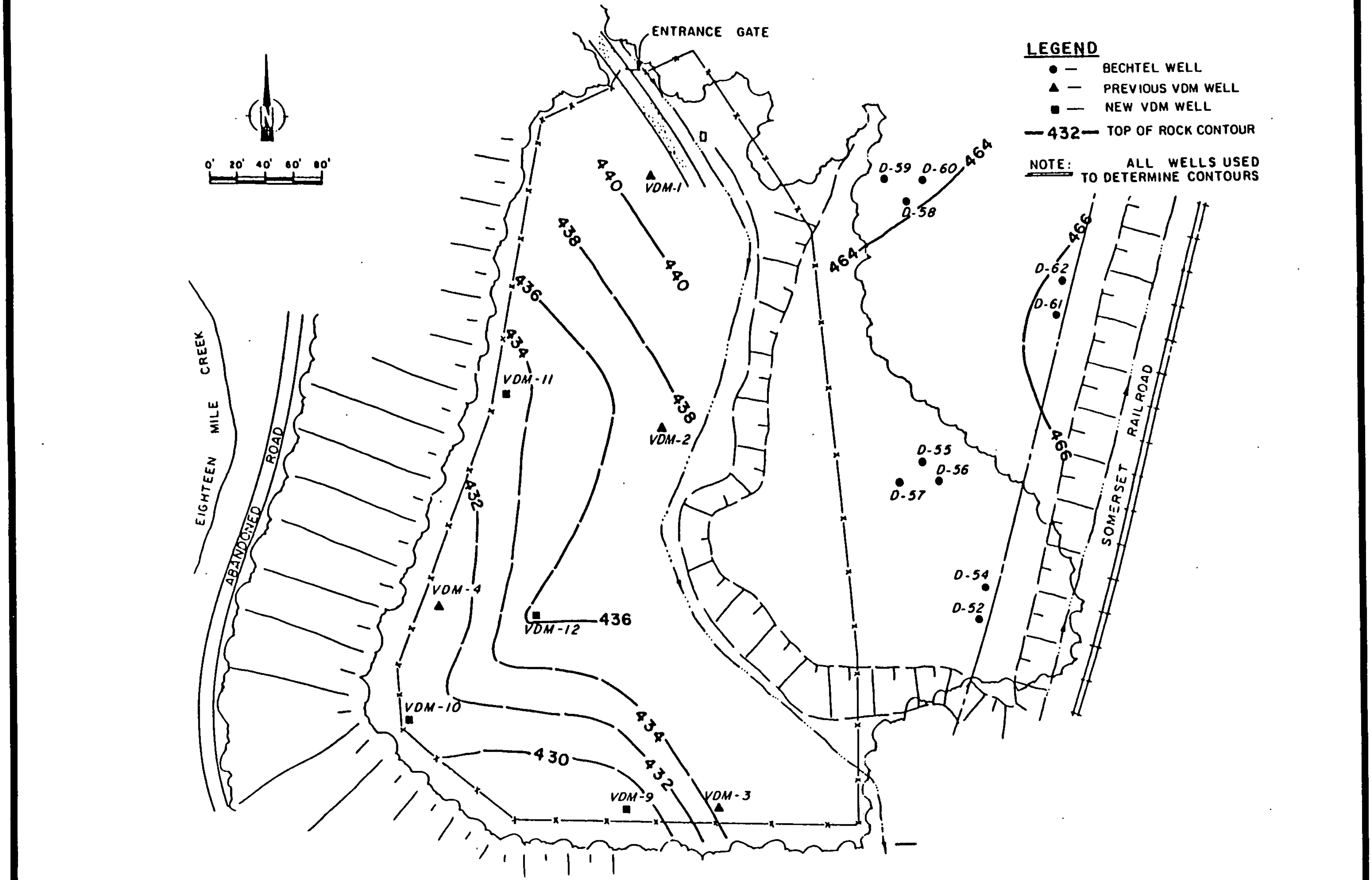
URS CONSULTANTS, INC.

GROUNDWATER ELEVATIONS SUMMARY PLOT

FIGURE 4-1

AH-7652G

J:\35395\CAD\ I=I 4/21/95-I KAH



SOURCE: CONESTOGA-ROVERS & ASSOCIATES, INC. 1984

URS CONSULTANTS, INC.

TOP OF BEDROCK CONTOURS

FIGURE 4-2

In light of the above discussions, there is no need, and/or benefit, to installing an upgradient, low-permeability barrier inasmuch as the groundwater flowing onto the site in the bedrock under existing conditions does not come into direct contact with the waste.

Additionally, as indicated by the historical water level measurements (Figure 4-1), there have been some minor variations in the groundwater levels along the upgradient boundary of the site in response to seasonal variations in temperature, precipitation and evapo/transpiration. However, in general terms the groundwater flux (flow onto site) across the upgradient site boundary has remained relatively unchanged.

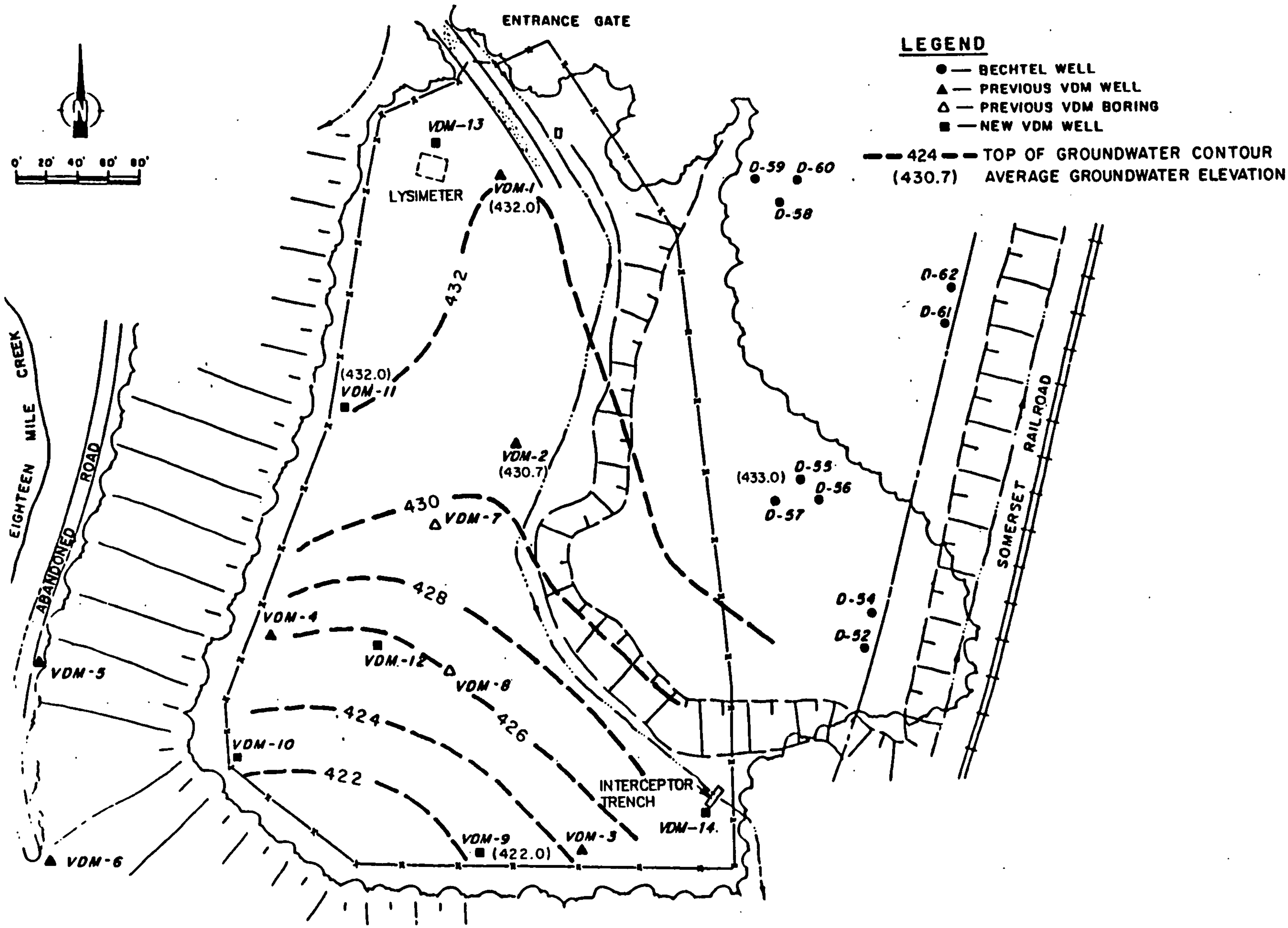
Based on the groundwater elevation data for wells screened in the Power Glen Formation (i.e. VDM-1, -9, -11, and D-55), a groundwater contour map was prepared (Figure 4-3). This map is based on the average groundwater elevations recorded during the period of November 1988 to present. As indicated previously, these groundwater levels have remained relatively constant throughout this period, and were not significantly impacted by installation of the cap.

The data from this map (i.e. hydraulic gradients) and hydraulic conductivity values for the Power Glen formation were utilized to calculate the groundwater flux across the site. Groundwater flux across the upgradient site boundary was calculated to be on the order of 0.026 gpm (14,500 gal/yr). Likewise the groundwater flux across the downgradient site boundary was calculated to be about 0.18 gpm (92,000 gal/yr). This indicates that approximately 0.15 gpm (79,000 gal/yr) is infiltrating through the landfill cap. The calculations are contained in Appendix C.

Considering that groundwater in the bedrock flowing onto the site does not come into direct contact with the waste materials as it flows under the landfill and ultimately discharges at the cliff face, it is not considered warranted to install an upgradient low-permeability barrier to restrict this flow. However, direct contact of groundwater with the waste is not the only mechanism involved in generating contaminated groundwater.

As surface water (precipitation) infiltrates through the cover system, it may come into contact with the waste materials. This results in the generation of hydrochloric acid and, AH-7652H

J:\35395\CAD\ 1=1 4/21/95-1 KAH



SOURCE: BASEMAP - CONESTOGA-ROVERS & ASSOCIATES, INC. 1993; CONTOURS - URS CONSULTANTS, INC. 1995

URS CONSULTANTS, INC.	POST CAPPING - AVERAGE GROUNDWATER CONTOURS	FIGURE 4-3

depending on other chemicals present in the waste, contaminated groundwater. As the acid and contaminated groundwater continue to migrate vertically downward, it passes through the crushed limestone in the bottom of the trench, and into the underlying bedrock where it ultimately comes in contact with the clean groundwater flowing under the site. The degree to which the clean groundwater becomes contaminated depends on several factors, including:

- Degree to which limestone neutralizes the acid;
- The concentration and type of contaminants contained in the percolating water;
- Volume of contaminated groundwater relative to volume of clean groundwater (dilution); and
- Physio-chemical properties of the contaminants (i.e., adsorption onto soils, volatility, solubility, etc.)

The mixture of clean and contaminated groundwater then flows along bedding planes and joints (predominantly horizontal) until it discharges at or near the cliff face, as previously discussed in Sections 1.2.1 and 2.3.3.

Eliminating the upgradient groundwater from entering the site and flowing under the landfill will not prevent the generation of contaminated groundwater. It would, however, reduce the overall volume of water flowing through the rock under the landfill. In this case, the only water available to leach and transport contaminants from the wastes would be infiltration through the cap which percolates downward through the wastes and into the existing water-bearing zones. Whereas the volume of groundwater discharging at the cliff face or to Eighteen Mile Creek would be reduced somewhat due to an upgradient barrier, the overall volume of contaminants would essentially be unchanged. This is due to the fact that the concentrations of contaminants in the reduced volume of flow would be correspondingly higher due to the lack of dilution which was previously provided by the clean water.

Inasmuch as the present groundwater discharge rate to the cliff face, and ultimately to Eighteen Mile Creek is so low that no discernible impacts to the creek have occurred, the installation of an upgradient low-permeability barrier would not appreciably improve upon this condition. Consequently, further evaluation of this alternative is not warranted.

4.3.3 Installation of a Synthetic Cap Over the Existing Clay Cap

This corrective measure would involve removal and stockpiling of the existing topsoil at the site followed by installation of a geosynthetic or bentonite-type liner. This liner would be protected by a drainage layer, up to 24 inches of barrier protection soils and 6 inches of stockpiled topsoil. The intent of this additional low permeability liner would be to further reduce the amount of infiltration through the landfill cap.

Based on the geotechnical testing which was performed during this study on samples of the existing low-permeability cap, it was determined that the existing clay cap is functioning as originally designed. The four samples exhibited permeability values ranging from 1.1 to 5.4 x 10^{-8} cm/sec, (Appendix D) which is less than the maximum allowable permeability of 1 x 10^{-7} cm/sec, and consistent with values obtained during construction (Appendix E).

In order to evaluate the comparative value of installing a synthetic or bentonite-type liner over the existing clay cap, the Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et al., 1988) was utilized. This computer model calculates the expected volume of infiltration through a landfill cap under varying conditions. Factors such as permeability, slope, precipitation, type of vegetation and evapotranspiration are considered in the model.

Initially, the model was used to calculate the anticipated infiltration through the original landfill cover, prior to regrading and capping. In this case it was assumed that the landfill was graded such that all precipitation falling on the site was directed into the landfill, and there was no run-off. Based on an average permeability of 3.6 x 10^{-5} cm/sec, the expected inflow for the 2.5-acre site is 790,00 gal/yr or 1.5 gpm (Appendix F).

Next, the model was used to calculate the anticipated infiltration through the existing clay cap. Based on an average permeability of 1 x 10^{-7} cm/sec, the expected inflow for the 2.5-acre site is 84,000 gal/yr or 0.16 gpm (Appendix F). This is consistent with the flux calculations which indicated an overall discharge volume from the shallow (Power Glen) aquifer below the landfill on the order of 0.18 gpm. which represents the combined flow of groundwater in the bedrock (0.03 gpm) and infiltration of precipitation to the site (0.15 gpm). Consequently, regrading the site and installing the clay cap reduced the infiltration to the site by approximately 90 percent, and the overall flow through the site by more than 88 percent.

The model was then utilized to calculate the estimated infiltration to the landfill assuming a synthetic geomembrane or bentonite liner with a permeability of 1 x 10^{-12} cm/sec was installed over the existing clay cap. All other parameters were kept the same. Results indicated that maximum infiltration would be on the order of 1,000 gallons per year or 1.9 x 10^{-3} gpm (Appendix F). This represents an additional reduction of about 9 percent in the infiltration rates through the cap, and about an 8 percent additional reduction in the overall groundwater flux across the site. Contact of infiltrating water with the landfilled waste would also be further reduced.

In addition to the HELP model, there are various other factors which need to be considered in evaluation of this alternative. These factors include:

- First and most importantly, under existing conditions the groundwater flux at the site and resultant mass loadings to Eighteen Mile Creek are so low since the site was capped in 1987 that no discernible impacts to the creek have occurred. Consequently, reducing the infiltration rate through the cap, by an additional 9 percent will not appreciably improve this situation.

- Additionally, in regards to groundwater which is discharged at or near the cliff face, evaporation may result in some additional reduction in the volume which ultimately reaches the creek. The slopes also have southern and western exposures which increases the amount of sunlight striking these areas, and winds in this area also tend to be from the west which would further increase evaporation rates.

In summary, the installation of a geosynthetic or bentonite-type liner would only result in a minor additional reduction in the overall groundwater flux across the site. Considering that the present groundwater discharge rate to the cliff face and ultimately to Eighteen Mile Creek is so low that no discernible impacts to the creek have occurred, the installation of a geosynthetic or bentonite-type liner would not appreciably improve upon this condition. Consequently, further evaluation of this alternative is not warranted.

Based on the above discussion, it appears that installation of a geosynthetic or bentonite-type liner would result in a slight additional reduction in the amount of precipitation infiltrating into the landfill and generation of contaminated groundwater. However, it also appears that installation of the additional cover would have almost no impact on the discharge of contaminants from the site, inasmuch as there are no visible seeps or discharges in the cliff face below the landfill under existing conditions. Consequently, considering there are no discernible impacts to Eighteen Mile Creek at present, installation of a geosynthetic or bentonite-type liner is not warranted.

4.3.4 Groundwater Collection and Pretreatment

This corrective measure involves the installation of a groundwater collection system combined with on-site treatment and discharge to Eighteen Mile Creek or the nearby wastewater treatment plant.

In order to satisfy the remedial action objective, the collection system would be designed to intercept and collect the contaminated groundwater which flows under the landfill in the Power Glen Formation before it discharges in the cliff face below the landfill.

Several types of collection systems were identified which could potentially be installed at the site. These include:

- Individual wells installed in the landfill to the base of the Power Glen formation;

- A series of wells installed around the downstream perimeter of the site to the base of the Power Glen formation;

- Horizontal or inclined drains installed from the cliff face at the base of the Power Glen formation; and,

- A collection trench excavated around the downstream perimeter of the site to the base of the Power Glen formation.

Additionally, several types of extraction systems to remove the contaminated groundwater could be utilized. These include:

- Submersible pumps;
- Vacuum system; and,
- Gravity drains.

Based on the extremely low flow rates across the site and the potentially corrosive groundwater conditions, it was considered that a passive collection system which does not require pumping would be the most applicable. Consequently, the corrective measure proposed for further evaluation consists of excavating a narrow bench in the cliff face in the upper portion of the Whirlpool Formation just below the contact with the Power Glen Formation. Small diameter drain holes would then be drilled from the cliff face into the saturated portion of the Power Glen. The holes would start from just below the contact and be angled upward so that they intersect as many bedding planes and horizontal joints as possible. The drain holes would be extended such that they penetrate the entire thickness of the saturated zone.

The individual drains would be connected to a header pipe positioned to gravity drain to the lowest point along the bench from where the contaminated groundwater would be conveyed downslope to a small treatment facility positioned at the base of the slope. This treatment facility would consist of a small air stripper to remove the VOCs and additional treatment to remove metals and/or adjust the pH prior to discharge to Eighteen Mile Creek. Alternatively, discharge of the pre-treated (air stripped) water directly to the Lockport Wastewater Treatment Plant located on the southwest side of Eighteen Mile Creek may be a possibility.

Whereas this system can be designed and installed to collect some percentage of the contaminated groundwater flowing under the site, no appreciable additional reduction in risk to human health and the environment would be achieved. This is based on the fact that the flow of contaminated groundwater under the site and discharge to the cliff face and ultimately Eighteen

Mile Creek is so low at present that no discernible impacts to the creek have occurred, and the risk presently posed by the site to human health and the environment is minimal. Consequently, collecting the groundwater before it reaches the exposed face will not appreciably improve upon present conditions. Further evaluation of this measure is not warranted.

5.0 SUMMARY AND CONCLUSIONS

5.1 Summary

- From 1957 to 1983, VDM disposed approximately 3,300 55-gal drums containing hexachlorodioxane, silicon tetrachloride, carbon and silicon carbide in their 2.5 acre landfill.

- The landfill was closed during the summer of 1987 in accordance with a NYSDEC approved closure plan. The closure consisted of regrading (mounding) the site and installing a low-permeability cover system. The cover system consisted of 24 inches of compacted clay with a maximum permeability of 1 x 10^{-7} cm/sec, 3-inches of sand drainage material, 15-inches of barrier protection soil and 6-inches of topsoil.

- Analytical data for groundwater samples collected from the five onsite monitoring wells during the four year investigative monitoring period following landfill closure indicated that several VOCs and metals exceeded the GPCs established in VDM's Part 373 post-closure permit. Some contaminants also exceeded the "Exceedance Concentrations" specified in the permit for two or more successive quarterly monitoring periods

- Analytical data for surface water samples collected in Eighteen Mile Creek following landfill closure did not show any exceedances of NYSDEC surface water standards for any site-related contaminants. NYSDEC has allowed VDM to discontinue monitoring of the Creek due to the lack of any observable impacts.

- Infiltration rates measured in the pan-lysimeter during this same four-year period were higher than anticipated based on design calculations.

- As specified in their NYSDEC Part 373 post-closure permit, VDM was required to perform a corrective measures study and assessment of the landfill cap

5.2 Conclusions

5.2.1 Corrective Measures

Based on a review of the existing information, a qualitative health risk assessment and evaluation of four alternative corrective measures, the following conclusions were reached.

- In order to provide a conservative assessment of the health risk posed by the site, all the chemicals specified in VDM's post-closure permit (Table 2-1) were determined to be potential chemicals of concern and retained for further evaluation.

- Based on the health risk assessment, there are two potentially completed exposure pathways for the site. The first exposure route is associated with discharge of contaminated groundwater in the cliff face as seeps or overland flow downslope to Eighteen Mile Creek. Considering that the seep which previously was noted in the cliff face has not been observed since capping of the landfill and the inaccessibility of the cliff (steepness, private property) to recreational trespassers, this is likely to be an occasional exposure activity at best.

- The second potential exposure route is associated with surface waters of Eighteen Mile Creek which might receive contaminated groundwater discharged from the site. Based on extremely low calculated potential mass loadings relative to the assimilative capacity of the creek, it appears that there would be no discernible impact on the surface waters of Eighteen Mile Creek, and the health risk associated with this exposure route would be minimal. This is supported by analytical data for surface waters in Eighteen Mile Creek adjacent to the site which show no exceedances of NYSDEC surface water standards for any site-related contaminants.

- There are no apparent ecological risks posed by the site.

- In developing and evaluating potential corrective measures which might be implemented at the site, the primary remedial action objective was to control groundwater discharges at the cliff face and/or discharges directly to Eighteen Mile Creek.

- Four potential corrective measures were developed based on discussions with the NYSDEC. These included 1) no further action; 2) installation of an upgradient low-permeability barrier; 3) installation of a synthetic cap over the existing clay cap; and, 4) installation of a groundwater collection and treatment system.

- Based on the available groundwater elevation data, the overall groundwater flux across the site was calculated to be about 0.18 gpm. Groundwater flow from upgradient areas onto the site accounts for about 0.03 gpm whereas infiltration through the existing cap accounts for the remaining 0.15 gpm.

- Evaporation rates in the cliff face may result in some additional reduction in the volume which ultimately reaches Eighteen Mile Creek. Southerly exposure of the cliff face, increased downslope areas and westerly winds may further increase evaporation rates for the site.

- The no further action alternative meets the remedial action objective in that based on the present groundwater discharge rate from the site, the mass loadings to Eighteen Mile Creek are so low relative to the assimilative capacity of the creek, that no appreciable adverse impact will occur. This is supported by analytical data for surface waters in Eighteen Mile Creek adjacent to the site which show no exceedances of NYSDEC surface water standards for any site-related contaminants. Consequently, the risk presently posed by the site to human health and the environment is minimal.

- It is estimated that installation of an upgradient low-permeability barrier will reduce the total groundwater flux across the site by about 0.03 gpm which represents about 15 percent of the total flow (0.18 gpm). However, considering that the groundwater currently flowing onto the site does not contact the wastes directly, and that the present groundwater discharge rate to the cliff face and ultimately to Eighteen Mile Creek is so low (without the barrier) that no discernible impacts to the creek have occurred, the risk presently posed by the site to human health and the environment is minimal. Consequently, implementing this measure will not appreciably improve upon existing conditions.

- It is estimated that installation of a geomembrane or bentonite-type liner over the existing clay cap would result in an additional reduction of infiltration to the site of about 9 percent as compared to the existing infiltration rates associated with the clay cap. However, considering that the present groundwater discharge rate to the cliff face and ultimately to Eighteen Mile Creek is so low that no discernible impacts to the Creek have occurred, the risk presently posed by the site to human health and the environment is minimal. Consequently, implementing this measure will not appreciably improve upon existing conditions.

- It is estimated that installation of a groundwater collection system would result in some portion of the groundwater flowing under the site being collected and treated prior to discharge to Eighteen Mile Creek or the nearby sewage treatment plant. However, as with the other alternatives, the risk presently posed by the site to human health and the environment under existing conditions is minimal. Consequently, implementing this measure will not appreciably improve upon existing conditions.

In summary, some of or all of the various corrective measures outlined herein could be implemented at the site to further reduce the amount of groundwater flowing under the site and/or being discharged in the cliff face and ultimately to Eighteen Mile Creek. However, inasmuch as groundwater discharges from the site under existing conditions and potential mass loadings to Eighteen Mile Creek are so low that no discernible impacts of the creek have resulted, and exposure risks are minimal or non-existent, it is considered unnecessary and unwarranted to undertake any additional corrective measures at this time.

5.2.2 Pan-Lysimeter

Based on the results of the geotechnical testing, a review of the construction details, and groundwater elevation measurements in the various monitoring wells, the following conclusions were reached:

- The low-permeability clay layer exhibits geotechnical properties which are very comparable to those obtained during construction and, consequently, can be expected to be performing as originally designed.

- Water levels in the landfill materials and/or shallow bedrock (Power Glen) are below the elevation of the pan lysimeter and bottom of the excavation, and therefore could not be the cause of the higher than expected infiltration rates observed in the pan-lysimeter.

- The most probable cause of the increased infiltration rates appears to be groundwater in the sand drainage layer and/or surface water seeping into the area of the pan lysimeter through secondary permeability features as opposed to water infiltrating solely through the low permeability layer. These secondary features may include some or all of the following:

    - openings around the steel riser pipe;
    - desiccation cracks;
    - sand stringers which penetrate the low-permeability layer; and,
    - preferential pathways along excavation interfaces

In summary, it appears that the low-permeability layer in particular, and the landfill cap in general, are functioning as designed. Furthermore, the higher than expected infiltration rates observed in the pan-lysimeter are not indicative of a failure of the capping system, but are more likely the result of other factors associated with the design and/or construction of the pan-lysimeter installation.

6.0 RECOMMENDATIONS

6.1 Corrective Measures

Based on evaluation of existing site conditions and the potential corrective measures, it is recommended that the No Further Action alternative be implemented at the site.

6.2 Pan-Lysimeter

In regards to the pan-lysimeter it is recommended that its use as a monitor of landfill cap performance be discontinued due to the probable erroneous nature of the data.

6.3 Monitoring

It is recommended that a Compliance Monitoring Program for the site be developed in consultation with the NYSDEC.

APPENDIX A

ANALYTICAL DATA SUMMARY TABLES
WELLS - VDM -9, -10, -11, -14 AND D-55
(PREPARED BY VDM)

KEY TO ANALYTICAL SUMMARY TABLES

Columns

#1 (no label)	Number of quarterly monitoring events
#2 - sample	Parameter concentration in μg/L (ppb)
#3 - Exc. Con.	Exceedance concentration as specified in VDM's post-closure permit (μg/L)
#4 - Pro Std.	Groundwater protection concentration as specified in VDM's post closure permit (μg/L)
#5 - Up Lim.	Statistical Level of Confidence of 95%

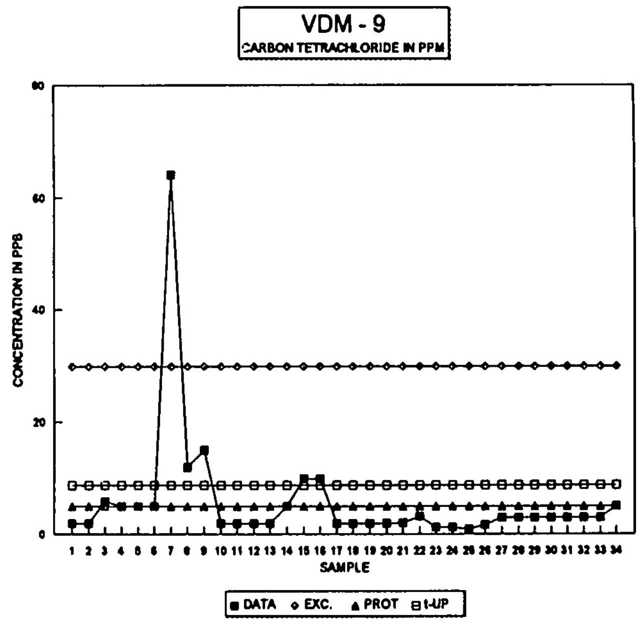
Abbreviations

Total	Utilizing all data points
Before	Before capping of landfill
After	After capping of landfill
Mean	Arithmetic mean (average value)
N	Number of data points
STD	Population Standard Deviation
Sx	Standard Error
df	Degrees of Freedom

WELL VDM - 9 : CARBON TETRACHLORIDE

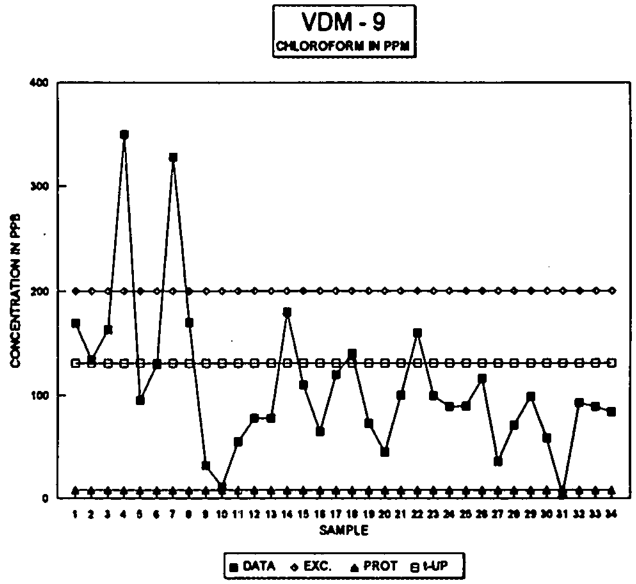
	SAMPLE	EXC CON	PRO STD	UP LIM
1	2	30	5	9
2	2	30	5	9
3	6	30	5	9
4	5	30	5	9
5	5	30	5	9
6	5	30	5	9
7	64	30	5	9
8	12	30	5	9
9	15	30	5	9
10	2	30	5	9
11	2	30	5	9
12	2	30	5	9
13	2	30	5	9
14	5	30	5	9
15	10	30	5	9
16	10	30	5	9
17	2	30	5	9
18	2	30	5	9
19	2	30	5	9
20	2	30	5	9
21	2.1	30	5	9
22	3.2	30	5	9
23	1.25	30	5	9
24	1.26	30	5	9
25	1	30	5	9
26	1.73	30	5	9
27	3	30	5	9
28	3	30	5	9
29	3	30	5	9
30	3	30	5	9
31	3	30	5	9
32	3	30	5	9
33	3	30	5	9
34	5	30	5	9

STATISTICS		STUDENT t TESTING	
TOTAL STD	10.63996	UPPER LIMIT	8.866987
TOTAL Sx	1.852179		
TOTAL MEAN	5.692353		
TOTAL N	34		
TOTAL df	33		
BEFORE MEAN	12.71429	UPPER LIMIT	29.28529
BEFORE STD	20.98785		
BEFORE Sx	8.568253		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	6.019286	UPPER LIMIT	9.8865
AFTER STD	11.67614		
AFTER Sx	2.247074		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : CHLOROFORM

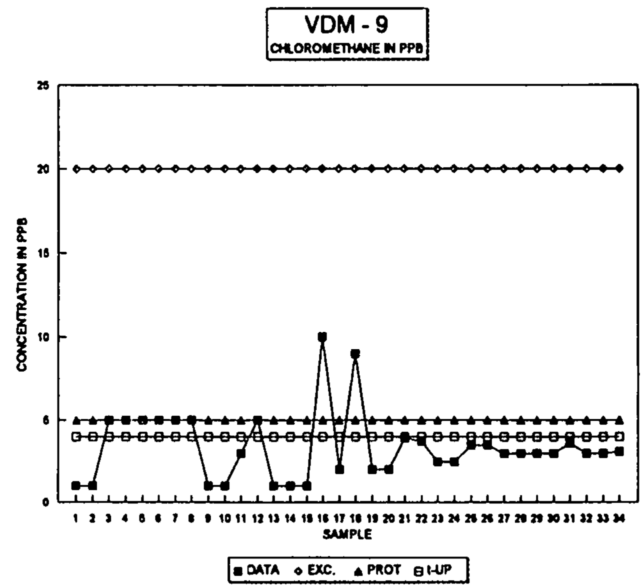
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1	169	200	8	131	TOTAL STD	72.09382	UPPER LIMIT	130.7376
2	134	200	8	131	TOTAL Sx	12.54989		
3	163	200	8	131	TOTAL MEAN	109.2647		
4	350	200	8	131	TOTAL N	34		
5	95	200	8	131	TOTAL df	33		
6	130	200	8	131				
7	328	200	8	131	BEFORE MEAN	195.5714	UPPER LIMIT	269.8382
8	170	200	8	131	BEFORE STD	93.62385		
9	32	200	8	131	BEFORE Sx	38.22169		
10	11	200	8	131	BEFORE N	7		
11	55	200	8	131	BEFORE df	6		
12	78	200	8	131				
13	78	200	8	131	AFTER MEAN	95.5	UPPER LIMIT	115.855
14	180	200	8	131	AFTER STD	61.45702		
15	110	200	8	131	AFTER Sx	11.82741		
16	65	200	8	131	AFTER N	28		
17	120	200	8	131	AFTER df	27		
18	140	200	8	131				
19	73	200	8	131				
20	45	200	8	131				
21	100	200	8	131				
22	160	200	8	131				
23	99.7	200	8	131				
24	89.1	200	8	131				
25	89.6	200	8	131				
26	116	200	8	131				
27	36	200	8	131				
28	71	200	8	131				
29	99	200	8	131				
30	59	200	8	131				
31	4	200	8	131				
32	93	200	8	131				
33	89	200	8	131				
34	84	200	8	131				



WELL VDM - 9 : CHLOROMETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	20	5	4
2	1	20	5	4
3	5	20	5	4
4	5	20	5	4
5	5	20	5	4
6	5	20	5	4
7	5	20	5	4
8	5	20	5	4
9	1	20	5	4
10	1	20	5	4
11	3	20	5	4
12	5	20	5	4
13	1	20	5	4
14	1	20	5	4
15	1	20	5	4
16	10	20	5	4
17	2	20	5	4
18	9	20	5	4
19	2	20	5	4
20	2	20	5	4
21	3.9	20	5	4
22	3.7	20	5	4
23	2.5	20	5	4
24	2.5	20	5	4
25	3.5	20	5	4
26	3.5	20	5	4
27	3	20	5	4
28	3	20	5	4
29	3	20	5	4
30	3	20	5	4
31	3.6	20	5	4
32	3	20	5	4
33	3	20	5	4
34	3.1	20	5	4

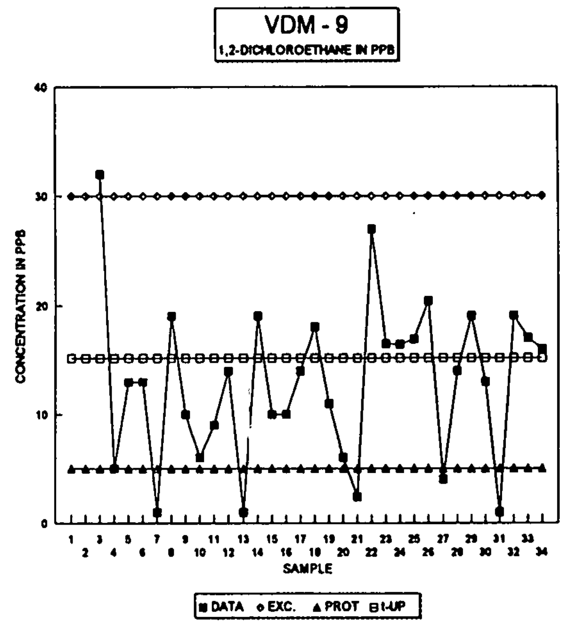
STATISTICS		STUDENT t TESTING	
TOTAL STD	2.045226	UPPER LIMIT	3.970929
TOTAL Sx	0.356028		
TOTAL MEAN	3.361765		
TOTAL N	34		
TOTAL df	33		
BEFORE MEAN	3.857143	UPPER LIMIT	5.290516
BEFORE STD	1.807016		
BEFORE Sx	0.737711		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	3.296429	UPPER LIMIT	3.98269
AFTER STD	2.072004		
AFTER Sx	0.398757		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : 1,2-DICHLOROETHANE

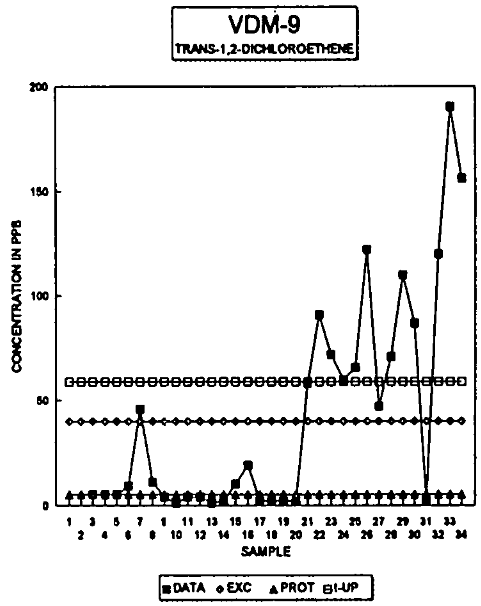
	SAMPLE	EXC CON	PRO STD	UP LIM
1		30	5	15
2		30	5	15
3	32	30	5	15
4	5	30	5	15
5	13	30	5	15
6	13	30	5	15
7	1	30	5	15
8	19	30	5	15
9	10	30	5	15
10	6	30	5	15
11	9	30	5	15
12	14	30	5	15
13	1	30	5	15
14	19	30	5	15
15	10	30	5	15
16	10	30	5	15
17	14	30	5	15
18	18	30	5	15
19	11	30	5	15
20	6	30	5	15
21	2.4	30	5	15
22	27	30	5	15
23	16.5	30	5	15
24	16.4	30	5	15
25	16.9	30	5	15
26	20.4	30	5	15
27	4	30	5	15
28	14	30	5	15
29	19	30	5	15
30	13	30	5	15
31	1	30	5	15
32	19	30	5	15
33	17	30	5	15
34	16	30	5	15

STATISTICS		STUDENT t TESTING	
TOTAL STD	7.249914	UPPER LIMIT	15.16075
TOTAL Sx	1.302123		
TOTAL MEAN	12.925		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	12.8	UPPER LIMIT	24.16978
BEFORE STD	10.66583		
BEFORE Sx	5.332917		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	12.52143	UPPER LIMIT	14.73504
AFTER STD	6.683474		
AFTER Sx	1.266235		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : TRANS-1,2-DICHLOROETHANE

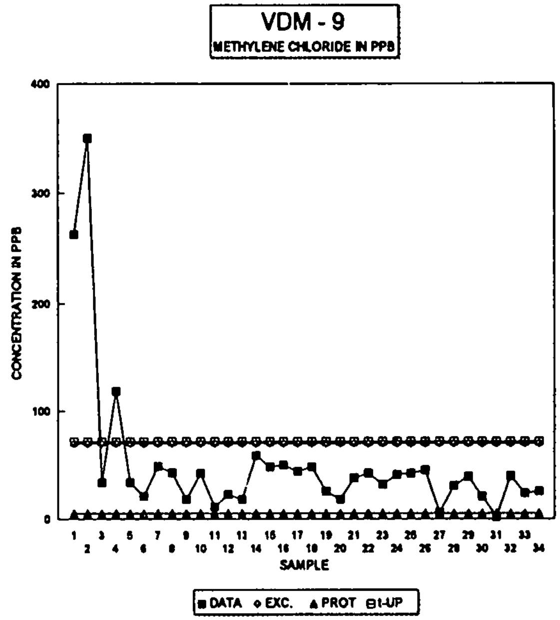
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		40	5	59	TOTAL STD	51.3104	UPPER LIMIT	59.12947
2		40	5	59	TOTAL Sx	9.215619		
3	5	40	5	59	TOTAL MEAN	43.30625		
4	5	40	5	59	TOTAL N	32		
5	5	40	5	59	TOTAL df	31		
6	9	40	5	59				
7	46	40	5	59	BEFORE MEAN	14	UPPER LIMIT	31.13576
8	11	40	5	59	BEFORE STD	16.07483		
9	4	40	5	59	BEFORE Sx	8.037413		
10	1	40	5	59	BEFORE N	5		
11	4	40	5	59	BEFORE df	4		
12	4	40	5	59				
13	1	40	5	59	AFTER MEAN	48.63571	UPPER LIMIT	66.10262
14	2	40	5	59	AFTER STD	52.73719		
15	10	40	5	59	AFTER Sx	10.14928		
16	19	40	5	59	AFTER N	28		
17	2	40	5	59	AFTER df	27		
18	2	40	5	59				
19	2	40	5	59				
20	2	40	5	59				
21	58	40	5	59				
22	91	40	5	59				
23	71.8	40	5	59				
24	59.8	40	5	59				
25	65.7	40	5	59				
26	122	40	5	59				
27	47	40	5	59				
28	71	40	5	59				
29	110	40	5	59				
30	87	40	5	59				
31	3	40	5	59				
32	120	40	5	59				
33	190	40	5	59				
34	156	40	5	59				



