Attachment 2

TECHNICAL MEMORANDUM

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Reference: Contract No. 68-W6-0042 (Subcontract 107061)
Work Assignment No. 148
Multi-Site Five-Year Review

SUBJECT: **Old Springfield Landfill, Springfield, Vermont**
Input for Five-Year Review

1.0 INTRODUCTION

TRC is assisting EPA in performing a five-year review of the Old Springfield Landfill Superfund Site (site) in accordance with OSWER Directive 9355.7-03B-P "Comprehensive Five-Year Review Guidance" (June 2001). This is the second five-year review conducted for the Old Springfield Landfill. The information in this Technical Memorandum will be used by EPA to evaluate and certify the protectiveness of the remedy in EPA's five-year review report.

TRC performed the following tasks to support EPA's five-year review:

- Reviewed site-related documents;
- Evaluated site conditions and performance of the remedy;
- Interviewed the Chief Operator of the Publicly-Operated Treatment Works (POTW), who is responsible for overseeing O&M of the site;
- Inspected the site to verify the integrity of the remedial system and to assess O&M; and
- Prepared this technical memorandum.

2.0 DOCUMENT REVIEW

The following documents were reviewed as part of the Second Five-Year Review Report:

- Record of Decision (Operable Unit No.1), September 1988 (ROD, 1988);
- Record of Decision (Operable Unit No.2), September 1990 (ROD, 1990);
- Long-Term Monitoring Plan, Years Three and Beyond, March 1993 (LTMP, 1993); and
- Five-Year Review Report, September 1998 (Five-Year Review, 1998).

2.1 Remedial Action Objectives

The remedial action at the Old Springfield landfill was divided into two operable units. Operable Unit No. 1 (O.U. 1) dealt primarily with the management of migration of contaminated seeps and groundwater from the site using a leachate collection and groundwater extraction system, pretreatment on site and off-site treatment of contaminated leachate and groundwater. Operable Unit No. 2 (O.U. 2) addressed source controls and included construction of a multi-layer cap, means of upgradient groundwater diversion and the installation of a source control groundwater extraction well.

The objectives and basis of the remedial action are to:

- Prevent exposure to contaminated surface soils or leachate by residents, construction workers, and future users of the site (i.e., prevent contact via ingestion and dermal absorption);
- Prevent volatilization of contaminants from contaminated soils, wastes and leachate seeps;
- Prevent contamination of fish in the Black River by limiting leachate migration from the site;
- Prevent the leaching of contaminants from site soils to shallow and bedrock aquifers;
- Prevent further migration of contaminated groundwater offsite; and
- Prevent the uncontrolled emission of landfill gases containing hazardous substances.

The remedies implemented to achieve the remedial objectives (ROD 1988; ROD, 1990) include:

- Stabilization of steep waste area side slopes (Areas 2 and 3) to prevent slope failure and construction of a multi-layer cap over Waste Areas 2, 3 and 4 to reduce infiltration and leachate generation (O.U. 2);
- Construction of upgradient french drains and surface water diversions (O.U. 2);
- Installation of a leachate collection system to limit migration of contaminated seeps from the site (O.U. 1);

- Installation of three extraction wells for extraction of contaminated groundwater from the site (O.U. 1 and 2);
- Treatment of leachate and contaminated groundwater at the publicly owned treatment works (POTW) facility, with pretreatment on site (O.U. 1). Average flows from the site pre-treatment facility to the POTW are around 25 gallons per minute, or 36,000 gallons per day.
- Installation of passive gas vents on Waste Areas 2, 3 and 4 (O.U. 2);
- Institutional controls, including deed restrictions and the restriction of groundwater use in the immediate vicinity of the landfill (O.U. 2); and
- Monitoring of groundwater, seeps and air for thirty years.

2.2 Design and Construction

The remedial design process was completed in April 1992 for O.U. 1 and in May 1993 for O.U. 2 (Superfund Five-Year Review, Sept. 1998). Construction activities for O.U. 1 began in June 1992 and were completed by June 1993. The components of O.U. 1 included 2 groundwater extraction wells, a leachate seepage collection system, and an on-site pretreatment facility. Construction of O.U. 2 began in May 1993. Components of O.U. 2 included a third groundwater extraction well (the "source control" well), two french drains, and a multi-layer cap including passive gas vents. The active gas collection and treatment system originally proposed (ROD, 1990) was not installed in Waste Area 3 due to the low landfill gas generation rate. Passive gas vents were installed to allow the minor landfill gas to escape through the Waste area 3 cap and granular activated carbon canisters were installed on all passive gas vents to remove volatile organic compounds (VOCs) from the air emissions.

Landfill cap construction activities began in July 1993. The landfill cap consisted of a 6-inch vegetated topsoil layer, 36-inch cover soil/frost protection layer, 12-inch sand drainage layer, 40-mil low density polyethylene geomembrane liner, a geosynthetic clay liner, and a 12-inch gas vent layer. The steep slopes on the eastern sides of Waste Areas 2 and 3 were stabilized with common borrow, followed by 40-mil textured geomembrane, followed by the typical cap cross-section. Construction of the cap over Waste Areas 2, 3 and 4 was completed in November 1993.

Long-term monitoring of the site began in December 1993, and the first Five-Year Review report was completed in September 1998.

2.3 Performance Standards

The goals for site cleanup will be achieved when the following conditions (ROD 1988; ROD, 1990) are met:

a) Soils in which contaminant concentrations exceed total carcinogenic risk levels of 10^{-5} (level of excess cancer risk considering dermal and ingestion exposure routes for soils contaminated with PAHs and PCBs) are capped. This included capping waste areas 2, 3, and 4;

b) Groundwater at and within the boundaries of the waste management unit (i.e., the site) must meet Vermont groundwater quality standards. The state standards are equivalent to the Federal maximum contaminant levels (MCLs) and/or maximum contaminant level goals (MCLGs) per the Safe Drinking Water Act. Cleanup goals for site groundwater contaminants are equal to Federal MCLs and state criteria, with the exception of tetrachloroethene (PCE). A PCE cleanup goal was waived by EPA based on its ARARs, because its MCL standard was below its practical quantitation limit, and therefore the MCL for PCE was not a technically feasible cleanup goal.

c) The effluent of leachate and/or groundwater that is treated off-site must meet the permitting requirements of the National Pollutant Discharge Elimination System (NPDES). In addition, the on-site pretreatment system will be designed, constructed and operated to ensure that all NPDES requirements are met.

d) Air strippers must be operated as part of the on-site pre-treatment system and must meet the emissions requirements (for volatiles) of 52 F.R. 3748, "Proposed Standards for Control of Emissions of Volatile Organics", February 1987.

e) The POTW must have a NPDES permit to discharge to the Black River, and must maintain compliance with that permit.

2.4 Monitoring Requirements

A monitoring program was established to monitor environmental media at the site for a period of 30 years. The objectives of the monitoring (LTMP, 1993) are:

- To monitor the effectiveness of the remedy and any subsequent remedies;
- To monitor groundwater quality changes and groundwater elevation changes and to identify the presence of new contaminated bedrock flows, seeps, or residential wells;
- To assess the potential for further impacts to public health and the environment; and
- To identify and monitor groundwater changes due to the implementation of the remedy.

The original requirements in the RODs (ROD, 1988; ROD, 1990) included monitoring of existing and new groundwater monitoring wells, residential wells, seeps, surface water, and collected leachate and groundwater. The monitoring program also included recommendations for (a) the installation of new bedrock wells (locations to be determined through additional studies completed prior to and during construction of the remedy), (b) the development of statistical methods for evaluating whether groundwater and leachate were meeting cleanup goals, and (c) consideration of the potential for new chemical compounds to appear as contaminants due to chemical mixing and degradation.

The initial frequency of monitoring for O.U. 1 was quarterly, pending completion of the final remedial action (ROD, 1988). After the construction and implementation of O.U. 2, quarterly sampling of monitoring wells was to continue for a period of three years. The sampling frequency for years four and five was set at semi-annually, per the 1988 ROD, and once per year for years five through ten. After year ten the sampling frequency may be reduced to once every other year. The analytical parameters for groundwater monitoring were VOCs, SVOCs, PCBs, and metals (ROD, 1988). The need to add or remove analytical parameters to this list was to be re-evaluated regularly during the monitoring period. Specifically, the need for monitoring plan modification is to be addressed during each five-year review, at a minimum. Recent modifications to the monitoring program include the elimination of residential well, surface water, and seep monitoring. The list of metals analytes were also reduced.

Currently, the PRP submits an annual O&M report to present monitoring data and analytical data, and provide an evaluation of the leachate collection system, groundwater extraction system, and landfill cap.