WELL VDM - 9 : METHYLENE CHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	263	70	5	71
2	350	70	5	71
3	34	70	5	71
4	118	70	5	71
5	34	70	5	71
6	21	70	5	71
7	49	70	5	71
8	43	70	5	71
9	18	70	5	71
10	42	70	5	71
11	11	70	5	71
12	23	70	5	71
13	18	70	5	71
14	59	70	5	71
15	48	70	5	71
16	50	70	5	71
17	44	70	5	71
18	48	70	5	71
19	26	70	5	71
20	18	70	5	71
21	38	70	5	71
22	42	70	5	71
23	32	70	5	71
24	41.2	70	5	71
25	42.1	70	5	71
26	45.2	70	5	71
27	5.7	70	5	71
28	31	70	5	71
29	39	70	5	71
30	21	70	5	71
31	2	70	5	71
32	40	70	5	71
33	24	70	5	71
34	26	70	5	71

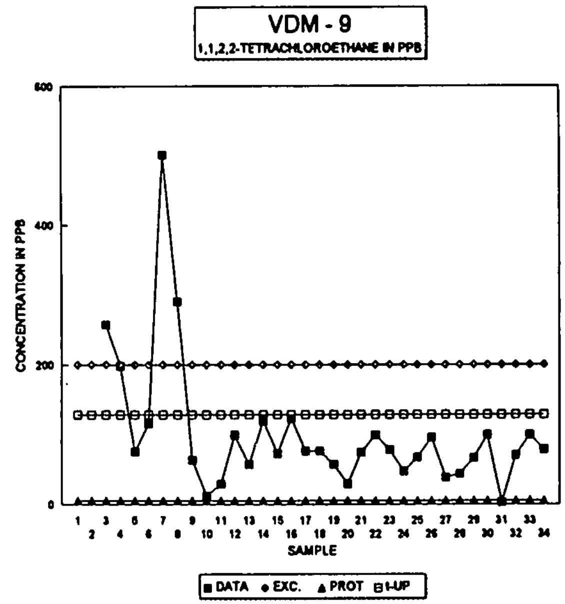
STATISTICS		STUDENT t TESTING	
TOTAL STD	67.54219	UPPER LIMIT	71.46135
TOTAL Sx	11.75759		
TOTAL MEAN	51.34412		
TOTAL N	34		
TOTAL df	33		
BEFORE MEAN	124.1429	UPPER LIMIT	220.301
BEFORE STD	121.224		
BEFORE Sx	49.4695		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	33.06071	UPPER LIMIT	37.82238
AFTER STD	14.37673		
AFTER Sx	2.768802		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : 1,1,2,2-TETRACHLOROETHANE

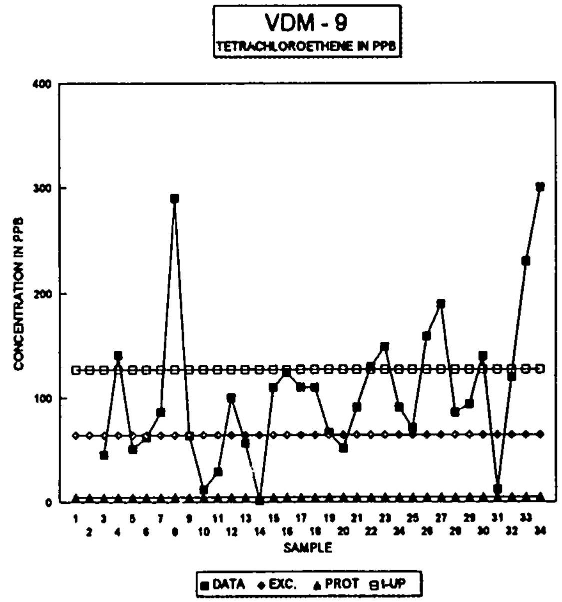
	SAMPLE	EXC CON	PRO STD	UP LIM
1		200	5	130
2		200	5	130
3	257	200	5	130
4	198	200	5	130
5	76	200	5	130
6	116	200	5	130
7	500	200	5	130
8	290	200	5	130
9	64	200	5	130
10	12	200	5	130
11	29	200	5	130
12	100	200	5	130
13	58	200	5	130
14	120	200	5	130
15	73	200	5	130
16	124	200	5	130
17	77	200	5	130
18	77	200	5	130
19	58	200	5	130
20	29	200	5	130
21	75	200	5	130
22	100	200	5	130
23	78.4	200	5	130
24	47.8	200	5	130
25	68.1	200	5	130
26	96	200	5	130
27	38	200	5	130
28	44	200	5	130
29	67	200	5	130
30	100	200	5	130
31	3	200	5	130
32	70	200	5	130
33	100	200	5	130
34	79	200	5	130

STATISTICS		STUDENT t TESTING	
TOTAL STD	93.59603	UPPER LIMIT	129.6102
TOTAL Sx	16.81034		
TOTAL MEAN	100.7469		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	229.4	UPPER LIMIT	388.4901
BEFORE STD	149.2402		
BEFORE Sx	74.6201		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	92.03214	UPPER LIMIT	122.9176
AFTER STD	93.25122		
AFTER Sx	17.94621		
AFTER N	28		
AFTER df	27		



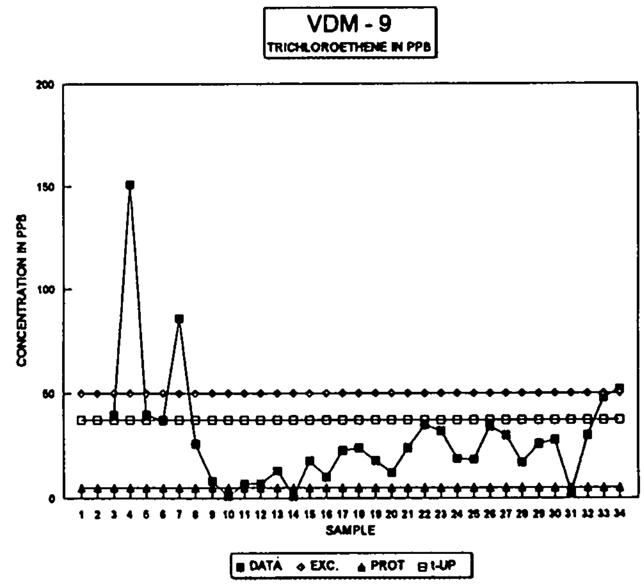
WELL VDM - 9 : TETRACHLOROETHENE

	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		65	5	127	TOTAL STD	69.92472	UPPER LIMIT	127.0823
2		65	5	127	TOTAL Sx	12.55885		
3	46	65	5	127	TOTAL MEAN	105.5188		
4	141	65	5	127	TOTAL N	32		
5	51	65	5	127	TOTAL df	31		
6	62	65	5	127				
7	87	65	5	127	BEFORE MEAN	77.4	UPPER LIMIT	114.5029
8	290	65	5	127	BEFORE STD	34.80575		
9	64	65	5	127	BEFORE Sx	17.40287		
10	12	65	5	127	BEFORE N	5		
11	29	65	5	127	BEFORE df	4		
12	100	65	5	127				
13	57	65	5	127	AFTER MEAN	109.8788	UPPER LIMIT	133.8165
14	1	65	5	127	AFTER STD	72.27506		
15	110	65	5	127	AFTER Sx	13.90934		
16	124	65	5	127	AFTER N	28		
17	110	65	5	127	AFTER df	27		
18	110	65	5	127				
19	67	65	5	127				
20	52	65	5	127				
21	91	65	5	127				
22	130	65	5	127				
23	149	65	5	127				
24	91	65	5	127				
25	71.6	65	5	127				
26	159	65	5	127				
27	190	65	5	127				
28	88	65	5	127				
29	94	65	5	127				
30	140	65	5	127				
31	12	65	5	127				
32	120	65	5	127				
33	230	65	5	127				
34	300	65	5	127				



WELL VDM - 9 : TRICHLOROETHENE

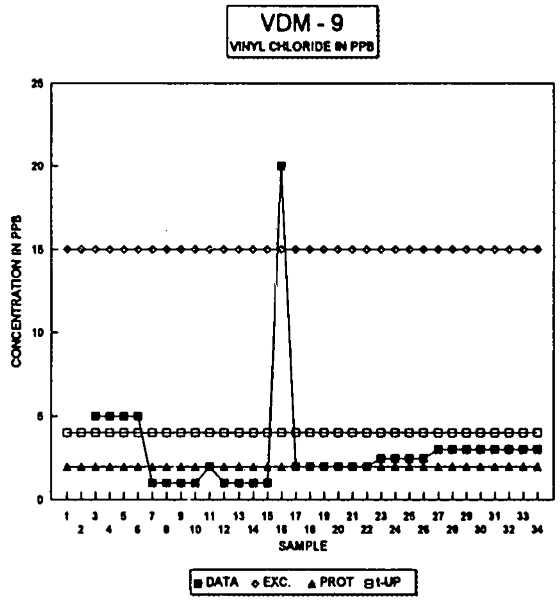
SAMPLE		EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		50	5	37	TOTAL STD	27.77827	UPPER LIMIT	37.26008
2		50	5	37	TOTAL Sx	4.989125		
3	40	50	5	37	TOTAL MEAN	28.69375		
4	151	50	5	37	TOTAL N	32		
5	40	50	5	37	TOTAL df	31		
6	37	50	5	37				
7	86	50	5	37	BEFORE MEAN	70.8	UPPER LIMIT	117.7592
8	26	50	5	37	BEFORE STD	44.05179		
9	8	50	5	37	BEFORE Sx	22.02589		
10	1	50	5	37	BEFORE N	5		
11	7	50	5	37	BEFORE df	4		
12	7	50	5	37				
13	13	50	5	37	AFTER MEAN	23.22143	UPPER LIMIT	29.01594
14	1	50	5	37	AFTER STD	17.49517		
15	18	50	5	37	AFTER Sx	3.366947		
16	10	50	5	37	AFTER N	28		
17	23	50	5	37	AFTER df	27		
18	24	50	5	37				
19	18	50	5	37				
20	12	50	5	37				
21	24	50	5	37				
22	35	50	5	37				
23	32.1	50	5	37				
24	18.8	50	5	37				
25	18.5	50	5	37				
26	34.3	50	5	37				
27	30	50	5	37				
28	17	50	5	37				
29	26	50	5	37				
30	28	50	5	37				
31	3	50	5	37				
32	30	50	5	37				
33	48	50	5	37				
34	52	50	5	37				



WELL VDM - 9 : VINYL CHLORIDE

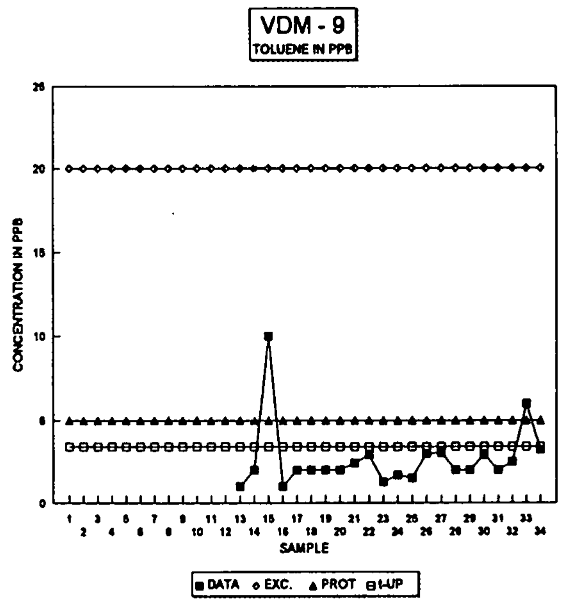
SAMPLE	EXC CON	PRO STD	UP LIM
1		15	2	4
2		15	2	4
3	5	15	2	4
4	5	15	2	4
5	5	15	2	4
6	5	15	2	4
7	1	15	2	4
8	1	15	2	4
9	1	15	2	4
10	1	15	2	4
11	2	15	2	4
12	1	15	2	4
13	1	15	2	4
14	1	15	2	4
15	1	15	2	4
16	20	15	2	4
17	2	15	2	4
18	2	15	2	4
19	2	15	2	4
20	2	15	2	4
21	2	15	2	4
22	2	15	2	4
23	2.5	15	2	4
24	2.5	15	2	4
25	2.5	15	2	4
26	2.5	15	2	4
27	3	15	2	4
28	3	15	2	4
29	3	15	2	4
30	3	15	2	4
31	3	15	2	4
32	3	15	2	4
33	3	15	2	4
34	3	15	2	4

STATISTICS		STUDENT t TESTING	
TOTAL STD	3.283481	UPPER LIMIT	4.012568
TOTAL Sx	0.589731		
TOTAL MEAN	3		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	4.2	UPPER LIMIT	5.9056
BEFORE STD	1.6		
BEFORE Sx	0.8		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	2.714286	UPPER LIMIT	3.845654
AFTER STD	3.415899		
AFTER Sx	0.65739		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : TOLUENE

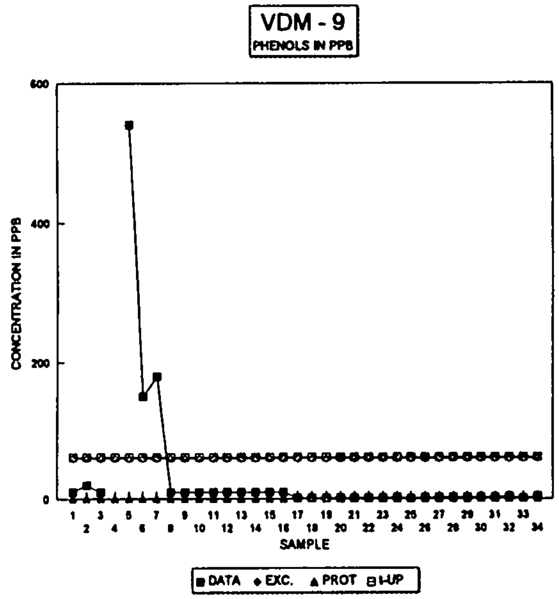
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		20	5	3	TOTAL STD	1.895265	UPPER LIMIT	3.394155
2		20	5	3	TOTAL Sx	0.413581		
3		20	5	3	TOTAL MEAN	2.651384		
4		20	5	3	TOTAL N	22		
5		20	5	3	TOTAL df	21		
6		20	5	3				
7		20	5	3	BEFORE MEAN	ERR	UPPER LIMIT	ERR
8		20	5	3	BEFORE STD	ERR		
9		20	5	3	BEFORE Sx	ERR		
10		20	5	3	BEFORE N	0		
11		20	5	3	BEFORE df	-1		
12		20	5	3				
13	1	20	5	3	AFTER MEAN	2.651384	UPPER LIMIT	3.376371
14	2	20	5	3	AFTER STD	1.895265		
15	10	20	5	3	AFTER Sx	0.413581		
16	1	20	5	3	AFTER N	22		
17	2	20	5	3	AFTER df	21		
18	2	20	5	3				
19	2	20	5	3				
20	2	20	5	3				
21	2.4	20	5	3				
22	2.9	20	5	3				
23	1.25	20	5	3				
24	1.69	20	5	3				
25	1.5	20	5	3				
26	2.99	20	5	3				
27	3	20	5	3				
28	2	20	5	3				
29	2	20	5	3				
30	3	20	5	3				
31	2.0	20	5	3				
32	2.5	20	5	3				
33	6	20	5	3				
34	3.2	20	5	3				



WELL VDM - 9 : PHENOLS

	SAMPLE	EXC CON	PRO STD	UP LIM
1	10	60	1	61
2	20	60	1	61
3	10	60	1	61
4		60	1	61
5	540	60	1	61
6	150	60	1	61
7	180	60	1	61
8	10	60	1	61
9	10	60	1	61
10	10	60	1	61
11	10	60	1	61
12	10	60	1	61
13	10	60	1	61
14	10	60	1	61
15	10	60	1	61
16	10	60	1	61
17	2	60	1	61
18	2	60	1	61
19	2	60	1	61
20	2	60	1	61
21	2	60	1	61
22	2	60	1	61
23	2	60	1	61
24	2.5	60	1	61
25	1	60	1	61
26	2.5	60	1	61
27	2.5	60	1	61
28	2.5	60	1	61
29	2.5	60	1	61
30	2.5	60	1	61
31	2.5	60	1	61
32	3.5	60	1	61
33	1	60	1	61
34	3	60	1	61

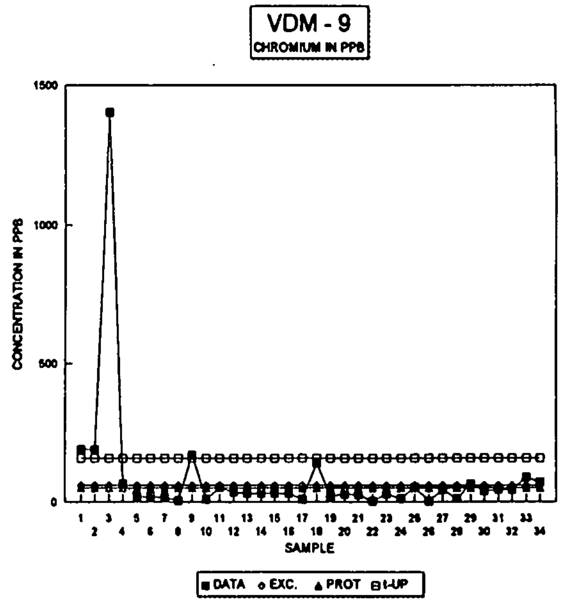
STATISTICS		STUDENT t TESTING	
TOTAL STD	97.75034	UPPER LIMIT	61.18488
TOTAL Sx	17.27998		
TOTAL MEAN	31.51515		
TOTAL N	33		
TOTAL df	32		
BEFORE MEAN	151.6667	UPPER LIMIT	319.8853
BEFORE STD	186.6741		
BEFORE Sx	83.4832		
BEFORE N	6		
BEFORE df	5		
AFTER MEAN	11.07143	UPPER LIMIT	21.906
AFTER STD	32.71241		
AFTER Sx	6.295507		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : CHROMIUM

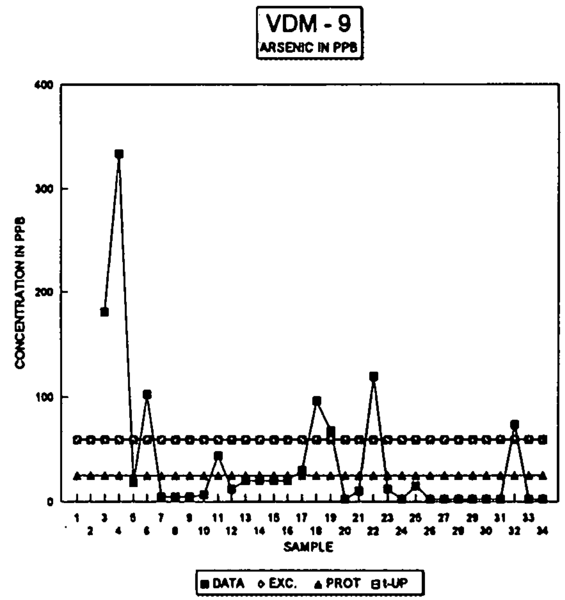
	SAMPLE	EXC CON	PRO STD	UP LIM
1	190	60	50	158
2	190	60	50	158
3	1400	60	50	158
4	66	60	50	158
5	17	60	50	158
6	19	60	50	158
7	16	60	50	158
8	5	60	50	158
9	170	60	50	158
10	9	60	50	158
11	51	60	50	158
12	33	60	50	158
13	30	60	50	158
14	30	60	50	158
15	30	60	50	158
16	30	60	50	158
17	8	60	50	158
18	140	60	50	158
19	20	60	50	158
20	27	60	50	158
21	25	60	50	158
22	2	60	50	158
23	26	60	50	158
24	10	60	50	158
25	53	60	50	158
26	2	60	50	158
27	42	60	50	158
28	10	60	50	158
29	63	60	50	158
30	38	60	50	158
31	42	60	50	158
32	42	60	50	158
33	90	60	50	158
34	71	60	50	158

STATISTICS		STUDENT t TESTING	
TOTAL STD	233.801	UPPER LIMIT	157.7839
TOTAL Sx	40.69952		
TOTAL MEAN	88.14706		
TOTAL N	34		
TOTAL df	33		
BEFORE MEAN	271.1429	UPPER LIMIT	641.1195
BEFORE STD	466.4199		
BEFORE Sx	190.4151		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	39.82143	UPPER LIMIT	52.51207
AFTER STD	38.3164		
AFTER Sx	7.373995		
AFTER N	28		
AFTER df	27		



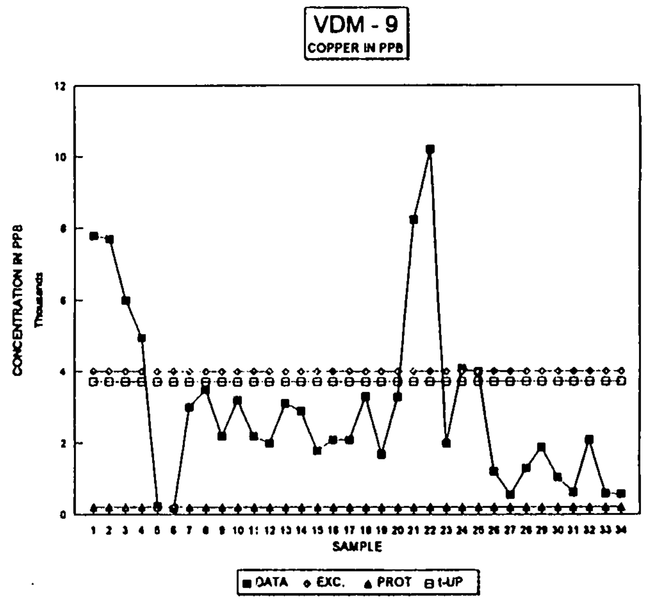
WELL VDM - 9 : ARSENIC

	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		60	25	60	TOTAL STD	67.47509	UPPER LIMIT	59.55187
2		60	25	60	TOTAL Sx	12.11888		
3	181	60	25	60	TOTAL MEAN	38.74375		
4	333	60	25	60	TOTAL N	32		
5	18	60	25	60	TOTAL df	31		
6	103	60	25	60				
7	5	60	25	60	BEFORE MEAN	128	UPPER LIMIT	256.5297
8	5	60	25	60	BEFORE STD	120.572		
9	5	60	25	60	BEFORE Sx	60.28599		
10	7	60	25	60	BEFORE N	5		
11	44	60	25	60	BEFORE df	4		
12	12	60	25	60				
13	20	60	25	60	AFTER MEAN	21.6	UPPER LIMIT	31.70825
14	20	60	25	60	AFTER STD	30.51946		
15	20	60	25	60	AFTER Sx	5.873472		
16	20	60	25	60	AFTER N	28		
17	30	60	25	60	AFTER df	27		
18	97	60	25	60				
19	68	60	25	60				
20	2	60	25	60				
21	10	60	25	60				
22	120	60	25	60				
23	12.4	60	25	60				
24	2	60	25	60				
25	15.4	60	25	60				
26	2	60	25	60				
27	2	60	25	60				
28	2	60	25	60				
29	2	60	25	60				
30	2	60	25	60				
31	2	60	25	60				
32	74	60	25	60				
33	2	60	25	60				
34	2	60	25	60				



WELL VDM - 9 : COPPER

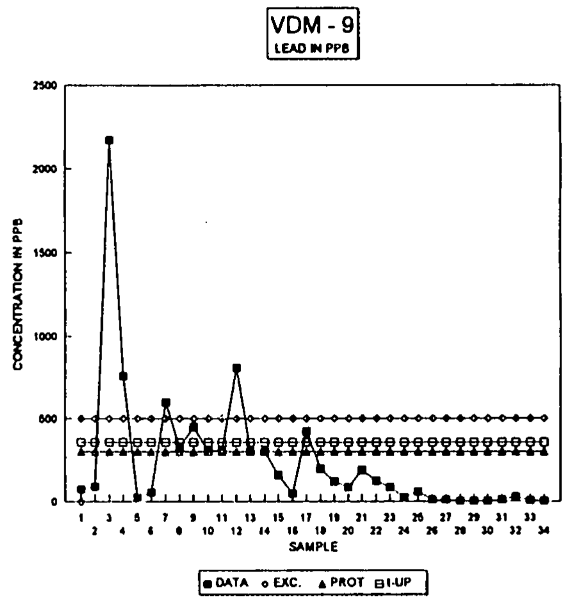
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1	7800	4000	200	3708	TOTAL STD	2419.442	UPPER LIMIT	3708.3
2	7700	4000	200	3708	TOTAL Sx	421.1708		
3	6000	4000	200	3708	TOTAL MEAN	2987.676		
4	4940	4000	200	3708	TOTAL N	34		
5	243	4000	200	3708	TOTAL df	33		
6	171	4000	200	3708				
7	3000	4000	200	3708	BEFORE MEAN	4264.857	UPPER LIMIT	6631.257
8	3500	4000	200	3708	BEFORE STD	2983.259		
9	2200	4000	200	3708	BEFORE Sx	1217.91		
10	3200	4000	200	3708	BEFORE N	7		
11	2200	4000	200	3708	BEFORE df	6		
12	2000	4000	200	3708				
13	3100	4000	200	3708	AFTER MEAN	2668.821	UPPER LIMIT	3361.482
14	2900	4000	200	3708	AFTER STD	2091.326		
15	1800	4000	200	3708	AFTER Sx	402.4758		
16	2100	4000	200	3708	AFTER N	28		
17	2100	4000	200	3708	AFTER df	27		
18	3300	4000	200	3708				
19	1680	4000	200	3708				
20	3280	4000	200	3708				
21	8240	4000	200	3708				
22	10200	4000	200	3708				
23	1990	4000	200	3708				
24	4090	4000	200	3708				
25	4000	4000	200	3708				
26	1200	4000	200	3708				
27	540	4000	200	3708				
28	1300	4000	200	3708				
29	1890	4000	200	3708				
30	1050	4000	200	3708				
31	620	4000	200	3708				
32	2100	4000	200	3708				
33	577	4000	200	3708				
34	570	4000	200	3708				



WELL VDM - 9 : LEAD

	SAMPLE	EXC CON	PRO STD	UP LIM
1	75	500	300	359
2	90	500	300	359
3	2170	500	300	359
4	760	500	300	359
5	28	500	300	359
6	57	500	300	359
7	600	500	300	359
8	330	500	300	359
9	450	500	300	359
10	310	500	300	359
11	310	500	300	359
12	810	500	300	359
13	300	500	300	359
14	300	500	300	359
15	160	500	300	359
16	50	500	300	359
17	425	500	300	359
18	196	500	300	359
19	120	500	300	359
20	88	500	300	359
21	192	500	300	359
22	124	500	300	359
23	88.4	500	300	359
24	28	500	300	359
25	61	500	300	359
26	12	500	300	359
27	9.1	500	300	359
28	2	500	300	359
29	3.6	500	300	359
30	2	500	300	359
31	10	500	300	359
32	29	500	300	359
33	6	500	300	359
34	2	500	300	359

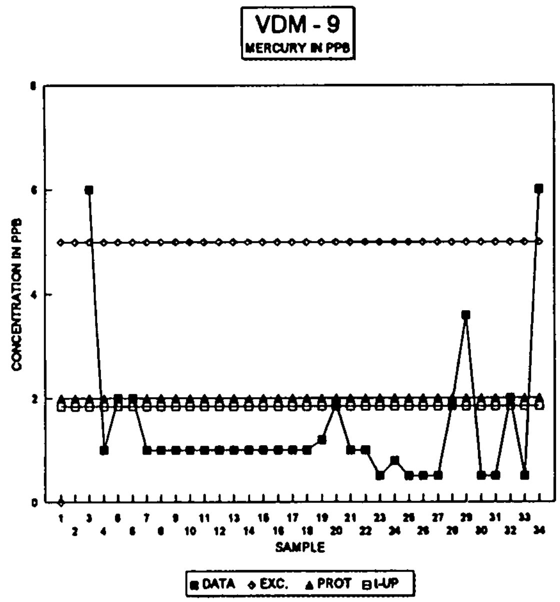
STATISTICS		STUDENT t TESTING	
TOTAL STD	397.1331	UPPER LIMIT	359.4054
TOTAL Sx	69.132		
TOTAL MEAN	241.1206		
TOTAL N	34		
TOTAL df	33		
BEFORE MEAN	540	UPPER LIMIT	1110.671
BEFORE STD	719.4301		
BEFORE Sx	293.7061		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	179.2179	UPPER LIMIT	245.9142
AFTER STD	201.3739		
AFTER Sx	38.75442		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : MERCURY

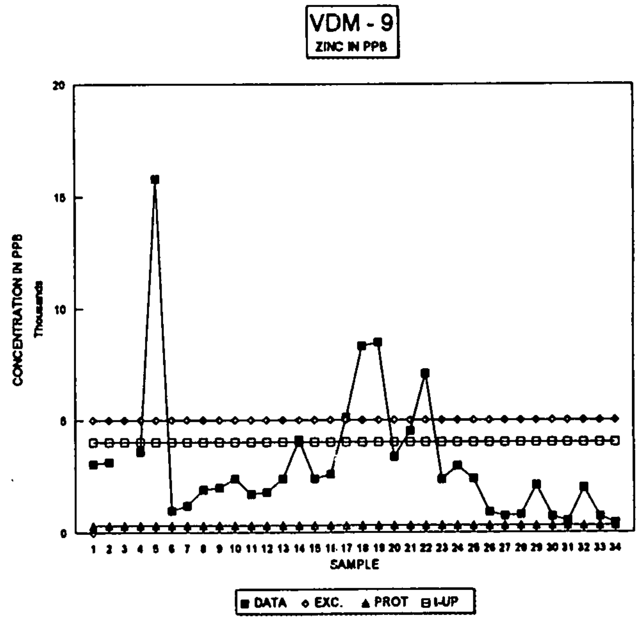
	SAMPLE	EXC CON	PRO STD	UP LIM
1		5	2	2
2		5	2	2
3	6	5	2	2
4	1	5	2	2
5	2	5	2	2
6	2	5	2	2
7	1	5	2	2
8	1	5	2	2
9	1	5	2	2
10	1	5	2	2
11	1	5	2	2
12	1	5	2	2
13	1	5	2	2
14	1	5	2	2
15	1	5	2	2
16	1	5	2	2
17	1	5	2	2
18	1	5	2	2
19	1.2	5	2	2
20	1.9	5	2	2
21	1	5	2	2
22	1	5	2	2
23	0.5	5	2	2
24	0.8	5	2	2
25	0.5	5	2	2
26	0.5	5	2	2
27	0.5	5	2	2
28	1.9	5	2	2
29	3.6	5	2	2
30	0.5	5	2	2
31	1	5	2	2
32	2	5	2	2
33	0.5	5	2	2
34	6	5	2	2

STATISTICS		STUDENT t TESTING	
TOTAL STD	1.338649	UPPER LIMIT	1.848574
TOTAL Sx	0.240069		
TOTAL MEAN	1.434375		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	2.4	UPPER LIMIT	4.377135
BEFORE STD	1.854724		
BEFORE Sx	0.927362		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	1.246429	UPPER LIMIT	1.614126
AFTER STD	1.110174		
AFTER Sx	0.213653		
AFTER N	28		
AFTER df	27		



WELL VDM - 9 : ZINC

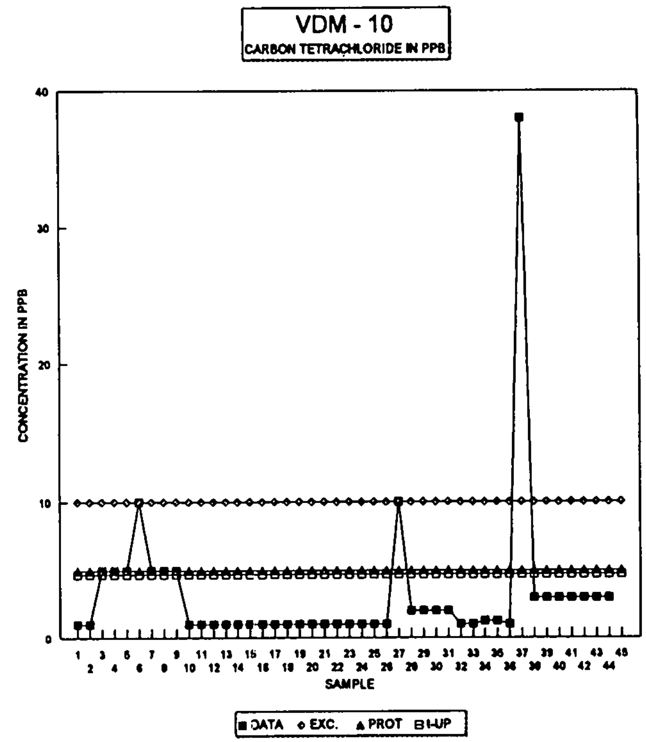
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1	3050	5000	300	4022	TOTAL STD	3020.187	UPPER LIMIT	4022.198
2	3150	5000	300	4022	TOTAL Sx	533.8987		
3		5000	300	4022	TOTAL MEAN	3108.697		
4	3600	5000	300	4022	TOTAL N	33		
5	15800	5000	300	4022	TOTAL df	32		
6	980	5000	300	4022				
7	1180	5000	300	4022	BEFORE MEAN	4626.667	UPPER LIMIT	9217.766
8	1900	5000	300	4022	BEFORE STD	5094.794		
9	2000	5000	300	4022	BEFORE Sx	2278.461		
10	2400	5000	300	4022	BEFORE N	6		
11	1700	5000	300	4022	BEFORE df	5		
12	1800	5000	300	4022				
13	2400	5000	300	4022	AFTER MEAN	2714.536	UPPER LIMIT	3430.425
14	4100	5000	300	4022	AFTER STD	2161.459		
15	2400	5000	300	4022	AFTER Sx	415.973		
16	2600	5000	300	4022	AFTER N	28		
17	5100	5000	300	4022	AFTER df	27		
18	8300	5000	300	4022				
19	8500	5000	300	4022				
20	3360	5000	300	4022				
21	4500	5000	300	4022				
22	7100	5000	300	4022				
23	2370	5000	300	4022				
24	2960	5000	300	4022				
25	2400	5000	300	4022				
26	920	5000	300	4022				
27	750	5000	300	4022				
28	790	5000	300	4022				
29	2100	5000	300	4022				
30	720	5000	300	4022				
31	520	5000	300	4022				
32	2000	5000	300	4022				
33	707	5000	300	4022				
34	430	5000	300	4022				



WELL VDM - 10 : CARBON TETRACHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	10	5	5
2	1	10	5	5
3	5	10	5	5
4	5	10	5	5
5	5	10	5	5
6	10	10	5	5
7	5	10	5	5
8	5	10	5	5
9	5	10	5	5
10	1	10	5	5
11	1	10	5	5
12	1	10	5	5
13	1	10	5	5
14	1	10	5	5
15	1	10	5	5
16	1	10	5	5
17	1	10	5	5
18	1	10	5	5
19	1	10	5	5
20	1	10	5	5
21	1	10	5	5
22	1	10	5	5
23	1	10	5	5
24	1	10	5	5
25	1	10	5	5
26	1	10	5	5
27	10	10	5	5
28	2	10	5	5
29	2	10	5	5
30	2	10	5	5
31	2	10	5	5
32	1	10	5	5
33	1	10	5	5
34	1.25	10	5	5
35	1.25	10	5	5
36	1	10	5	5
37	38	10	5	5
38	3	10	5	5
39	3	10	5	5
40	3	10	5	5
41	3	10	5	5
42	3	10	5	5
43	3	10	5	5
44	3	10	5	5
45		10	5	5

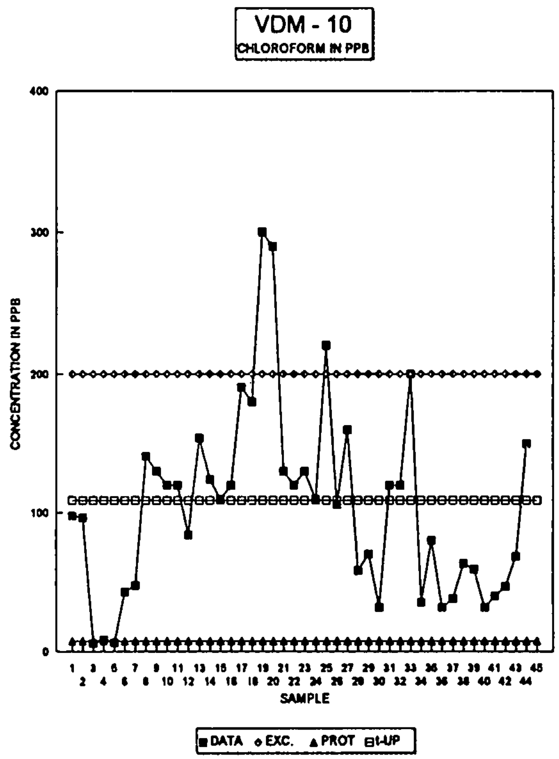
STATISTICS		STUDENT t TESTING	
TOTAL STD	5.726878	UPPER LIMIT	4.697968
TOTAL Sx	0.873341		
TOTAL MEAN	3.215909		
TOTAL N	44		
TOTAL df	43		
BEFORE MEAN	3.2	UPPER LIMIT	4.441652
BEFORE STD	2.638181		
BEFORE Sx	0.705084		
BEFORE N	15		
BEFORE df	14		
AFTER MEAN	3.080645	UPPER LIMIT	5.140521
AFTER STD	6.594043		
AFTER Sx	1.203902		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : CHLOROFORM

	SAMPLE	EXC CON	PRO STD	UP LIM
1	97.6	200	8	109
2	96.46	200	8	109
3	5.97	200	8	109
4	8.8	200	8	109
5	6.3	200	8	109
6	43.2	200	8	109
7	47.8	200	8	109
8	141	200	8	109
9	130	200	8	109
10	120	200	8	109
11	120	200	8	109
12	84	200	8	109
13	154	200	8	109
14	124	200	8	109
15	110	200	8	109
16	120	200	8	109
17	190	200	8	109
18	180	200	8	109
19	300	200	8	109
20	290	200	8	109
21	130	200	8	109
22	120	200	8	109
23	130	200	8	109
24	110	200	8	109
25	220	200	8	109
26	106	200	8	109
27	160	200	8	109
28	58	200	8	109
29	70	200	8	109
30	32	200	8	109
31	120	200	8	109
32	120	200	8	109
33	200	200	8	109
34	35.3	200	8	109
35	79.9	200	8	109
36	32	200	8	109
37	38	200	8	109
38	63	200	8	109
39	59	200	8	109
40	32	200	8	109
41	40	200	8	109
42	47.-	200	8	109
43	68	200	8	109
44	150	200	8	109
45		200	8	109

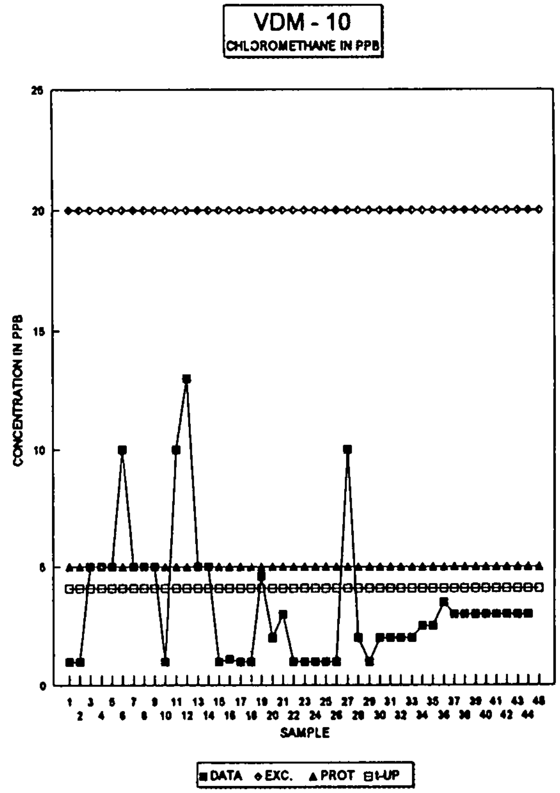
STATISTICS		STUDENT t TESTING	
TOTAL STD	71.23194	UPPER LIMIT	109.163
TOTAL Sx	10.17599		
TOTAL MEAN	92.0266		
TOTAL N	50		
TOTAL df	49		
BEFORE MEAN	85.942	UPPER LIMIT	109.0542
BEFORE STD	49.10718		
BEFORE Sx	13.12445		
BEFORE N	15		
BEFORE df	14		
AFTER MEAN	95.84324	UPPER LIMIT	117.5421
AFTER STD	76.71953		
AFTER Sx	12.78659		
AFTER N	37		
AFTER df	36		



WELL VDM - 10 : CHLOROMETHANE

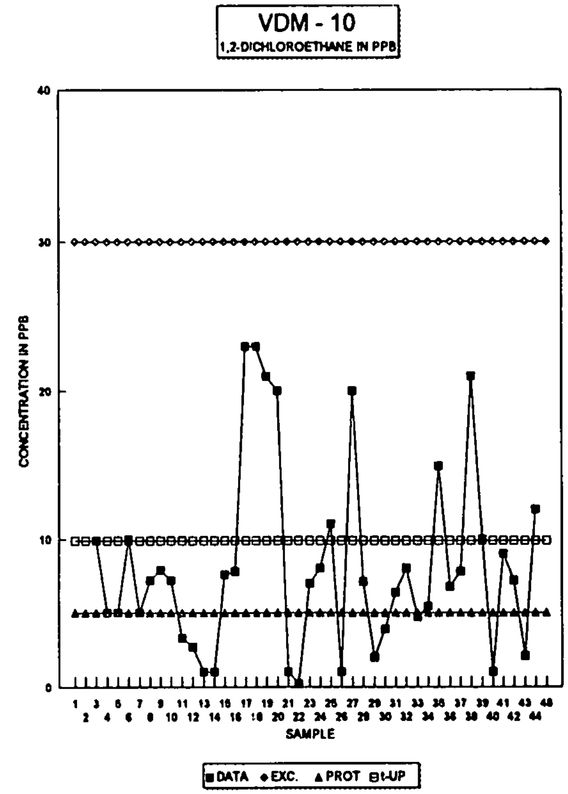
	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	20	5	4
2	1	20	5	4
3	5	20	5	4
4	5	20	5	4
5	5	20	5	4
6	10	20	5	4
7	5	20	5	4
8	5	20	5	4
9	5	20	5	4
10	1	20	5	4
11	10	20	5	4
12	13	20	5	4
13	5	20	5	4
14	5	20	5	4
15	1	20	5	4
16	1.1	20	5	4
17	1	20	5	4
18	1	20	5	4
19	4.6	20	5	4
20	2	20	5	4
21	3	20	5	4
22	1	20	5	4
23	1	20	5	4
24	1	20	5	4
25	1	20	5	4
26	1	20	5	4
27	10	20	5	4
28	2	20	5	4
29	1	20	5	4
30	2	20	5	4
31	2	20	5	4
32	2	20	5	4
33	2	20	5	4
34	2.5	20	5	4
35	2.5	20	5	4
36	3.5	20	5	4
37	3	20	5	4
38	3	20	5	4
39	3	20	5	4
40	3	20	5	4
41	3	20	5	4
42	3	20	5	4
43	3	20	5	4
44	3	20	5	4
45		20	5	4

STATISTICS		STUDENT t TESTING	
TOTAL STD	2.754977	UPPER LIMIT	4.081142
TOTAL Sx	0.42013		
TOTAL MEAN	3.368182		
TOTAL N	44		
TOTAL df	43		
BEFORE MEAN	5.133333	UPPER LIMIT	6.753405
BEFORE STD	3.442222		
BEFORE Sx	0.919972		
BEFORE N	15		
BEFORE df	14		
AFTER MEAN	2.490323	UPPER LIMIT	3.033905
AFTER STD	1.740107		
AFTER Sx	0.317699		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : 1,2-DICHLOROETHANE

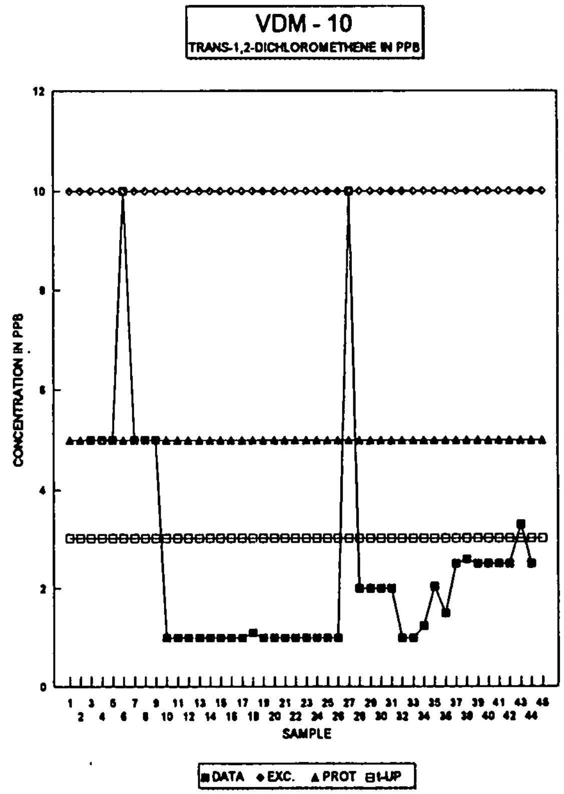
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		30	5	10	TOTAL STD	6.278048	UPPER LIMIT	9.880518
2		30	5	10	TOTAL Sx	0.980466		
3	9.9	30	5	10	TOTAL MEAN	8.216667		
4	5	30	5	10	TOTAL N	42		
5	5	30	5	10	TOTAL df	41		
6	10	30	5	10				
7	5	30	5	10	BEFORE MEAN	5.6	UPPER LIMIT	7.09202
8	7.2	30	5	10	BEFORE STD	2.900398		
9	7.9	30	5	10	BEFORE Sx	0.837273		
10	7.2	30	5	10	BEFORE N	13		
11	3.3	30	5	10	BEFORE df	12		
12	2.7	30	5	10				
13	1	30	5	10	AFTER MEAN	9.06129	UPPER LIMIT	11.22509
14	1	30	5	10	AFTER STD	6.92671		
15	7.6	30	5	10	AFTER Sx	1.264638		
16	7.8	30	5	10	AFTER N	31		
17	23	30	5	10	AFTER df	30		
18	23	30	5	10				
19	21	30	5	10				
20	20	30	5	10				
21	1	30	5	10				
22	0.2	30	5	10				
23	7	30	5	10				
24	8	30	5	10				
25	11	30	5	10				
26	1	30	5	10				
27	20	30	5	10				
28	7.1	30	5	10				
29	2	30	5	10				
30	3.9	30	5	10				
31	6.4	30	5	10				
32	8	30	5	10				
33	4.7	30	5	10				
34	5.45	30	5	10				
35	14.9	30	5	10				
36	6.75	30	5	10				
37	7.8	30	5	10				
38	21	30	5	10				
39	10	30	5	10				
40	1	30	5	10				
41	9	30	5	10				
42	7.2	30	5	10				
43	2.1	30	5	10				
44	12	30	5	10				
45		30	5	10				



WELL VDM - 10 : TRANS-1,2-DICHLOROETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		10	5	3
2		10	5	3
3	5	10	5	3
4	5	10	5	3
5	5	10	5	3
6	10	10	5	3
7	5	10	5	3
8	5	10	5	3
9	5	10	5	3
10	1	10	5	3
11	1	10	5	3
12	1	10	5	3
13	1	10	5	3
14	1	10	5	3
15	1	10	5	3
16	1	10	5	3
17	1	10	5	3
18	1.1	10	5	3
19	1	10	5	3
20	1	10	5	3
21	1	10	5	3
22	1	10	5	3
23	1	10	5	3
24	1	10	5	3
25	1	10	5	3
26	1	10	5	3
27	10	10	5	3
28	2	10	5	3
29	2	10	5	3
30	2	10	5	3
31	2	10	5	3
32	1	10	5	3
33	1	10	5	3
34	1.25	10	5	3
35	2.04	10	5	3
36	1.5	10	5	3
37	2.5	10	5	3
38	2.6	10	5	3
39	2.5	10	5	3
40	2.5	10	5	3
41	2.5	10	5	3
42	2.5	10	5	3
43	3.3	10	5	3
44	2.5	10	5	3
45		10	5	3

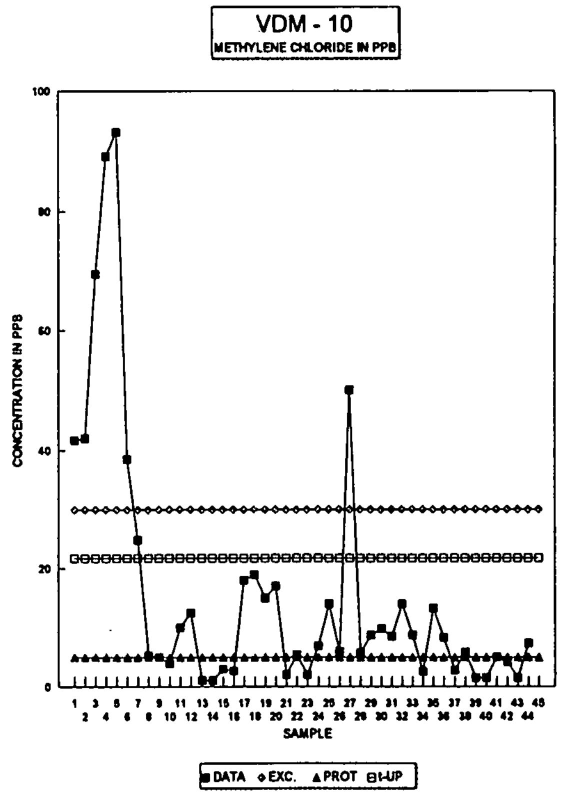
STATISTICS		STUDENT t TESTING	
TOTAL STD	2.164474	UPPER LIMIT	3.021025
TOTAL Sx	0.338034		
TOTAL MEAN	2.447381		
TOTAL N	42		
TOTAL df	41		
BEFORE MEAN	3.538462	UPPER LIMIT	4.916068
BEFORE STD	2.677984		
BEFORE Sx	0.773067		
BEFORE N	13		
BEFORE df	12		
AFTER MEAN	1.896452	UPPER LIMIT	2.407113
AFTER STD	1.634721		
AFTER Sx	0.298458		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : METHYLENE CHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	41.7	30	5	22
2	42	30	5	22
3	69.5	30	5	22
4	89.1	30	5	22
5	93.2	30	5	22
6	38.5	30	5	22
7	24.8	30	5	22
8	5.3	30	5	22
9	5	30	5	22
10	4	30	5	22
11	10	30	5	22
12	12.5	30	5	22
13	1	30	5	22
14	1	30	5	22
15	3	30	5	22
16	2.6	30	5	22
17	18	30	5	22
18	19	30	5	22
19	15	30	5	22
20	17	30	5	22
21	2	30	5	22
22	5.4	30	5	22
23	2	30	5	22
24	7	30	5	22
25	14	30	5	22
26	6	30	5	22
27	50	30	5	22
28	5.8	30	5	22
29	8.8	30	5	22
30	9.8	30	5	22
31	8.6	30	5	22
32	14	30	5	22
33	8.8	30	5	22
34	2.5	30	5	22
35	13.2	30	5	22
36	8.31	30	5	22
37	2.8	30	5	22
38	5.9	30	5	22
39	1.5	30	5	22
40	1.5	30	5	22
41	5	30	5	22
42	4.2	30	5	22
43	1.5	30	5	22
44	7.4	30	5	22
45		30	5	22

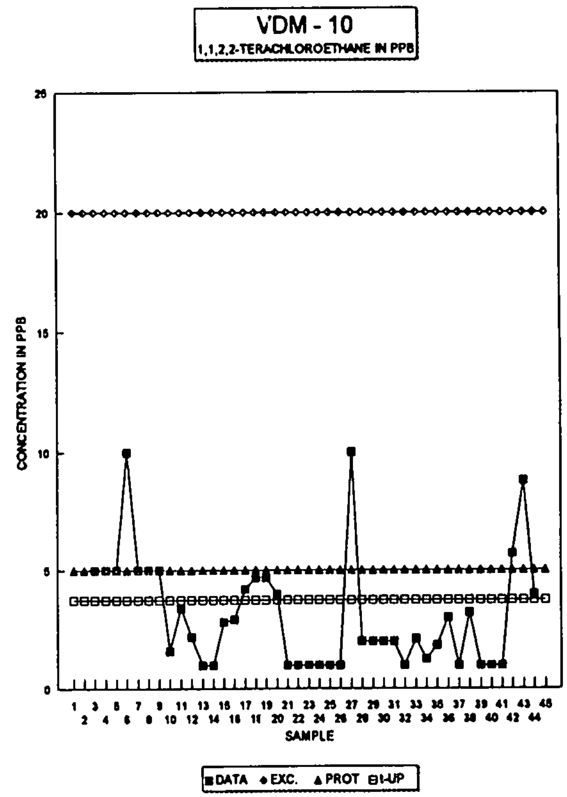
STATISTICS		STUDENT t TESTING	
TOTAL STD	21.82965	UPPER LIMIT	21.74498
TOTAL Sx	3.328991		
TOTAL MEAN	16.09568		
TOTAL N	44		
TOTAL df	43		
BEFORE MEAN	29.37333	UPPER LIMIT	43.98106
BEFORE STD	31.03754		
BEFORE Sx	8.29513		
BEFORE N	15		
BEFORE df	14		
AFTER MEAN	8.761613	UPPER LIMIT	11.62524
AFTER STD	9.168989		
AFTER Sx	1.673656		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : 1,1,2,2-TETRACHLOROETHANE

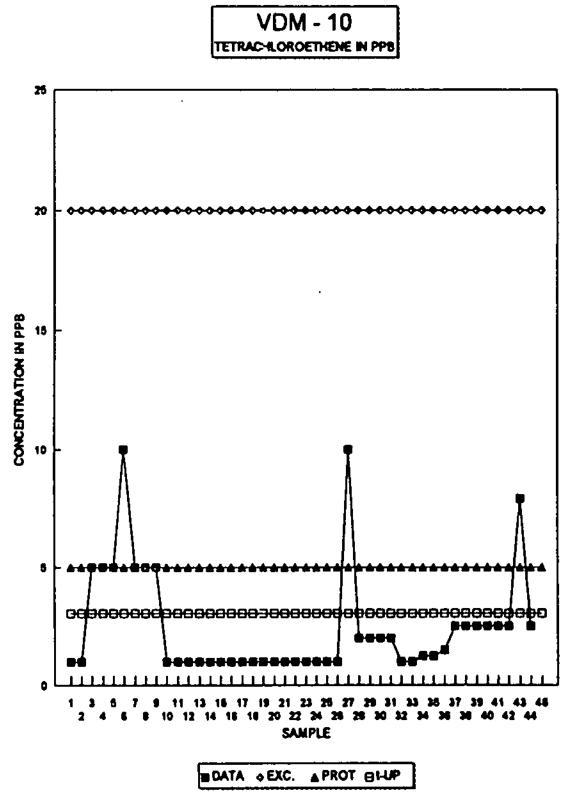
SAMPLE		EXC CON	PRO STD	UP LIM
1		20	5	4
2		20	5	4
3	5	20	5	4
4	5	20	5	4
5	5	20	5	4
6	10	20	5	4
7	5	20	5	4
8	5	20	5	4
9	5	20	5	4
10	1.6	20	5	4
11	3.4	20	5	4
12	2.2	20	5	4
13	1	20	5	4
14	1	20	5	4
15	2.8	20	5	4
16	2.9	20	5	4
17	4.2	20	5	4
18	4.7	20	5	4
19	4.7	20	5	4
20	4	20	5	4
21	1	20	5	4
22	1	20	5	4
23	1	20	5	4
24	1	20	5	4
25	1	20	5	4
26	1	20	5	4
27	10	20	5	4
28	2	20	5	4
29	2	20	5	4
30	2	20	5	4
31	2	20	5	4
32	1	20	5	4
33	2.1	20	5	4
34	1.25	20	5	4
35	1.83	20	5	4
36	3	20	5	4
37	1	20	5	4
38	3.2	20	5	4
39	1	20	5	4
40	1	20	5	4
41	1	20	5	4
42	5.7	20	5	4
43	8.8	20	5	4
44	4	20	5	4
45		20	5	4

STATISTICS		STUDENT t TESTING	
TOTAL STD	2.388203	UPPER LIMIT	3.755733
TOTAL Sx	0.369851		
TOTAL MEAN	3.128095		
TOTAL N	42		
TOTAL df	41		
BEFORE MEAN	4	UPPER LIMIT	5.2005
BEFORE STD	2.3337		
BEFORE Sx	0.673681		
BEFORE N	13		
BEFORE df	12		
AFTER MEAN	2.683226	UPPER LIMIT	3.378058
AFTER STD	2.224284		
AFTER Sx	0.406097		
AFTER N	31		
AFTER df	30		



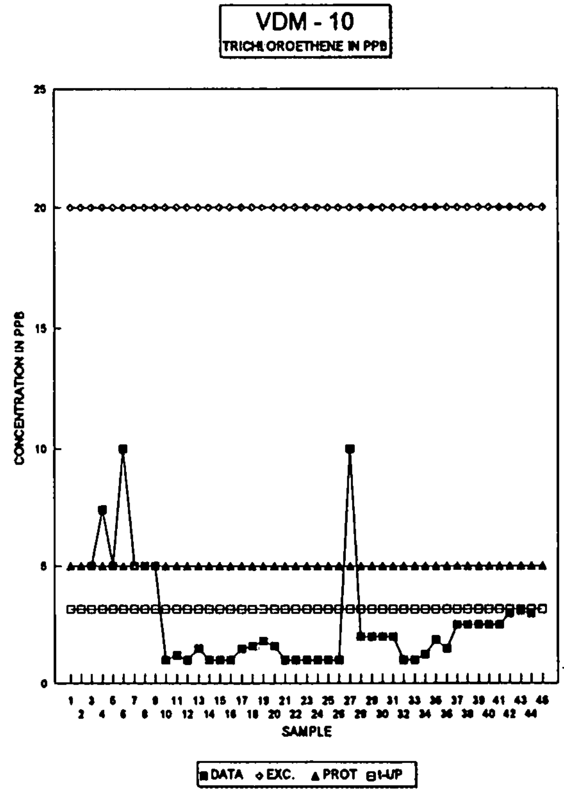
WELL VDM - 10 : TETRACHLOROETHENE

	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1	1	20	5	3	TOTAL STD	2.293651	UPPER LIMIT	3.057211
2	1	20	5	3	TOTAL Sx	0.349779		
3	5	20	5	3	TOTAL MEAN	2.463636		
4	5	20	5	3	TOTAL N	44		
5	5	20	5	3	TOTAL df	43		
6	10	20	5	3				
7	5	20	5	3	BEFORE MEAN	3.2	UPPER LIMIT	4.441652
8	5	20	5	3	BEFORE STD	2.638181		
9	5	20	5	3	BEFORE Sx	0.705084		
10	1	20	5	3	BEFORE N	15		
11	1	20	5	3	BEFORE df	14		
12	1	20	5	3				
13	1	20	5	3	AFTER MEAN	2.012903	UPPER LIMIT	2.619599
14	1	20	5	3	AFTER STD	1.942146		
15	1	20	5	3	AFTER Sx	0.354586		
16	1	20	5	3	AFTER N	31		
17	1	20	5	3	AFTER df	30		
18	1	20	5	3				
19	1	20	5	3				
20	1	20	5	3				
21	1	20	5	3				
22	1	20	5	3				
23	1	20	5	3				
24	1	20	5	3				
25	1	20	5	3				
26	1	20	5	3				
27	10	20	5	3				
28	2	20	5	3				
29	2	20	5	3				
30	2	20	5	3				
31	2	20	5	3				
32	1	20	5	3				
33	1	20	5	3				
34	1.25	20	5	3				
35	1.25	20	5	3				
36	1.5	20	5	3				
37	2.5	20	5	3				
38	2.5	20	5	3				
39	2.5	20	5	3				
40	2.5	20	5	3				
41	2.5	20	5	3				
42	2.5	20	5	3				
43	7.9	20	5	3				
44	2.5	20	5	3				
45		20	5	3				



WELL VDM - 10 : TRICHLOROETHENE

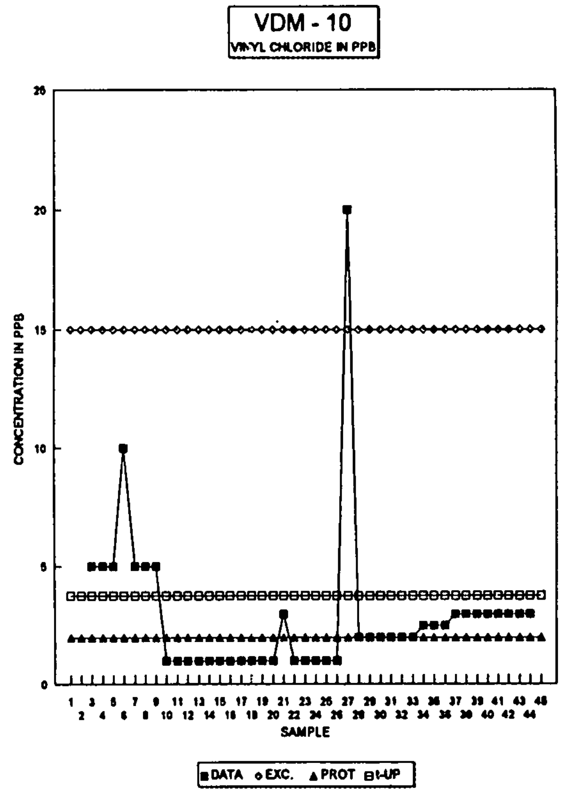
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		20	5	3	TOTAL STD	2.221473	UPPER LIMIT	3.179941
2		20	5	3	TOTAL Sx	0.346936		
3	5	20	5	3	TOTAL MEAN	2.59119		
4	7.4	20	5	3	TOTAL N	42		
5	5	20	5	3	TOTAL df	41		
6	10	20	5	3				
7	5	20	5	3	BEFORE MEAN	3.776923	UPPER LIMIT	5.217883
8	5	20	5	3	BEFORE STD	2.801141		
9	5	20	5	3	BEFORE Sx	0.80862		
10	1	20	5	3	BEFORE N	13		
11	1.2	20	5	3	BEFORE df	12		
12	1	20	5	3				
13	1.5	20	5	3	AFTER MEAN	1.99129	UPPER LIMIT	2.495915
14	1	20	5	3	AFTER STD	1.615395		
15	1	20	5	3	AFTER Sx	0.294929		
16	1	20	5	3	AFTER N	31		
17	1.5	20	5	3	AFTER df	30		
18	1.6	20	5	3				
19	1.8	20	5	3				
20	1.6	20	5	3				
21	1	20	5	3				
22	1	20	5	3				
23	1	20	5	3				
24	1	20	5	3				
25	1	20	5	3				
26	1	20	5	3				
27	10	20	5	3				
28	2	20	5	3				
29	2	20	5	3				
30	2	20	5	3				
31	2	20	5	3				
32	1	20	5	3				
33	1	20	5	3				
34	1.25	20	5	3				
35	1.88	20	5	3				
36	1.5	20	5	3				
37	2.5	20	5	3				
38	2.5	20	5	3				
39	2.5	20	5	3				
40	2.5	20	5	3				
41	2.5	20	5	3				
42	3	20	5	3				
43	3.1	20	5	3				
44	3	20	5	3				
45		20	5	3				



WELL VDM - 10 : VINYL CHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		15	2	4
2		15	2	4
3	5	15	2	4
4	5	15	2	4
5	5	15	2	4
6	10	15	2	4
7	5	15	2	4
8	5	15	2	4
9	5	15	2	4
10	1	15	2	4
11	1	15	2	4
12	1	15	2	4
13	1	15	2	4
14	1	15	2	4
15	1	15	2	4
16	1	15	2	4
17	1	15	2	4
18	1	15	2	4
19	1	15	2	4
20	1	15	2	4
21	3	15	2	4
22	1	15	2	4
23	1	15	2	4
24	1	15	2	4
25	1	15	2	4
26	1	15	2	4
27	20	15	2	4
28	2	15	2	4
29	2	15	2	4
30	2	15	2	4
31	2	15	2	4
32	2	15	2	4
33	2	15	2	4
34	2.5	15	2	4
35	2.5	15	2	4
36	2.5	15	2	4
37	3	15	2	4
38	3	15	2	4
39	3	15	2	4
40	3	15	2	4
41	3	15	2	4
42	3	15	2	4
43	3	15	2	4
44	3	15	2	4
45		15	2	4

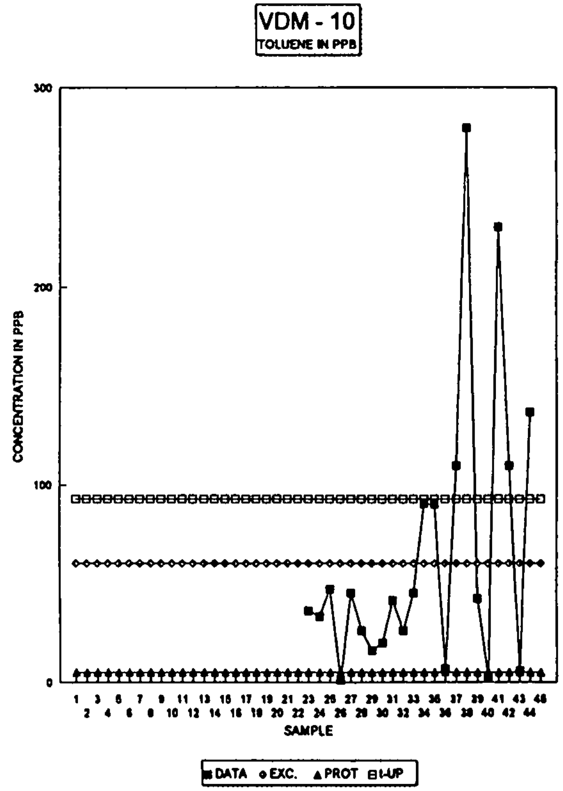
STATISTICS		STUDENT t TESTING	
TOTAL STD	3.208836	UPPER LIMIT	3.767094
TOTAL Sx	0.501136		
TOTAL MEAN	2.916667		
TOTAL N	42		
TOTAL df	41		
BEFORE MEAN	3.538462	UPPER LIMIT	4.916068
BEFORE STD	2.677984		
BEFORE Sx	0.773067		
BEFORE N	13		
BEFORE df	12		
AFTER MEAN	2.532258	UPPER LIMIT	3.562176
AFTER STD	3.296957		
AFTER Sx	0.601939		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : TOLUENE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		60	5	93
2		60	5	93
3		60	5	93
4		60	5	93
5		60	5	93
6		60	5	93
7		60	5	93
8		60	5	93
9		60	5	93
10		60	5	93
11		60	5	93
12		60	5	93
13		60	5	93
14		60	5	93
15		60	5	93
16		60	5	93
17		60	5	93
18		60	5	93
19		60	5	93
20		60	5	93
21		60	5	93
22		60	5	93
23	36	60	5	93
24	33	60	5	93
25	47	60	5	93
26	1	60	5	93
27	45	60	5	93
28	26	60	5	93
29	16	60	5	93
30	20	60	5	93
31	41	60	5	93
32	26	60	5	93
33	45	60	5	93
34	90.4	60	5	93
35	89.9	60	5	93
36	6.5	60	5	93
37	110	60	5	93
38	280	60	5	93
39	42	60	5	93
40	2.9	60	5	93
41	230	60	5	93
42	110	60	5	93
43	5.8	60	5	93
44	137	60	5	93
45		60	5	93

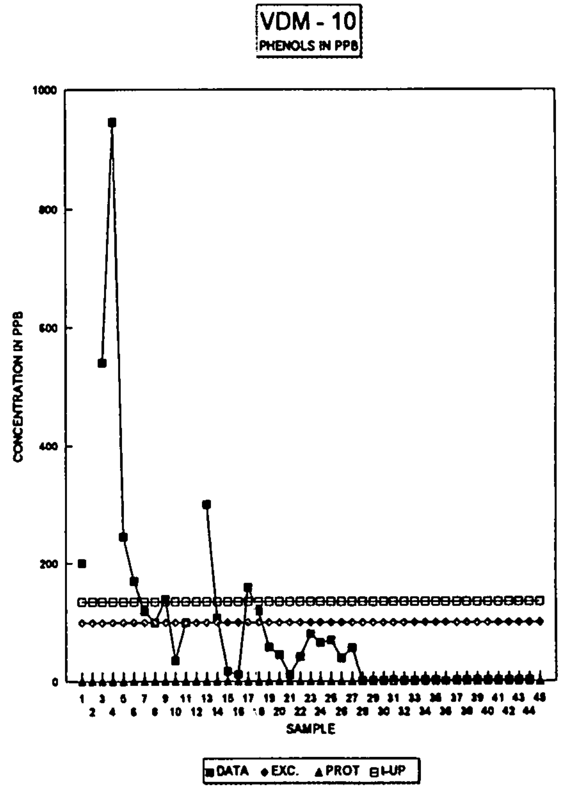
STATISTICS		STUDENT t TESTING	
TOTAL STD	70.83446	UPPER LIMIT	93.02226
TOTAL Sx	15.45735		
TOTAL MEAN	65.47727		
TOTAL N	22		
TOTAL df	21		
BEFORE MEAN	ERR	UPPER LIMIT	ERR
BEFORE STD	ERR		
BEFORE Sx	ERR		
BEFORE N	0		
BEFORE df	-1		
AFTER MEAN	65.47727	UPPER LIMIT	92.574
AFTER STD	70.83446		
AFTER Sx	15.45735		
AFTER N	22		
AFTER df	21		



WELL VDM - 10 : PHENOLS

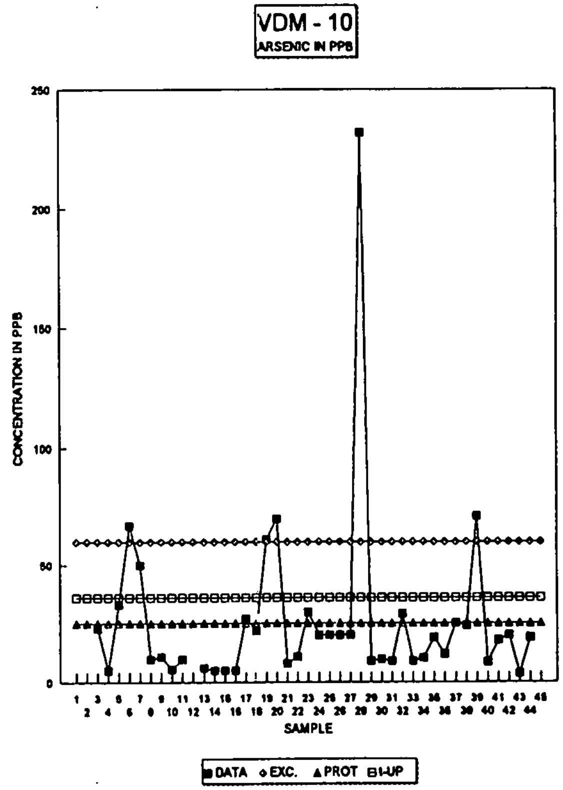
	SAMPLE	EXC CON	PRO STD	UP LIM
1	200	100	1	136
2		100	1	136
3	540	100	1	136
4	946	100	1	136
5	244	100	1	136
6	170	100	1	136
7	120	100	1	136
8	100	100	1	136
9	140	100	1	136
10	36	100	1	136
11	100	100	1	136
12		100	1	136
13	299	100	1	136
14	106	100	1	136
15	18	100	1	136
16	12	100	1	136
17	160	100	1	136
18	120	100	1	136
19	59	100	1	136
20	46	100	1	136
21	11	100	1	136
22	43	100	1	136
23	81	100	1	136
24	66	100	1	136
25	70	100	1	136
26	40	100	1	136
27	56	100	1	136
28	2	100	1	136
29	2	100	1	136
30	2	100	1	136
31	3	100	1	136
32	2	100	1	136
33	2	100	1	136
34	2.5	100	1	136
35	2.5	100	1	136
36	1	100	1	136
37	2.5	100	1	136
38	2.5	100	1	136
39	2.5	100	1	136
40	2.5	100	1	136
41	2.5	100	1	136
42	2.5	100	1	136
43	2.5	100	1	136
44	2.5	100	1	136
45		100	1	136

STATISTICS		STUDENT t TESTING	
TOTAL STD	168.4446	UPPER LIMIT	135.7376
TOTAL Sx	26.30663		
TOTAL MEAN	91.09524		
TOTAL N	42		
TOTAL df	41		
BEFORE MEAN	232.3846	UPPER LIMIT	357.5484
BEFORE STD	243.311		
BEFORE Sx	70.23763		
BEFORE N	13		
BEFORE df	12		
AFTER MEAN	30.03226	UPPER LIMIT	42.9015
AFTER STD	41.1968		
AFTER Sx	7.521472		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : ARSENIC

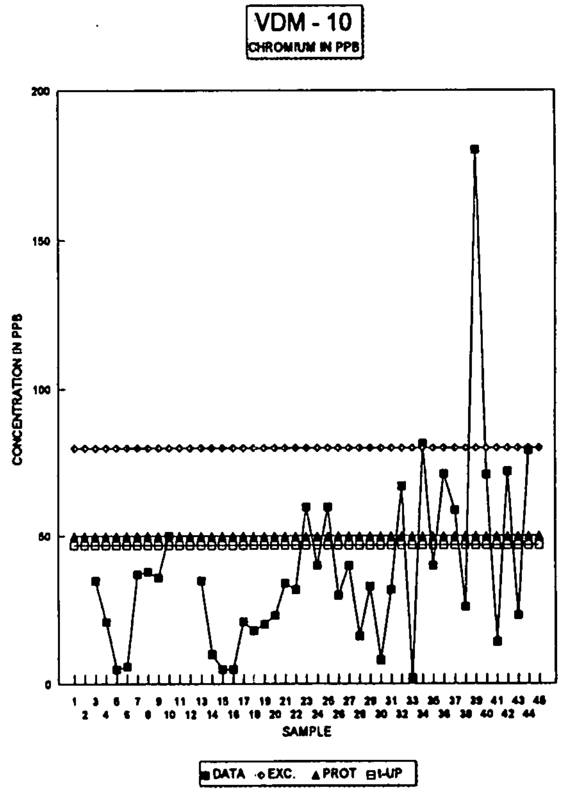
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1		60	25	36	TOTAL STD	37.14075	UPPER LIMIT	36.14119
2		60	25	36	TOTAL Sx	5.872468		
3	23	60	25	36	TOTAL MEAN	26.17561		
4	5	60	25	36	TOTAL N	41		
5	33	60	25	36	TOTAL df	40		
6	67	60	25	36				
7	50	60	25	36	BEFORE MEAN	19.20833	UPPER LIMIT	29.85857
8	10	60	25	36	BEFORE STD	19.66751		
9	11	60	25	36	BEFORE Sx	5.929976		
10	5.5	60	25	36	BEFORE N	12		
11	10	60	25	36	BEFORE df	11		
12		60	25	36				
13	6	60	25	36	AFTER MEAN	27.50645	UPPER LIMIT	40.32201
14	5	60	25	36	AFTER STD	41.02497		
15	5	60	25	36	AFTER Sx	7.490101		
16	5	60	25	36	AFTER N	31		
17	27	60	25	36	AFTER df	30		
18	22	60	25	36				
19	61	60	25	36				
20	70	60	25	36				
21	8	60	25	36				
22	11	60	25	36				
23	30	60	25	36				
24	20	60	25	36				
25	20	60	25	36				
26	20	60	25	36				
27	20	60	25	36				
28	232	60	25	36				
29	9	60	25	36				
30	10	60	25	36				
31	9	60	25	36				
32	29	60	25	36				
33	9	60	25	36				
34	10.5	60	25	36				
35	19	60	25	36				
36	12	60	25	36				
37	25	60	25	36				
38	24	60	25	36				
39	71	60	25	36				
40	8.4	60	25	36				
41	18	60	25	36				
42	20	60	25	36				
43	3.8	60	25	36				
44	19	60	25	36				
45		60	25	36				



WELL VDM - 10 : CHROMIUM

	SAMPLE	EXC CON	PRO STD	UP LIM
1		80	50	47
2		80	50	47
3	35	80	50	47
4	21	80	50	47
5	5	80	50	47
6	6	80	50	47
7	37	80	50	47
8	38	80	50	47
9	36	80	50	47
10	50	80	50	47
11		80	50	47
12		80	50	47
13	35	80	50	47
14	10	80	50	47
15	5	80	50	47
16	5	80	50	47
17	21	80	50	47
18	18	80	50	47
19	20	80	50	47
20	23	80	50	47
21	34	80	50	47
22	32	80	50	47
23	60	80	50	47
24	40	80	50	47
25	60	80	50	47
26	30	80	50	47
27	40	80	50	47
28	16	80	50	47
29	33	80	50	47
30	8	80	50	47
31	32	80	50	47
32	67	80	50	47
33	2	80	50	47
34	81.5	80	50	47
35	40.1	80	50	47
36	71.2	80	50	47
37	59	80	50	47
38	26	80	50	47
39	180	80	50	47
40	71	80	50	47
41	14	80	50	47
42	72	80	50	47
43	23	80	50	47
44	79	80	50	47
45		80	50	47

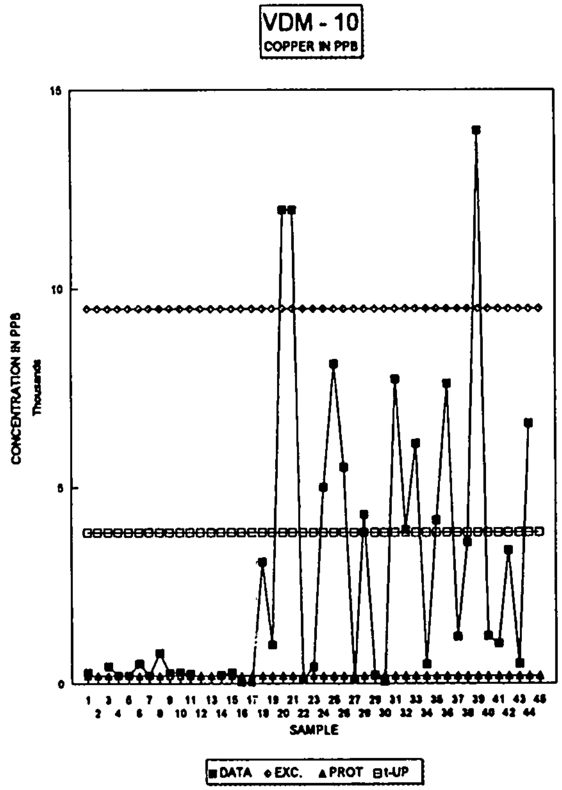
STATISTICS		STUDENT t TESTING	
TOTAL STD	31.58784	UPPER LIMIT	46.9766
TOTAL Sx	5.058102		
TOTAL MEAN	38.395		
TOTAL N	40		
TOTAL df	39		
BEFORE MEAN	25.27273	UPPER LIMIT	34.03601
BEFORE STD	15.55104		
BEFORE Sx	4.917669		
BEFORE N	11		
BEFORE df	10		
AFTER MEAN	41.05806	UPPER LIMIT	51.85885
AFTER STD	34.5753		
AFTER Sx	6.312558		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : COPPER