2.5 Cleanup Levels

Cleanup levels were developed for both soil and groundwater. The soil cleanup levels were achieved during the implementation of the remedy by capping the solid waste and contaminated soils. Groundwater cleanup levels were established for those contaminants that were identified in the 1988 Endangerment Assessment (EA) which were found to pose an unacceptable risk to either public health or the environment. The site's groundwater cleanup levels are achieved when the analytical data from monitored wells is below the federal MCLs (and the equivalent state criteria). Table 2-1 summarizes the cleanup goals specified in the 1990 ROD for O.U. 2 for a subset of the contaminants of concern identified in groundwater.

Table 2-1
Groundwater Cleanup Goals
Old Springfield Landfill

Parameter	Unit	Cleanup Level / MCL
VOCs		
Benzene	ug/l	5
1,1-Dichloroethene	ug/l	7
Tetrachloroethene	ug/l	5
Trichloroethene	ug/l	5
Xylenes (total)	ug/l	400
Vinyl Chloride	ug/l	2

3.0 DATA REVIEW

3.1 Introduction

TRC reviewed monitoring data presented in the Annual Operations and Maintenance Plans for the site for the following years: 1997, 1999, 2000, 2001 and 2002. As discussed previously, environmental monitoring data are available for the monitoring wells, extraction wells, surface water drainage channels, leachate, seeps, and air discharges. A summary of the reviewed data is presented below.

3.2 Groundwater Monitoring Data

During the five-year review period, groundwater quality at the site has been monitored in 10 monitoring wells and three extraction points on an annual basis for Target Compound List (TCL) VOCs and metals (iron, manganese, molybdenum, mercury and sodium). The locations of the monitoring wells are shown on the figures in Attachment 1.

Originally, groundwater samples were tested for all of the Target Analyte List (TAL) metals, but the metals list has been shortened during the course of the project life per EPA and VTANR approval. In previous years, groundwater samples were also analyzed for base neutral/acid (BNA) extractable (or semi-volatile) compounds and PCBs. However, based on data summarized in the PRP's annual O&M reports, it appears these parameters were dropped from analytical requirements for monitoring wells sometime prior to the current five-year review period.

3.2.1 Metals in Monitoring Wells

There are no site-specific cleanup levels for metals in site groundwater. Conservatively, MCLs are used to evaluate monitoring results for metals (LTMP, 1993).

A review of the 2002 groundwater quality data indicates that only three TAL metals (iron, manganese and/or sodium) were detected above the laboratory quantitation limits. Of the metals detected, MCLs have not been established and only iron and manganese have non-enforceable secondary drinking water standards of 300 ug/L and 50 ug/L, respectively. Iron and/or manganese exceeded the secondary standard in only four of the 10 monitoring wells (MW-20, MW-41B, MW-41G and MW-45B). The highest iron (3200 ug/L) and manganese (1500 ug/L) concentrations were detected in the 2002 sample from monitoring well MW-41G.

3.2.2 VOCs in Monitoring Wells

Prior to the implementation of the groundwater treatment system, more than eight VOC analytes were previously detected in monitoring well samples at levels exceeding the maximum contaminant levels (MCLs) specified in the LTMP. These contaminants include vinyl chloride, methylene chloride, 1,1-dichloroethene, 1,2-dichloroethene (1,2-DCE), 1,1,1-trichloroethane, trichloroethene (TCE), tetrachloroethene, and acetone.

During 1998, three VOC analytes were detected in groundwater samples at concentrations exceeding the site-specific MCLs. These contaminants were vinyl chloride, 1,2-DCE, and TCE. The most recent (2002) round of groundwater monitoring results indicate that only these three contaminants continue to be detected at concentrations exceeding the MCLs. Therefore, it appears that the number of VOC contaminants in groundwater exceeding MCLs has remained stable and did not increase over the past 5 years.

Table 3-1 summarizes the number of monitoring wells in which VOCs were detected at concentrations exceeding the cleanup goals, for each annual sampling event during the 5-year review period. The monitoring wells are broken into three categories based on the subsurface geologic unit over which they are screened (e.g., sand/gravel, till, or bedrock).

Table 3-1
Number of Wells exceeding USEPA MCL VOC Standards
Old Springfield Landfill

	Sept. 1998	July 1999	Sept. 2000	Dec. 2001	Oct. 2002
Total Wells Sampled	10	10	10	10	10
Number of Wells in which one or more VOCs exceeded MCLS:					
Wells Screened in Bedrock	1	1	1	1	1
Wells Screened in Till	1	1	1	1	1
Wells Screened in Gravel/Sand	1	0	0	1	1

MCL -- Maximum contaminant level from National Primary Drinking Water Regulations.

Table 3-2 presents the monitoring well and the concentrations of the contaminants exceeding the MCL during the period from 1998 to 2002.

Table 3-2
VOC MCL Exceedances
Old Springfield Landfill

	MCL Standard	Sept. 1998	July 1999	Sept. 2000	Dec. 2001	Oct. 2002
MW-45B						
Vinyl Chloride	2	8	26	37	83E	36
Trichloroethene	5	5	8	12	36	9
1,2-Dichloroethene	70	31	29	40	100E	31
MW-45T						
Vinyl Chloride	2	2J	31	1J	55E	39
Trichloroethene	5	25	34	26	50	31
1,2-Dichloroethene	70	82	95	84	140E	99
MW-52G						
Trichloroethene	5	40	ND	4J	24	13

MCL -- Maximum contaminant level from National Primary Drinking Water Regulations.
E -- Laboratory estimated value.
J -- Laboratory estimated value.
ND -- Not detected.

3.2.2.1 *Trend Analysis of VOC Data in Monitoring Wells*

An analysis of the temporal trend in VOCs including vinyl chloride, 1,2-DCE and TCE was completed for historical data in three monitoring wells using simple linear regression. Well MW-52G was selected because the well is screened in the high-permeability subsurface gravel layer and the well is located between the extraction wells and the west seep. Wells MW-45T and MW-45B (screened in the till and bedrock layers, respectively) were selected based on their downgradient location at the base of the landfill. VOCs data for each of the three select wells was plotted versus time (one plot for each constituent) and a trendline was incorporated into each plot using a linear line fit. Attachment 2 presents the regression analysis plots.

For the purposes of the temporal analysis, each sample event was represented cumulatively by month, i.e. 1...4...7...n, and paired with a corresponding VOC concentration. All VOC data presented as "less than the method detection limit", were converted to one-half of that value. The paired data were then subjected to a linear regression analysis. TRC has assigned 0.05 a probability (p) levels to all R^2-values generated by the regression analysis with a t-statistic (t_s).

As a guide to this analysis, cited probability or p-values indicate what the likelihood of getting a particular test-statistic would be. More specifically, the p-value indicates the probability of getting a value more extreme than your test result. As a rule of thumb, a test result is statistically significant if $p \leq 0.05$. This means that if 95% of your expected test results fall under the curve, then anything that falls beyond it, say into the 99% bracket, is highly unusual and statistically significant at the 0.01 level (99%). Conversely, if $p > 0.05$ then that is generally reported as non-significant (NS).

Trends in the data are represented in three ways. A (+) sign indicates an increasing trend, a (-) sign indicates a decreasing trend, and (No trend) when time cannot be used to effectively predict which way the concentrations of constituents are going, regardless of the slope of the line. No trend may also indicate that in spite of the absence of a trend, recent "spikes" in the constituent warrant further investigation. A summary of the R^2 and "p" values and related trends that were identified based on the time-series analysis of contaminant trends in each well is summarized in Table 3-3 below.

Table 3-3
Summary Trend Analysis for Select VOCs, 1993 to 2002
Old Springfield Landfill

Well ID	VOC	R^2	p-value	Identified Trend
MW-52G	Vinyl chloride	0.4724	0.002	-
MW-52G	1,2-DCE	0.4595	0.003	-
MW-52G	TCE	0.6677	0.0001	-
MW-45T	Vinyl chloride	0.0385	0.61 NS	No Trend
MW-45T	1,2-DCE	0.0002	0.96 NS	No Trend
MW-45T	TCE	0.0557	0.54 NS	No Trend

Table 3-3 Summary Trend Analysis for Select VOCs, 1993 to 2002 Old Springfield Landfill				
Well ID	VOC	R^2	*p*-value	Identified Trend
MW-45B	Vinyl chloride	0.1561	0.12 NS	No Trend
MW-45B	1,2-DCE	0.2088	0.07 NS	No Trend
MW-45B	TCE	0.0073	0.75 NS	No Trend

Notes:

All reported significance levels are non-directional. Testing of a non-directional hypothesis makes no assumptions about the direction of the correlation relationship. That is, no assumptions are made about the positive or negative relationship between a given set of variables.