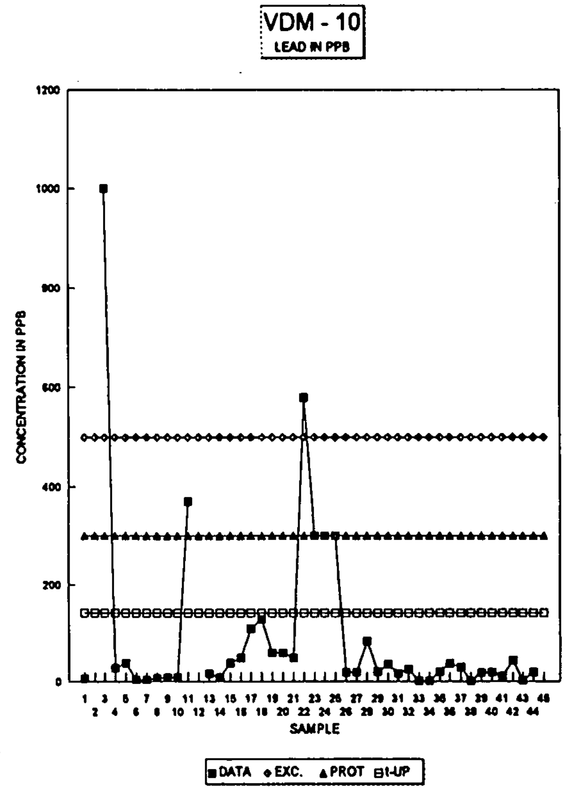
	SAMPLE	EXC CON	PRO STD	UP LIM
1	280	9500	200	3855
2		9500	200	3855
3	450	9500	200	3855
4	200	9500	200	3855
5	200	9500	200	3855
6	510	9500	200	3855
7	200	9500	200	3855
8	780	9500	200	3855
9	270	9500	200	3855
10	280	9500	200	3855
11	250	9500	200	3855
12		9500	200	3855
13		9500	200	3855
14	230	9500	200	3855
15	280	9500	200	3855
16	35	9500	200	3855
17	30	9500	200	3855
18	3100	9500	200	3855
19	990	9500	200	3855
20	12000	9500	200	3855
21	12000	9500	200	3855
22	100	9500	200	3855
23	430	9500	200	3855
24	5000	9500	200	3855
25	8100	9500	200	3855
26	5500	9500	200	3855
27	100	9500	200	3855
28	4300	9500	200	3855
29	215	9500	200	3855
30	50	9500	200	3855
31	7720	9500	200	3855
32	3920	9500	200	3855
33	6100	9500	200	3855
34	498	9500	200	3855
35	4160	9500	200	3855
36	7600	9500	200	3855
37	1200	9500	200	3855
38	3600	9500	200	3855
39	14000	9500	200	3855
40	1220	9500	200	3855
41	1030	9500	200	3855
42	3400	9500	200	3855
43	508	9500	200	3855
44	6600	9500	200	3855
45		9500	200	3855

STATISTICS		STUDENT t TESTING	
TOTAL STD	3693.116	UPPER LIMIT	3855.471
TOTAL Sx	583.933		
TOTAL MEAN	2864.537		
TOTAL N	41		
TOTAL df	40		
BEFORE MEAN	328.3333	UPPER LIMIT	417.665
BEFORE STD	164.9683		
BEFORE Sx	49.73922		
BEFORE N	12		
BEFORE df	11		
AFTER MEAN	3677.935	UPPER LIMIT	4900.477
AFTER STD	3913.58		
AFTER Sx	714.5187		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : LEAD

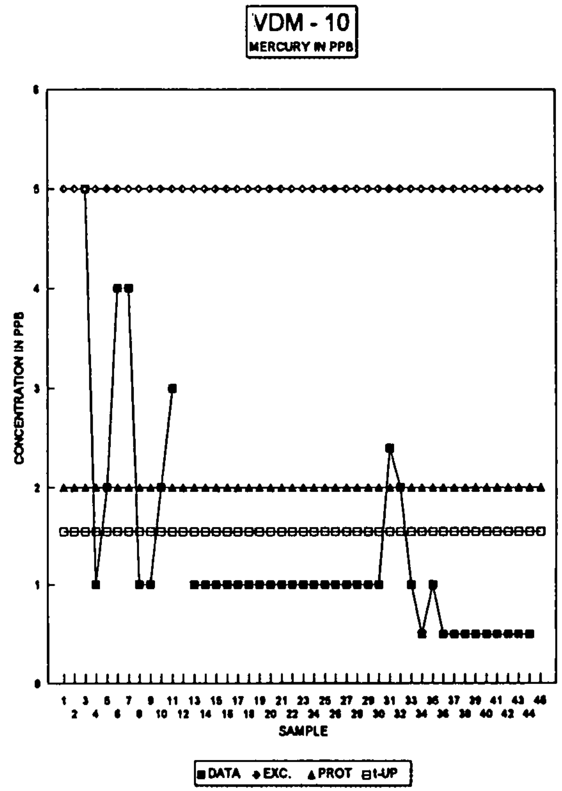
	SAMPLE	EXC CON	PRO STD	UP LIM	STATISTICS		STUDENT t TESTING	
1	7	500	300	143	TOTAL STD	185.033	UPPER LIMIT	142.6601
2		500	300	143	TOTAL Sx	28.8973		
3	1000	500	300	143	TOTAL MEAN	83.62143		
4	28	500	300	143	TOTAL N	42		
5	39	500	300	143	TOTAL df	41		
6	5	500	300	143				
7	5	500	300	143	BEFORE MEAN	119.2692	UPPER LIMIT	258.8212
8	8	500	300	143	BEFORE STD	271.2808		
9	10	500	300	143	BEFORE Sx	78.31201		
10	8.5	500	300	143	BEFORE N	13		
11	370	500	300	143	BEFORE df	12		
12		500	300	143				
13	18	500	300	143	AFTER MEAN	78.43871	UPPER LIMIT	117.1241
14	10	500	300	143	AFTER STD	123.8392		
15	40	500	300	143	AFTER Sx	22.60984		
16	50	500	300	143	AFTER N	31		
17	110	500	300	143	AFTER df	30		
18	130	500	300	143				
19	60	500	300	143				
20	60	500	300	143				
21	50	500	300	143				
22	580	500	300	143				
23	300	500	300	143				
24	300	500	300	143				
25	300	500	300	143				
26	20	500	300	143				
27	20	500	300	143				
28	84	500	300	143				
29	21	500	300	143				
30	37	500	300	143				
31	17	500	300	143				
32	26	500	300	143				
33	2	500	300	143				
34	2	500	300	143				
35	22	500	300	143				
36	37.4	500	300	143				
37	31	500	300	143				
38	2	500	300	143				
39	19	500	300	143				
40	20	500	300	143				
41	13	500	300	143				
42	45	500	300	143				
43	3.2	500	300	143				
44	20	500	300	143				
45		500	300	143				



WELL VDM - 10 : MERCURY

	SAMPLE	EXC CON	PRO STD	UP LIM
1		5	2	2
2		5	2	2
3	5	5	2	2
4	1	5	2	2
5	2	5	2	2
6	4	5	2	2
7	4	5	2	2
8	1	5	2	2
9	1	5	2	2
10	2	5	2	2
11	3	5	2	2
12		5	2	2
13	1	5	2	2
14	1	5	2	2
15	1	5	2	2
16	1	5	2	2
17	1	5	2	2
18	1	5	2	2
19	1	5	2	2
20	1	5	2	2
21	1	5	2	2
22	1	5	2	2
23	1	5	2	2
24	1	5	2	2
25	1	5	2	2
26	1	5	2	2
27	1	5	2	2
28	1	5	2	2
29	1	5	2	2
30	1	5	2	2
31	2.4	5	2	2
32	2	5	2	2
33	1	5	2	2
34	0.5	5	2	2
35	1	5	2	2
36	0.5	5	2	2
37	0.5	5	2	2
38	0.5	5	2	2
39	0.5	5	2	2
40	0.5	5	2	2
41	0.5	5	2	2
42	0.5	5	2	2
43	0.5	5	2	2
44	0.5	5	2	2
45		5	2	2

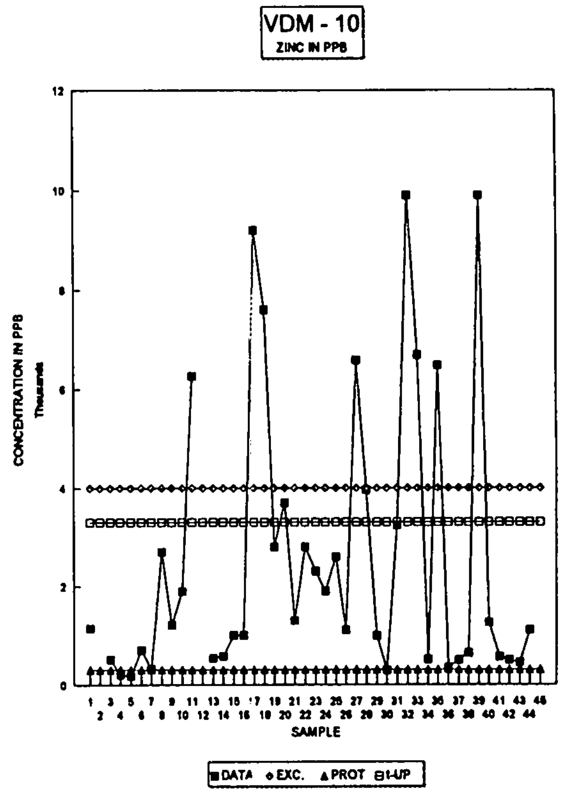
STATISTICS		STUDENT t TESTING	
TOTAL STD	1.015613	UPPER LIMIT	1.550878
TOTAL Sx	0.160582		
TOTAL MEAN	1.278049		
TOTAL N	41		
TOTAL df	40		
BEFORE MEAN	2.166667	UPPER LIMIT	2.927147
BEFORE STD	1.404358		
BEFORE Sx	0.42343		
BEFORE N	12		
BEFORE df	11		
AFTER MEAN	0.916129	UPPER LIMIT	1.044585
AFTER STD	0.411211		
AFTER Sx	0.075077		
AFTER N	31		
AFTER df	30		



WELL VDM - 10 : ZINC

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1140	4000	300	3303
2		4000	300	3303
3	510	4000	300	3303
4	200	4000	300	3303
5	180	4000	300	3303
6	700	4000	300	3303
7	320	4000	300	3303
8	2700	4000	300	3303
9	1200	4000	300	3303
10	1900	4000	300	3303
11	6280	4000	300	3303
12		4000	300	3303
13	540	4000	300	3303
14	580	4000	300	3303
15	1000	4000	300	3303
16	1000	4000	300	3303
17	9200	4000	300	3303
18	7600	4000	300	3303
19	2800	4000	300	3303
20	3700	4000	300	3303
21	1300	4000	300	3303
22	2800	4000	300	3303
23	2300	4000	300	3303
24	1900	4000	300	3303
25	2600	4000	300	3303
26	1100	4000	300	3303
27	6600	4000	300	3303
28	3960	4000	300	3303
29	990	4000	300	3303
30	290	4000	300	3303
31	3240	4000	300	3303
32	9900	4000	300	3303
33	6700	4000	300	3303
34	517	4000	300	3303
35	6500	4000	300	3303
36	340	4000	300	3303
37	500	4000	300	3303
38	640	4000	300	3303
39	9900	4000	300	3303
40	1260	4000	300	3303
41	560	4000	300	3303
42	500	4000	300	3303
43	451	4000	300	3303
44	1100	4000	300	3303
45		4000	300	3303

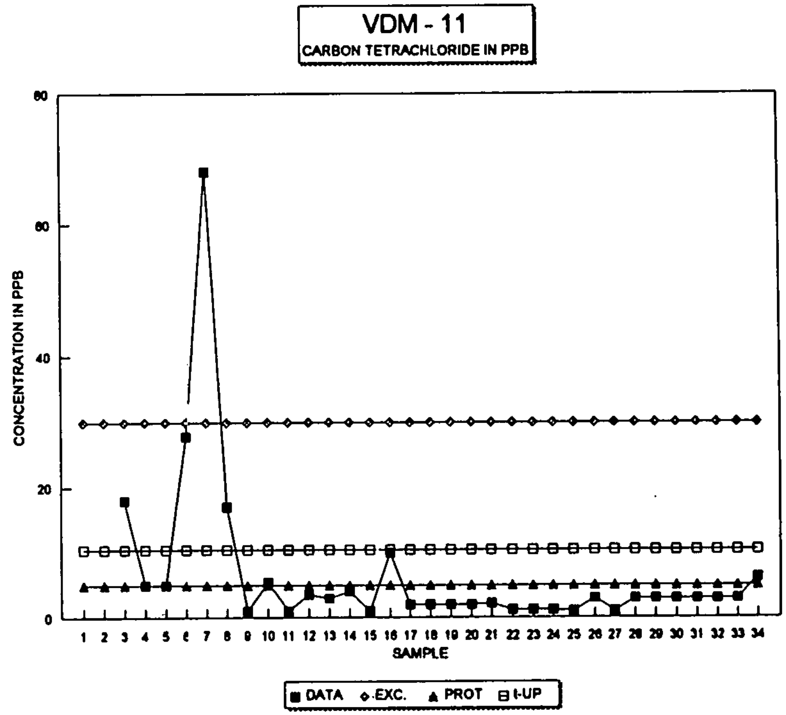
STATISTICS		STUDENT t TESTING	
TOTAL STD	2804.727	UPPER LIMIT	3302 804
TOTAL Sx	438.0248		
TOTAL MEAN	2559.476		
TOTAL N	42		
TOTAL df	41		
BEFORE MEAN	1326.923	UPPER LIMIT	2143.307
BEFORE STD	1587.002		
BEFORE Sx	458.128		
BEFORE N	13		
BEFORE df	12		
AFTER MEAN	2962.194	UPPER LIMIT	3899.724
AFTER STD	3001.207		
AFTER Sx	547.943		
AFTER N	31		
AFTER df	30		



WELL VDM - 11 : CARBON TETRACHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		30	5	10
2		30	5	10
3	18	30	5	10
4	5	30	5	10
5	5	30	5	10
6	27.8	30	5	10
7	68	30	5	10
8	17	30	5	10
9	1	30	5	10
10	5.5	30	5	10
11	1	30	5	10
12	3.5	30	5	10
13	3	30	5	10
14	4	30	5	10
15	1	30	5	10
16	10	30	5	10
17	2	30	5	10
18	2	30	5	10
19	2	30	5	10
20	2	30	5	10
21	2.2	30	5	10
22	1.2	30	5	10
23	1.25	30	5	10
24	1.25	30	5	10
25	1	30	5	10
26	3	30	5	10
27	1	30	5	10
28	3	30	5	10
29	3	30	5	10
30	3	30	5	10
31	3	30	5	10
32	3	30	5	10
33	3	30	5	10
34	6.15	30	5	10

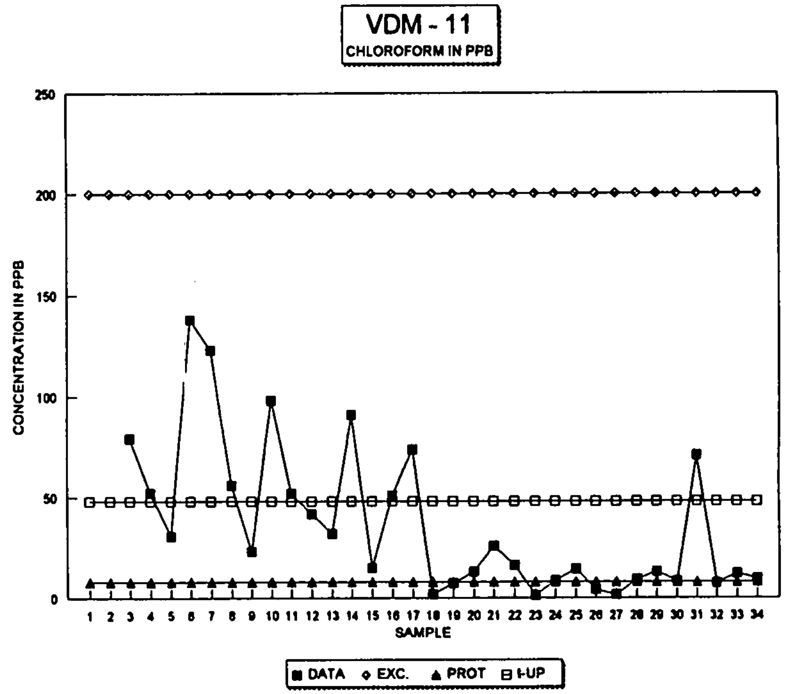
STATISTICS		STUDENT t TESTING	
TOTAL STD	12.42827	UPPER LIMIT	10.48422
TOTAL Sx	2.232184		
TOTAL MEAN	6.651563		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	24.76	UPPER LIMIT	49.55706
BEFORE STD	23.26178		
BEFORE Sx	11.63089		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	6.374138	UPPER LIMIT	10.55146
AFTER STD	12.8738		
AFTER Sx	2.43292		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : CHLOROFORM

	SAMPLE	EXC CON	PRO STD	UP LIM
1		200	8	48
2		200	8	48
3	79.2	200	8	48
4	52.2	200	8	48
5	30.7	200	8	48
6	138	200	8	48
7	123	200	8	48
8	56	200	8	48
9	23	200	8	48
10	98	200	8	48
11	52	200	8	48
12	42	200	8	48
13	32	200	8	48
14	91	200	8	48
15	15	200	8	48
16	51	200	8	48
17	74	200	8	48
18	2	200	8	48
19	7.4	200	8	48
20	13	200	8	48
21	26	200	8	48
22	16	200	8	48
23	1.25	200	8	48
24	8.55	200	8	48
25	14.3	200	8	48
26	4	200	8	48
27	1.58	200	8	48
28	9.2	200	8	48
29	13	200	8	48
30	8.4	200	8	48
31	71	200	8	48
32	7.1	200	8	48
33	12	200	8	48
34	9.6	200	8	48

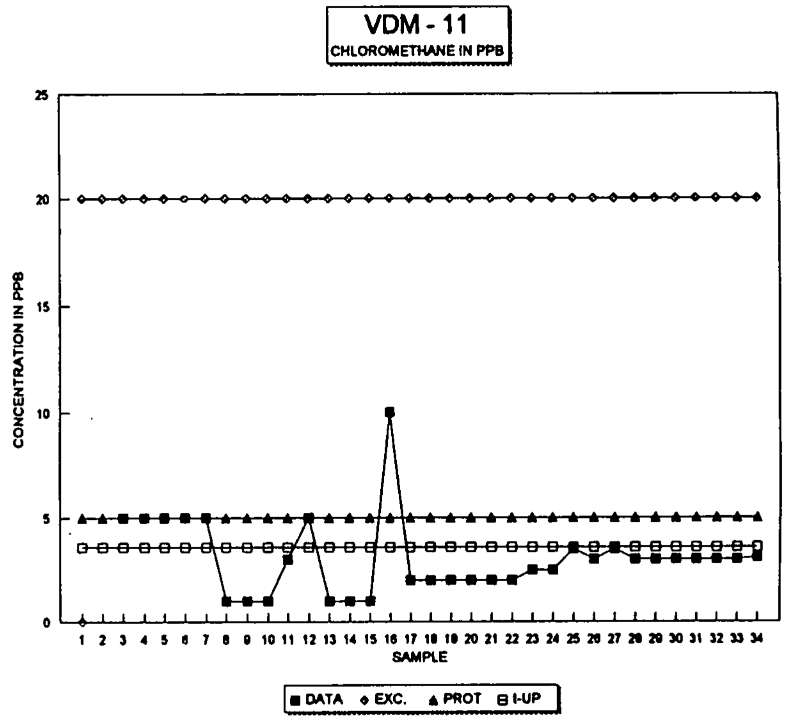
STATISTICS		STUDENT t TESTING	
TOTAL STD	36.6335	UPPER LIMIT	48.21837
TOTAL Sx	6.579571		
TOTAL MEAN	36.92125		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	84.62	UPPER LIMIT	128.0789
BEFORE STD	40.76824		
BEFORE Sx	20.38412		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	35.15103	UPPER LIMIT	47.32102
AFTER STD	37.50582		
AFTER Sx	7.087935		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : CHLOROMETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		20	5	4
2		20	5	4
3	5	20	5	4
4	5	20	5	4
5	5	20	5	4
6	5	20	5	4
7	5	20	5	4
8	1	20	5	4
9	1	20	5	4
10	1	20	5	4
11	3	20	5	4
12	5	20	5	4
13	1	20	5	4
14	1	20	5	4
15	1	20	5	4
16	10	20	5	4
17	2	20	5	4
18	2	20	5	4
19	2	20	5	4
20	2	20	5	4
21	2	20	5	4
22	2	20	5	4
23	2.5	20	5	4
24	2.5	20	5	4
25	3.5	20	5	4
26	3	20	5	4
27	3.5	20	5	4
28	3	20	5	4
29	3	20	5	4
30	3	20	5	4
31	3	20	5	4
32	3	20	5	4
33	3	20	5	4
34	3.1	20	5	4

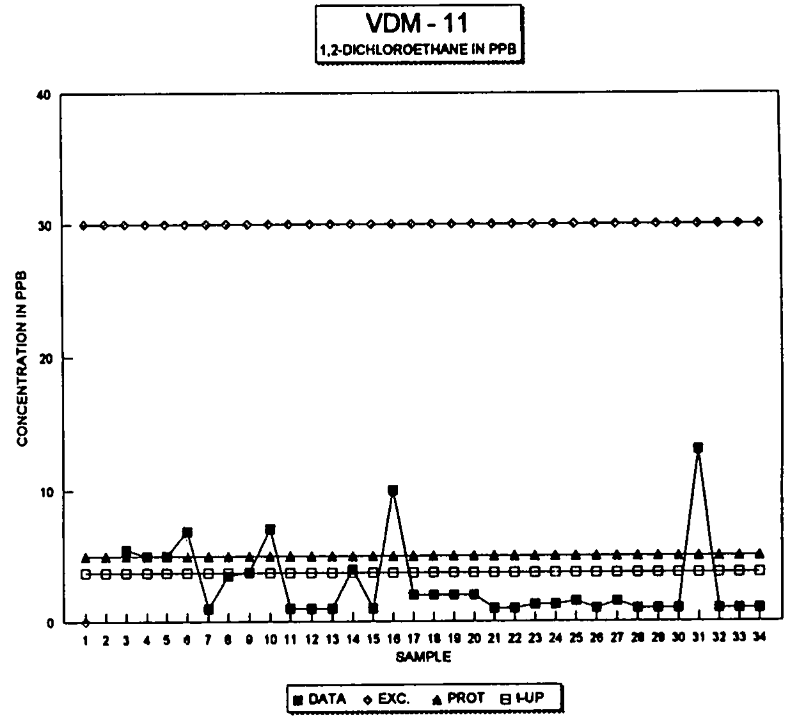
STATISTICS		STUDENT t TESTING	
TOTAL STD	1.802535	UPPER LIMIT	3.590245
TOTAL Sx	0.323745		
TOTAL MEAN	3.034375		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	5	UPPER LIMIT	5
BEFORE STD	0		
BEFORE Sx	0		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	2.831034	UPPER LIMIT	3.406404
AFTER STD	1.773192		
AFTER Sx	0.335102		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : 1,2-DICHLOROETHANE

SAMPLE		EXC CON	PRO STD	UP LIM
1		30	5	4
2		30	5	4
3	5.5	30	5	4
4	5	30	5	4
5	5	30	5	4
6	6.9	30	5	4
7	1	30	5	4
8	3.5	30	5	4
9	3.8	30	5	4
10	7.1	30	5	4
11	1	30	5	4
12	1	30	5	4
13	1	30	5	4
14	4	30	5	4
15	1	30	5	4
16	10	30	5	4
17	2	30	5	4
18	2	30	5	4
19	2	30	5	4
20	2	30	5	4
21	1	30	5	4
22	1	30	5	4
23	1.25	30	5	4
24	1.25	30	5	4
25	1.5	30	5	4
26	1	30	5	4
27	1.5	30	5	4
28	1	30	5	4
29	1	30	5	4
30	1	30	5	4
31	13	30	5	4
32	1	30	5	4
33	1	30	5	4
34	1	30	5	4

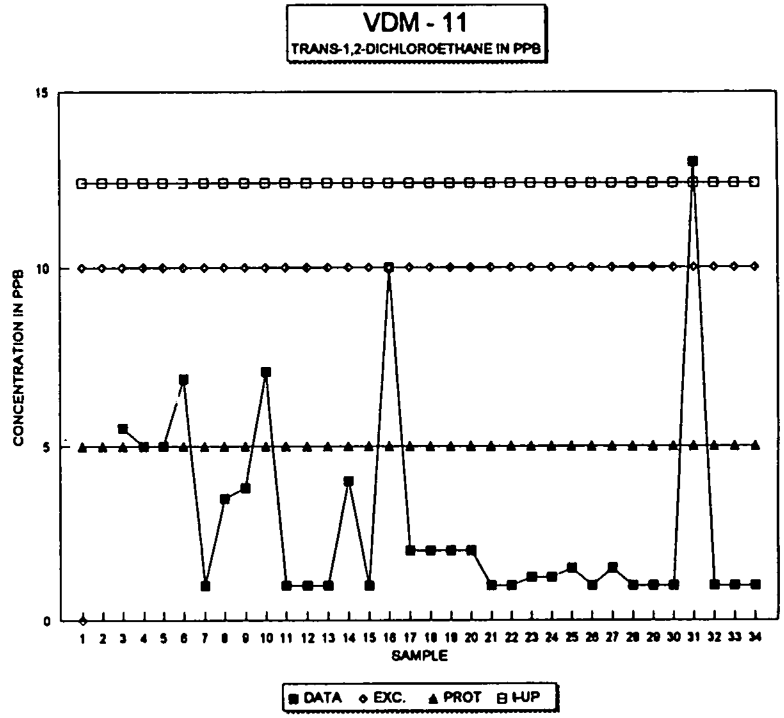
STATISTICS		STUDENT t TESTING	
TOTAL STD	2.889067	UPPER LIMIT	3.744062
TOTAL Sx	0.518892		
TOTAL MEAN	2.853125		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	4.68	UPPER LIMIT	6.77696
BEFORE STD	1.96713		
BEFORE Sx	0.983565		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	2.613793	UPPER LIMIT	3.564999
AFTER STD	2.931455		
AFTER Sx	0.553993		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : TRANS-1,2-DICHLOROETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		10	5	12
2		10	5	12
3	5	10	5	12
4	5	10	5	12
5	5	10	5	12
6	5	10	5	12
7	1	10	5	12
8	2.1	10	5	12
9	1	10	5	12
10	1	10	5	12
11	1	10	5	12
12	1.5	10	5	12
13	1	10	5	12
14	1	10	5	12
15	1	10	5	12
16	10	10	5	12
17	2	10	5	12
18	2	10	5	12
19	2	10	5	12
20	2	10	5	12
21	1	10	5	12
22	1	10	5	12
23	1.25	10	5	12
24	1.25	10	5	12
25	1.5	10	5	12
26	2.5	10	5	12
27	1.5	10	5	12
28	2.5	10	5	12
29	2.5	10	5	12
30	2.5	10	5	12
31	120	10	5	12
32	2.5	10	5	12
33	2.6	10	5	12
34	2.5	10	5	12

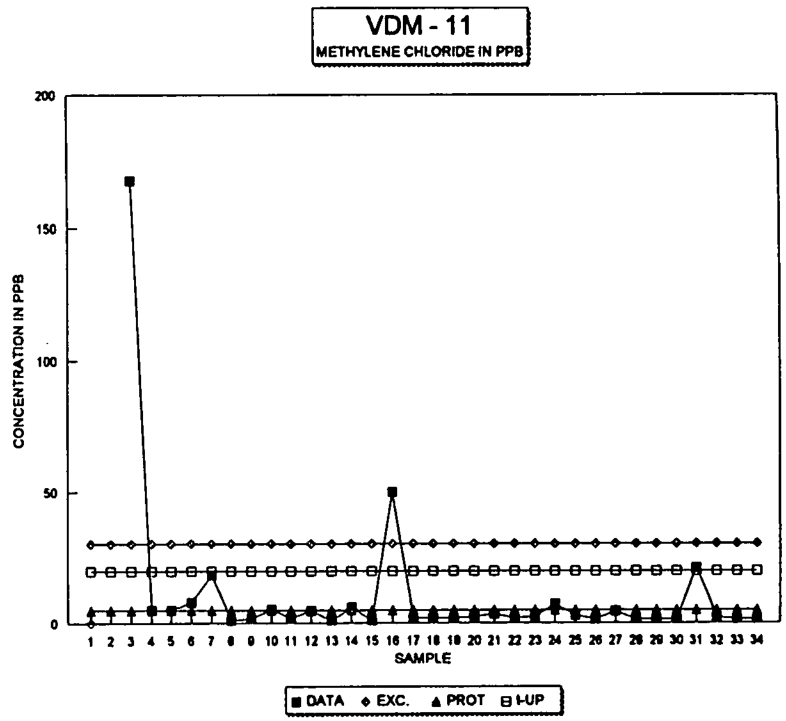
STATISTICS		STUDENT t TESTING	
TOTAL STD	20.548	UPPER LIMIT	12.38977
TOTAL Sx	3.69053		
TOTAL MEAN	6.053125		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	4.2	UPPER LIMIT	5.9056
BEFORE STD	1.6		
BEFORE Sx	0.8		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	6.162069	UPPER LIMIT	13.16497
AFTER STD	21.58175		
AFTER Sx	4.078567		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : METHYLENE CHLORIDE

SAMPLE		EXC CON	PRO STD	UP LIM
1		30	5	20
2		30	5	20
3	168	30	5	20
4	5	30	5	20
5	5	30	5	20
6	7.8	30	5	20
7	18.3	30	5	20
8	1	30	5	20
9	1.7	30	5	20
10	5.1	30	5	20
11	2	30	5	20
12	4.8	30	5	20
13	1	30	5	20
14	6	30	5	20
15	1	30	5	20
16	50	30	5	20
17	2	30	5	20
18	2	30	5	20
19	2	30	5	20
20	2.5	30	5	20
21	3.4	30	5	20
22	2	30	5	20
23	2.5	30	5	20
24	7.16	30	5	20
25	3	30	5	20
26	1.5	30	5	20
27	4.43	30	5	20
28	1.5	30	5	20
29	1.5	30	5	20
30	1.5	30	5	20
31	21	30	5	20
32	2.2	30	5	20
33	1.5	30	5	20
34	1.5	30	5	20

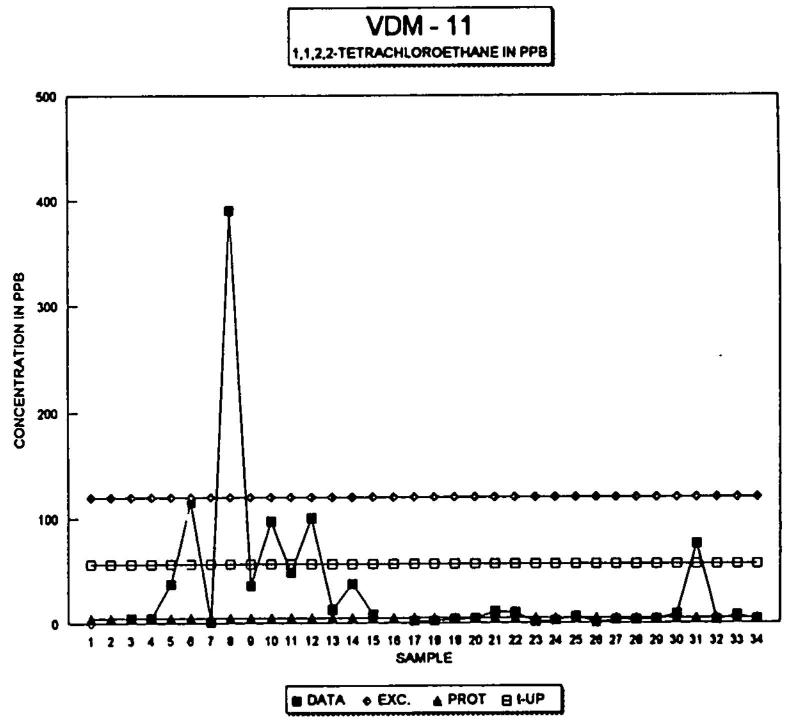
STATISTICS		STUDENT t TESTING	
TOTAL STD	29.70364	UPPER LIMIT	19.78164
TOTAL Sx	5.334931		
TOTAL MEAN	10.62156		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	40.82	UPPER LIMIT	108.8077
BEFORE STD	63.77832		
BEFORE Sx	31.88916		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	5.582414	UPPER LIMIT	8.693704
AFTER STD	9.588469		
AFTER Sx	1.81205		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : 1,1,2,2-TETRACHLOROETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		120	5	56
2		120	5	56
3	5	120	5	56
4	5	120	5	56
5	37.2	120	5	56
6	115	120	5	56
7	1	120	5	56
8	390	120	5	56
9	35	120	5	56
10	97	120	5	56
11	48	120	5	56
12	100	120	5	56
13	13	120	5	56
14	37	120	5	56
15	8	120	5	56
16		120	5	56
17	2.2	120	5	56
18	2	120	5	56
19	3.8	120	5	56
20	4.6	120	5	56
21	11	120	5	56
22	10	120	5	56
23	1.25	120	5	56
24	2.4	120	5	56
25	6.22	120	5	56
26	1	120	5	56
27	3	120	5	56
28	3.1	120	5	56
29	3.8	120	5	56
30	8.5	120	5	56
31	76	120	5	56
32	2.9	120	5	56
33	7.2	120	5	56
34	3.5	120	5	56

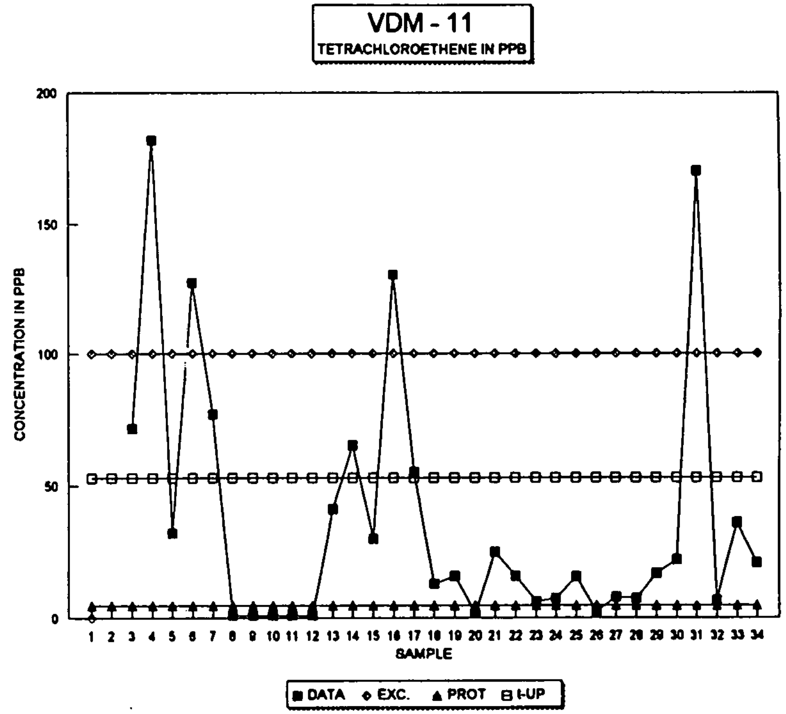
STATISTICS		STUDENT t TESTING	
TOTAL STD	72.38541	UPPER LIMIT	56.46387
TOTAL Sx	13.21571		
TOTAL MEAN	33.66677		
TOTAL N	31		
TOTAL df	30		
BEFORE MEAN	32.64	UPPER LIMIT	78.69562
BEFORE STD	43.20415		
BEFORE Sx	21.60207		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	35.58821	UPPER LIMIT	60.67742
AFTER STD	75.75092		
AFTER Sx	14.57827		
AFTER N	28		
AFTER df	27		



WELL VDM - 11 : TETRACHLOROETHENE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		100	5	53
2		100	5	53
3	71.6	100	5	53
4	182	100	5	53
5	32.3	100	5	53
6	127	100	5	53
7	76.8	100	5	53
8	1	100	5	53
9	1	100	5	53
10	1	100	5	53
11	1	100	5	53
12	1	100	5	53
13	41	100	5	53
14	65	100	5	53
15	30	100	5	53
16	130	100	5	53
17	55	100	5	53
18	13	100	5	53
19	16	100	5	53
20	2	100	5	53
21	25	100	5	53
22	16	100	5	53
23	6.25	100	5	53
24	7.58	100	5	53
25	15.9	100	5	53
26	2.5	100	5	53
27	8.1	100	5	53
28	7.5	100	5	53
29	17	100	5	53
30	22	100	5	53
31	170	100	5	53
32	6.9	100	5	53
33	36	100	5	53
34	21	100	5	53

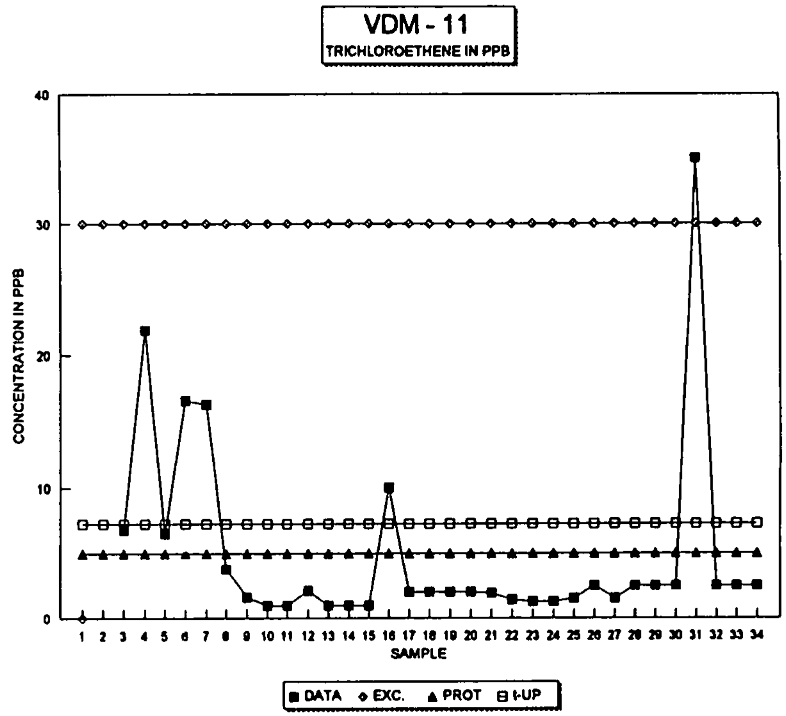
STATISTICS		STUDENT t TESTING	
TOTAL STD	48.6273	UPPER LIMIT	52.75924
TOTAL Sx	8.733722		
TOTAL MEAN	37.76344		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	97.94	UPPER LIMIT	153.0428
BEFORE STD	51.69114		
BEFORE Sx	25.84557		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	31.81138	UPPER LIMIT	45.63871
AFTER STD	42.61347		
AFTER Sx	8.05319		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : TRICHLOROETHENE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		30	5	7
2		30	5	7
3	6.8	30	5	7
4	21.9	30	5	7
5	6.5	30	5	7
6	16.6	30	5	7
7	16.3	30	5	7
8	3.8	30	5	7
9	1.6	30	5	7
10	1	30	5	7
11	1	30	5	7
12	2.1	30	5	7
13	1	30	5	7
14	1	30	5	7
15	1	30	5	7
16	10	30	5	7
17	2	30	5	7
18	2	30	5	7
19	2	30	5	7
20	2	30	5	7
21	1.9	30	5	7
22	1.4	30	5	7
23	1.25	30	5	7
24	1.25	30	5	7
25	1.5	30	5	7
26	2.5	30	5	7
27	1.5	30	5	7
28	2.5	30	5	7
29	2.5	30	5	7
30	2.5	30	5	7
31	35	30	5	7
32	2.5	30	5	7
33	2.5	30	5	7
34	2.5	30	5	7