N=number of samples; NS denotes non-significance. (-) denotes decreasing trend; (+) denotes increasing trend; and (No trend) indicates that the p-value denotes randomness.

As seen in Table 3-3, analytical results for all three VOC constituents exhibited a decreasing trend in well MW-52G. This decreasing trend could be attributed to the operation of the groundwater treatment system. For all three VOC constituents, the temporal trend in wells MW-45T and MW-45B is not significant and concentrations appear to occur independently of time.

The scatter plots in Attachment 2 depict three, somewhat distinct trends in the shape of the data. Specifically, MW-52G data consistently exhibit a downward trend with some randomness; MW-45T data are widely scattered and random; and finally the data in MW-45B exhibit randomness in combination with what appears to be a pronounced seasonality (cycle and random).

Concentrations of VOCs have been generally decreasing in most of the wells monitored. However, groundwater data from 1998 to 2001 shows a sudden and noticeable increase in concentrations of certain VOCs (i.e., vinyl chloride, 1,1-DCA, 1,2-DCE TCE, and acetone) in bedrock well MW-45B. During the most recent (2002) monitoring round, the concentrations of these VOCs decreased to concentrations more consistent with historic levels, indicating that the previous increases in VOC levels in this well may have been a temporary, seasonally-influenced or non-significant trend. However, the VOC concentrations in this downgradient bedrock monitoring well should be examined in the future for indications of further increases that may indicate the off-site migration of contaminants.

3.2.3 *VOCs in Extraction and Source Control Wells*

The extraction wells (EW-1 and EW-2) remove groundwater from the subsurface sand and gravel unit for the purpose of containing contaminated groundwater to the site boundary, and minimizing the migration of contaminants to the discharge point at the Western Seep. Historically, only one or two VOCs have been detected at low levels in EW-1, while EW-2 contributes a majority of contaminants removed at the PTF. In general, the number of contaminants and the concentrations of contaminants in EW-1 and EW-2 has decreased or remained stable over time (since 1993). This data, in part, indicates these extraction wells are effectively and consistently removing contaminated groundwater from the sand and gravel layer, and controlling migration of contaminants to the Western Seep.

The source control well (SC-1, or EW-3) removes groundwater from the weathered bedrock layer that slopes towards the east, below the site, thereby minimizing migration of contaminated groundwater towards the Black River and the eastern seeps. While the number of contaminants detected has remained stable or increased, the concentrations of contaminants in SC-1 appear to have decreased over time (since 1994). An increase in the number of compounds detected may indicate that degradation products are becoming more prevalent, and that SC-1 has remained effective in capturing contaminated groundwater entering the bedrock layer. In addition, decreasing contaminant concentrations in SC-1 indicate the treatment system, combined with the effectiveness of other source controls (i.e., the cap, French drains, etc.) is limiting the migration of contamination into the bedrock layer and towards the Black River.

Samples are collected annually from EW-1, EW-2 and SC-1 and analyzed for TCL VOCs. In 1998, five VOCs (methylene chloride, vinyl chloride, 1,1,1-trichloroethane, trichloroethene, and tetrachloroethene) were detected in both EW-2 and SC-1 at concentrations at or exceeding their MCLs. In addition, trichloroethene was detected in EW-1 at a concentration exceeding its MCL.

In 2002, 1,1,1-trichloroethane concentrations in EW-2 and SC-1 decreased to below MCLs, but the four other VOCs listed for 1998 (vinyl chloride, 1,1-dichloroethene, trichloroethene and tetrachloroethene) were again detected in both samples at concentrations exceeding the MCLs. In 2002, two VOCs (trichloroethene and acetone) were detected in the EW-1 sample, but at concentrations below the MCL, where applicable.

3.2.4 French Drain Monitoring

Water samples are collected on an annual basis in three French drain valve and meter vaults at the site and analyzed for TCL VOCs. The purpose of the French drains is to intercept off-site groundwater before it enters the landfill mass. Flow from the French drains appears to be seasonally influenced (higher flows during the wetter spring months). This is consistent with the objective of intercepting shallow overburden groundwater. Since the construction of the cap, VOCs have been sporadically detected in the French drain samples. The source of the VOCs may be small amounts of leachate from the adjacent waste areas. The presence of VOCs in the collected water is not a concern since the water is treated at the Pre-Treatment Facility and the POTW.

3.2.5 Groundwater Elevation Contours

Groundwater elevation data was used to prepare potentiometric surface contour maps for the purpose of determining potentiometric gradient and potential contaminant migration pathways, and to evaluate the performance of the leachate collection and groundwater extraction systems. Groundwater elevation data was obtained from the *Annual Operations and Maintenance Report, May 2003*. Depth to groundwater data for the 1998-2003 period included data for five bedrock monitoring wells and 10 overburden monitoring wells. However, depth to groundwater data for the extraction and source control wells were not included in the reports reviewed by TRC.

Therefore, groundwater draw down around the extraction wells is inferred based on water levels from surrounding monitoring wells.

Groundwater elevations measured in site monitoring wells during the past five years were reviewed to determine the highest and lowest water table events. The highest measured water table event during the five-year period occurred during May 2000, and the lowest measured water table event occurred during July 1999.

Groundwater elevations measured during the high and low events in bedrock wells and in overburden wells were each plotted on the site map to evaluate groundwater flow direction. Figures 1 and 2 show the elevations of groundwater in overburden wells and bedrock wells, respectively, as measured during the high event on May 24, 2000. Figures 3 and 4 show the elevations of groundwater in overburden and bedrock wells, respectively, as measured during the low event on July 15, 1999.

As shown in the figures presented in Attachment 1, groundwater flow at the site generally occurs in a northeasterly direction below the cap and then in a more easterly direction, following the steep slope towards the Black River. On the west side of the site, groundwater also flows in a westerly direction towards Seavers Brook. Overall, these elevations indicate a drop in water table elevation of over 200 feet from the top of the site to the base of the slope near the Black River. In general, the water table fluctuated approximately two feet in each well from the low to the high event.

Locally, it is assumed groundwater flow in the vicinity of the source control well and extraction wells (SC-1, EW-1 and EW-2) is influenced by the extraction of groundwater at these points. However, as mentioned above, depth to water measurements for these extraction points was not provided in the documents reviewed as part of this five-year review. Therefore, the groundwater contours derived by TRC in the vicinity of SC-1, EW-1 and EW-2 were based solely on groundwater elevations measured in nearby monitoring wells.

While the extent of the capture zone of EW-1 and EW-2 cannot be determined precisely from the available data, the lower water elevation at MW-41G indicates the extraction is lowering the water table in the local vicinity. The locally low water level at well MW-41B may also be an indication of drawdown caused by the source control well SC-1.

3.3 Surface Water Monitoring

Surface water controls for the site include the interception of seep water from 10 seeps identified on the eastern slope and 4 seeps on the western slope. The seep water is intercepted by a French drain system. The west seep French drain system accounts for a little more than half of the total collection system flow. A surface water collection system was installed to direct surface water runoff away from the waste areas and cap. Concrete and grass lined ditches direct stormwater to a claymax® lined holding pond designed for controlling a 100-year flood.

The LTMP calls for semi-annual testing of a composite sample of drainage channel discharge. Based on available information, it appears EPA and ANR agreed that this surface water sampling could be discontinued as of 1996 or 1997.

Naturally-occurring surface water bodies located in proximity to the site include Seavers Brook, located approximately 350 feet west of the Site, and the Black River, located less than 200 feet east (downgradient) of the Site. These surface water bodies are not sampled as part of site monitoring activities. However, TRC reviewed the following reports by EPA dated 1999: "Lower Black River Assessment Report"; and "Minor Tributaries - Lower Black River Assessment Report" (Reports are included in Attachment 3). The first report discussed the section of the Black River nearest the Springfield, VT Wastewater Treatment Facility (which receives treated groundwater from the site), and the second report included a general discussion of Seavers Brook water quality impacts.

The first report noted that water quality in the Black River was threatened by algae, organic and nutrient enrichment and pathogens as a result of Wastewater Treatment Facility discharges and road runoff from Route 11, but did not reference potential impacts resulting from site conditions. This report also noted that the site was capped and a groundwater pump and treat system was in operation since 1994, and that volatile contaminants from the identified landfill seeps were likely to volatilize before reaching the River, according to Matt Germon of VTDEC. The second report noted that water quality in Seavers Brook was threatened by sedimentation resulting from nearby encroaching developments, but did not mention potential impacts to Seavers Brook from the site.

Construction of the landfill cap and the collection and discharge of leachate to the POTW were designed to eliminate the discharge of contaminants to surface water receptors. With continued maintenance of the landfill cap and leachate collection system, future compliance regarding surface water and sediments can be expected without additional remedial action.

3.4 Extraction System Monitoring

3.4.1 Flow Monitoring

Flows at each of the seven groundwater and leachate collection points are measured continuously by digitized totalizing flow meters. A totalizing flow meter is also located on the downstream side of the equalization tank in the PTF. Leachate flow readings are recorded from meters at each collection point and the PTF influent on a daily basis, and this information is summarized in annual O&M reports for the site.

The design average flow rate for influent to the PTF is 87 gallons per minute (gpm). Historically, actual mean flows have been only about 25% of the design flow rate (around 21 gpm). EW-1 and EW-2 have accounted for a majority (about 75%) of the flow to the PTF. The remainder of flow into the PTF originates from the source control well, French drains 1, 2 and 3, and the eastern leachate seep collection system (LSE 3/4). The running average flow to the PTF (presented in Annual O&M Reports) suggests the flow rate has been fairly steady since 1996.

Flow rates in EW-1 and EW-2 decreased between 1994 and 1999 until new discharge piping was installed due to the build up of fouling agents. The flow rate increased after the new piping was installed and has decreased to pre-1999 levels in 2002. This suggests that the discharge piping has become fouled and should be either cleaned or replaced. Similarly the flow rate from the source control well increased after the replacement of the discharge piping and pump in 2001. The flow rate from SC-1 should be monitored in the future for indications of fouling or pump problems.

The flow rate from the eastern leachate seep collection system (LSE-3 and LSE-4) averages approximately 1.7 gpm. The flow rate varies over time and appears to be seasonally influenced (higher flow during the wet spring months).

The flow rates from the three French Drains average less than 1 gpm each. The flow rates also vary over time and appear to be seasonally influenced.

3.4.2 PTF Influent Concentrations

Quarterly analysis of the combined PTF influent water shows the presence of several VOCs including 11 chlorinated hydrocarbons, acetone, bromoform and MEK. Trichloroethene, vinyl chloride, 1,1-dichloroethene, tetrachloroethene, and methylene chloride are consistently detected above the drinking water standard. The majority of the contaminant load appears to from EW-2 and SC-1. On the other hand, contaminant concentrations in the discharge from EW-1 is consistently below the detection limit and only three concentrations exceeded the drinking water standard since 1993.

3.5 Seep Monitoring

An annual sample of the discharge from the Eastern Leachate Seeps (LSE-3 and LSE-4) is collected in the LSE 3/4 common valve meter vault. The LSE 3/4 samples are submitted for analysis of VOCs. In general, LSE 3/4 analytical results for the past 5 years show similar VOCs present in 2002 and at slightly higher concentrations than in 1997. Of the nine VOCs detected in the LSE 3/4 sample in 1997, two VOCs, vinyl chloride and methylene chloride, were detected at concentrations exceeding their MCLs. In 2002, 10 VOCs were detected in the LSE 3/4 sample. These VOCs included 1,1-DCE, tetrachloroethene, and TCE at concentrations above their MCLs, and vinyl chloride at a concentration equal to its MCL. In 2002, TCE was detected at an unusually high concentration (310 μg/L), over 60 times its MCL. This concentration was well above the long-term average for TCE in the LSE 3/4 samples.

The Western Seep is sampled on a quarterly basis for VOCs and metals and annually for PCBs, pesticides and SVOCs. A review of analytical data from 1997 and 2002 suggests that contaminant concentrations are decreasing. During the 1997 annual sampling period, six TAL Metals were detected in the Western Seep sample (barium, calcium, manganese, magnesium, potassium, and sodium) at concentrations below drinking water standards. PCBs, pesticides, and SVOCs were not detected above laboratory reporting limits in the 1997 samples. One VOC (methylene chloride) was detected in the summer, fall and winter 1997 quarterly samples, each time at concentrations exceeding its MCL.

In 2002, no VOCs were detected in the Western Seep sample in February and July, and up two three VOCs were detected at low concentrations (well below MCLs) in March and October. Therefore, VOC levels in the Western Seep appear to have decreased over the past 5 years.

The LTMP calls for the sampling of any newly identified seeps. Two new seep samples were collected on May 29, 2003. In accordance with the LTMP, one sample was collected from a new seep (LSE-1A) in a sinkhole area located approximately half way between LSE-01 and LSE-02. A second sample ("Headwall") was collected from a suspected seep, where water was flowing over the concrete lining at the junction of two fabriform ditches near the southeast corner of the site. In addition a third sample was collected from the LSE-02/Station 2 seep location at eh request of EPA. The May 2003 seep samples were submitted for analysis of Target Analyte List (TAL) Metals and VOCs. A copy of the laboratory analytical report for the May 2003 Supplemental Seep sampling is included in Attachment 4.

VOCs were not detected above the laboratory's method detection limits in either the LSE-1A or the LSE-02 samples. Acetone and methylene chloride were detected in the Headwall sample, but at concentrations below applicable MCLs.

Metals were not detected at concentrations exceeding applicable MCLs in the Headwall sample. Antimony was detected at concentrations of 8.2 and 7.4 μg/L, in the new seep (LSE-1A) and Station 2 (LSE-2), respectively. These concentrations exceed the MCL of 6 μg/L for Antimony. Concentrations of this metal previously did not exceed the MCL in the seeps sampled during the five-year review period or before. According to David Deane of Dufresne-Henry, antimony is not known to be a site contaminant, but was likely used at one or more of the manufacturers historically operating in Springfield. Only methylene chlorifde was detected at an estimated concentration o 1 ug/L in the Headwall and LSE-1A samples.

3.6 System Performance Evaluation

The selected remedy for the site includes both source control and management of migration (through groundwater containment) components including:

- providing alternative water supply to residents;
- grading and placement of a RCRA cap over the landfill;
- surface water controls;
- leachate collection/groundwater extraction;
- treatment of leachate and contaminated groundwater onsite and at the Springfield Publicly Operated Treatment Works;
- monitoring; and
- institutional controls.

3.6.1 Cap and French Drains

The remedial objectives of the cap have been achieved by preventing direct exposure to waste and contaminated soils and controlling gas emissions. There is no indication that the cap is leaking, therefore, the objective of reducing or eliminating the generation of landfill leachate has been met. The cap is well-maintained, and is periodically inspected and repaired as necessary.

Two French drain systems were constructed to intercept upgradient, overburden ground water and prevent it from entering the wastes of Waste areas 3 and 4. The French drain systems extend to about 25 feet below ground surface (bgs) and are designed to intercept shallow groundwater that may migrate along the top of till. Water collected in the French drain sumps is pumped to the PTF.

The running average flows in the French drains have remained fairly steady since 1995. Monthly flows in the French drains vary, apparently due to seasonal fluctuations in the shallow groundwater table. The overall steady average flow in the French drains indicates the French drain system is operating reliably and as intended.

3.6.2 Extraction Wells

The groundwater extraction system includes two groundwater extraction wells (EW-1 and EW-2). These extraction wells were installed in the vicinity of Waste Areas 3 and 4 to extract contaminated groundwater from the shallow sand and gravel layer that exhibits a preferential gradient towards Seavers Brook and the Western Seep. Extracted groundwater is routed to the PTF prior to being conveyed to the POTW. About half of the water received at the PTF is derived from these extraction wells.

While the degree of containment is uncertain, groundwater elevations in the vicinity of the extraction wells indicate localized groundwater containment. Additional evidence of groundwater containment is the decreasing contaminant trends in wells MW-41G and MW-52G. Contaminant concentrations have been below the MCL in MW-41G since 1998 and the regression analysis presented herein shows decreasing trends for vinyl chloride, 1,2-Dichloroethene, and TCE at well MW-52G. Both of these wells are located within the sand and gravel unit near or downgradient of the extraction wells.

The concentrations of chemicals of concern at the site have basically stabilized. The primary contaminant of concern, trichloroethene, remains at a concentration of about 1 ppm at the influent to the PTF, which is at a level about 200 times the potable groundwater standard. Declines in well concentrations over time should occur as the source material is depleted, by natural degradation, by sorption to organic matter, natural chemical reactions, dispersion and capture by the treatment system.

The steady concentration of TCE in groundwater may be due to the presence of free product TCE in the ground, also referred to as dense nonaqueous phase liquid (DNAPL). The natural biodegradation of TCE to vinyl chloride and 1,2-DCE likely accounts for their presence at stable levels in groundwater. The slow steady leaching of TCE DNAPL and desorption from the matrix rock will likely continue at the site for tens of years or longer.