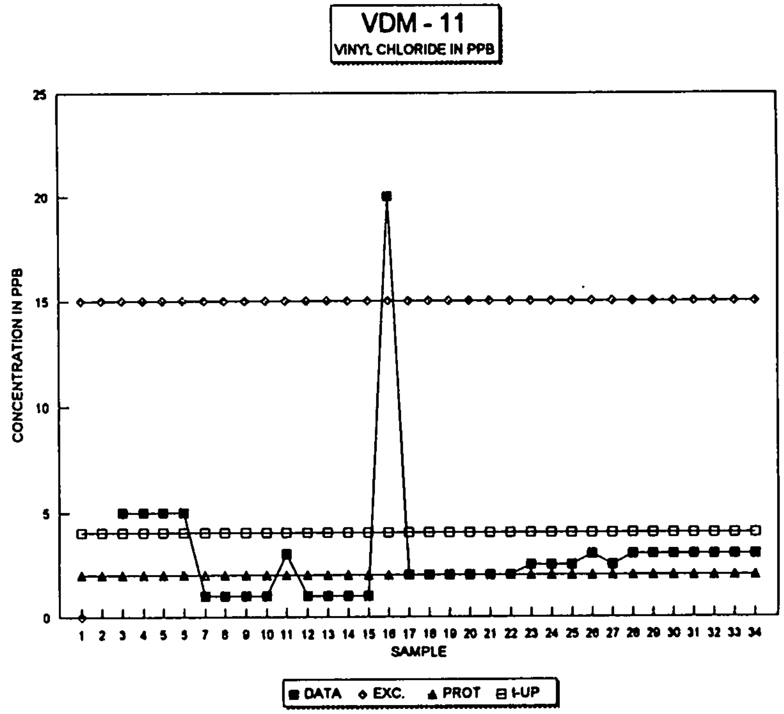
STATISTICS		STUDENT t TESTING	
TOTAL STD	7.362712	UPPER LIMIT	7.267405
TOTAL Sx	1.322382		
TOTAL MEAN	4.996875		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	13.62	UPPER LIMIT	20.0484
BEFORE STD	6.03039		
BEFORE Sx	3.015195		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	4.3	UPPER LIMIT	6.578077
AFTER STD	7.020647		
AFTER Sx	1.326778		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : VINYL CHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		15	2	4
2		15	2	4
3	5	15	2	4
4	5	15	2	4
5	5	15	2	4
6	5	15	2	4
7	1	15	2	4
8	1	15	2	4
9	1	15	2	4
10	1	15	2	4
11	3	15	2	4
12	1	15	2	4
13	1	15	2	4
14	1	15	2	4
15	1	15	2	4
16	20	15	2	4
17	2	15	2	4
18	2	15	2	4
19	2	15	2	4
20	2	15	2	4
21	2	15	2	4
22	2	15	2	4
23	2.5	15	2	4
24	2.5	15	2	4
25	2.5	15	2	4
26	3	15	2	4
27	2.5	15	2	4
28	3	15	2	4
29	3	15	2	4
30	3	15	2	4
31	3	15	2	4
32	3	15	2	4
33	3	15	2	4
34	3	15	2	4

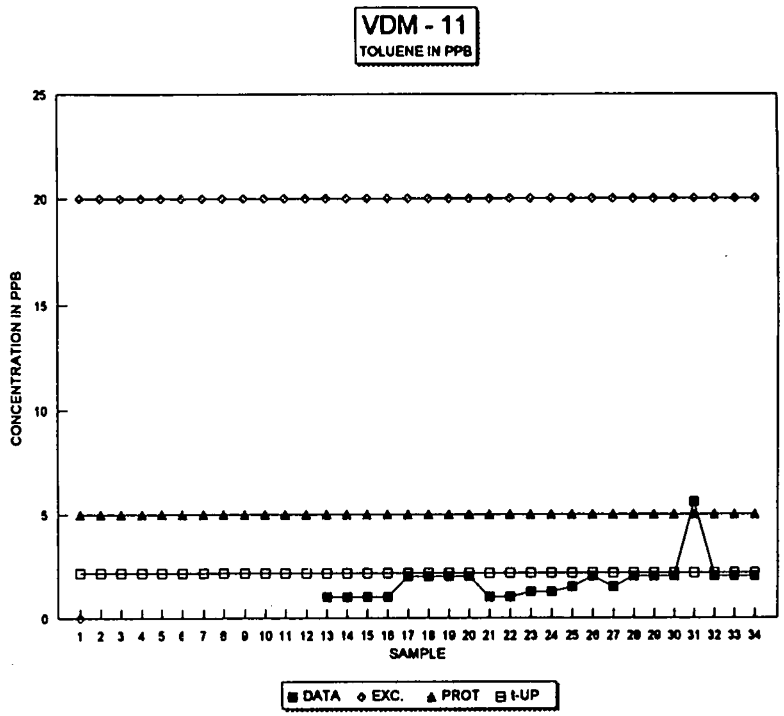
STATISTICS		STUDENT t TESTING	
TOTAL STD	3.27857	UPPER LIMIT	4.042303
TOTAL Sx	0.588849		
TOTAL MEAN	3.03125		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	4.2	UPPER LIMIT	5.9056
BEFORE STD	1.6		
BEFORE Sx	0.8		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	2.827586	UPPER LIMIT	3.924056
AFTER STD	3.379134		
AFTER Sx	0.638596		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : TOLUENE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		20	5	2
2		20	5	2
3		20	5	2
4		20	5	2
5		20	5	2
6		20	5	2
7		20	5	2
8		20	5	2
9		20	5	2
10		20	5	2
11		20	5	2
12		20	5	2
13	1	20	5	2
14	1	20	5	2
15	1	20	5	2
16	1	20	5	2
17	2	20	5	2
18	2	20	5	2
19	2	20	5	2
20	2	20	5	2
21	1	20	5	2
22	1	20	5	2
23	1.25	20	5	2
24	1.25	20	5	2
25	1.5	20	5	2
26	2	20	5	2
27	1.5	20	5	2
28	2	20	5	2
29	2	20	5	2
30	2	20	5	2
31	5.6	20	5	2
32	2	20	5	2
33	2	20	5	2
34	2	20	5	2

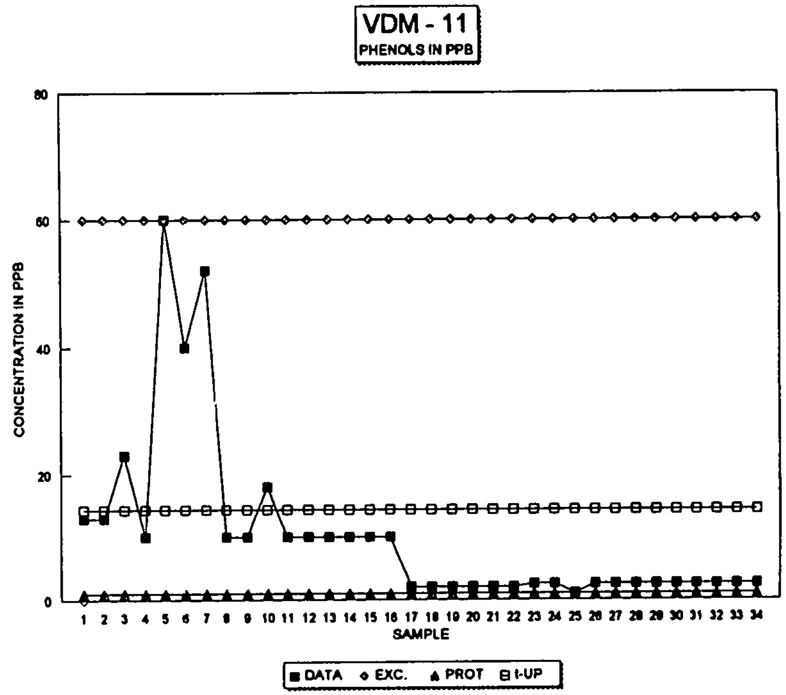
STATISTICS		STUDENT t TESTING	
TOTAL STD	0.941315	UPPER LIMIT	2.146192
TOTAL Sx	0.205412		
TOTAL MEAN	1.777273		
TOTAL N	22		
TOTAL df	21		
BEFORE MEAN	ERR	UPPER LIMIT	ERR
BEFORE STD	ERR		
BEFORE Sx	ERR		
BEFORE N	0		
BEFORE df	-1		
AFTER MEAN	1.777273	UPPER LIMIT	2.13736
AFTER STD	0.941315		
AFTER Sx	0.205412		
AFTER N	22		
AFTER df	21		



WELL VDM - 11 : PHENOLS

SAMPLE		EXC CON	PRO STD	UP LIM
1	13	60	1	14
2	13	60	1	14
3	23	60	1	14
4	10	60	1	14
5	60	60	1	14
6	40	60	1	14
7	52	60	1	14
8	10	60	1	14
9	10	60	1	14
10	18	60	1	14
11	10	60	1	14
12	10	60	1	14
13	10	60	1	14
14	10	60	1	14
15	10	60	1	14
16	10	60	1	14
17	2	60	1	14
18	2	60	1	14
19	2	60	1	14
20	2	60	1	14
21	2	60	1	14
22	2	60	1	14
23	2.5	60	1	14
24	2.5	60	1	14
25	1	60	1	14
26	2.5	60	1	14
27	2.5	60	1	14
28	2.5	60	1	14
29	2.5	60	1	14
30	2.5	60	1	14
31	2.5	60	1	14
32	2.5	60	1	14
33	2.5	60	1	14
34	2.5	60	1	14

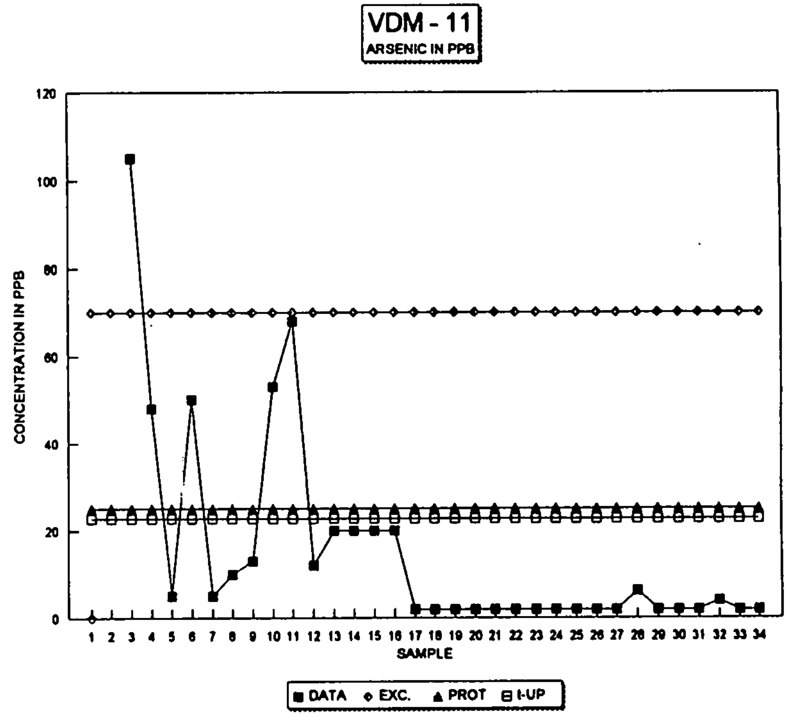
STATISTICS		STUDENT t TESTING	
TOTAL STD	13.8225	UPPER LIMIT	14.3964
TOTAL Sx	2.406189		
TOTAL MEAN	10.27941		
TOTAL N	34		
TOTAL df	33		
BEFORE MEAN	30.14286	UPPER LIMIT	45.16594
BEFORE STD	18.93922		
BEFORE Sx	7.731902		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	7.948276	UPPER LIMIT	11.60832
AFTER STD	11.27963		
AFTER Sx	2.13165		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : ARSENIC

	SAMPLE	EXC CON	PRO STD	UP LIM
1		70	25	23
2		70	25	23
3	105	70	25	23
4	48	70	25	23
5	5	70	25	23
6	50	70	25	23
7	5	70	25	23
8	10	70	25	23
9	13	70	25	23
10	53	70	25	23
11	68	70	25	23
12	12	70	25	23
13	20	70	25	23
14	20	70	25	23
15	20	70	25	23
16	20	70	25	23
17	2	70	25	23
18	2	70	25	23
19	2	70	25	23
20	2	70	25	23
21	2	70	25	23
22	2	70	25	23
23	2	70	25	23
24	2	70	25	23
25	2	70	25	23
26	2	70	25	23
27	2	70	25	23
28	6.1	70	25	23
29	2	70	25	23
30	2	70	25	23
31	2	70	25	23
32	4	70	25	23
33	2	70	25	23
34	2	70	25	23

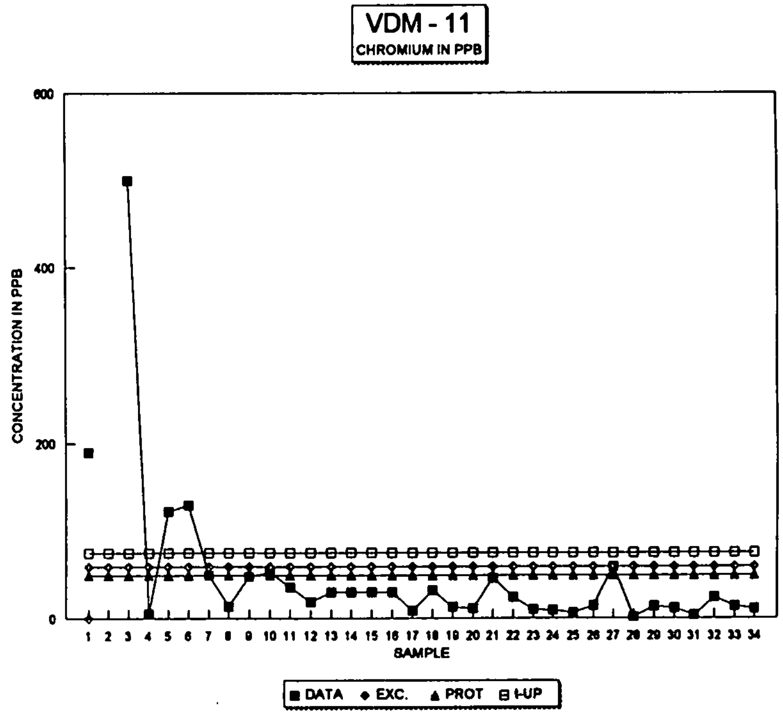
STATISTICS		STUDENT t TESTING	
TOTAL STD	23.65465	UPPER LIMIT	22.64155
TOTAL Sx	4.248501		
TOTAL MEAN	15.34688		
TOTAL N	32		
TOTAL df	31		
BEFORE MEAN	42.6	UPPER LIMIT	81.92717
BEFORE STD	36.89228		
BEFORE Sx	18.44614		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	11.48621	UPPER LIMIT	16.96316
AFTER STD	16.87904		
AFTER Sx	3.189838		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : CHROMIUM

	SAMPLE	EXC CON	PRO STD	UP LIM
1	190	60	50	76
2		60	50	76
3	500	60	50	76
4	6	60	50	76
5	123	60	50	76
6	130	60	50	76
7	50	60	50	76
8	14	60	50	76
9	48	60	50	76
10	53	60	50	76
11	36	60	50	76
12	19	60	50	76
13	30	60	50	76
14	30	60	50	76
15	30	60	50	76
16	30	60	50	76
17	9	60	50	76
18	32	60	50	76
19	13	60	50	76
20	12	60	50	76
21	46	60	50	76
22	24	60	50	76
23	10.2	60	50	76
24	10	60	50	76
25	6.9	60	50	76
26	15	60	50	76
27	60	60	50	76
28	2	60	50	76
29	14	60	50	76
30	12	60	50	76
31	4	60	50	76
32	24	60	50	76
33	14	60	50	76
34	11	60	50	76

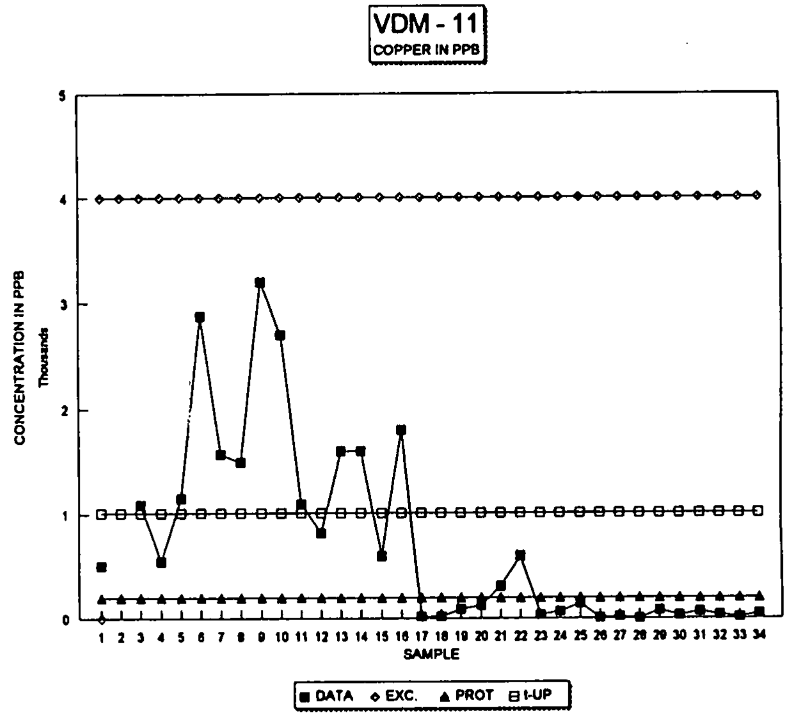
STATISTICS		STUDENT t TESTING	
TOTAL STD	89.15554	UPPER LIMIT	75.79129
TOTAL Sx	15.76062		
TOTAL MEAN	48.7303		
TOTAL N	33		
TOTAL df	32		
BEFORE MEAN	166.5	UPPER LIMIT	311.0246
BEFORE STD	160.3805		
BEFORE Sx	71.72436		
BEFORE N	6		
BEFORE df	5		
AFTER MEAN	27.21034	UPPER LIMIT	35.27954
AFTER STD	24.8679		
AFTER Sx	4.699592		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : COPPER

	SAMPLE	EXC CON	PRO STD	UP LIM
1	510	4000	200	1013
2		4000	200	1013
3	1090	4000	200	1013
4	550	4000	200	1013
5	1150	4000	200	1013
6	2880	4000	200	1013
7	1570	4000	200	1013
8	1500	4000	200	1013
9	3200	4000	200	1013
10	2700	4000	200	1013
11	1100	4000	200	1013
12	820	4000	200	1013
13	1600	4000	200	1013
14	1600	4000	200	1013
15	600	4000	200	1013
16	1800	4000	200	1013
17	19	4000	200	1013
18	21	4000	200	1013
19	90	4000	200	1013
20	130	4000	200	1013
21	310	4000	200	1013
22	600	4000	200	1013
23	35.5	4000	200	1013
24	66.7	4000	200	1013
25	150	4000	200	1013
26	10	4000	200	1013
27	20	4000	200	1013
28	5	4000	200	1013
29	80	4000	200	1013
30	31	4000	200	1013
31	68	4000	200	1013
32	40	4000	200	1013
33	15	4000	200	1013
34	50	4000	200	1013

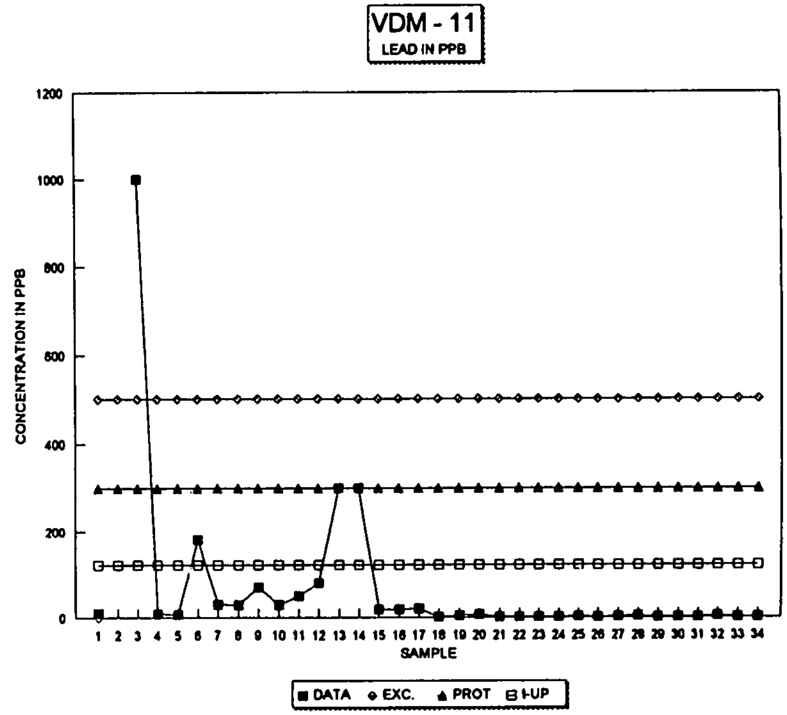
STATISTICS		STUDENT t TESTING	
TOTAL STD	899.2264	UPPER LIMIT	1012.672
TOTAL Sx	158.9623		
TOTAL MEAN	739.7333		
TOTAL N	33		
TOTAL df	32		
BEFORE MEAN	1291.667	UPPER LIMIT	2010.891
BEFORE STD	798.1315		
BEFORE Sx	356.9353		
BEFORE N	6		
BEFORE df	5		
AFTER MEAN	727.9724	UPPER LIMIT	1037.702
AFTER STD	952.3161		
AFTER Sx	179.9708		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : LEAD

	SAMPLE	EXC CON	PRO STD	UP LIM
1	10	500	300	122
2		500	300	122
3	1000	500	300	122
4	9	500	300	122
5	8	500	300	122
6	180	500	300	122
7	31	500	300	122
8	30	500	300	122
9	70	500	300	122
10	29	500	300	122
11	50	500	300	122
12	80	500	300	122
13	300	500	300	122
14	300	500	300	122
15	20	500	300	122
16	20	500	300	122
17	21	500	300	122
18	2	500	300	122
19	5	500	300	122
20	7	500	300	122
21	2	500	300	122
22	2	500	300	122
23	2	500	300	122
24	2	500	300	122
25	3	500	300	122
26	2	500	300	122
27	3	500	300	122
28	5.4	500	300	122
29	2.3	500	300	122
30	2	500	300	122
31	2	500	300	122
32	5	500	300	122
33	2	500	300	122
34	2	500	300	122

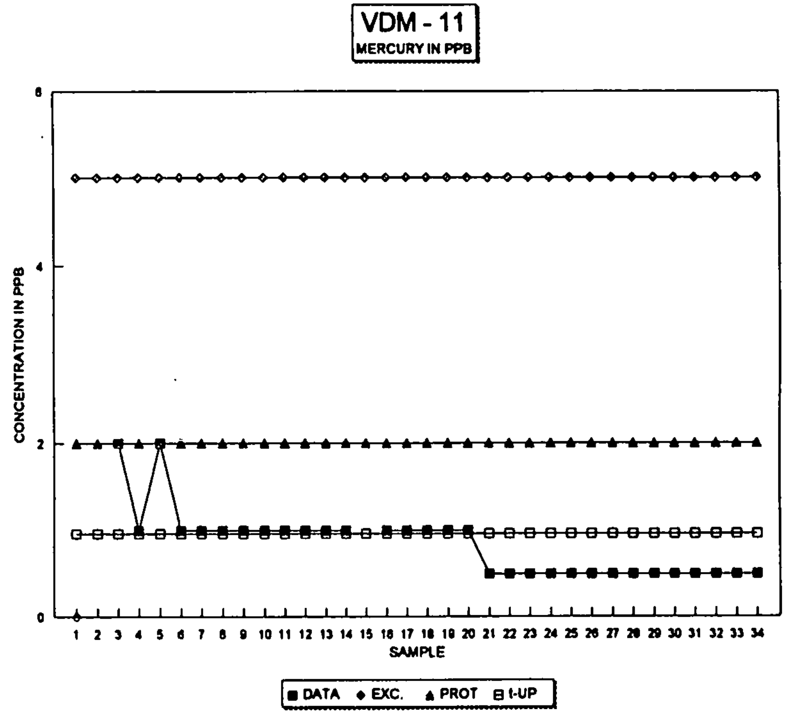
STATISTICS		STUDENT t TESTING	
TOTAL STD	181.137	UPPER LIMIT	121.91
TOTAL Sx	32.0208		
TOTAL MEAN	66.9303		
TOTAL N	33		
TOTAL df	32		
BEFORE MEAN	206.3333	UPPER LIMIT	530.86
BEFORE STD	360.1308		
BEFORE Sx	161.0554		
BEFORE N	6		
BEFORE df	5		
AFTER MEAN	40.74828	UPPER LIMIT	66.46675
AFTER STD	79.25999		
AFTER Sx	14.97873		
AFTER N	29		
AFTER df	28		



WELL VDM - 11 : MERCURY

	SAMPLE	EXC CON	PRO STD	UP LIM
1		5	2	1
2		5	2	1
3	2	5	2	1
4	1	5	2	1
5	2	5	2	1
6	1	5	2	1
7	1	5	2	1
8	1	5	2	1
9	1	5	2	1
10	1	5	2	1
11	1	5	2	1
12	1	5	2	1
13	1	5	2	1
14	1	5	2	1
15		5	2	1
16	1	5	2	1
17	1	5	2	1
18	1	5	2	1
19	1	5	2	1
20	1	5	2	1
21	0.5	5	2	1
22	0.5	5	2	1
23	0.5	5	2	1
24	0.5	5	2	1
25	0.5	5	2	1
26	0.5	5	2	1
27	0.5	5	2	1
28	0.5	5	2	1
29	0.5	5	2	1
30	0.5	5	2	1
31	0.5	5	2	1
32	0.5	5	2	1
33	0.5	5	2	1
34	0.5	5	2	1

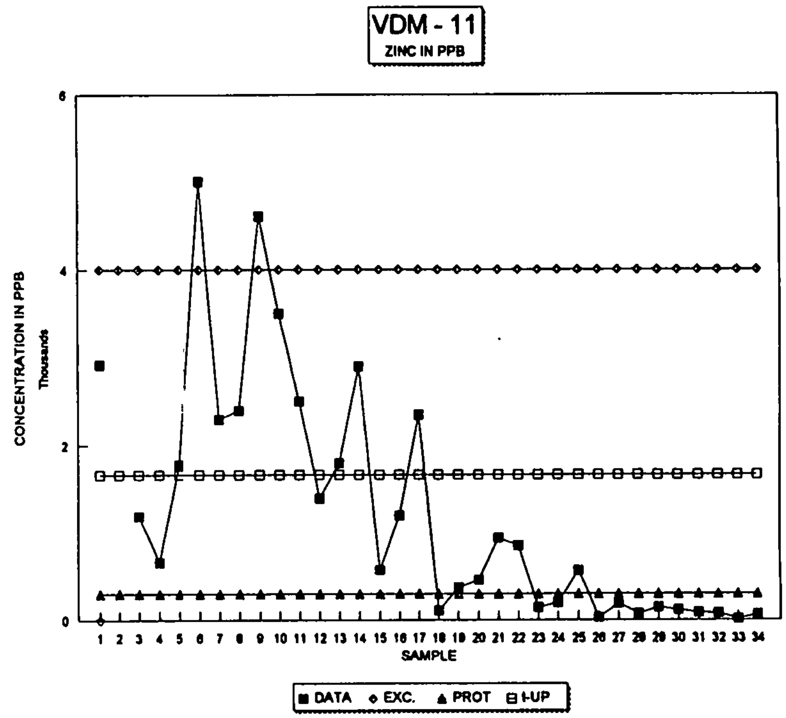
STATISTICS		STUDENT t TESTING	
TOTAL STD	0.389108	UPPER LIMIT	0.961255
TOTAL Sx	0.071041		
TOTAL MEAN	0.83871		
TOTAL N	31		
TOTAL df	30		
BEFORE MEAN	1.4	UPPER LIMIT	1.922231
BEFORE STD	0.489898		
BEFORE Sx	0.244949		
BEFORE N	5		
BEFORE df	4		
AFTER MEAN	0.75	UPPER LIMIT	0.832802
AFTER STD	0.25		
AFTER Sx	0.048113		
AFTER N	28		
AFTER df	27		



WELL VDM - 11 : ZINC

	SAMPLE	EXC CON	PRO STD	UP LIM
1	2920	4000	300	1669
2		4000	300	1669
3	1190	4000	300	1669
4	660	4000	300	1669
5	1780	4000	300	1669
6	5000	4000	300	1669
7	2300	4000	300	1669
8	2400	4000	300	1669
9	4600	4000	300	1669
10	3500	4000	300	1669
11	2500	4000	300	1669
12	1400	4000	300	1669
13	1800	4000	300	1669
14	2900	4000	300	1669
15	580	4000	300	1669
16	1200	4000	300	1669
17	2350	4000	300	1669
18	110	4000	300	1669
19	370	4000	300	1669
20	460	4000	300	1669
21	940	4000	300	1669
22	850	4000	300	1669
23	145	4000	300	1669
24	197	4000	300	1669
25	570	4000	300	1669
26	30	4000	300	1669
27	190	4000	300	1669
28	75	4000	300	1669
29	145	4000	300	1669
30	120	4000	300	1669
31	88	4000	300	1669
32	80	4000	300	1669
33	20	4000	300	1669
34	70	4000	300	1669

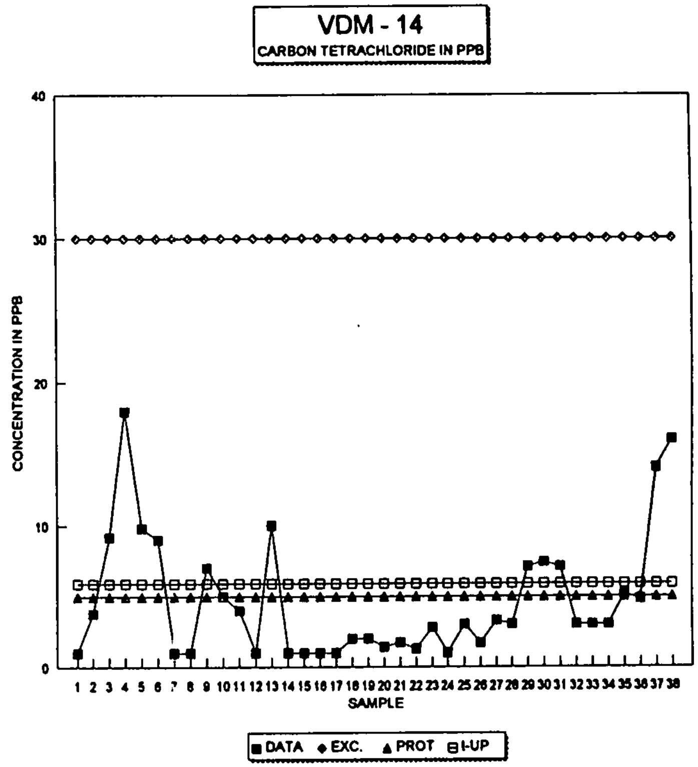
STATISTICS		STUDENT t TESTING	
TOTAL STD	1352.039	UPPER LIMIT	1669.166
TOTAL Sx	239.0089		
TOTAL MEAN	1258.788		
TOTAL N	33		
TOTAL df	32		
BEFORE MEAN	2308.333	UPPER LIMIT	3575.6
BEFORE STD	1406.3		
BEFORE Sx	628.9166		
BEFORE N	6		
BEFORE df	5		
AFTER MEAN	1206.552	UPPER LIMIT	1660.87
AFTER STD	1400.13		
AFTER Sx	264.5998		
AFTER N	29		
AFTER df	28		



WELL VDM - 14 : CARBON TETRACHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	30	5	6
2	3.8	30	5	6
3	9.2	30	5	6
4	18	30	5	6
5	9.8	30	5	6
6	9	30	5	6
7	1	30	5	6
8	1	30	5	6
9	7	30	5	6
10	5	30	5	6
11	4	30	5	6
12	1	30	5	6
13	10	30	5	6
14	1	30	5	6
15	1	30	5	6
16	1	30	5	6
17	1	30	5	6
18	2	30	5	6
19	2	30	5	6
20	1.4	30	5	6
21	1.7	30	5	6
22	1.25	30	5	6
23	2.81	30	5	6
24	1	30	5	6
25	3	30	5	6
26	1.67	30	5	6
27	3.3	30	5	6
28	3	30	5	6
29	7.1	30	5	6
30	7.4	30	5	6
31	7.1	30	5	6
32	3	30	5	6
33	3	30	5	6
34	3	30	5	6
35	5.1	30	5	6
36	4.8	30	5	6
37	14	30	5	6
38	16	30	5	6

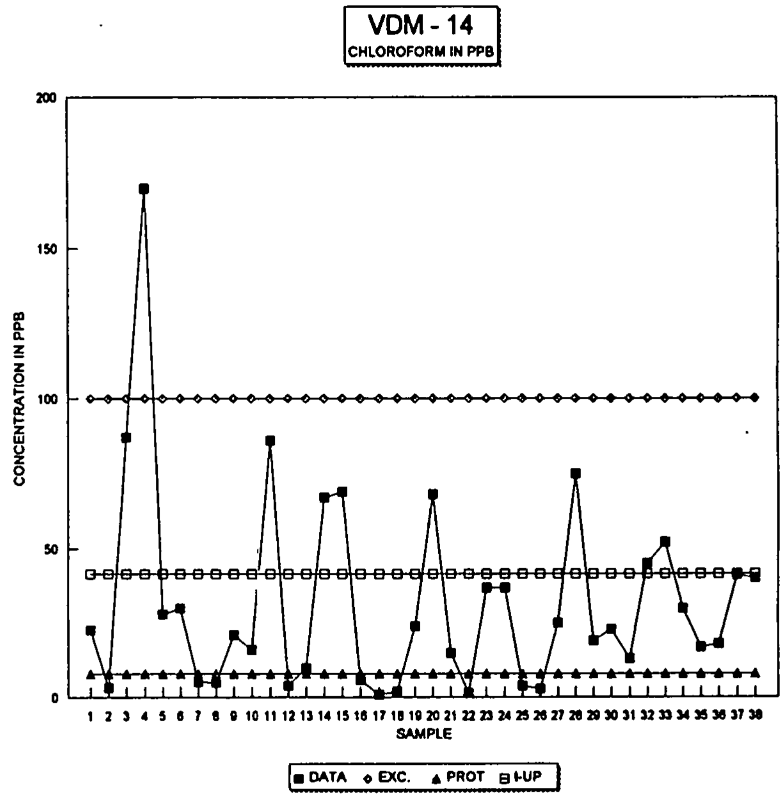
STATISTICS		STUDENT t TESTING	
TOTAL STD	4.317283	UPPER LIMIT	5.887863
TOTAL Sx	0.709757		
TOTAL MEAN	4.669211		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	7.4	UPPER LIMIT	11.83478
BEFORE STD	5.590809		
BEFORE Sx	2.282438		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	3.957188	UPPER LIMIT	5.09885
AFTER STD	3.684931		
AFTER Sx	0.661833		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : CHLOROFORM

	SAMPLE	EXC CON	PRO STD	UP LIM
1	22.7	100	8	41
2	3.2	100	8	41
3	87	100	8	41
4	170	100	8	41
5	28	100	8	41
6	30	100	8	41
7	5.2	100	8	41
8	5.1	100	8	41
9	21	100	8	41
10	16	100	8	41
11	86	100	8	41
12	4	100	8	41
13	10	100	8	41
14	67	100	8	41
15	69	100	8	41
16	5.9	100	8	41
17	1	100	8	41
18	2	100	8	41
19	24	100	8	41
20	68	100	8	41
21	15	100	8	41
22	1.25	100	8	41
23	36.8	100	8	41
24	36.8	100	8	41
25	4	100	8	41
26	2.8	100	8	41
27	25	100	8	41
28	75	100	8	41
29	19	100	8	41
30	23	100	8	41
31	13	100	8	41
32	45	100	8	41
33	52	100	8	41
34	30	100	8	41
35	17	100	8	41
36	18	100	8	41
37	41	100	8	41
38	40	100	8	41

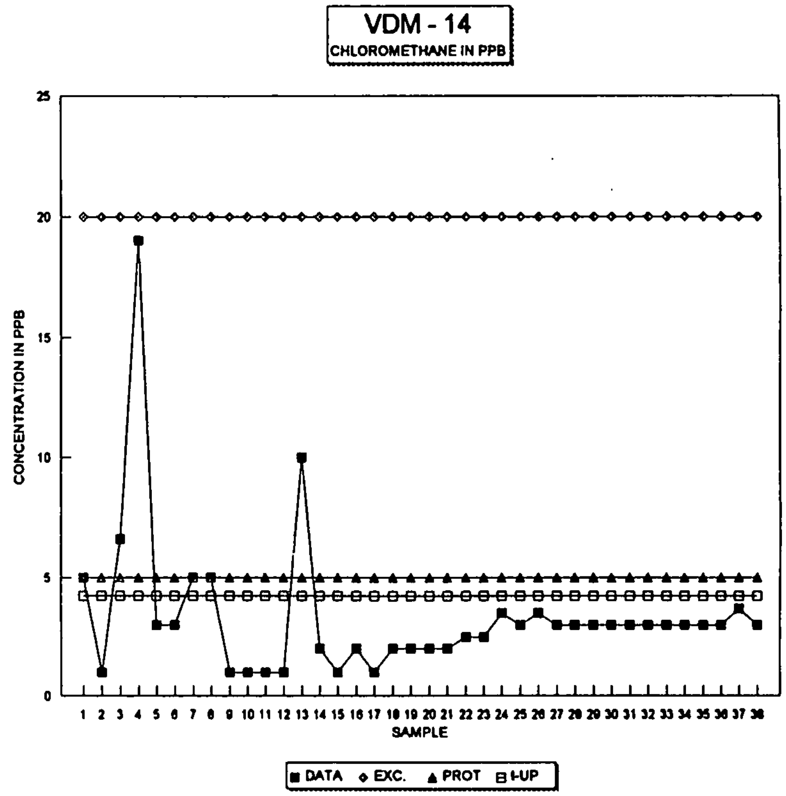
STATISTICS		STUDENT t TESTING	
TOTAL STD	33.27276	UPPER LIMIT	41.49069
TOTAL Sx	5.470008		
TOTAL MEAN	32.09868		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	49.44286	UPPER LIMIT	93.49922
BEFORE STD	55.54071		
BEFORE Sx	22.6744		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	27.46406	UPPER LIMIT	34.89447
AFTER STD	23.98304		
AFTER Sx	4.30748		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : CHLOROMETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	5	20	5	4
2	1	20	5	4
3	6.6	20	5	4
4	19	20	5	4
5	3	20	5	4
6	3	20	5	4
7	5	20	5	4
8	5	20	5	4
9	1	20	5	4
10	1	20	5	4
11	1	20	5	4
12	1	20	5	4
13	10	20	5	4
14	2	20	5	4
15	1	20	5	4
16	2	20	5	4
17	1	20	5	4
18	2	20	5	4
19	2	20	5	4
20	2	20	5	4
21	2	20	5	4
22	2.5	20	5	4
23	2.5	20	5	4
24	3.5	20	5	4
25	3	20	5	4
26	3.5	20	5	4
27	3	20	5	4
28	3	20	5	4
29	3	20	5	4
30	3	20	5	4
31	3	20	5	4
32	3	20	5	4
33	3	20	5	4
34	3	20	5	4
35	3	20	5	4
36	3	20	5	4
37	3.7	20	5	4
38	3	20	5	4