In general, the groundwater extraction system appears to be functioning as originally approved in 1994 and is consistent with its intended purpose of groundwater containment. Continued monitoring at remote monitoring wells and continued operation of the leachate and groundwater recovery system will ensure the effectiveness of the groundwater containment system.

3.6.3 Source Control Well

The source control well, SC-1 (also referred to as EW-3) is located within Waste Area 3 to extract contaminated groundwater from the underlying weathered bedrock formation. SC-1 was configured to target the bedrock groundwater that would otherwise flow downgradient (over the steep bedrock incline) towards the Black River. Groundwater that is recovered in SC-1 is pumped to the PTF prior to being conveyed to the POTW.

In general, the running average flow in SC-1 decreased gradually from 1995 to 2000, and has been increasing slightly since 2000. In particular, daily flows have been slightly higher, overall, since July 2001. The reason for this increase is unclear, but could be related to the replacement of the pump in SC-1 in 2001.

Based on the regression analysis, concentrations of contaminants are not increasing with time at well MW-45B. This suggests that no additional contaminants are migrating from the site through the upper weathered bedrock to the west. Ultimately the groundwater contamination in well MW-45 is expected to discharge into the Black River and become highly diluted and likely below aquatic risk levels. In any case, the nearby residences are on a public water supply and are therefore protected from groundwater consumption exposures.

3.6.4 Western Leachate Seep

The Western Seep refers to groundwater that formerly discharged to the ground surface to the west of the site, near Seavers Brook. Prior to the implementation of the remedy, it was found that this groundwater was contaminated with landfill related contaminants. The source of the Western Seep appears to be the sand and gravel unit present in the waste areas that has a hydraulic gradient to the west. To prevent human contact and/or ingestion with this seep, groundwater is intercepted at the Western Seep via a French drain and is discharged to the POTW untreated. The leachate and groundwater quality is monitored and reported in accordance with the POTW permit for volatile organic compounds, total metals and alkalinity/conductivity.

As a result of the operation of the Western Seep collection system, the Western Seep has been effectively captured and is no longer exiting at the ground surface. Running average flow rates for the Western Seep collection system show a sharp decrease in flow in 1993. Flows have remained steady since 1994 (around 26 to 27 gallons per minute). This may suggest that the flow to the Western seep was affected by the groundwater extraction system within the landfill.

3.6.5 *Eastern Leachate Seeps*

The capture and treatment of two primary leachate seeps, located on the east side of the landfill, was included as part of the remedy. These eastern leachate seeps, LSE-03 and LSE-04, were formerly located near the middle of the steep slope on the eastern side of the landfill. A French drain collection network with two sumps (LSE-03 and LSE-04) was installed in 1993 to collect the eastern seeps and convey them to the PTF for treatment prior to being discharged to the POTW. The combined flow from LSE-03/04 is measured in their shared meter vault.

The fact that no new seeps have developed in the area of LSE-3 and LSE-4 indicates the collection system is effectively capturing the leachate and preventing the leachate from impacting surface water resources.

As discussed in Section 3.5, a new small seep has developed on the eastern slope where the two fabriform concrete-lined ditches converge. This flow was observed by TRC, Dufresne-Henry and EPA during a site visit in May 2003. The flow rate of the seep could not be estimated accurately, but appeared to be less than 1 gallon per minute. The new seep has likely developed because the concrete lining prevents normal discharge of shallow groundwater into the drainage channels. Therefore, shallow groundwater would tend to concentrate at the convergence of the two fabriform channels. Samples show moderate levels of some leachate indicators (i.e., iron and manganese). However, flow from the new seep is low and contaminants will be highly diluted in the receiving surface water (Black River).

3.7 Air Monitoring, Emissions, and Compliance

The landfill gas vents and an air stripper used as part of the contaminated groundwater treatment system emit some contaminants to the ambient air. Analytical data for landfill gas samples collected by the PRP in 2001 were evaluated to identify any applicable air regulations.

3.7.1 *Potential Landfill Gas Emission Routes to the Atmosphere*

The landfill vents extend to some depth below the landfill cover to provide an outlet for gases generated in remaining waste. The vents help to minimize the amount of potentially explosive methane gas in the landfill, a major constituent of landfill gas.

The groundwater treatment system at the site employs an air stripper where volatile and, to a lesser degree, semi-volatile contaminants are preferentially transferred from liquid media (groundwater) to gaseous media (air) within the stripper. The contaminant-bearing air stream is then passed through a carbon bed where the contaminants adhere to the carbon. The carbon beds are changed periodically to minimize breakthrough, noted as a sharp increase in the levels of one or more contaminants in the exhaust air.

3.7.2 *Emissions Data*

Air emissions test data were obtained by the PRP's contractor in 2001. Test results for the air stripper compared influent and effluent concentrations for target analytes along with respective

Vermont Hazardous Ambient Air Standards (HAAS) and "potential release" estimates for 8-hour periods. Results for each landfill gas vent are compared the HAAS and NIOSH 8-hour TWA but do not include any exhaust flow data.

3.7.3 Regulatory Review

Air emissions from landfills are potentially subject to state and Federal air regulations.

3.7.3.1 State Air Regulations

Vermont's Air Pollution Control Regulations are found in Chapter V of the Environmental Protection Regulations. The regulations generally focus on new sources or modifications to existing sources that emit air contaminants above specific regulatory thresholds. The air emissions data reviewed for this site did not include any quantification of emissions (mass of contaminant emitted per unit time) for the landfill vents that would be required to conduct a more complete regulatory applicability analysis of the site. Given that restraint, the following is a review of regulations that may apply to the site, but for which no definitive conclusion may be drawn for some regulations due to the lack of quantified emissions data.

Item (17) of 5-401 (Classification of Air Contaminant Sources) allows for a case-by-case determination to be made by the Air Pollution Control Officer. The corresponding Air Pollution Control Permitting Handbook (1999) indicates that a new landfill could be considered as an air contaminant source under 5-401(17). However, the subject landfill is not a new source and does not trigger any current air permitting requirements. The permitting threshold for sources identified in this regulation is allowable emissions of "10 tons per year or more of all air contaminants in the aggregate". A source meeting this requirement is referred to as a "Subchapter X major source".

Regulation 5-253(20) (Other Sources that Emit Volatile Organic Compounds) contains a minimum emissions threshold of 50 tons per year, above which the regulation applies. A number of the contaminants measured as part of the air monitoring effort at the site are classified as VOCs. Landfill gas, at the methane-producing stage, consists mostly of methane and carbon dioxide, with small amounts of non-methane organic compounds (NMOCs). The NMOCs include the VOCs reported in the ambient sampling for the site. Given the low concentration levels of NMOCs in landfill gas, it is unlikely that the site has VOC emissions approaching the 50-ton per year threshold.

Regulation 5-261 (Control of Hazardous Air Contaminants) applies to any source that emits a hazardous air contaminant above a contaminant-specific Action Level, given in terms of pounds of contaminant emitted per 8-hour period. Under subpart (2) of this regulation, a facility emitting any Category I contaminant listed in Appendix C had to submit an emissions inventory to the Air Pollution Control Officer by December 31, 1993. Review of the sampling data reveals a number of Category I air contaminants were sampled by OSM. Under (6)(a) of this regulation, any source emitting a Category I air contaminant after January 1, 1993 cannot cause an exceedance of a stationary source hazardous air impact standard (numerically equivalent to the

HAAS, see Appendix C of the regulations). A stationary source may be requested by ANR to conduct an air dispersion modeling study to evaluate its compliance with (6)(a).

There are provisions for the ANR to modify a HAAS and, under 5-261(7), to develop an HAAS for a facility emitting a hazardous air contaminant which is not listed in Appendix B of the regulations. It is possible that the subject facility may have to demonstrate compliance with any modified or new HAAS at the request of ANR. A "General News" item on the Air Pollution Controls Division (APCD) indicates that APCD and the VT Department of Health are working jointly on revisions to the HAAS. No target date for the revisions is identified in the brief.

Information available on the ANR's Vermont Air Toxics Program web page indicate that "most" point sources are required to register their hazardous air contaminant (HAC) emissions annually. ANR's Point Source Registration Program web page contains the annual reporting threshold of 5 tons per year of actual emissions of criteria pollutants. While not explicitly stated on either of the above web pages, it is likely that any source meeting the annual registration requirement would also trigger the need to report HAC emissions. A review of annual emissions for sources in VT also available on the ANR website for two recent years does not include the subject landfill.

The state's air pollution control regulations address ambient air quality standards for the criteria pollutants in sections 5-302 to 5-312, reflecting the National Ambient Air Quality Standards (NAAQS). Vermont also has ambient standards for particulate matter (total suspended particulate) and a secondary standard for sulfates at 5-312.

For a source that ANR felt was causing or contributing to a condition of air pollution, the ambient air quality standards and/or HAAS would form the basis for demonstrating compliance through the conduct of an air dispersion modeling study for such a source. Sampling data for the subject site are compared with HAAS. Sampling results for the water stripper exhaust show that none of the action levels (pounds per 8-hour period) are triggered. Results for the landfill vents indicate that some hazardous air contaminants are emitted to the atmosphere in concentrations exceeding respective HAAS. Given the difference between measured data from within the source and HAAS, it is likely that the emitted air contaminants would not pose a threat at the facility property line, the nearest point at which ambient air is defined. Further, based on a discussion with an ANR representative (see below), an opinion was expressed that the subject landfill does not pose any threat to ambient air quality standards and/or the HAAS as of this writing. Although the HAAS were exceeded, the HAAS are based on constant lifetime exposure and site workers are briefly and infrequently exposed to gas vents.

Air quality modeling may be required under 5-406 by ANR for any new source or modification to an existing source addressed under 5-501 and for indirect sources at 5-503. The subject source is not classified as new and is not an indirect source, and modeling is therefore not required under this regulation.

Regulation 5-241 (Prohibition of Nuisance and Odor) is a wide-ranging regulation that addresses conditions that may emanate from the site, such as odor, that may trigger a regulatory review and possible enforcement action if detected beyond a facility's property line. It is possible that ANR could require a source to perform an air dispersion modeling analysis of the problem source as part of their evaluation. Given the low odor detection levels of some components of landfill gas, such as hydrogen sulfide, there is incentive for the facility's operator to maintain equipment in good working order.

Vermont's operating permit program regulations are found in Subchapter X. The subject landfill does not meet any of the applicability criteria under 5-1003, and is therefore not subject to this regulation.

3.7.3.2 State Agency Contact

As part of this effort, TRC contacted an ANR representative familiar with the state's landfill air emissions. Mr. Doug Elliott stated that the landfills that were closed in the 1990s were all reviewed and the appropriate level of air emissions controls was in place.

3.7.3.3 Federal Air Regulations

Federal air regulations are not applicable to the Old Springfield Landfill. The Federal rules for landfills apply to facilities that have accepted waste after November 7, 1987 and have uncontrolled non-methane organic compound (NMOC) air emissions of approximately 55 tons per year. (National Emission Standards for Hazardous Air Pollutants (NESHAPS) at 40 CFR 63 Subpart WWW (Municipal Solid Waste Landfills) and New Source Performance Standards (NSPS) at 40 CFR 60 Subpart Cc (Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills))

A MACT standard is being developed by EPA under 40 CFR 63 Subpart AAAA. This standard will only apply to facilities meeting the same applicability criteria as NESHAPS WWW. Therefore, the proposed MACT standard does not apply to the Old Springfield Landfill.

The air stripper vent is subject to performance criteria under RCRA regulations at Subpart CC. These regulations were identified as an ARAR via a reference in the ROD to regulations proposed in 1987 that eventually were promulgated as Subpart CC. This control device employs activated carbon to reduce emissions. The RCRA regulations call for 95 percent removal of all organics by the carbon media with carbon media changes occurring on a regular basis. Periodic sampling of the exhaust should be done to monitor for breakthrough. The sampling period may range from daily to one-fifth of the period expected for total working capacity to be used. If breakthrough occurs, the media should be changed immediately with the contaminated media disposed of properly.

TRC reviewed four sets of measurement data for the carbon bed influent and effluent for 2002. The results show that for 3 of the sets of measurements (2/6, 4/24, and 8/9), the 95 percent control efficiency was being achieved. The measurement data for 10/3 showed 53 percent control. However, there is at least one unusual finding associated with that data that could be used to challenge its validity. A number of compounds were detected in the effluent in concentrations greater than seen in the influent measurements. The total loading of organics into the carbon bed for the October test was also the lowest of the four tests. One other potential factor in the lower control level could be the elapsed time from the last carbon media change to the October test. The average control for the 4 tests is 92 percent, just below the 95 percent threshold in Subpart CC.

3.7.4 Compliance with Air Regulations

Based on available information, a review of Federal and state air regulations for the Old Springfield landfill indicates that the facility is not subject to existing air permitting requirements. However, some additional future effort may be required at the request of VT ANR to demonstrate compliance with any new or revised HAAS.

Further, review of existing and proposed Federal air regulations for landfills indicates that the facility should not be subject to NSPS or MACT standards. However, it appears that monitoring of the air stripper carbon bed performance should be more frequent and that the media should be changed as soon as breakout has been detected to comply with RCRA requirements.

4.0 SITE INSPECTION

4.1 Summary of Current Site Inspection

Amy Stattel, a TRC engineer, conducted the semi-annual inspection of the Old Springfield Landfill on April 18, 2003. The inspection was performed as part of the semi-annual inspection and also the Five-Year Review for the landfill. The Semi-Annual Inspection Report is presented at Attachment 5. A Five-Year Review checklist was used to document the observations made during the inspection. The report is based on observations made by TRC during the visual inspection of the landfill surface. No testing was performed on components of the landfill system.

TRC inspected components of the landfill cover system, as summarized below.

- **Landfill surface** – The landfill surface was generally in good condition with some rodent holes on Waste Areas 3 and 4.

- **Fabri-Form Channels**– Overall, the three Fabri-Form channels were observed to be in good condition. A slight separation was observed at a seam in the Fabri-Form material in the southern channel. A cavity was present in the soils next to the seam, where runoff was entering the cavity from off the cap. Repair of the channel was recommended to prevent further degradation of the Fabri-Form channel.

- **Cover penetrations** – In general the gas vents and gas vent sheds were in good condition with no signs of operational issues. However, rodent damage, including mounded soil and displaced insulation, was observed in many of the sheds. TRC recommended removal of the mounded soils and continued rodent control measures. The O&M staff indicated that they planned to install concrete floors in the gas vent sheds in the next year. This should not affect the performance of the gas vents.

- **Cover drainage layer** – The drain pipe outlets for the drainage layer into the Fabri-Form channels appeared to be in good condition and flowing freely.

- **Detention/Sedimentation Basin** – A recent slope failure was observed on the western sidewall of the detention basin, near the southwest corner. The Geosynthetic Clay Liner appears to be degraded and is promoting infiltration of water into the soils underlying the basin. Due to sidewall erosion that has occurred in the past (2001-2002), TRC recommended that the GCL below the detention basin be replaced, and that the sidewall be repaired.

- **Groundwater systems** – The above ground portions of the systems were in good condition. At the time of the inspection, the granular activated carbon units in the PTF were being replaced.

Recommendations of corrective actions based on the inspection included the investigating the cause of the seep and repairing related erosion in the detention basin, repair of the split in the southern Fabri-Form channel, continued monitoring and removal of sediments and vegetation in the channels, and continued rodent removal on the cap. The overall conclusion based on the site inspection is that the components of the landfill cover system are working as designed, with the exception of the detention basin.

4.2 Past Inspections

Semi-annual inspections of the Old Springfield Landfill have been conducted by TRC since November 1999. There have been no major issues regarding the operation and maintenance of the landfill remedial system. Operations, maintenance, and monitoring have adequately established the landfill cap integrity, leachate collection, and groundwater extraction systems continued operation.

5.0 INTERVIEWS

During the semi-annual inspection of the Old Springfield Landfill on April 18, 2003, Amy Stattel of TRC interviewed Mr. Rick Chambers, Chief Operator of the Town of Springfield Wastewater Treatment Plant/Publicly-Owned Treatment Works (POTW). Mr. Chambers, on behalf of the POTW, oversees the operations and maintenance of the landfill on an ongoing (almost daily) basis. Mr. Chambers was at the site on the day of the inspection to answer TRC's questions and to oversee the replacement of the granular activated carbon units at the PTF.

TRC asked if there were any outstanding operational/maintenance issues to be aware of during the semiannual inspection. Rick indicated that a system alarm was currently sounding at the pre-treatment building control panel due to defective pump in groundwater pumping well LSE-3 (manhole P4). He indicated that the pump would be replaced the following week (week ending 4/25/03).

TRC asked what the flow has been from the pretreatment building to the POTW (given the snowmelt from winter 2002/2003 and the heavy spring 2003 rains). Mr. Chambers indicated that the total flow (2003, to-date) was currently at 30,000 gallons as of April 2003, and that the site discharge permit is for 75,000 gallons annually. He also indicated that the total flow for fall/winter last year was only 18,000 gallons, so the total annual flow last year was well below the permitted annual flow.