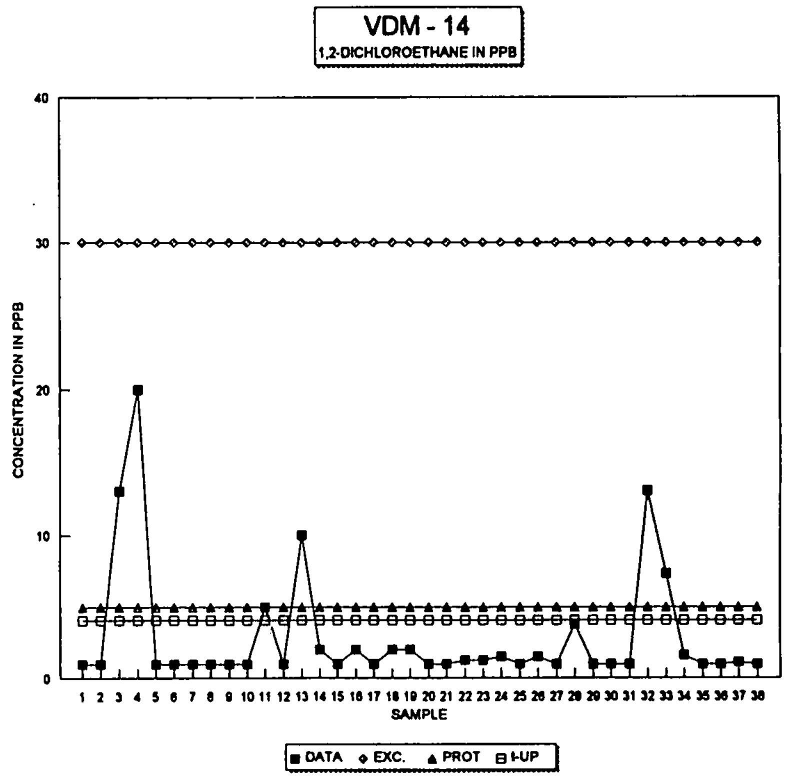
STATISTICS		STUDENT t TESTING	
TOTAL STD	3.081332	UPPER LIMIT	4.219777
TOTAL Sx	0.506568		
TOTAL MEAN	3.35		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	6.085714	UPPER LIMIT	10.47474
BEFORE STD	5.533128		
BEFORE Sx	2.25889		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	2.803125	UPPER LIMIT	3.314707
AFTER STD	1.651228		
AFTER Sx	0.296569		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : 1,2-DICHLOROETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	30	5	4
2	1	30	5	4
3	13	30	5	4
4	20	30	5	4
5	1	30	5	4
6	1	30	5	4
7	1	30	5	4
8	1	30	5	4
9	1	30	5	4
10	1	30	5	4
11	5	30	5	4
12	1	30	5	4
13	10	30	5	4
14	2	30	5	4
15	1	30	5	4
16	2	30	5	4
17	1	30	5	4
18	2	30	5	4
19	2	30	5	4
20	1	30	5	4
21	1	30	5	4
22	1.25	30	5	4
23	1.25	30	5	4
24	1.5	30	5	4
25	1	30	5	4
26	1.5	30	5	4
27	1	30	5	4
28	3.8	30	5	4
29	1	30	5	4
30	1	30	5	4
31	1	30	5	4
32	13	30	5	4
33	7.3	30	5	4
34	1.6	30	5	4
35	1	30	5	4
36	1	30	5	4
37	1.1	30	5	4
38	1	30	5	4

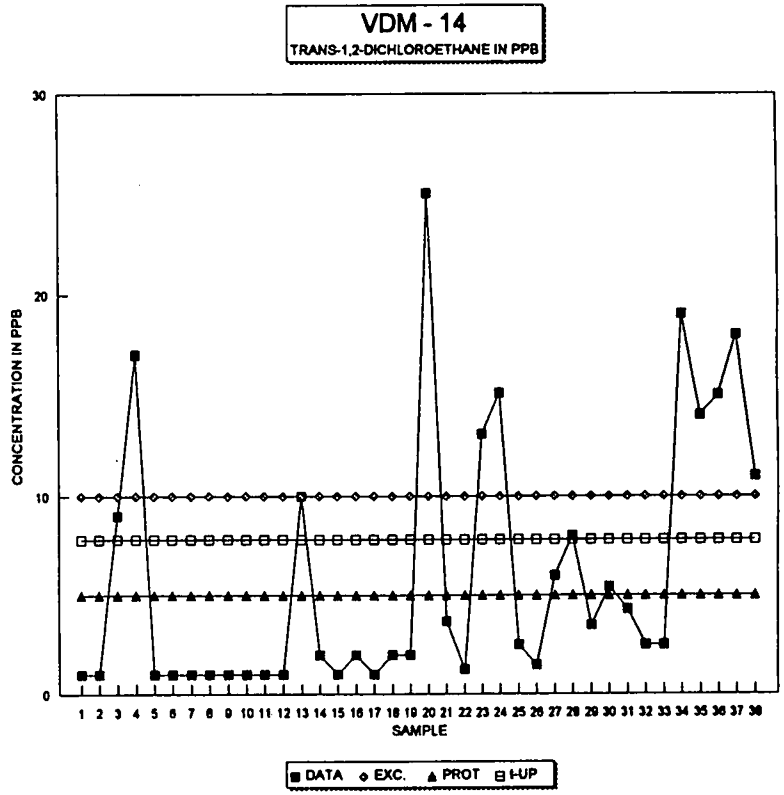
STATISTICS		STUDENT t TESTING	
TOTAL STD	4.182494	UPPER LIMIT	4.056921
TOTAL Sx	0.687598		
TOTAL MEAN	2.876316		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	5.428571	UPPER LIMIT	11.17772
BEFORE STD	7.247801		
BEFORE Sx	2.958902		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	2.259375	UPPER LIMIT	3.112736
AFTER STD	2.754384		
AFTER Sx	0.494702		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : TRANS-1,2-DICHLOROETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	10	5	8
2	1	10	5	8
3	9	10	5	8
4	17	10	5	8
5	1	10	5	8
6	1	10	5	8
7	1	10	5	8
8	1	10	5	8
9	1	10	5	8
10	1	10	5	8
11	1	10	5	8
12	1	10	5	8
13	10	10	5	8
14	2	10	5	8
15	1	10	5	8
16	2	10	5	8
17	1	10	5	8
18	2	10	5	8
19	2	10	5	8
20	25	10	5	8
21	3.7	10	5	8
22	1.25	10	5	8
23	13.1	10	5	8
24	15.1	10	5	8
25	2.5	10	5	8
26	1.5	10	5	8
27	6	10	5	8
28	8	10	5	8
29	3.5	10	5	8
30	5.4	10	5	8
31	4.3	10	5	8
32	2.5	10	5	8
33	2.5	10	5	8
34	19	10	5	8
35	14	10	5	8
36	15	10	5	8
37	18	10	5	8
38	11	10	5	8

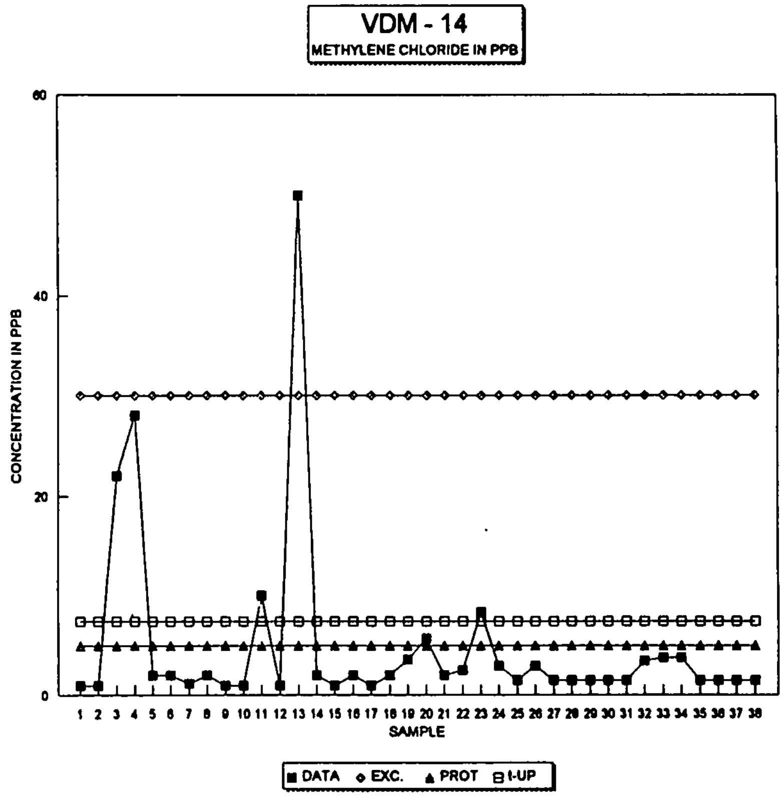
STATISTICS		STUDENT t TESTING	
TOTAL STD	6.459512	UPPER LIMIT	7.806241
TOTAL Sx	1.061937		
TOTAL MEAN	5.982895		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	4.428571	UPPER LIMIT	9.051059
BEFORE STD	5.827451		
BEFORE Sx	2.379047		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	6.167188	UPPER LIMIT	8.183005
AFTER STD	6.506434		
AFTER Sx	1.16859		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : METHYLENE CHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	30	5	7
2	1	30	5	7
3	22	30	5	7
4	28	30	5	7
5	2	30	5	7
6	2	30	5	7
7	1.2	30	5	7
8	2	30	5	7
9	1	30	5	7
10	1	30	5	7
11	10	30	5	7
12	1	30	5	7
13	50	30	5	7
14	2	30	5	7
15	1	30	5	7
16	2	30	5	7
17	1	30	5	7
18	2	30	5	7
19	3.6	30	5	7
20	5.7	30	5	7
21	2	30	5	7
22	2.5	30	5	7
23	8.32	30	5	7
24	3	30	5	7
25	1.5	30	5	7
26	3	30	5	7
27	1.5	30	5	7
28	1.5	30	5	7
29	1.5	30	5	7
30	1.5	30	5	7
31	1.5	30	5	7
32	3.5	30	5	7
33	3.8	30	5	7
34	3.8	30	5	7
35	1.5	30	5	7
36	1.5	30	5	7
37	1.5	30	5	7
38	1.5	30	5	7

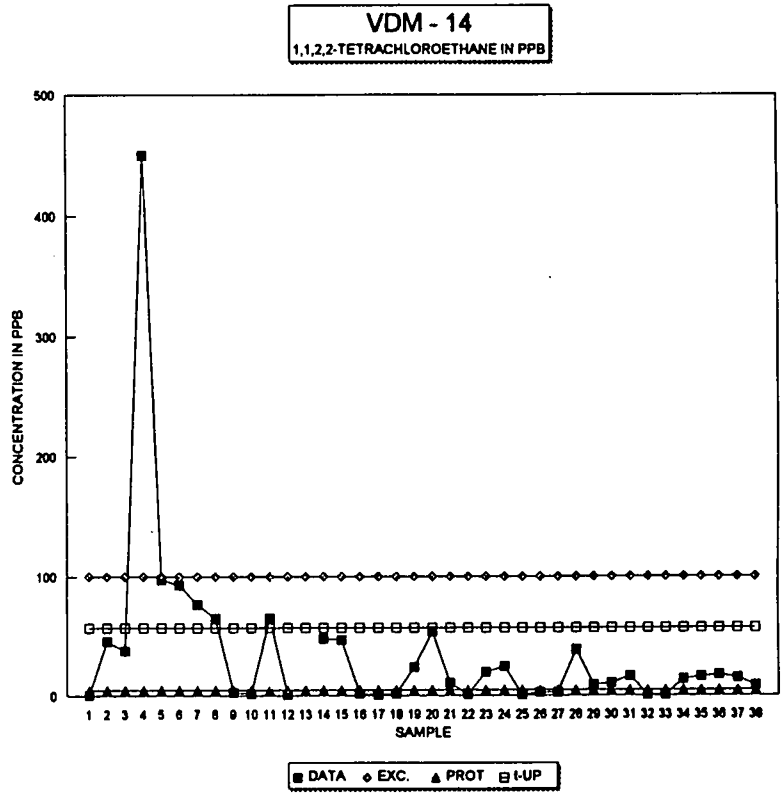
STATISTICS		STUDENT t TESTING	
TOTAL STD	9.193781	UPPER LIMIT	7.448315
TOTAL Sx	1.511448		
TOTAL MEAN	4.853158		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	8.171429	UPPER LIMIT	16.71492
BEFORE STD	10.77056		
BEFORE Sx	4.397061		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	4.013125	UPPER LIMIT	6.647514
AFTER STD	8.50299		
AFTER Sx	1.527182		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : 1,1,2,2-TETRACHLOROETHANE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	100	5	57
2	46	100	5	57
3	38	100	5	57
4	450	100	5	57
5	97	100	5	57
6	93	100	5	57
7	77	100	5	57
8	65	100	5	57
9	3	100	5	57
10	2	100	5	57
11	65	100	5	57
12	1	100	5	57
13		100	5	57
14	48	100	5	57
15	47	100	5	57
16	2	100	5	57
17	1	100	5	57
18	2	100	5	57
19	24	100	5	57
20	54	100	5	57
21	11	100	5	57
22	1.25	100	5	57
23	19.6	100	5	57
24	24.4	100	5	57
25	1	100	5	57
26	3	100	5	57
27	3	100	5	57
28	39	100	5	57
29	9.3	100	5	57
30	11	100	5	57
31	17	100	5	57
32	1	100	5	57
33	1	100	5	57
34	14	100	5	57
35	16	100	5	57
36	18	100	5	57
37	15	100	5	57
38	8.6	100	5	57

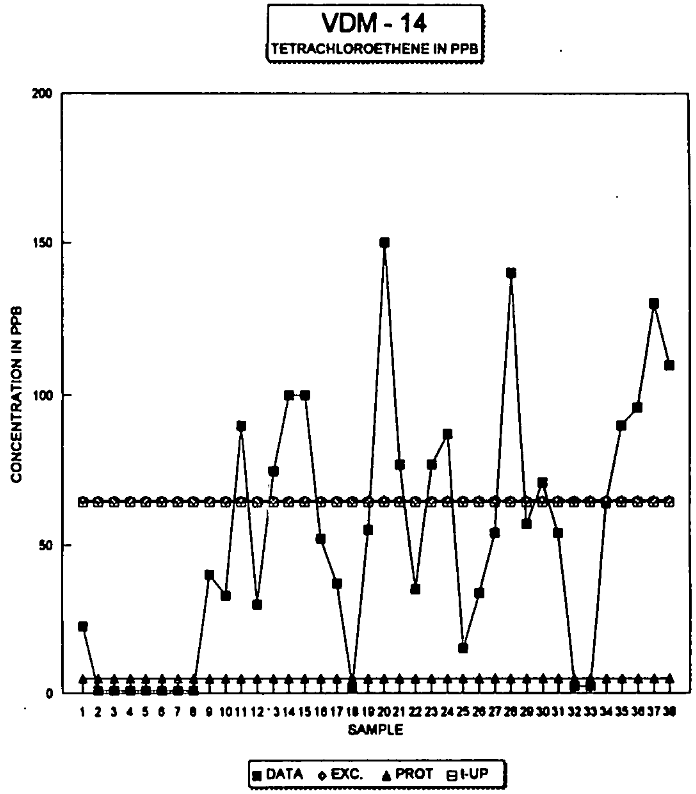
STATISTICS		STUDENT t TESTING	
TOTAL STD	74.06982	UPPER LIMIT	57.11929
TOTAL Sx	12.34497		
TOTAL MEAN	35.92297		
TOTAL N	37		
TOTAL df	36		
BEFORE MEAN	114.5714	UPPER LIMIT	226.0117
BEFORE STD	140.4898		
BEFORE Sx	57.35473		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	19.48871	UPPER LIMIT	26.41735
AFTER STD	21.88565		
AFTER Sx	3.995754		
AFTER N	31		
AFTER df	30		



WELL VDM - 14 : TETRACHLOROETHENE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	22.4	65	5	64
2	1	65	5	64
3	1	65	5	64
4	1	65	5	64
5	1	65	5	64
6	1	65	5	64
7	1	65	5	64
8	1	65	5	64
9	40	65	5	64
10	33	65	5	64
11	90	65	5	64
12	30	65	5	64
13	75	65	5	64
14	100	65	5	64
15	100	65	5	64
16	52	65	5	64
17	37	65	5	64
18	2	65	5	64
19	55	65	5	64
20	150	65	5	64
21	77	65	5	64
22	35	65	5	64
23	77.1	65	5	64
24	87.3	65	5	64
25	15	65	5	64
26	33.7	65	5	64
27	54	65	5	64
28	140	65	5	64
29	57	65	5	64
30	71	65	5	64
31	54	65	5	64
32	2.5	65	5	64
33	2.5	65	5	64
34	64	65	5	64
35	90	65	5	64
36	96	65	5	64
37	130	65	5	64
38	110	65	5	64

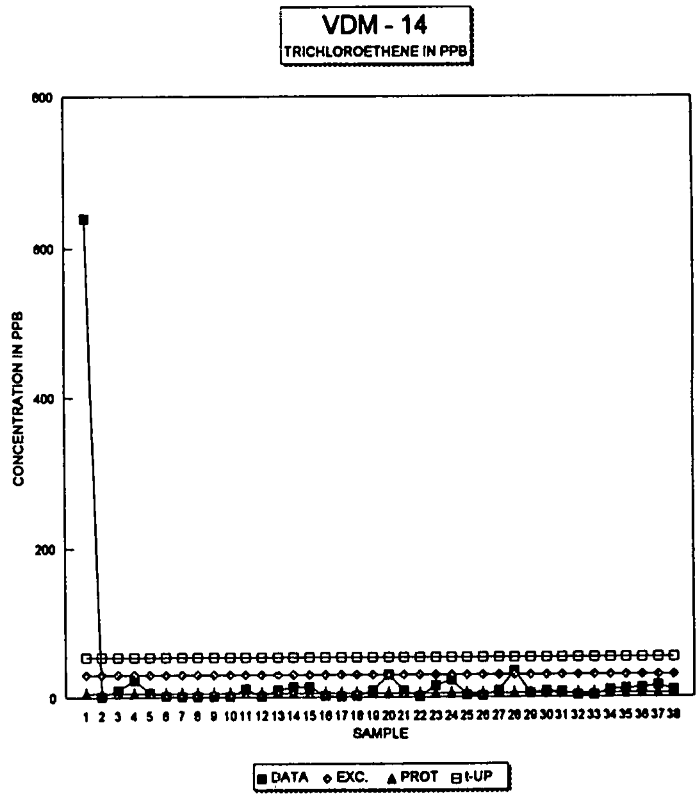
STATISTICS		STUDENT t TESTING	
TOTAL STD	42.76338	UPPER LIMIT	64.42621
TOTAL Sx	7.030256		
TOTAL MEAN	52.35526		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	4.057143	UPPER LIMIT	9.997171
BEFORE STD	7.48844		
BEFORE Sx	3.057143		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	61.31563	UPPER LIMIT	73.90501
AFTER STD	40.63462		
AFTER Sx	7.298192		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : TRICHLOROETHENE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	639	30	5	54
2	1	30	5	54
3	10	30	5	54
4	23	30	5	54
5	5.8	30	5	54
6	1.7	30	5	54
7	1	30	5	54
8	1	30	5	54
9	1	30	5	54
10	1	30	5	54
11	11	30	5	54
12	1	30	5	54
13	10	30	5	54
14	14	30	5	54
15	14	30	5	54
16	2	30	5	54
17	1	30	5	54
18	2	30	5	54
19	8.8	30	5	54
20	30	30	5	54
21	9.2	30	5	54
22	1.25	30	5	54
23	15.4	30	5	54
24	23.7	30	5	54
25	2.5	30	5	54
26	1.89	30	5	54
27	8.6	30	5	54
28	35	30	5	54
29	5.6	30	5	54
30	8.1	30	5	54
31	7	30	5	54
32	2.5	30	5	54
33	2.5	30	5	54
34	10	30	5	54
35	11	30	5	54
36	12	30	5	54
37	16	30	5	54
38	10	30	5	54

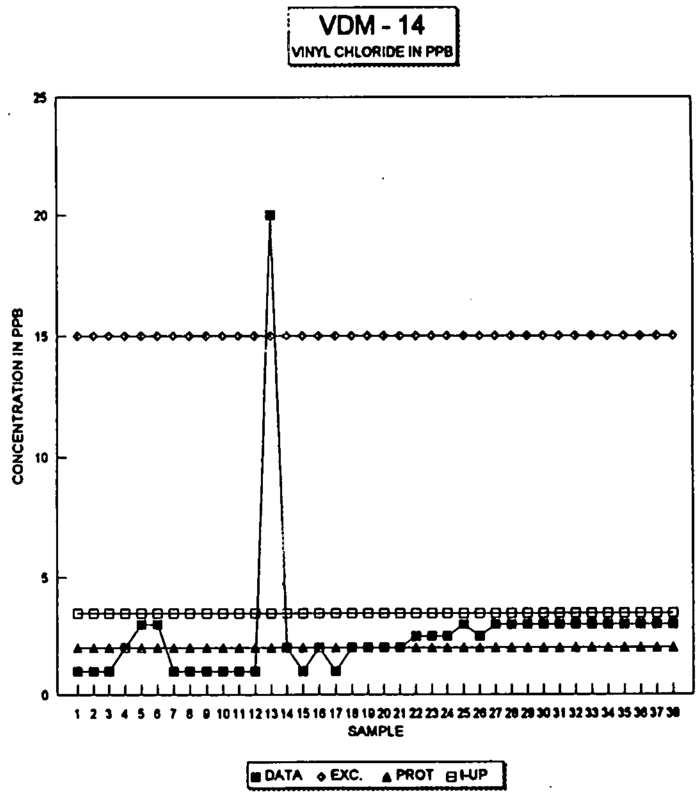
STATISTICS		STUDENT t TESTING	
TOTAL STD	101.2274	UPPER LIMIT	53.85113
TOTAL Sx	16.64168		
TOTAL MEAN	25.27737		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	97.35714	UPPER LIMIT	272.853
BEFORE STD	221.2431		
BEFORE Sx	90.32213		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	8.75125	UPPER LIMIT	11.33588
AFTER STD	8.34237		
AFTER Sx	1.498334		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : VINYL CHLORIDE

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	15	2	3
2	1	15	2	3
3	1	15	2	3
4	2	15	2	3
5	3	15	2	3
6	3	15	2	3
7	1	15	2	3
8	1	15	2	3
9	1	15	2	3
10	1	15	2	3
11	1	15	2	3
12	1	15	2	3
13	20	15	2	3
14	2	15	2	3
15	1	15	2	3
16	2	15	2	3
17	1	15	2	3
18	2	15	2	3
19	2	15	2	3
20	2	15	2	3
21	2	15	2	3
22	2.5	15	2	3
23	2.5	15	2	3
24	2.5	15	2	3
25	3	15	2	3
26	2.5	15	2	3
27	3	15	2	3
28	3	15	2	3
29	3	15	2	3
30	3	15	2	3
31	3	15	2	3
32	3	15	2	3
33	3	15	2	3
34	3	15	2	3
35	3	15	2	3
36	3	15	2	3
37	3	15	2	3
38	3	15	2	3

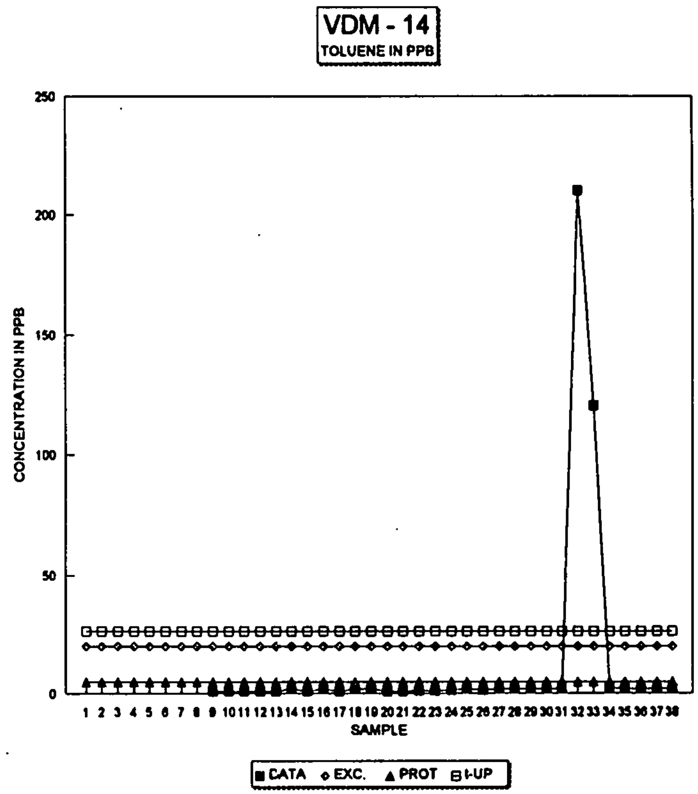
STATISTICS		STUDENT t TESTING	
TOTAL STD	2.972869	UPPER LIMIT	3.47074
TOTAL Sx	0.488737		
TOTAL MEAN	2.631579		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	1.714286	UPPER LIMIT	2.412825
BEFORE STD	0.880631		
BEFORE Sx	0.359516		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	2.78125	UPPER LIMIT	3.770837
AFTER STD	3.19408		
AFTER Sx	0.573674		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : TOLUENE

	SAMPLE	EXC CON	PRO STD	UP LIM
1		20	5	26
2		20	5	26
3		20	5	26
4		20	5	26
5		20	5	26
6		20	5	26
7		20	5	26
8		20	5	26
9	1	20	5	26
10	1	20	5	26
11	1	20	5	26
12	1	20	5	26
13	1	20	5	26
14	2	20	5	26
15	1	20	5	26
16	2	20	5	26
17	1	20	5	26
18	2	20	5	26
19	2	20	5	26
20	1	20	5	26
21	1	20	5	26
22	1.25	20	5	26
23	1.25	20	5	26
24	1.5	20	5	26
25	2	20	5	26
26	1.5	20	5	26
27	2	20	5	26
28	2	20	5	26
29	2	20	5	26
30	2	20	5	26
31	2	20	5	26
32	210	20	5	26
33	120	20	5	26
34	2.5	20	5	26
35	2	20	5	26
36	2	20	5	26
37	2	20	5	26
38	2	20	5	26

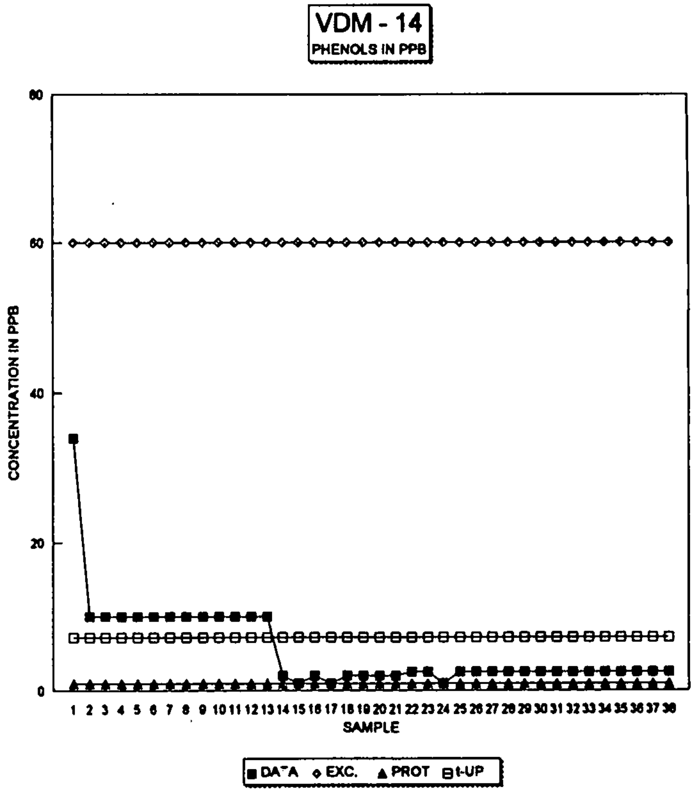
STATISTICS		STUDENT t TESTING	
TOTAL STD	42.38371	UPPER LIMIT	26.35988
TOTAL Sx	7.870458		
TOTAL MEAN	12.5		
TOTAL N	30		
TOTAL df	29		
BEFORE MEAN	ERR	UPPER LIMIT	ERR
BEFORE STD	ERR		
BEFORE Sx	ERR		
BEFORE N	0		
BEFORE df	-1		
AFTER MEAN	12.5	UPPER LIMIT	26.14737
AFTER STD	42.38371		
AFTER Sx	7.870458		
AFTER N	30		
AFTER df	29		



WELL VDM - 14 : PHENOLS

	SAMPLE	EXC CON	PRO STD	UP LIM
1	34	60	1	7
2	10	60	1	7
3	10	60	1	7
4	10	60	1	7
5	10	60	1	7
6	10	60	1	7
7	10	60	1	7
8	10	60	1	7
9	10	60	1	7
10	10	60	1	7
11	10	60	1	7
12	10	60	1	7
13	10	60	1	7
14	2	60	1	7
15	1	60	1	7
16	2	60	1	7
17	1	60	1	7
18	2	60	1	7
19	2	60	1	7
20	2	60	1	7
21	2	60	1	7
22	2.5	60	1	7
23	2.5	60	1	7
24	1	60	1	7
25	2.5	60	1	7
26	2.5	60	1	7
27	2.5	60	1	7
28	2.5	60	1	7
29	2.5	60	1	7
30	2.5	60	1	7
31	2.5	60	1	7
32	2.5	60	1	7
33	2.5	60	1	7
34	2.5	60	1	7
35	2.5	60	1	7
36	2.5	60	1	7
37	2.5	60	1	7
38	2.5	60	1	7

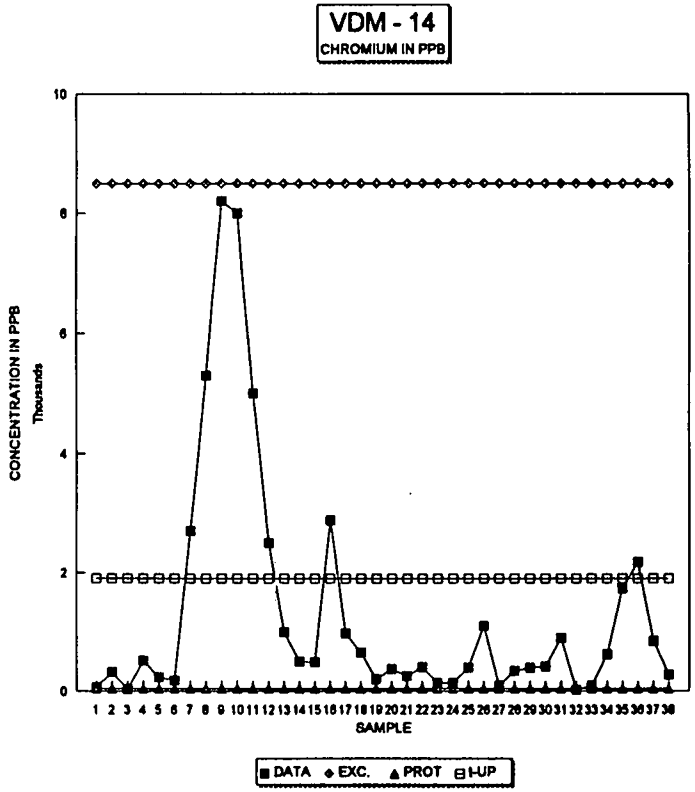
STATISTICS		STUDENT t TESTING	
TOTAL STD	5.923859	UPPER LIMIT	7.172146
TOTAL Sx	0.973876		
TOTAL MEAN	5.5		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	13.42857	UPPER LIMIT	20.09029
BEFORE STD	8.398251		
BEFORE Sx	3.428571		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	3.90625	UPPER LIMIT	4.914232
AFTER STD	3.253454		
AFTER Sx	0.584338		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : CHROMIUM

	SAMPLE	EXC CON	PRO STD	UP LIM
1	64	8500	50	1899
2	330	8500	50	1899
3	34	8500	50	1899
4	520	8500	50	1899
5	240	8500	50	1899
6	190	8500	50	1899
7	2700	8500	50	1899
8	5300	8500	50	1899
9	8200	8500	50	1899
10	8000	8500	50	1899
11	5000	8500	50	1899
12	2500	8500	50	1899
13	1000	8500	50	1899
14	510	8500	50	1899
15	488	8500	50	1899
16	2880	8500	50	1899
17	970	8500	50	1899
18	650	8500	50	1899
19	208	8500	50	1899
20	380	8500	50	1899
21	260	8500	50	1899
22	406	8500	50	1899
23	139	8500	50	1899
24	140	8500	50	1899
25	395	8500	50	1899
26	1100	8500	50	1899
27	100	8500	50	1899
28	350	8500	50	1899
29	400	8500	50	1899
30	420	8500	50	1899
31	900	8500	50	1899
32	25	8500	50	1899
33	100	8500	50	1899
34	619	8500	50	1899
35	1730	8500	50	1899
36	2180	8500	50	1899
37	847	8500	50	1899
38	276	8500	50	1899

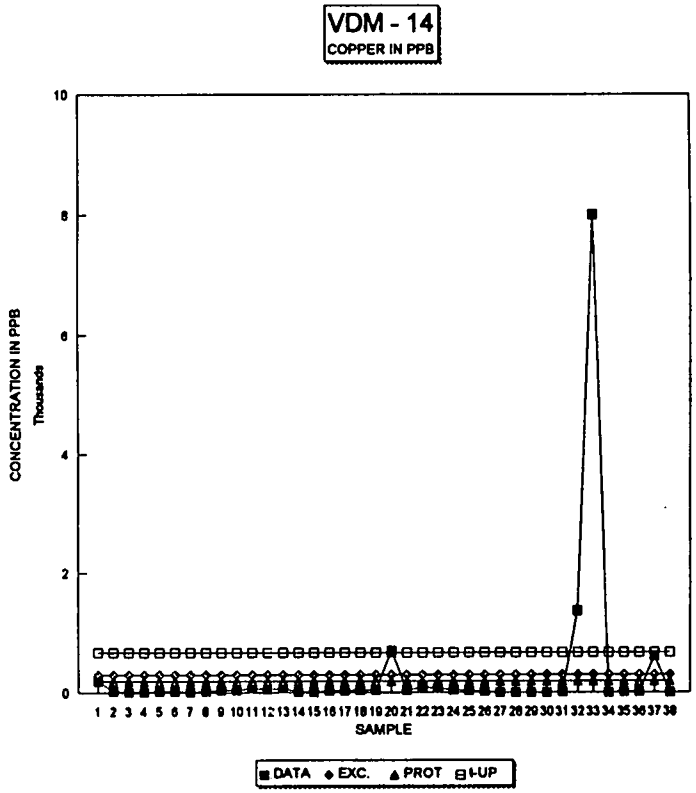
STATISTICS		STUDENT t TESTING	
TOTAL STD	2015.032	UPPER LIMIT	1899.079
TOTAL Sx	331.2692		
TOTAL MEAN	1330.289		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	582.5714	UPPER LIMIT	1278.788
BEFORE STD	877.702		
BEFORE Sx	358.3203		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	1536.656	UPPER LIMIT	2197.298
AFTER STD	2132.345		
AFTER Sx	382.9805		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : COPPER

	SAMPLE	EXC CON	PRO STD	UP LIM
1	200	300	200	680
2	21	300	200	680
3	14	300	200	680
4	15	300	200	680
5	28	300	200	680
6	22	300	200	680
7	18	300	200	680
8	26	300	200	680
9	50	300	200	680
10	50	300	200	680
11	80	300	200	680
12	60	300	200	680
13	80	300	200	680
14	19	300	200	680
15	16	300	200	680
16	40	300	200	680
17	39	300	200	680
18	50	300	200	680
19	50	300	200	680
20	710	300	200	680
21	50	300	200	680
22	93.3	300	200	680
23	79.7	300	200	680
24	50	300	200	680
25	40	300	200	680
26	30	300	200	680
27	5	300	200	680
28	10	300	200	680
29	10	300	200	680
30	10	300	200	680
31	18	300	200	680
32	1370	300	200	680
33	8000	300	200	680
34	10	300	200	680
35	15	300	200	680
36	18	300	200	680
37	610	300	200	680
38	10	300	200	680

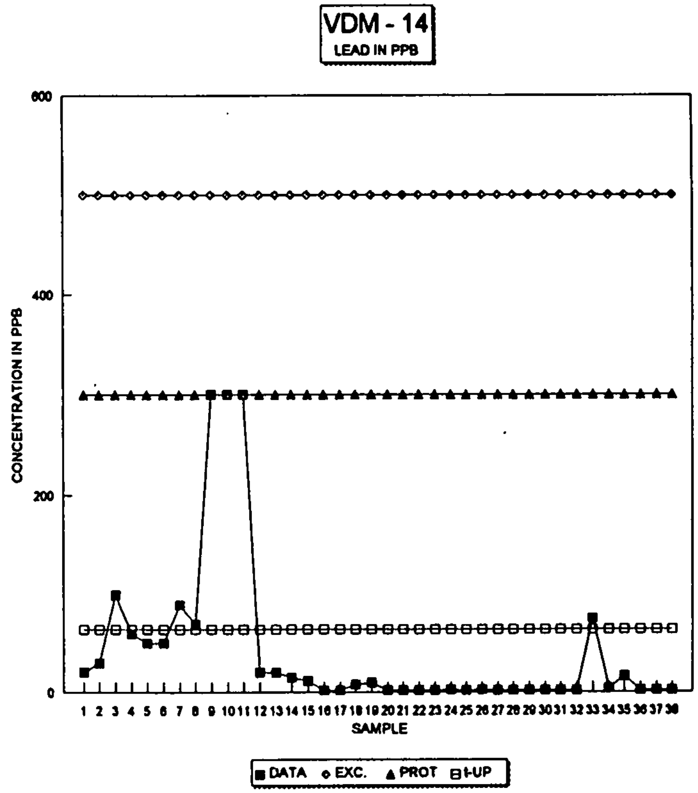
STATISTICS		STUDENT t TESTING	
TOTAL STD	1288.105	UPPER LIMIT	679.8341
TOTAL Sx	211.7631		
TOTAL MEAN	316.2368		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	45.42857	UPPER LIMIT	95.60353
BEFORE STD	63.25427		
BEFORE Sx	25.82345		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	366.1563	UPPER LIMIT	799.2038
AFTER STD	1397.743		
AFTER Sx	251.0421		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : LEAD

	SAMPLE	EXC CON	PRO STD	UP LIM
1	21	500	300	64
2	30	500	300	64
3	100	500	300	64
4	60	500	300	64
5	50	500	300	64
6	50	500	300	64
7	90	500	300	64
8	70	500	300	64
9	300	500	300	64
10	300	500	300	64
11	300	500	300	64
12	20	500	300	64
13	20	500	300	64
14	15	500	300	64
15	12	500	300	64
16	2	500	300	64
17	2	500	300	64
18	8	500	300	64
19	10	500	300	64
20	2	500	300	64
21	2	500	300	64
22	2	500	300	64
23	2	500	300	64
24	3	500	300	64
25	2	500	300	64
26	3	500	300	64
27	2	500	300	64
28	2	500	300	64
29	2	500	300	64
30	2	500	300	64
31	2	500	300	64
32	2	500	300	64
33	76	500	300	64
34	4	500	300	64
35	16	500	300	64
36	2	500	300	64
37	2	500	300	64
38	2	500	300	64

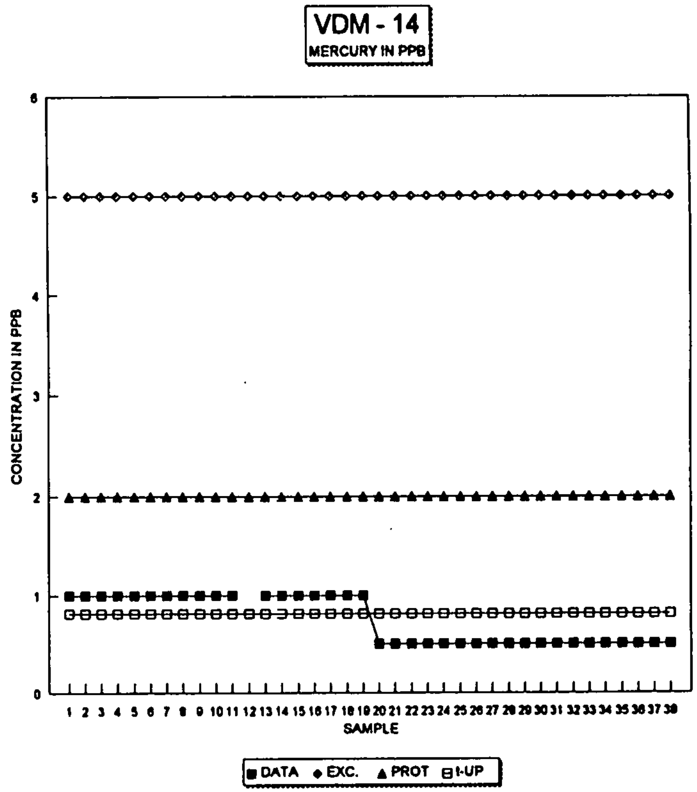
STATISTICS		STUDENT t TESTING	
TOTAL STD	80.11095	UPPER LIMIT	64.45527
TOTAL Sx	13.17016		
TOTAL MEAN	41.84211		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	57.28571	UPPER LIMIT	78.63226
BEFORE STD	26.91104		
BEFORE Sx	10.98639		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	39.96875	UPPER LIMIT	66.76312
AFTER STD	86.48392		
AFTER Sx	15.53297		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : MERCURY