On July 23, 2003, TRC contacted Rick Chambers via telephone for a follow-up interview. TRC asked about maintenance events in the last year that may have influenced flow. Rick indicated that the pump in LSE-3/P4 (pump was malfunctioning during TRC's Spring 2003 Inspection) was replaced at the end of April 2003. Rick also indicated that the switch meters are cleaned periodically due to fouling, but that this activity has a temporary effect only on localized flow; not total flow. Also, they plan to gradually replace all of the iron extraction system lines (2 or 3 per year) with plastic pipes to decrease clogging (some already replaced). Other periodic flow-maintenance activities performed by the POTW staff include periodic replacement of the screens at the ends of the lines to the french drains because they tend to get clogged.

6.0 TECHNICAL ASSESSMENT

6.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

6.1.1 Remedial Action Performance

The work performed during production of this memorandum indicates that the remedy is functioning as intended. The information sources include review of the available documents and data, TRC's trend and statistical analysis of groundwater, the interview, and the site inspection. The landfill cap, and the O&M of the leachate seep collection and groundwater extraction systems have achieved the remedial objectives: to minimize the migration of contaminants and prevent direct contact with or ingestion of contaminants. Based on the fairly consistent detection of VOCs in perimeter monitoring wells over the past five years, and the slowly decreasing concentrations, the long term goal of groundwater restoration at the site will likely not be achieved for many years.

The lack of statistical trends in VOC concentrations in a few wells (i.e., MW-45T and MW-45B) warrant close monitoring in future inspections and data reviews to evaluate whether the migration of impacted water off-site is increasing or additional hydraulic controls may be considered to ensure the capture of landfill contamination. These wells monitor the deep-aquifer groundwater that flows east towards the Black River.

The presence of leachate indicators (manganese and iron) at low concentrations in new seeps does not warrant additional sampling.

6.1.2 System Operations/O&M

Operation and maintenance of the cap and leachate seep collection and groundwater extraction systems has been, and continues to be effective. Issues identified during the semi-annual site inspections are regularly addressed or continue to be monitored.

Groundwater flow and potentiometric surface is currently measured at only seven bedrock wells and 14 overburden wells. Only one bedrock well (MW-45B) located on or at the base of steep eastern slope (downgradient of wastes) is included in groundwater elevation measurements, to monitor the hydraulic gradient related to the weathered bedrock unit that flows towards the Black River. Also, only one overburden well is measured within the sand and gravel layer to the west of the landfill, where shallow groundwater tends to flow towards the Western Seep. To more accurately evaluate groundwater flow and the effectiveness of the groundwater containment system (source control and extraction wells), TRC recommends adding additional wells to regular groundwater elevation measurement activities. Specifically, it would be useful to add groundwater elevations from deep wells on the west slope (e.g., MW-42T, if serviceable) and from available shallow wells on the east side of the site, between the extraction wells and the Western Seep (e.g., MW-29, MW-15). Water levels in the extraction wells (EW-1, EW-2 and SC-1) should also be measured at least once per year in order to evaluate drawdown and capture at the wells.

6.1.3 Opportunities for Optimization

The groundwater extraction system is the only system at the Site where optimization is possible. The low level of contaminants in the discharge of EW-1 indicates extraction at that point is not needed, or the extraction rate is too high causing excessive amounts of clean groundwater to be drawn into the well. If optimization is attempted, the EW-1 flow rate should be reduced gradually over a period of months. The concentration in the discharge should be monitored periodically until the contaminant removal rate is maximized. Groundwater in the sand and gravel unit should be monitored quarterly, if not monthly to ensure that contaminant concentrations do not increase indicating a decrease in the extraction well capture zone.

6.1.4 Early Indicators of Potential Issues

One indication of a potential performance deficiency in the remedy is the lack of statistical trends (continued detection) in VOC concentrations in monitoring wells MW-45T and MW-45B. The data should be monitored for an increasing trend that may indicate VOCs in the weathered bedrock unit are bypassing the source control well and migrating to the east towards the Black River.

6.1.5 Implementation of Institutional Controls and Other Measures

Institutional controls implemented at the site include the fencing of the landfill to limit access and exposure, limited development within the fence line, the restriction of groundwater use by the town of Springfield outside the fence enclosing the cap, and a public water supply provided to nearby residents. The attached figure (Attachment 6) shows the location of the water supply line currently utilized by nearby residents. No activities were observed that would have violated the institutional controls.

6.2 Question B: Is There a Need to Update any of the Monitoring Plans used to Evaluate the Performance of the Remedy?

TRC conducted a review of the sampling and analytical procedures to determine the need to update any of the monitoring plans used to evaluate the performance of the remedy. Prior to the implementation of the remedy, hydraulic monitoring was conducted about semiannually at up to 23 monitoring wells. However, the number of monitored wells has declined sharply. The list of wells recommended in the 1993 LTMP for groundwater elevation measurements did not include the wells described above. Consideration should be given to supplementing the number of groundwater elevations measured and improving accuracy in evaluating groundwater flow by adding additional wells.

6.3 Question C: Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

From all of the activities conducted as part of this five-year review, no new information has come to light which would call into question the effectiveness of the remedy. No new human or ecological receptors have been identified at this time. No evidence of damage due to natural disasters or lack of maintenance was noted during the site inspection.

7.0 REFERENCES

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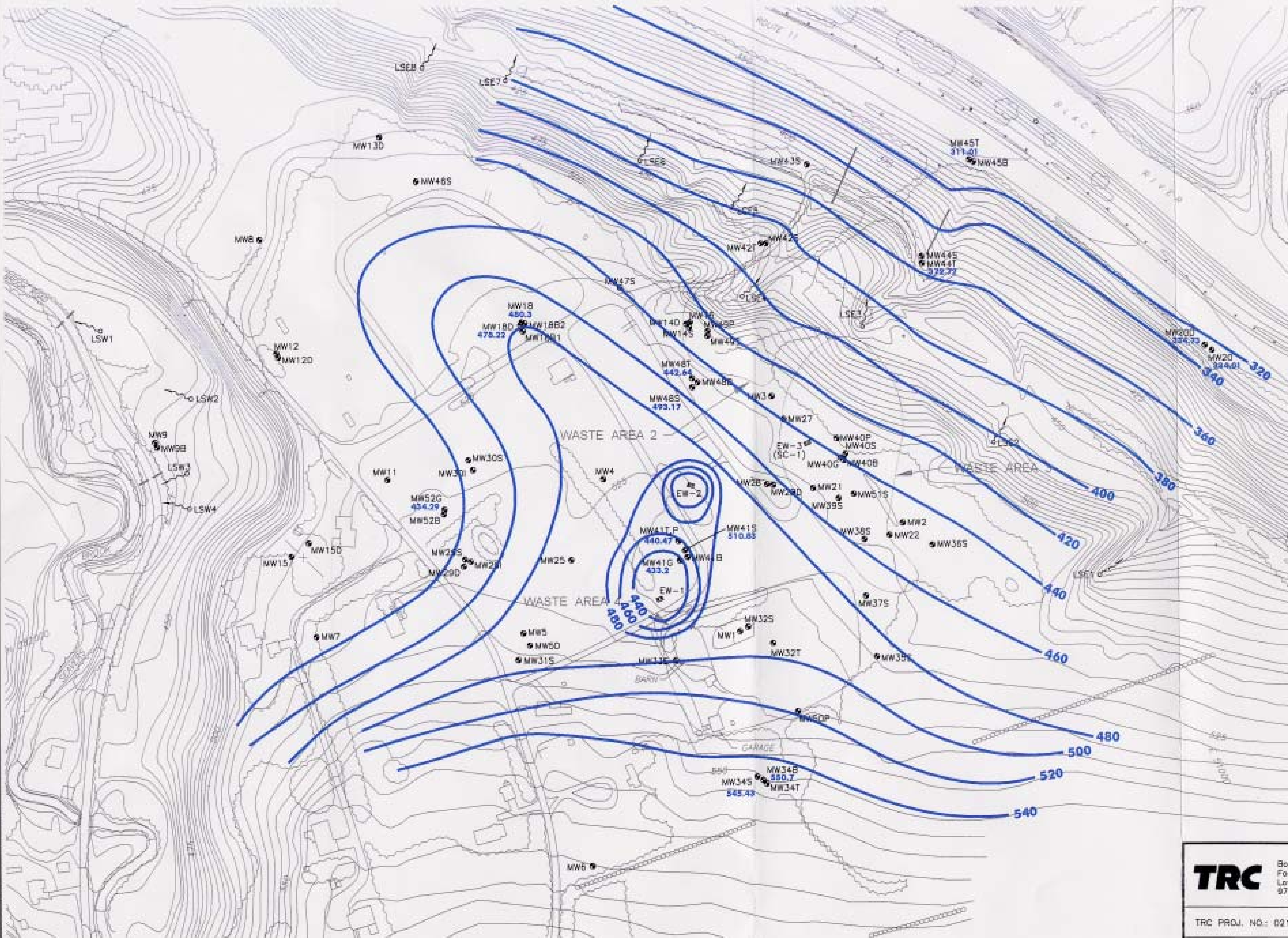
ATTACHMENT 1