	SAMPLE	EXC CON	PRO STD	UP LIM
1	1	5	2	1
2	1	5	2	1
3	1	5	2	1
4	1	5	2	1
5	1	5	2	1
6	1	5	2	1
7	1	5	2	1
8	1	5	2	1
9	1	5	2	1
10	1	5	2	1
11	1	5	2	1
12		5	2	1
13	1	5	2	1
14	1	5	2	1
15	1	5	2	1
16	1	5	2	1
17	1	5	2	1
18	1	5	2	1
19	1	5	2	1
20	0.5	5	2	1
21	0.5	5	2	1
22	0.5	5	2	1
23	0.5	5	2	1
24	0.5	5	2	1
25	0.5	5	2	1
26	0.5	5	2	1
27	0.5	5	2	1
28	0.5	5	2	1
29	0.5	5	2	1
30	0.5	5	2	1
31	0.5	5	2	1
32	0.5	5	2	1
33	0.5	5	2	1
34	0.5	5	2	1
35	0.5	5	2	1
36	0.5	5	2	1
37	0.5	5	2	1
38	0.5	5	2	1

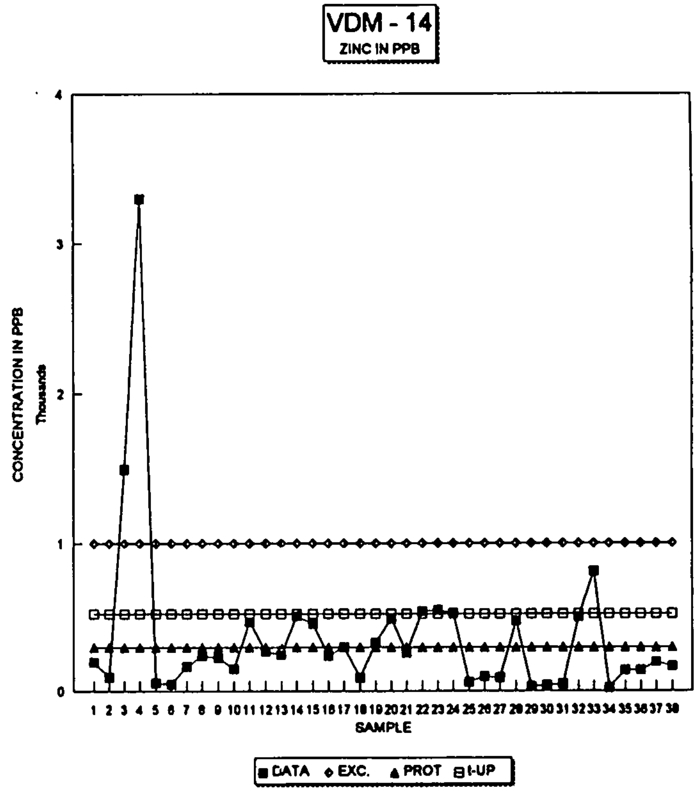
STATISTICS		STUDENT t TESTING	
TOTAL STD	0.249909	UPPER LIMIT	0.814759
TOTAL Sx	0.041651		
TOTAL MEAN	0.743243		
TOTAL N	37		
TOTAL df	36		
BEFORE MEAN	1	UPPER LIMIT	1
BEFORE STD	0		
BEFORE Sx	0		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	0.693548	UPPER LIMIT	0.77065
AFTER STD	0.243543		
AFTER Sx	0.044465		
AFTER N	31		
AFTER df	30		



WELL VDM - 14 : ZINC

	SAMPLE	EXC CON	PRO STD	UP LIM
1	200	1000	300	528
2	95	1000	300	528
3	1500	1000	300	528
4	3300	1000	300	528
5	57	1000	300	528
6	47	1000	300	528
7	170	1000	300	528
8	240	1000	300	528
9	230	1000	300	528
10	150	1000	300	528
11	470	1000	300	528
12	270	1000	300	528
13	250	1000	300	528
14	510	1000	300	528
15	460	1000	300	528
16	240	1000	300	528
17	300	1000	300	528
18	90	1000	300	528
19	330	1000	300	528
20	490	1000	300	528
21	260	1000	300	528
22	545	1000	300	528
23	550	1000	300	528
24	530	1000	300	528
25	60	1000	300	528
26	100	1000	300	528
27	91	1000	300	528
28	480	1000	300	528
29	31	1000	300	528
30	40	1000	300	528
31	47	1000	300	528
32	506	1000	300	528
33	810	1000	300	528
34	24	1000	300	528
35	141	1000	300	528
36	142	1000	300	528
37	200	1000	300	528
38	170	1000	300	528

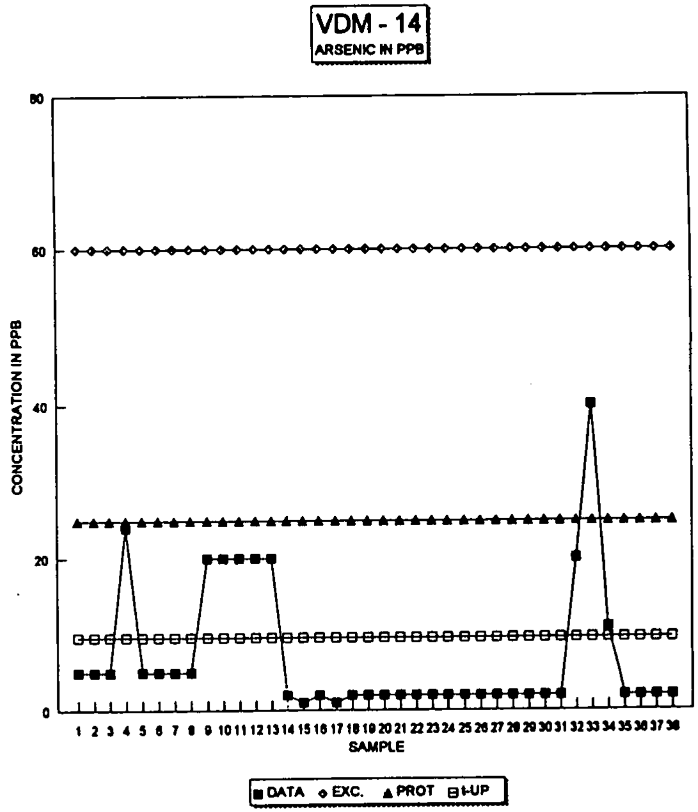
STATISTICS		STUDENT t TESTING	
TOTAL STD	554.044	UPPER LIMIT	528.1285
TOTAL Sx	91.08428		
TOTAL MEAN	371.7368		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	767	UPPER LIMIT	1671.684
BEFORE STD	1140.511		
BEFORE Sx	465.6117		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	278.9688	UPPER LIMIT	339.7345
AFTER STD	196.1328		
AFTER Sx	35.2265		
AFTER N	32		
AFTER df	31		



WELL VDM - 14 : ARSENIC

	SAMPLE	EXC CON	PRO STD	UP LIM
1	5	60	25	10
2	5	60	25	10
3	5	60	25	10
4	24	60	25	10
5	5	60	25	10
6	5	60	25	10
7	5	60	25	10
8	5	60	25	10
9	20	60	25	10
10	20	60	25	10
11	20	60	25	10
12	20	60	25	10
13	20	60	25	10
14	2	60	25	10
15	1	60	25	10
16	2	60	25	10
17	1	60	25	10
18	2	60	25	10
19	2	60	25	10
20	2	60	25	10
21	2	60	25	10
22	2	60	25	10
23	2	60	25	10
24	2	60	25	10
25	2	60	25	10
26	2	60	25	10
27	2	60	25	10
28	2	60	25	10
29	2	60	25	10
30	2	60	25	10
31	2	60	25	10
32	20	60	25	10
33	40	60	25	10
34	11	60	25	10
35	2	60	25	10
36	2	60	25	10
37	2	60	25	10
38	2	60	25	10

STATISTICS		STUDENT t TESTING	
TOTAL STD	8.895671	UPPER LIMIT	9.668903
TOTAL Sx	1.462439		
TOTAL MEAN	7.157895		
TOTAL N	38		
TOTAL df	37		
BEFORE MEAN	7.714286	UPPER LIMIT	12.98814
BEFORE STD	6.648615		
BEFORE Sx	2.714286		
BEFORE N	7		
BEFORE df	6		
AFTER MEAN	6.96875	UPPER LIMIT	9.814077
AFTER STD	9.183832		
AFTER Sx	1.649465		
AFTER N	32		
AFTER df	31		



The Following Image(s) are the Best Copy Available

BIEL'S

UNITS = ppm

VANDERMARK LANDFILL: QUARTERLY MONITORING PROGRAM RESULTS

WELL 0-55

CONSTITUENT:	1/6/84	3/21/84	1/28/87	6/3/87	9/2/87	11/5/87	03/31/88	06/29/88	08/31/88	11/16/88	02/15/89	STANDARD DEVIATION	STUDENT T (95%)
WELL ELEVATION			434.05	432.77	432.96	433.19	433.71	432.61	432.8	433.58	433.05		
CHLORIDE	49	636	10.3	15	35	20	13	25	25	27	24	176.1586	-0.1002
pH	7.545	6.571	6.4	6.81	6.92	6.55	6.59	7.36	7.53	7.22	7.63	0.3781	0.4496
TOTAL PHENOLS		0.005	0.028	0.02	0.01	0.002	0.01	0.01	0.01	0.01	0.015	0.0071	0.1417
BROMODICHLOROMETHANE			0.005	0.001	0.005	0.005	0.0002	0.0002	0.0002	0.001	0.0002	0.0022	-0.2911
BROMOFORM			0.005	0.005	0.005	0.005	0.001	0.0002	0.001	0.003	0.0004	0.0021	-0.4185
BROMOMETHANE			0.005	0.001	0.005	0.005	0.0008	0.0008	0.0004	0.005	0.0002	0.0022	-0.3861
CARBON TETRACHLORIDE		0.00022	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0018	-0.2197
CHLOROETHANE			0.005	0.001	0.005	0.001	0.0004	0.0002	0.0002	0.002	0.001	0.0018	-0.1475
2-CHLOROETHYLVINYL ETHER			0.005	0.001	0.005	0.01	0.001	0.0002	0.001	0.003	0.0004	0.0018	-0.3075
CHLOROFORM		0.00013	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0018	-0.2164
CHLOROMETHANE		0.00026	0.005	0.001	0.005	0.005	0.0004	0.0004	0.0004	0.003	0.001	0.0020	-0.1898
DIBROMOCHLOROMETHANE			0.005	0.001	0.005	0.005	0.0002	0.0002	0.0002	0.001	0.0002	0.0022	-0.2911
1,1-DICHLOROETHANE			0.005	0.001	0.005	0.001	0.00039	0.0002	0.0002	0.001	0.0013	0.0018	-0.0732
1,2 DICHLOROETHANE			0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0019	-0.2500
1,1-DICHLOROETHENE			0.005	0.001	0.005	0.001	0.0004	0.0002	0.0002	0.002	0.0002	0.0019	-0.2781
TRANS-1,2-DICHLOROETHENE			0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0019	-0.2500
1,2 DICHLOROPROPANE			0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.003	0.0002	0.0019	-0.2854
CIS 1,3 DICHLOROPROPENE			0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0019	-0.2500
TRANS-1,3-DICHLOROPROPENE			0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0019	-0.2500
METHYLENE CHLORIDE		0.00376	0.005	0.001	0.005	0.001	0.0002	0.0032	0.0002	0.002	0.00035	0.0018	-0.3317
1,1,2,2-TETRACHLOROETHANE			0.005	0.001	0.005	0.001	0.00053	0.0002	0.0002	0.001	0.0002	0.0019	-0.3601
TETRACHLOROETHENE		0.00014	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0018	-0.2167
1,1,1-TRICHLOROETHANE			0.005	0.001	0.005	0.001	0.00033	0.0002	0.0002	0.001	0.0002	0.0019	-0.2510
1,1,2-TRICHLOROETHANE			0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0019	-0.2500
TRICHLOROETHENE			0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0019	-0.2500
VINYL CHLORIDE			0.005	0.001	0.005	0.001	0.0004	0.0004	0.0004	0.003	0.0002	0.0019	-0.3057
TRICHLOROFLUOROMETHANE			0.005	0.001	0.005	0.001						0.0020	-0.5774
DICHLORODIFLUOROMETHANE			0.005	0.001	0.005	0.001						0.0020	-0.5774
ARSENIC			0.005	0.005	0.005	0.005	0.005	0.026	0.005	0.005	0.005	0.0066	-0.1250
CHROMIUM		0.16	0.029	0.028	0.005	0.039	0.005	0.054	0.038	0.018	0.01	0.0449	-0.1670
COPPER		0.08	0.2	0.2	0.2	0.2	0.009	0.4	0.014	0.039	0.013	0.1203	-0.3394
IRON	0.2	0.0001	5.2	0.4	0.23	0.21	0.34	39	1.4	0.8	0.55	11.0400	-0.1326
LEAD		0.003	0.015	0.003	0.005	0.005	0.03	0.05	0.06	0.05	0.07	0.0234	0.5162
MERCURY			0.001	0.001	0.001	0.001	0.0002	0.0005	0.0002	0.0004	0.0004	0.0003	-0.5427
ZINC		0.00025	0.05	0.07	0.05	0.25	0.041	0.28	0.047	0.036	0.21	0.0833	0.4568

APPENDIX B

EIGHTEEN MILE CREEK ANALYTICAL DATA

UNITS = ppm

VANDEMARK LANDFILL: QUARTERLY MONITORING PROGRAM RESULTS

18 MILE CREEK UPSTREAM

CONSTITUENT:	5/12/86	1/22/87	6/3/87	9/2/87	11/5/87	03/31/88	06/28/88	08/31/88	11/16/88	02/15/89	STANDARD DEVIATION	STUDENT T (95%)
CHLORIDE	34.4	35.8	45	44	28	51	27	36	37	86	16.1445	0.9992
pH	7.89	7.67	7.63	7.41	8.25	8.31	8.25	8.14	8.3	9.35	0.5114	0.8017
TOTAL PHENOLS	0.01	0.22	0.01	0.01	0.003	0.01	0.01	0.01	0.01	0.01	0.0633	-0.1070
BROMODICHLOROMETHANE	0.01	0.005	0.001	0.005	0.005	0.0002	0.0002	0.0002	0.001	0.0002	0.0032	-0.2721
BROMOFORM	0.01	0.005	0.005	0.005	0.005	0.001	0.0002	0.001	0.003	0.0004	0.0029	-0.3524
BROMOMETHANE	0.005	0.005	0.001	0.005	0.005	0.0008	0.0009	0.0004	0.005	0.0002	0.0022	-0.3998
CARBON TETRACHLORIDE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
CHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0004	0.0002	0.0002	0.002	0.001	0.0020	-0.1833
2-CHLOROETHYLVINYL ETHER	0.005	0.005	0.001	0.005	0.01	0.001	0.0002	0.001	0.003	0.0004	0.0030	-0.3113
CHLOROFORM	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
CHLOROMETHANE	0.005	0.005	0.001	0.005	0.005	0.0004	0.0004	0.0004	0.003	0.001	0.0021	-0.2609
DIBROMOCHLOROMETHANE	0.01	0.005	0.001	0.005	0.005	0.0002	0.0002	0.0002	0.001	0.0002	0.0032	-0.2721
1,1-DICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,2-DICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,1-DICHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.0004	0.0002	0.0002	0.002	0.0002	0.0020	-0.2953
TRANS-1,2-DICHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.00047	0.0002	0.0002	0.0021	0.0002	0.0020	-0.2989
1,2-DICHLOROPROPANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.003	0.0002	0.0021	-0.3025
CIS-1,3-DICHLOROPROPENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
TRANS-1,3-DICHLOROPROPENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
METHYLENE CHLORIDE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0016	0.0002	0.002	0.00079	0.0019	-0.2414
1,1,2,2-TETRACHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
TETRACHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,1,1-TRICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,1,2-TRICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
TRICHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
VINYL CHLORIDE	0.005	0.005	0.001	0.005	0.001	0.0004	0.0004	0.0004	0.003	0.0002	0.0020	-0.3204
TRICHLOROFLUOROMETHANE	0.005	0.005	0.001	0.005	0.001						0.0020	-0.8675
DICHLORODIFLUOROMETHANE	0.005	0.005	0.001	0.005	0.001						0.0020	-0.8675
ARSENIC	0.005	0.005	0.005	0.005	0.005	0.01	0.005	0.005	0.005	0.005	0.0015	-0.1111
CHROMIUM	0.5	0.196	0.005	0.005	0.021	0.005	0.006	0.008	0.024	0.011	0.1506	-0.1457
COPPER	0.2	0.2	0.2	0.2	0.2	0.008	0.015	0.011	0.026	0.01	0.0931	-0.3473
IRON	0.8	1.08	0.45	0.37	0.025	0.99	0.74	0.98	0.36	0.25	0.3477	-0.3465
LEAD	1	0.013	0.011	0.019	0.005	0.03	0.05	0.06	0.05	0.07	0.2905	-0.0698
MERCURY	0.001	0.02	0.001	0.001	0.001	0.0002	0.0005	0.0008	0.0004	0.0004	0.0058	-0.1243
ZINC	0.52	0.15	0.05	0.05	0.05	0.014	0.037	0.014	0.026	0.026	0.1460	-0.1477

UNITS = ppm

VANDEMARK LANDFILL: QUARTERLY MONITORING PROGRAM RESULTS

13 MILE CREEK DOWNSTREAM

CONSTITUENT:	5/12/86	1/22/87	6/3/87	9/2/87	11/5/87	03/31/88	06/28/88	08/31/88	11/16/88	02/15/89	STANDARD DEVIATION	STUDENT T (95%)
CHLORIDE	40.1	36	50	45	27	54	47	35	37	86	15.4239	0.8707
pH	8.13	7.13	7.67	7.05	8.23	8.3	8.32	8.32	8.52	8.5	0.5148	0.3127
TOTAL PHENOLS	0.01	0.022	0.01	0.01	0.002	0.01	0.01	0.01	0.01	0.01	0.0045	-0.0293
BROMODICHLOROMETHANE	0.01	0.005	0.001	0.005	0.005	0.0002	0.0002	0.0002	0.001	0.0002	0.0032	-0.2721
BROMOFORM	0.01	0.005	0.005	0.005	0.005	0.001	0.0002	0.001	0.003	0.0004	0.0029	-0.3624
BROMOMETHANE	0.005	0.005	0.001	0.005	0.005	0.0008	0.0008	0.0004	0.005	0.0002	0.0022	-0.3983
CARBON TETRACHLORIDE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
CHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0004	0.0002	0.0002	0.002	0.001	0.0020	-0.1833
2-CHLOROETHYLVINYL ETHER	0.005	0.005	0.001	0.005	0.01	0.001	0.0002	0.001	0.002	0.0004	0.0030	-0.2979
CHLOROFORM	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.003	0.0002	0.0021	-0.3025
CHLOROMETHANE	0.005	0.005	0.001	0.005	0.005	0.0004	0.0004	0.0004	0.001	0.001	0.0021	-0.2233
DIBROMOCHLOROMETHANE	0.01	0.005	0.001	0.005	0.005	0.0002	0.0002	0.0002	0.003	0.0002	0.0031	-0.2955
1,1-DICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,2-DICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,1-DICHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.0004	0.0002	0.0002	0.002	0.0002	0.0020	-0.2953
TRANS-1,2-DICHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.00066	0.0002	0.0002	0.001	0.0002	0.0020	-0.2826
1,2-DICHLOROPROPANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.003	0.0002	0.0021	-0.3025
CIS-1,3-DICHLOROPROPENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
TRANS-1,3-DICHLOROPROPENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
METHYLENE CHLORIDE	0.005	0.005	0.001	0.005	0.001	0.0002	0.00078	0.0002	0.002	0.00024	0.0020	-0.3002
1,1,2,2-TETRACHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.00026	0.0002	0.0002	0.001	0.0002	0.0021	-0.2723
TETRACHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,1,1-TRICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
1,1,2-TRICHLOROETHANE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
TRICHLOROETHENE	0.005	0.005	0.001	0.005	0.001	0.0002	0.0002	0.0002	0.001	0.0002	0.0021	-0.2706
VINYL CHLORIDE	0.005	0.005	0.001	0.005	0.001	0.0004	0.0004	0.0004	0.003	0.0002	0.0020	-0.3204
TRICHLOROFLUOROMETHANE	0.005	0.005	0.001	0.005	0.001						0.0020	-0.8675
DICHLORODIFLUOROMETHANE	0.005	0.005	0.001	0.005	0.001						0.0020	-0.8675
ARSENIC	0.005	0.005	0.005	0.005	0.005	0.009	0.005	0.005	0.005	0.005	0.0012	-0.1111
CHROMIUM	0.5	[illegible]	0.005	0.005	0.005	0.005	0.007	0.008	0.018	0.011	0.1468	-0.1135
COPPER	0.2	0.2	0.2	0.2	0.2	0.009	0.012	0.01	0.018	0.01	0.0941	-0.3592
IRON	0.74	0.74	0.46	0.36	0.3	0.86	1.1	0.94	0.34	0.25	0.2662	-0.4204
LEAD	1	0.011	0.011	0.017	0.005	0.03	0.05	0.06	0.05	0.07	0.2907	-0.0693
MERCURY	0.003	0.004	0.002	0.001	0.001	0.0002	0.0005	0.0002	0.0004	0.0004	0.0012	-0.2329
ZINC	0.22	0.05	0.05	0.05	0.05	0.016	0.036	0.016	0.026	0.027	0.0569	-0.1589

APPENDIX C

GROUNDWATER FLUX CALCULATIONS

APPENDIX C

GROUNDWATER FLUX CALCULATIONS

Based on the groundwater elevation data for wells screened in the Power Glen Formation (i.e. VDM-1, -9, -11 and D-55) a groundwater contour map was prepared (Figure 3-3). This map is based on the average groundwater elevations over the period of November 1988 to the present (March 95). As indicated previously, these groundwater levels have remained relatively constant throughout this period, and were not significantly impacted by installation of the cap.

In order to estimate the relative contribution provided by flow of groundwater through the bedrock to the overall flow, the groundwater flux across the site in the Power Glen Formation was calculated using the Darcy equation.

$$Q = KiA$$

Where

K	= Horizontal hydraulic conductivity
i	= Hydraulic gradient
A	= Length of site boundary X saturated thickness

Based on pressure test results in the Power Glen the average hydraulic conductivities away from the cliff are on the order of $1x10^{-5}$ cm/sec. Nearer the cliff face (downgradient boundary) the effective hydraulic conductivity value may be as high as $1x10^{-3}$ cm/sec.

The horizontal hydraulic gradients were determined from the groundwater contour map (Figure 3-3) which was prepared based on the average groundwater elevations. Gradients calculated for the upgradient or northern half of the site ranged from 0.003 to 0.031 feet/feet. Consequently, a value of 0.02 was selected for the upgradient site boundary. In the downgradient or southern half of the site, gradients ranged from 0.031 to 0.037. However, based on the nature of the site it was assumed that gradients in most areas of the site would be relatively flat, except near the cliff face where they would be expected to steepen sharply due to the more open nature of the rock in this zone. Consequently, an average hydraulic gradient of 0.02 was also utilized for the downgradient boundary of the site.

The saturated thickness was calculated as the difference between the water table elevation and the elevation of the base of the Power Glen (top of Whirlpool Formation). This equates to a saturated thickness of 16 feet at VDM-1, and 10 feet at VDM-9.

The length of the upgradient site boundary was estimated at 560 feet. Additionally, the length of the downgradient site boundary (VDM-11 to VDM-14) is on the order of 600 feet.

Groundwater flux across the upgradient site boundary was calculated to be on the order of 0.026 gpm (14,500 gal/yr). Likewise, the groundwater flux across the downgradient site boundary was estimated to be on the order of 0.18 gpm (92,00 gal/yr). This indicates that approximately 0.15 gpm (79,000 gal/yr) must be infiltrating through the landfill cap.

URS CONSULTANTS, INC.

PAGE 1 OF
SHEET NO. OF
JOB NO.
MADE BY RRH DATE 3/24/95
CHKD. BY DATE

PROJECT VDM - CORRECTIVE MEASURES STUDY
SUBJECT GROUNDWATER FLUX CALCULATIONS

REF. PAGE

USE DARCY EQUATION:

$Q = KiA$

WHERE:

K = HORIZONTAL HYDRAULIC CONDUCTIVITY (ft/min)
i = HYDRAULIC GRADIENT (ft/ft)
A = AREA (sf)

UPGRADIENT BOUNDARY

A = PERIMETER LENGTH x SATURATED THICKNESS

- LENGTH FROM VDM-1 TO VDM-14 ≈ 560 ft
- SAT'D THICKNESS
  - VDM-1 W.L @ EL 432 - EL 416 (BASE OF POWER GLEN) = 16'
  - VDM-2 W.L @ EL 431 - EL 415 (" " " ") = 16'

∴ A = 560 ft x 16 ft
= 8960 sf

i = HYDRAULIC GRADIENT

VDM-1 TO VDM-2	432 - 430.7 / 180'	= 0.006 ft/ft
VDM-1 TO VDM-11	432 - 431.5 / 180'	= 0.003 ft/ft
D-55 TO VDM-14	433.7 - 427.5 / 200	= 0.031 ft/ft

USE 0.02

$K = 1 \times 10^{-5}$ cm/sec
$= 1.97 \times 10^{-4}$ ft/min

$Q = (1.97 \times 10^{-4}) \times 0.02 \times 8960$
$= 3.5 \times 10^{-3}$ cf/min
= 0.026 gpm (14,459 gal/yr)

DOWNGRADIENT BOUNDARY

A = PERIMETER LENGTH x SATURATED THICKNESS

- LENGTH FROM VDM-11 TO VDM-14 ≈ 600 ft
- SAT'D THICKNESS
  VDM-9 WL @ EL. 422 - EL 412 (BASE OF PGL) = 10'

∴ A = 600 ft x 10 ft
= 6000 sf

i = HYDRAULIC GRADIENT

VDM-2 TO VDM-9	430.7 - 421.9/270'	= 0.033
VDM-11 TO VDM-9	431.5 - 421.9/300'	= 0.032
D-55 TO VDM-9	433.7 - 421.9/320'	= 0.037
	AVG	0.035 *

* CONSIDERING THE NATURE OF THE BEDROCK IT IS LIKELY THAT THE GRADIENT AWAY FROM THE VALLEY WALL IS LESS STEEP, CONSEQUENTLY, A VALUE OF 0.02 IS PROBABLY MORE TYPICAL

K = 1×10^{-4} cm/sec
= 1.97×10^{-4} ft/min

Q = $(1.97 \times 10^{-4}) \times 0.02 \times 6000$
= 0.023 cf/min
= 0.175 gpm (92,000 gal/yr)

APPENDIX D

GEOTECHNICAL LABORATORY TEST RESULTS

Glynn Geotechnical Engineering
GEOTECHNICAL AND CIVIL ENGINEERING SERVICES

LABORATORY SUMMARY SHEET

PROJECT: VAN-DE-MARK
LOCATION: N. TRANSIT ROAD
CLIENT: URS CONSULTANTS
REQUIREMENT: NA

DATE REPORTED: JANUARY 18, 1995
PROJECT NO.: 94 - 1120
GGE FOR NO.: 95 - 01
QUANTITY: NA

SAMPLE ID	GGE SAMPLE NO.	N.M.C.	UNIT WEIGHT (pcf)	GSA	PROCTOR pcf / %	MAX. / MIN. pcf	PERMEABILITY cm/sec
ST - 1	95 - 01	18.8	114.4				4.6 E- 08
ST - 2	95 - 02	19.2	108.3				1.1 E- 08
ST - 3	95 - 03	20.2	111.5				5.4 E- 08
ST - 4	95 - 04	21.9	111.5				2.4 E- 08

NOTES:

SUBMITTED BY: Sonda DelPalazzo
SONDA DELPALAZZO

REVIEWED BY: ARH /
A.R.H. / MARK W. GLYNN, P.E.

DOCFILE:LABSUMM

Glynn Geotechnical Engineering
GEOTECHNICAL AND CIVIL ENGINEERING SERVICES

TRIAXIAL PERMEABILITY
ASTM D - 5084

PROJECT: VAN DE MARK
DATE REPORTED: JANUARY 18, 1995 (Rev. 2/3/95)
LOCATION: N. TRANSIT ROAD
PROJECT NO.: 94 - 1120
CLIENT: URS CONSULTANTS
SAMPLE NO.: 95 - 01
DATE SAMPLED: JANUARY 10, 1995
DEPTH: 2' - 4'
SAMPLE DESCRIPTION: SHELBY TUBE ST - 1, 3' - 3½' TESTED
SAMPLE CLASSIFICATION: ** medium brown, silty CLAY (visual)

INITIAL DATA		
Initial Height	11.73	cm
Initial Diameter	7.11	cm
Moisture Content	18.8	%
Dry Density	114.4	pcf
% Proctor	NA	%

FINAL DATA		
Final Height	11.63	cm
Final Diameter	7.18	cm
Moisture Content	18.5	%
Dry Density	114.1	pcf
Saturation	100	%

TEST DATA		
Confining Pressure	70	psi
Head Water Pressure	65	psi
Tail Water Pressure	60	psi
Gradient, i	32	

NOTES

DEAIRED WATER WAS UTILIZED AS PERMEANT LIQUID.

SAMPLE TAKEN VIA 3" DIAMETER SHELBY TUBE..

RESULTS

AVERAGE PERMEABILITY, K = 4.6 E -08 (cm/sec) at 20° c

REPORTED BY: Sonda DelPalazzo
SONDA DELPALAZZO

REVIEWED BY: ARH / Mark W. Glynn
A.R.H. / MARK W. GLYNN, P.E.

DOC FILE: TRIAXRPT

REV 6/92

6503 CAMPBELL BLVD. • LOCKPORT, N.Y. 14094 • 716 / 625-6933 • FAX: 716 / 625-6983

Glynn Geotechnical Engineering
GEOTECHNICAL AND CIVIL ENGINEERING SERVICES

TRIAXIAL PERMEABILITY
ASTM D - 5084

PROJECT: VAN DE MARK
DATE REPORTED: JANUARY 18, 1995 (Rev. 2/3/95)
LOCATION: N. TRANSIT ROAD
PROJECT NO.: 94 - 1120
CLIENT: URS CONSULTANTS
SAMPLE NO.: 95 - 02
DATE SAMPLED: JANUARY 10, 1995
DEPTH: 2' - 4'
SAMPLE DESCRIPTION: SHELBY TUBE ST-2, 3' - 3½' TESTED
SAMPLE CLASSIFICATION: ** medium brown, silty CLAY (visual)

INITIAL DATA		
Initial Height	8.90	cm
Initial Diameter	7.11	cm
Moisture Content	19.2	%
Dry Density	108.3	pcf
% Proctor	NA	%

FINAL DATA		
Final Height	8.97	cm
Final Diameter	7.15	cm
Moisture Content	23.2	%
Dry Density	103.5	pcf
Saturation	100	%

TEST DATA		
Confining Pressure	89	psi
Head Water Pressure	84	psi
Tail Water Pressure	80	psi
Gradient, i	33	

NOTES

DEAIRED WATER WAS UTILIZED AS PERMEANT LIQUID.

SAMPLE TAKEN VIA 3" DIAMETER SHELBY TUBE..

RESULTS

AVERAGE PERMEABILITY, K = 1.1 E -08 (cm/sec) at 20° c

REPORTED BY: Sonda DelPalazzo
SONDA DELPALAZZO

REVIEWED BY: ARH / Mark W. Glynn
A.R.H. / MARK W. GLYNN, P.E.

DOC FILE: TRIAXRPT

REV: 6/92

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GEOTECHNICAL AND CIVIL ENGINEERING SERVICES

TRIAXIAL PERMEABILITY
ASTM D - 5084

PROJECT: VAN DE MARK
DATE REPORTED: JANUARY 18, 1995 (Rev. 2/3/95)
LOCATION: N. TRANSIT ROAD
PROJECT NO.: 94 - 1120
CLIENT: URS CONSULTANTS
SAMPLE NO.: 95 - 03
DATE SAMPLED: JANUARY 10, 1995
DEPTH: 2' - 4'
SAMPLE DESCRIPTION: SHELBY TUBE ST - 3, 3' - 3½' TESTED
SAMPLE CLASSIFICATION: **medium brown, silty CLAY (visual)

INITIAL DATA		
Initial Height	12.49	cm
Initial Diameter	7.11	cm
Moisture Content	20.2	%
Dry Density	111.5	pcf
% Proctor	NA	%

FINAL DATA		
Final Height	12.51	cm
Final Diameter	7.58	cm
Moisture Content	19.0	%
Dry Density	99.5	pcf
Saturation	97	%

TEST DATA		
Confining Pressure	90	psi
Head Water Pressure	85	psi
Tail Water Pressure	80	psi
Gradient, i	30	

NOTES

DEAIRED WATER WAS UTILIZED AS PERMEANT LIQUID.

SAMPLE TAKEN VIA 3" DIAMETER SHELBY TUBE..

RESULTS

AVERAGE PERMEABILITY, K = 5.4 E -08 (cm/sec) at 20° c

REPORTED BY: Sonda DelPalazzo
SONDA DELPALAZZO

REVIEWED BY: ARH / [signature]
A.R.H. / MARK W. GLYNN, P.E.

DOC FILE: TRIAXRPT

REV:6/92

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GEOTECHNICAL AND CIVIL ENGINEERING SERVICES

TRIAXIAL PERMEABILITY
ASTM D - 5084

PROJECT: VAN DE MARK
DATE REPORTED: JANUARY 18, 1995 (Rev. 2/3/95)
LOCATION: N. TRANSIT ROAD
PROJECT NO.: 94 - 1120
CLIENT: URS CONSULTANTS
SAMPLE NO.: 95 - 04
DATE SAMPLED: JANUARY 10, 1995
DEPTH: 2' - 3½'
SAMPLE DESCRIPTION: SHELBY TUBE ST - 4, 2½' - 3' TESTED
SAMPLE CLASSIFICATION: ** medium brown, silty CLAY (visual)

INITIAL DATA		
Initial Height	12.20	cm
Initial Diameter	7.11	cm
Moisture Content	21.9	%
Dry Density	111.5	pcf
% Proctor	NA	%

FINAL DATA		
Final Height	12.34	cm
Final Diameter	7.20	cm
Moisture Content	12.7	%
Dry Density	115.8	pcf
Saturation	100	%

TEST DATA		
Confining Pressure	90	psi
Head Water Pressure	85	psi
Tail Water Pressure	80	psi
Gradient, i	27	

NOTES

DEAIRED WATER WAS UTILIZED AS PERMEANT LIQUID.

SAMPLE TAKEN VIA 3" DIAMETER SHELBY TUBE..

RESULTS

AVERAGE PERMEABILITY, K = 2.4 E -08 ***(cm/sec) at 20° c***

REPORTED BY: [signature] SONDA DELPALAZZO

REVIEWED BY: [signature] A.R.H. / MARK W. GLYNN, P.E.

DOC FILE: TRIAXRPT

REV:6/92

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APPENDIX E

LANDFILL CAP CONSTRUCTION QA/QC DATA

Glynn Geotechnical Engineering

6437 LOCUST STREET EXTN. • LOCKPORT, NEW YORK 14094 (716) 434-7118

August 28, 1987

87 - 0125 - 3

Conestoga Rovers Associates, Inc.
7703 Niagara Falls Blvd.
Niagara Falls, New York 14304
Attention: David E. Black / Mark Becker

SUBJECT: VAN DE MARK CHEMICAL LANDFILL CAP TESTING

Gentlemen,

This report presents the results of field and laboratory testing of soils used to construct an impermeable clay barrier cap on the former landfill owned by Van de Mark Chemical Co. The landfill site is located in Lockport, New York near the City Sewage Treatment Plant and the Gulf Railroad Bridge of the Somerset Railroad. Design and construction monitoring were performed by Conestoga Rovers Associates. GGE provided testing services as a subcontractor to CRA.

Site work was performed by SLC Consultants/Constructors, Inc. of Lockport, New York. Testing work required by the closure plan was performed in coordination with SLC and CRA to meet the requirements of NYSDEC.

Initial testing by GGE consisted of density testing of proposed borrow soil used to construct clay "test pads". Subsequent to receipt of acceptable permeability test results from the test pads, SLC used clay overburden from Frontier Stone to construct the 24" thick, 2.5 acre cap.

The schedule of all testing was performed at rates required by NYSDEC. As a result 12 permeability cylinders were sampled and tested for hydraulic conductivity as measured by the constant head method. Density testing was typically performed by the Nuclear Method excepting a few tests conducted at the lysimeter location that were performed by the sand cone method. The attached reports document a minimum compaction of 90% modified proctor. In areas were the 90% value was not initially achieved the contractor was notified and then acted to further compact the material until the 90% value was reached. Density retests were subsequently taken and documented. A minimum of 9 passing tests are reported for each 6 inch layer per acre of surface area.

Proctor results were very close and grain size distribution curves followed a narrow band. Atterberg Limit values were less consistent but indicative of good material for clay cap construction. Grain size analysis and atterberg limit testing was performed in concert with each permeability sample.

In accordance with NYSDEC requirements the borrow material was tested at 5000 cubic yard intervals for recompacted permeability. The first 5000 yards of soil was prequalified by the samples taken from the test pads. The second soil sample taken part way through the project was tested for recompacted permeability after laboratory preparation of the sample. Results of this test failed to meet the 1.0 X 10^{-7}cm/sec requirement, however results of field permeability samples justified use of the material from Frontier Stone. The test sample, identified as bag #2, was compacted to 91% of the modified proctor maximum density at a moisture content equal to that normally occurring in the field. The resulting permeability test was 4.7 X 10^{-7}cm/sec. Although the void ratio of the recompacted sample was nearly equal to that of test pad cylinder #3, the permeability rate was an entire order of magnitude greater. Apparently the method of laboratory compaction does not bind clay soil in the same manner as field compaction with heavy vibratory sheepsfoot equipment.

In addition to the above variation, a discrepancy in the required permeability rate also occurred in two areas sampled and tested during construction. Cylinders #9A and #11A yielded results of 1.09 and 2.20 X 10^{-7}cm/sec respectively. Test #9A variation from the required value is insignificant and therefore not retested. Test sample #11A was considered borderline due to some disturbance from driving the cylinder and since sample #11B (all test cylinders were taken in pairs to provide a backup sample in the event of a poor test) fractured when removed from the cylinder the need for resampling was necessary. Cylinder #11R2 was taken in the same location as samples #11A & B and yielded a result of 4.96 X 10^{-7}cm/sec.

Upon review of the entire distribution of results the taking of another sample at location was dismissed. An anomaly occurs in the pattern of data for permeability tests above and below the 1.0 X 10^{-7}cm/sec threshold. Those cylinders having a perm rate below the threshold level exhibited a higher density than the companion field density test. In addition those same cylinders routinely showed a decrease in the moisture content when compared to the companion field moisture associated with the density test. Because of this reciprocal relationship in critical test data the permeability rates from the cylinders #11A and #11R2 should not be considered indicative of field conditions. A graph of void ratio (after test) versus permeability fails to provide a clear relationship of these factors and hence does not provide any further clue as to why these test cylinders do not meet the required rate.

Not-with-standing the last comments, a stratigraphic view of the various permeability cylinders indicate an acceptable average rate throughout the clay cap.

As requested our testing program also included collecting and analyzing a topsoil sample for pH. Results indicate a value of 6.8.

With the exception of pH testing all laboratory and field test data is included in this report. If there are any questions or comments regarding this report please contact our office.

Sincerely,

GLYNN GEOTECHNICAL ENGINEERING

Mark W. Glynn, P.E.
Geotechnical Consultant

cc: Matthew Barmasse
Safety/Environmental Engineer
Van de Mark Chemical Co.
1 North Transit Road
Lockport, New York 14094

Glynn Geotechnical Engineering

BY H.W. GLYNN DATE 8-19-87 SHEET 1 OF 1

CHKD. BY ______ DATE ______ PROJECT NO. 87-0125

CLIENT CONESTOGA ROVERS

PROJECT VAN DE MARK CHEMICAL

SUBJECT SUMMARY OF TEST DATA

PERMEABILITY TEST TABLE

SAMPLE NO.	PERMEABILITY RATE $\times 10^{-7}$ CM/SEC	CYLINDER DRY DENSITY	MOISTURE CONTENT FIELD	MOISTURE CONTENT CYL.	PERCENT COMPACTION FIELD	PERCENT COMPACTION CYL.	ATTERBERG'S LIQUID LIMIT	ATTERBERG'S PLASTIC LIMIT	VOID RATIO BEFORE TEST	VOID RATIO AFTER TEST
TEST PAD	0.723	108.6	20.4	19.5	89.3	94.8	37	23	.592	.501
TEST PAD	0.221	108.9	21.8	20.1	91.9	95.1	39	22	.494	.478
TEST PAD	0.471	107.3	19.8	19.3	90.8	93.7	—	—	.569	.577
1B	0.176	110.2	17.4	16.5	94.2	96.2	42	22	.489	.505
2B	0.510	105.7	24.1	19.5	88.9	92.3	37	20	.623	.619
3A	0.200	107.8	18.7	15.8	90.8	94.1	39	20	.563	.560
4A	0.440	110.7	18.1	17.7	93.2	96.7	38	20	.505	.454
5B	0.248	108.7	19.4	18.5	92.7	94.9	34	19	.573	.572
6A	0.569	109.2	19.9	19.8	92.8	95.4	36	17	.571	.559
7A	0.460	110.5	18.1	14.9	91.6	96.5	45	24	.468	.429
8B	0.418	109.8	21.9	17.0	90.9	95.9	36	19	.562	.552
9A	1.09	105.0	18.5	18.2	93.0	91.7	48	26	.670	.707
10B	0.336	103.2	16.9	15.6	90.2	90.1	38	19	.608	.579
11B	2.201	101.9	17.7	18.2	90.7	89.0	38	20	.709	.630
11R2	4.96	102.4	N.A.	13.3	90.7	89.4	32	19	.656	.600
12A	0.574	108.5	18.5	17.8	90.1	94.8	48	25	.599	.653
BAG #2	4.12	107.1 (RECOMPACT)	N.A.	19.1 (REMOLD)	N.A.	93.5 (REMOLD)	35	18	.608	.617
AVG. 1-12	0.60	107.6	—	—	—	—				

PERMEABILITY BY STRATA

LIFT	NORTH SECTOR	MIDDLE SECTOR	SOUTH SECTOR
4th	0.34	2.20	0.57
3RD	0.46	0.42	1.09
2ND	0.44	0.25	0.57
1ST	0.18	0.51	0.20
AVG.	0.36	0.85	0.61

APPENDIX F

HELP MODEL RESULTS

TO: Bob Henschel
FROM: Marek Ostrowski
REF: Van De Mark Landfill infiltration analysis
DATE: 3/23/95

As you requested, I tried to estimate the difference in infiltration between the existing clay cap and the possible cap including a liner. I used the HELP model, with the following input:

* Existing cap
  - 6" of topsoil
  - 15" of fill
  - 3" of sand drainage layer
  - 24" of clay barrier
  - Average slope of 7%
  - Average drainage length of 100 ft
* Liner cap
  - 6" of topsoil
  - 18" of fill
  - 6" of sand drainage layer
  - Liner on 24" of clay barrier
  - Average slope of 7%
  - Average drainage length of 100 ft
  - Liner leakage fraction of 0.0003 to 0.01

In both cases I used the same soil parameters and climatic data. Fair grass was used as a surface cover.
The results are:

cap	infiltration	infiltration flow rate over 2.5 acres	
	[in/yr]	[gall/yr]	[gall/min]
clay cap	1.2	84,000	0.2
liner cap	5E-4 to 1.5E-2	40 to 1030	approx 0.

I also estimated the infiltration during the period before the installation of the cap. I assumed the same topsoil (6") and fill (12") as in the runs above. Fair grass was used as surface cover. It was assumed that the site was graded inward, eliminating the offsite runoff. The results are:

	infiltration	infiltration flow rate over 2.5 acres	
	[in/yr]	[gall/yr]	[gall/min]
pre-cap	11.6	790,000	1.5

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 Van de Mark Landfill infiltration analysis, M.O., 3/23/95
 Existing conditions: 6" tops(#6,VPL), 15" fill(#6,VPL),
 3" drainage (#2,LDL,100 ft,7%), 24" caly(#16,BL)

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                              FAIR GRASS

                               LAYER  1
                               --------

                     VERTICAL PERCOLATION LAYER
   THICKNESS                              =       6.00 INCHES
   POROSITY                               =       0.4530 VOL/VOL
   FIELD CAPACITY                         =       0.1901 VOL/VOL
   WILTING POINT                          =       0.0848 VOL/VOL
   INITIAL SOIL WATER CONTENT             =       0.4196 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =       0.002160000149 CM/SEC


                               LAYER  2
                               --------

                     VERTICAL PERCOLATION LAYER
   THICKNESS                              =      15.00 INCHES
   POROSITY                               =       0.3609 VOL/VOL
   FIELD CAPACITY                         =       0.1638 VOL/VOL
   WILTING POINT                          =       0.0848 VOL/VOL
   INITIAL SOIL WATER CONTENT             =       0.3642 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =       0.000036000001 CM/SEC


                               LAYER  3
                               --------

                       LATERAL DRAINAGE LAYER
   THICKNESS                              =       3.00 INCHES
   POROSITY                               =       0.4370 VOL/VOL
   FIELD CAPACITY                         =       0.0624 VOL/VOL
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WILTING POINT                          =      0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT             =      0.4370 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =      0.005799999926 CM/SEC
SLOPE                                  =      7.00 PERCENT
DRAINAGE LENGTH                        =    100.0 FEET
```

LAYER 4

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                         BARRIER SOIL LINER
THICKNESS                              =     24.00 INCHES
POROSITY                               =      0.4300 VOL/VOL
FIELD CAPACITY                         =      0.3663 VOL/VOL
WILTING POINT                          =      0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT             =      0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =      0.000000100000 CM/SEC
```

GENERAL SIMULATION DATA

```
SCS RUNOFF CURVE NUMBER                =       68.71
TOTAL AREA OF COVER                    =    43560. SQ FT
EVAPORATIVE ZONE DEPTH                 =      20.00 INCHES
UPPER LIMIT VEG. STORAGE               =       7.7706 INCHES
INITIAL VEG. STORAGE                   =       7.6391 INCHES
          SOIL WATER CONTENT INITIALIZED BY PROGRAM.
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CLIMATOLOGICAL DATA

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SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR      BUFFALO              NEW YORK

MAXIMUM LEAF AREA INDEX                   = 2.00
START OF GROWING SEASON (JULIAN DATE)     =  138
END OF GROWING SEASON (JULIAN DATE)       =  279
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NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.18	2.61	2.78	2.97	2.89	2.21
	2.95	4.39	3.13	3.11	4.24	2.96
STD. DEVIATIONS	0.55	1.01	0.91	0.80	0.78	0.65
	1.06	2.04	1.46	1.37	1.06	0.73
RUNOFF						
TOTALS	0.177	0.250	0.750	0.001	0.000	0.000
	0.000	0.001	0.000	0.013	0.069	0.120
STD. DEVIATIONS	0.236	0.456	1.084	0.002	0.000	0.000
	0.000	0.004	0.000	0.042	0.219	0.256
EVAPOTRANSPIRATION						
TOTALS	0.426	0.645	2.297	2.956	3.199	2.958
	3.541	4.193	2.586	2.008	0.916	0.520
STD. DEVIATIONS	0.114	0.160	0.176	0.598	0.976	0.614
	1.149	1.240	1.130	0.397	0.118	0.127
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.3062	1.3672	1.3848	1.0828	0.9997	0.5453
	0.1227	0.0054	0.0214	0.1426	0.5225	1.0621
STD. DEVIATIONS	0.4487	0.2076	0.2837	0.1578	0.2322	0.3163
	0.2299	0.0169	0.0678	0.2929	0.5144	0.6256
PERCOLATION FROM LAYER 4						
TOTALS	0.1678	0.1672	0.1836	0.1505	0.1269	0.1066
	0.0736	0.0163	0.0149	0.0247	0.0676	0.1320
STD. DEVIATIONS	0.0370	0.0293	0.0277	0.0225	0.0167	0.0082
	0.0262	0.0182	0.0292	0.0368	0.0606	0.0642

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	37.42	(2.873)	135835.	100.00
RUNOFF	1.382	(0.972)	5015.	3.69
EVAPOTRANSPIRATION	26.241	(2.013)	95256.	70.13

LATERAL DRAINAGE FROM LAYER 3	8.5628 (1.7728)	31083.	22.88
PERCOLATION FROM LAYER 4	1.2318 (0.2271)	4471.	3.29
CHANGE IN WATER STORAGE	0.002 (1.555)	9.	0.01

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	2.81	10200.3
RUNOFF	1.604	5821.2
LATERAL DRAINAGE FROM LAYER 3	0.0644	233.8
PERCOLATION FROM LAYER 4	0.0068	24.8
HEAD ON LAYER 4	24.3	
SNOW WATER	3.03	10987.1

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3885
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0846

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FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	2.56	0.4264
2	5.46	0.3642
3	1.31	0.4370
4	10.32	0.4300
SNOW WATER	0.03	

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 Van de Mark Landfill infiltration analysis, M.O., 3/23/95
 Synthetic liner: 6" tops(#6,VPL),18" fill(#6,VPL), 6" drain(#2,LDL,
 100 ft,7%), liner on 24" clay(#16,f=0.003,BL)

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1901 VOL/VOL
WILTING POINT	=	0.0848 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3047 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.002160000149 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.3609 VOL/VOL
FIELD CAPACITY	=	0.1638 VOL/VOL
WILTING POINT	=	0.0848 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3622 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000036000001 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL

WILTING POINT = 0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4370 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.005799999926 CM/SEC
SLOPE = 7.00 PERCENT
DRAINAGE LENGTH = 100.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 24.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC
LINER LEAKAGE FRACTION = 0.00030000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 68.71
TOTAL AREA OF COVER = 43560. SQ FT
EVAPORATIVE ZONE DEPTH = 20.00 INCHES
UPPER LIMIT VEG. STORAGE = 7.7706 INCHES
INITIAL VEG. STORAGE = 6.9286 INCHES
SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 279

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.18	2.61	2.78	2.97	2.89	2.21
	2.95	4.39	3.13	3.11	4.24	2.96
STD. DEVIATIONS	0.55	1.01	0.91	0.80	0.78	0.65
	1.06	2.04	1.46	1.37	1.06	0.73
RUNOFF						
TOTALS	0.003	0.000	0.034	0.000	0.000	0.000
	0.000	0.001	0.000	0.013	0.000	0.000
STD. DEVIATIONS	0.008	0.000	0.076	0.000	0.000	0.000
	0.000	0.004	0.000	0.042	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.426	0.645	2.305	2.963	3.201	2.958
	3.354	4.177	2.587	2.015	0.917	0.520
STD. DEVIATIONS	0.114	0.160	0.182	0.598	0.974	0.614
	1.156	1.253	1.132	0.402	0.118	0.127
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.6672	1.8045	2.1627	1.7059	1.1650	0.5225
	0.1789	0.0561	0.0412	0.1439	0.5800	1.3346
STD. DEVIATIONS	0.7146	0.3436	0.4934	0.3621	0.4530	0.3714
	0.1806	0.0290	0.0457	0.2632	0.6118	0.8462
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	37.42	(2.873)	135835.	100.00
RUNOFF	0.051	(0.087)	184.	0.14

EVAPOTRANSPIRATION	26.066	(1.965)	94620.	69.66
LATERAL DRAINAGE FROM LAYER 3	11.3624	(2.8367)	41246.	30.36
PERCOLATION FROM LAYER 4	0.0005	(0.0000)	2.	0.00
CHANGE IN WATER STORAGE	-0.060	(1.638)	-217.	-0.16

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	2.81	10200.3
RUNOFF	0.229	833.1
LATERAL DRAINAGE FROM LAYER 3	0.1056	383.4
PERCOLATION FROM LAYER 4	0.0000	0.0
HEAD ON LAYER 4	29.7	
SNOW WATER	3.03	10987.4

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3851

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0846

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FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	1.35	0.2256
2	6.41	0.3563
3	2.62	0.4370
4	10.32	0.4300
SNOW WATER	0.03	

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 Van de Mark Landfill infiltration analysis, M.O., 3/23/95
 Synthetic liner: 6" tops(#6,VPL),18" fill(#6,VPL), 6" drain(#2,LDL,
 100 ft,7%), liner on 24" clay(#16,f=0.01,BL)

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                              FAIR GRASS

                               LAYER  1
                               --------

                      VERTICAL PERCOLATION LAYER
   THICKNESS                              =        6.00 INCHES
   POROSITY                               =        0.4530 VOL/VOL
   FIELD CAPACITY                         =        0.1901 VOL/VOL
   WILTING POINT                          =        0.0848 VOL/VOL
   INITIAL SOIL WATER CONTENT             =        0.3043 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =        0.002160000149 CM/SEC


                               LAYER  2
                               --------

                      VERTICAL PERCOLATION LAYER
   THICKNESS                              =       18.00 INCHES
   POROSITY                               =        0.3609 VOL/VOL
   FIELD CAPACITY                         =        0.1638 VOL/VOL
   WILTING POINT                          =        0.0848 VOL/VOL
   INITIAL SOIL WATER CONTENT             =        0.3622 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =        0.000036000001 CM/SEC


                               LAYER  3
                               --------

                        LATERAL DRAINAGE LAYER
   THICKNESS                              =        6.00 INCHES
   POROSITY                               =        0.4370 VOL/VOL
   FIELD CAPACITY                         =        0.0624 VOL/VOL
```

WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4370 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.005799999926 CM/SEC
SLOPE	=	7.00 PERCENT
DRAINAGE LENGTH	=	100.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC
LINER LEAKAGE FRACTION	=	0.01000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.71
TOTAL AREA OF COVER	=	43560. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	7.7706 INCHES
INITIAL VEG. STORAGE	=	6.9262 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	138
END OF GROWING SEASON (JULIAN DATE)	=	279

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.18	2.61	2.78	2.97	2.89	2.21
	2.95	4.39	3.13	3.11	4.24	2.96
STD. DEVIATIONS	0.55	1.01	0.91	0.80	0.78	0.65
	1.06	2.04	1.46	1.37	1.06	0.73
RUNOFF						
TOTALS	0.003	0.000	0.033	0.000	0.000	0.000
	0.000	0.001	0.000	0.013	0.000	0.000
STD. DEVIATIONS	0.008	0.000	0.075	0.000	0.000	0.000
	0.000	0.004	0.000	0.042	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.426	0.645	2.305	2.963	3.201	2.958
	3.354	4.177	2.587	2.015	0.917	0.520
STD. DEVIATIONS	0.114	0.160	0.182	0.598	0.974	0.614
	1.156	1.253	1.132	0.402	0.118	0.127
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.6658	1.8039	2.1619	1.7047	1.1633	0.5214
	0.1767	0.0549	0.0402	0.1428	0.5791	1.3339
STD. DEVIATIONS	0.7141	0.3436	0.4935	0.3626	0.4533	0.3731
	0.1777	0.0285	0.0457	0.2631	0.6120	0.8464
PERCOLATION FROM LAYER 4						
TOTALS	0.0015	0.0015	0.0018	0.0014	0.0012	0.0011
	0.0011	0.0011	0.0010	0.0011	0.0011	0.0014
STD. DEVIATIONS	0.0004	0.0003	0.0004	0.0003	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0004

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	37.42	(2.873)	135835.	100.00
RUNOFF	0.050	(0.086)	182.	0.13

EVAPOTRANSPIRATION	26.066	(1.965)	94620.	69.66
LATERAL DRAINAGE FROM LAYER 3	11.3486	(2.8360)	41195.	30.33
PERCOLATION FROM LAYER 4	0.0151	(0.0013)	55.	0.04
CHANGE IN WATER STORAGE	-0.060	(1.638)	-217.	-0.16

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	2.81	10200.3
RUNOFF	0.226	819.8
LATERAL DRAINAGE FROM LAYER 3	0.1056	383.4
PERCOLATION FROM LAYER 4	0.0001	0.3
HEAD ON LAYER 4	29.7	
SNOW WATER	3.03	10987.4

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3851

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0846

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FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	1.35	0.2252
2	6.41	0.3563
3	2.62	0.4370
4	10.32	0.4300
SNOW WATER	0.03	

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 Van de Mark Landfill infiltration analysis, M.O., 05/01/95
 Pre-capp coditions: 6" Tops(#6,VPL), 12" Fill(#6,VPL,COMP)
 Site cannot drain

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                              FAIR GRASS

                               LAYER  1
                               --------

                      VERTICAL PERCOLATION LAYER
   THICKNESS                              =       6.00 INCHES
   POROSITY                               =       0.4530 VOL/VOL
   FIELD CAPACITY                         =       0.1901 VOL/VOL
   WILTING POINT                          =       0.0848 VOL/VOL
   INITIAL SOIL WATER CONTENT             =       0.2280 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =       0.002160000149 CM/SEC


                               LAYER  2
                               --------

                      VERTICAL PERCOLATION LAYER
   THICKNESS                              =      12.00 INCHES
   POROSITY                               =       0.3609 VOL/VOL
   FIELD CAPACITY                         =       0.1638 VOL/VOL
   WILTING POINT                          =       0.0848 VOL/VOL
   INITIAL SOIL WATER CONTENT             =       0.2880 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =       0.000036000001 CM/SEC


                        GENERAL SIMULATION DATA
                        -----------------------

   SCS RUNOFF CURVE NUMBER                =       68.71
   TOTAL AREA OF COVER                    =    43560. SQ FT
   EVAPORATIVE ZONE DEPTH                 =       20.00 INCHES
```

POTENTIAL RUNOFF FRACTION = 0.000000
UPPER LIMIT VEG. STORAGE = 7.0488 INCHES
INITIAL VEG. STORAGE = 4.8562 INCHES
SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 279

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.18	2.61	2.78	2.97	2.89	2.21
	2.95	4.39	3.13	3.11	4.24	2.96
STD. DEVIATIONS	0.55	1.01	0.91	0.80	0.78	0.65
	1.06	2.04	1.46	1.37	1.06	0.73
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.426	0.645	2.309	2.969	3.230	2.905
	3.046	4.187	2.579	2.023	0.922	0.522
STD. DEVIATIONS	0.114	0.160	0.184	0.598	0.985	0.674
	1.024	1.266	1.146	0.412	0.119	0.128

PERCOLATION FROM LAYER 2

TOTALS	2.4187	2.0879	2.0357	0.5040	0.1095	0.0353
	0.0013	0.0275	0.0701	0.4586	1.9545	1.9424
STD. DEVIATIONS	0.8588	0.6801	1.5369	0.5555	0.0858	0.0154
	0.0013	0.0712	0.2217	0.6630	1.5164	0.9705

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	37.42	(2.873)	135835.	100.00
RUNOFF	0.000	(0.000)	0.	0.00
EVAPOTRANSPIRATION	25.763	(2.056)	93519.	68.85
PERCOLATION FROM LAYER 2	11.6456	(3.0901)	42273.	31.12
CHANGE IN WATER STORAGE	0.012	(0.664)	42.	0.03

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	2.81	10200.3
RUNOFF	0.000	0.0
PERCOLATION FROM LAYER 2	1.1210	4069.4
SNOW WATER	3.02	10956.2

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3585

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0846

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FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	1.33	0.2225
2	3.62	0.3020
SNOW WATER	0.03	

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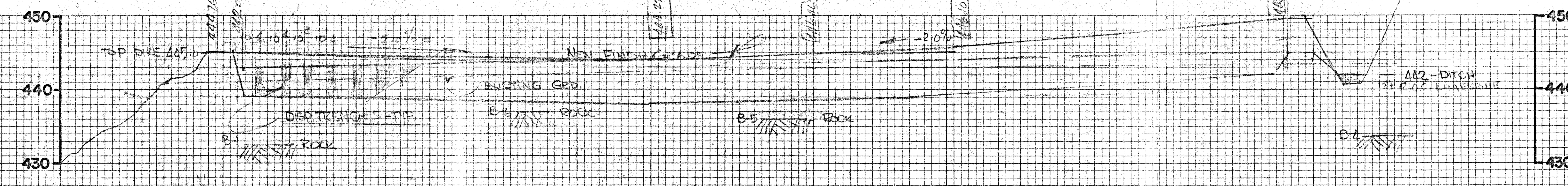
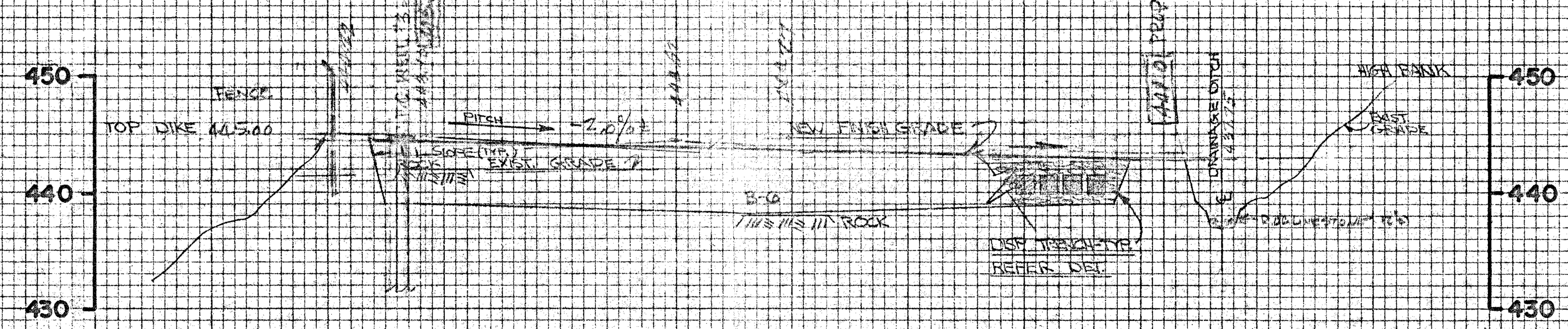


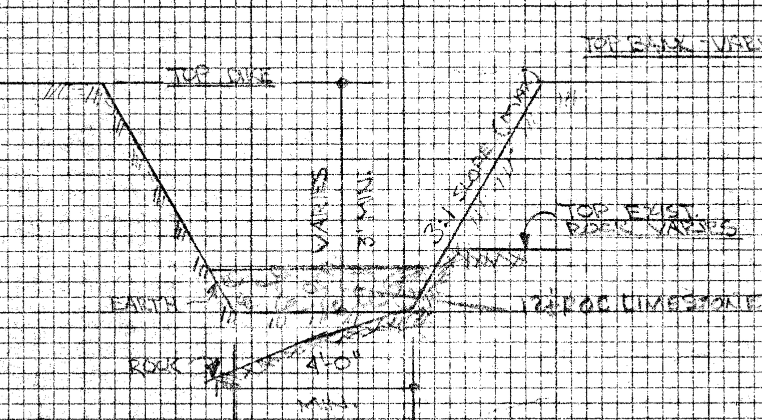
SECT. 98,350E - TYP

1" = 10' V 1" = 30' H



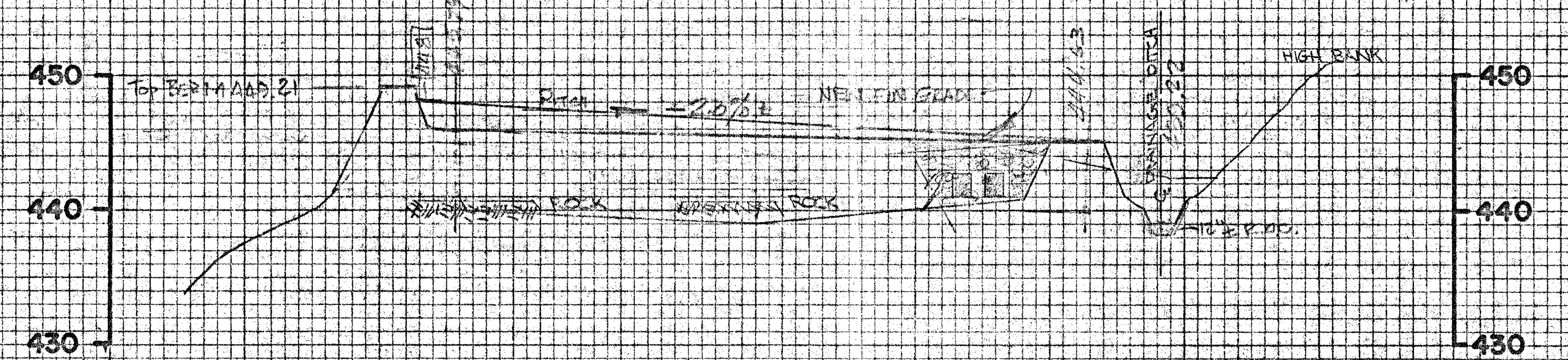
SECT. 119,300 N

1" = 10' V 1" = 30' H



TYPE D-4C

TYPICAL DITCH SECTION



SECT. 119,500 N

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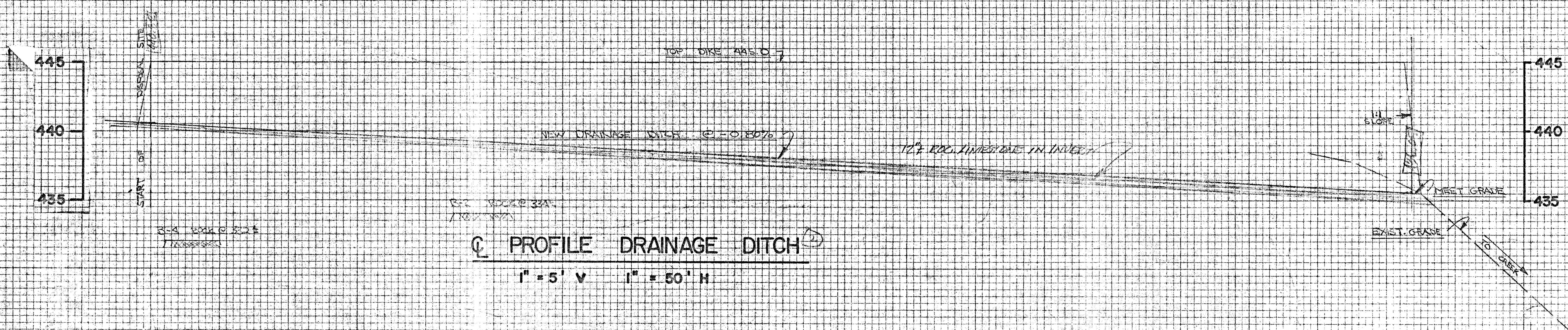
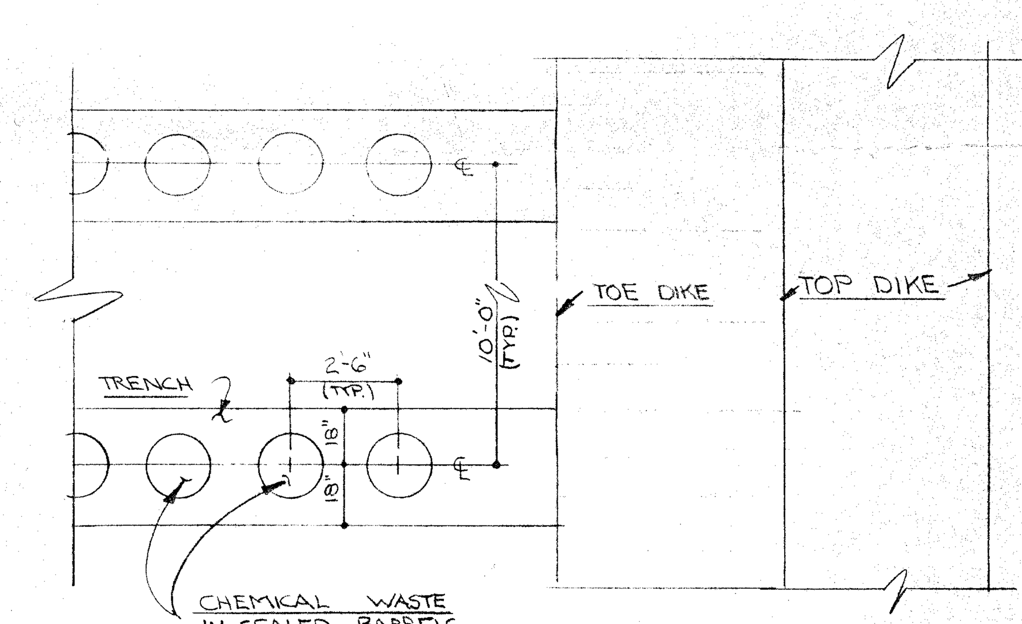


℄ PROFILE DRAINAGE DITCH

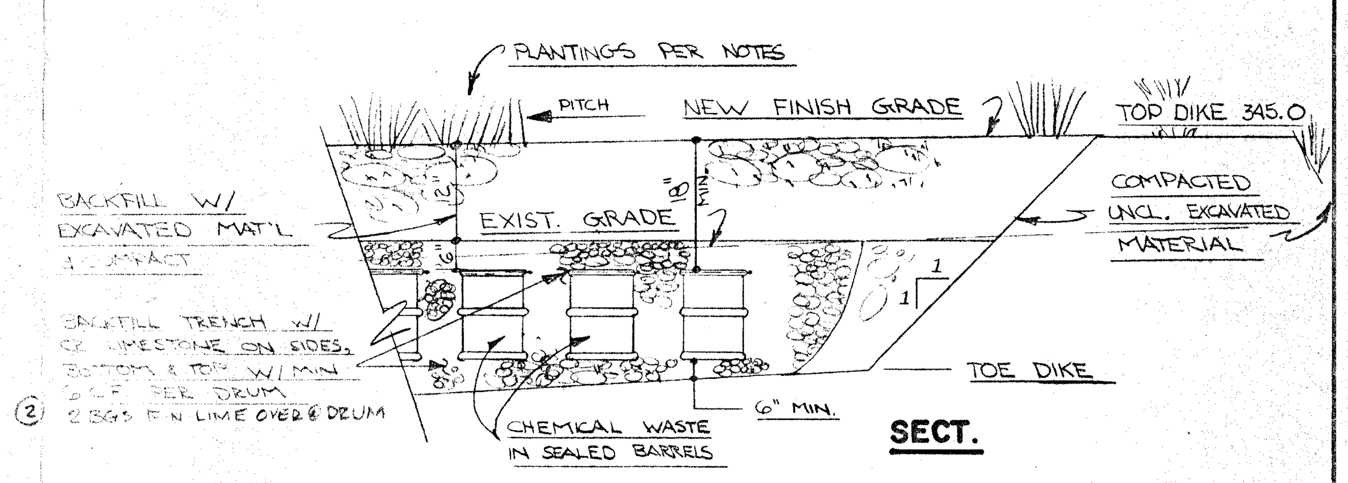
1" = 5' V 1" = 50' H

CONSTRUCTION NOTES

1. RECRAIE EXISTING SITE AND FORM DIKES ON WEST, SOUTH AND EAST SIDES PER SECTION. USE EXISTING NON-WASTE MATERIAL TO CONSTRUCT. COMPACT WITH BULLDOZER IN LAYERS.
2. EXCAVATE AND FORM NEW DRANINAGE DITCH ALONG EAST SIDE OF THE EAST DIKE INCLUDING ROCK REMOVAL AS REQUIRED TO MEET PROFILE.
3. REGRADE ACCESS ROAD AND INSTALL DITCHES TO DRAIN AS INDICATED. EAST SIDE TO DRAINAGE DITCH. WEST SIDE TO NEW DITCH TO WEST EMBANKMENT.
4. BOTTOM TO PITCH TO CENTER OF AREA. TOP OF EXISTING WASTE AREAS TO PITCH [redacted] FROM FINISHED ELEVATION 445 USGS. SLOPE SIDES OF WASTE AREA BANK ON 1:1 PITCH. EXCESS SOIL (BELOW DIKE TOP) TO REMAIN FOR FUTURE FILL AND GRADE TO PROPER BOTTOM SLOPE.
5. INSTALL PLANTINGS PER MGT./OPER. PLAN.
6. INSTALL ENTRANCE GATE (12 ft. x 8 ft. HIGH) AND FENCE WITH 3 ROWS BARBED WIRE EXTENDING TO E/W EMBANKMENTS.
7. INSTALL MINIMUM OF 6 METAL SIGNS WITH 6" LETTERS "DANGER-WATE DISPOSAL" ON ALL SIDES OF SITE AND ONE ON FENCE GATE "NO ADMITTANCE-CHEMICAL WASTE DISPOSAL SITE - VAN DE MARK CHEMICAL CO., INC."
8. RECONSTRUCT CONTROL GATE AT MILL STREET ENTRANCE USING EXISTING GATE, 6" IPS GALVANIZED POSTS, STANDARD GATE LOCKING HARDWARE AND EXTEND 8 ft. CHAIN LINK FENCE WITH 3 ROWS BARBED WIRE WITH 6 IPS (OR EQUAL) IRON POSTS SET IN ROCK WITH CONCRETE TO HIGH BANK EACH SIDE OF GATE. INSTALL RED AND BLACK METAL SIGN, 6" LETTERS "DANGER - NO ADMITTANCE CHEMICAL WASTE DISPOSAL SITE" PROMINENTLY ON FENCE.
9. PROTECT CASED MONITORING WELLS, EXTEND CAPS AS NECESSARY TO 12" ABOVE FINISH GRADE, REPAINT WITH FLORESCENT PAINT AND MARK NUMBER ON EACH PER PLAN. REPAIR WITH WELDING INCLUDING WELDED HASPS, PADLOCKS (MASTER KEYED).



PLAN



SECT.

TRENCH DET.

1/4" = 1'-0"

NOTE: IT IS ILLEGAL TO REUSE THIS PLAN WITHOUT EXPRESS WRITTEN PERMISSION OF ENGINEER

DATE	REVISIONS

VAN DE MARK CHEMICAL CO. INC.
N. TRANSIT RD., LOCKPORT N.Y.
SOLID WASTE DISPOSAL PROJ.
DISPOSAL SITE CROSS SECTIONS
DETAILS

DATE: 6-30-77
SCALE: NOTED
DWN: JRM
CHKD: WWW

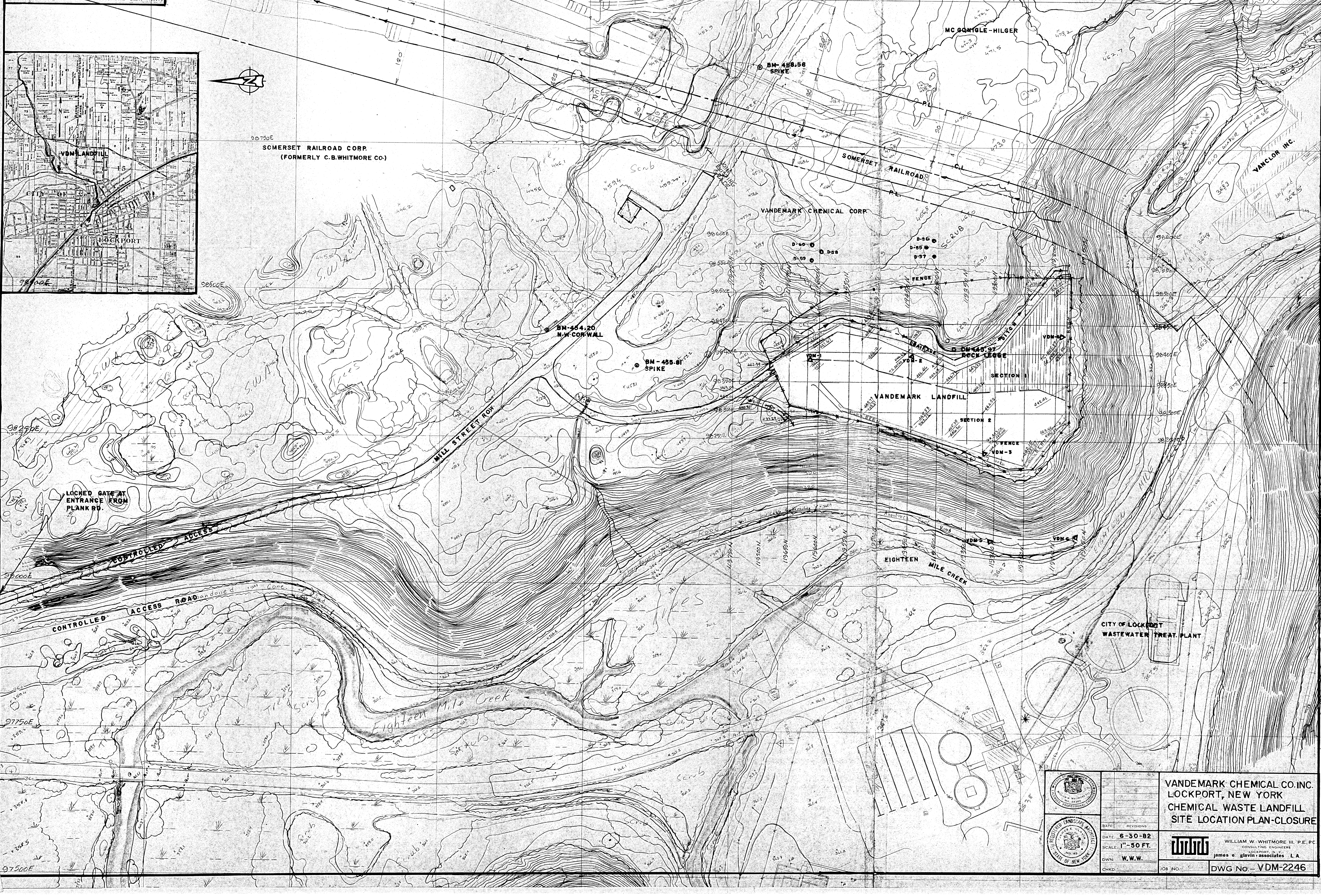
WILLIAM W. WHITMORE III, P.E., P.C.
CONSULTING ENGINEERS
LOCKPORT, N. Y.

JOB NO. P-426 DWG No.- VDM-1967

STATE OF NEW YORK — HAL G. ROGERS — No. 46798 — LICENSED PROFESSIONAL ENGINEER

MONITORING WELL DATA

Well	TOP CASING ELEV.	BOT. BORE ELEV.
VDM-1	447.67	420.2
VDM-2	447.40	418.7
VDM-3	445.04	352.18
VDM-4	445.35	347.66
VDM-5	366.6	345.6
VDM-6	367.2	345.6
BTL-D-58	467.68	414.20
BTL-D-59	467.68	365.00
BTL-D-60	467.75	407.70
BTL-D-55	469.36	420.7
BTL-D-56	469.49	357.25
BTL-D-57	469.27	407.70



STATE OF NEW YORK · WILLIAM W. WHITMORE III · No. 24360 · LICENSED PROFESSIONAL ENGINEER

REGISTERED LANDSCAPE ARCHITECT · JAMES E. GLAVIN · No. 49 · STATE OF NEW YORK

DATE | REVISIONS

DATE: 6-30-82
SCALE: 1"-50 FT.
DWN: W.W.W.
CHKD:

VANDEMARK CHEMICAL CO. INC.
LOCKPORT, NEW YORK
CHEMICAL WASTE LANDFILL
SITE LOCATION PLAN-CLOSURE

WILLIAM W. WHITMORE III, P.E., P.C.
CONSULTING ENGINEERS
LOCKPORT, N. Y.
james e. glavin + associates L.A.

JOB NO.-
DWG No.- VDM-2246

NOTE: IT IS ILLEGAL TO REUSE THIS PLAN WITHOUT EXPRESS WRITTEN PERMISSION OF ENGINEER

STATE OF NEW YORK — WILLIAM W. WHITMORE — No. 24360 — LICENSED PROFESSIONAL ENGINEER

STATE OF NEW YORK — HAL G. ROGERS — No. 46798 — LICENSED PROFESSIONAL ENGINEER

DATE	REVISIONS

VAN DE MARK CHEMICAL CO. INC.
N. TRANSIT RD., LOCKPORT N.Y.
SOLID WASTE DISPOSAL PROJ.
AERIAL LOCATION MAP

DATE: 6-30-77
SCALE: 1" = 200'
DWN: JRM
CHKD: WWW

WILLIAM W. WHITMORE III, P.E., P.C.
CONSULTING ENGINEERS
LOCKPORT, N. Y.

JOB NO.– P-428

DWG No.– VDM-1965

STANPAT PRODUCTS INC. PORT WASHINGTON, N.Y.