FIGURES



LEGEND:

- 375 — CONTOUR INTERVAL 5 FEET
- • POLE OR FENCE POST
- LSE3 — SEEP/SPRING LOCATION AND DESIGNATION
- IDENTIFIED LIMITS OF SOLID WASTE DISPOSAL AREA
- RIVER OR CREEK
- EXISTING CULVERT
- MW3 550.7 — MONITORING WELL LOCATION AND DESIGNATION WITH GROUNDWATER ELEVATION DATA
- EW-1 — EXTRACTION WELL LOCATION
- 320 — APPROX. GROUNDWATER CONTOUR

NOTES:

1. COMPLETE CONSTRUCTION ACTIVITIES ASSOCIATED WITH OU1/I NOT SHOWN AS EXISTING CONDITIONS ON THIS PLAN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. DEPTH TO GROUNDWATER DATA FOR EXTRACTION WELLS WAS NOT AVAILABLE FOR THE GROUNDWATER EVENT SHOWN. THEREFORE, GROUNDWATER CONTOURS ARE BASED ON MONITORING WELL ELEVATION DATA ONLY.

BASE MAP SOURCE:
REMCOR, APRIL 6, 1993. DRAWING NO. 92093-E124.

SCALE, FEET
100 0 100 200

TRC
Boott Mills South
Foot of John Street
Lowell, MA 01852
978-970-5600

TRC PROJ. NO.: 02136-0530-02022

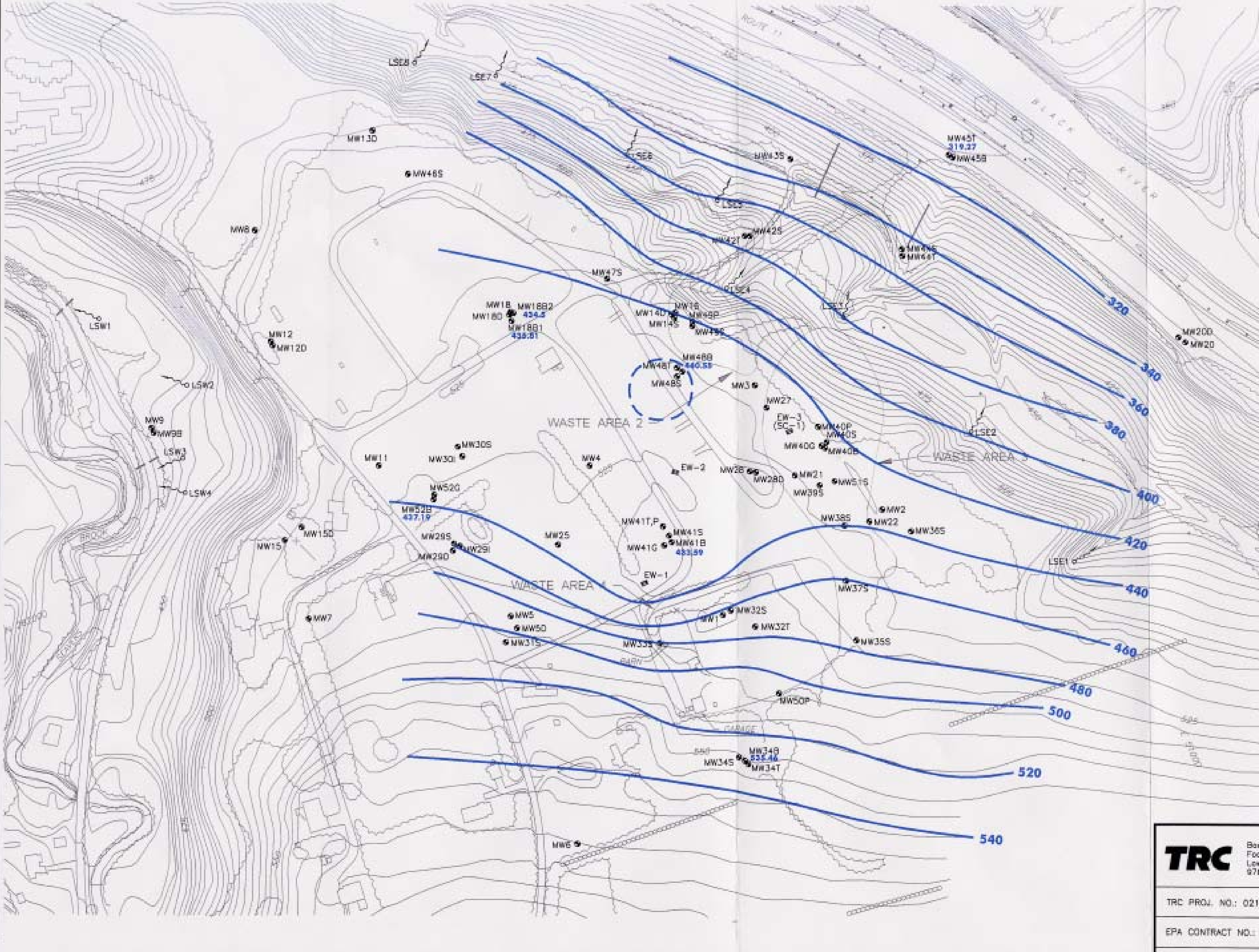
EPA CONTRACT NO.: 68-W6-0042

RAC SUBCONTRACT NO.: 107061

FIGURE 1
GROUNDWATER CONTOUR MAP
MAY 24, 2000
HIGH GROUNDWATER CONDITIONS
OVERBURDEN WELLS

OLD SPRINGFIELD LANDFILL
SPRINGFIELD, VERMONT

M&E Metcalf & Eddy



LEGEND:

375	CONTOUR INTERVAL 5 FEET
•	POLE OR FENCE POST
LSE3	SEEP/SPRING LOCATION AND DESIGNATION
	IDENTIFIED LIMITS OF SOLID WASTE DISPOSAL AREA
	RIVER OR CREEK
	EXISTING CULVERT
MW3 319.27	MONITORING WELL LOCATION AND DESIGNATION WITH GROUNDWATER ELEVATION DATA
EW-1	EXTRACTION WELL LOCATION
320	APPROX. GROUNDWATER CONTOUR

NOTES:

1. COMPLETE CONSTRUCTION ACTIVITIES ASSOCIATED WITH OU1/I NOT SHOWN AS EXISTING CONDITIONS ON THIS PLAN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. DEPTH TO GROUNDWATER DATA FOR EXTRACTION WELLS WAS NOT AVAILABLE FOR THE GROUNDWATER EVENT SHOWN. THEREFORE, GROUNDWATER CONTOURS ARE BASED ON MONITORING WELL ELEVATION DATA ONLY.

BASE MAP SOURCE:
REMCOR, APRIL 6, 1993. DRAWING NO. 92093-E124.

SCALE, FEET
100 0 100 200

TRC
Boott Mills South
Foot of John Street
Lowell, MA 01852
978-970-5600

TRC PROJ. NO.: 02136-0530-02022

EPA CONTRACT NO.: 68-W6-0042

RAC SUBCONTRACT NO.: 107061

FIGURE 2
GROUNDWATER CONTOUR MAP
MAY 24, 2000
HIGH GROUNDWATER CONDITIONS
BEDROCK WELLS

OLD SPRINGFIELD LANDFILL
SPRINGFIELD, VERMONT

M&E Metcalf & Eddy

LEGEND:

- — 375 — CONTOUR INTERVAL 5 FEET
- • POLE OR FENCE POST
- LSE3 SEEP/SPRING LOCATION AND DESIGNATION
- IDENTIFIED LIMITS OF SOLID WASTE DISPOSAL AREA
- RIVER OR CREEK
- EXISTING CULVERT
- MW3 309.81 MONITORING WELL LOCATION AND DESIGNATION WITH GROUNDWATER ELEVATION DATA
- EW-1 EXTRACTION WELL LOCATION
- — 320 APPROX. GROUNDWATER CONTOUR

NOTES:

1. COMPLETE CONSTRUCTION ACTIVITIES ASSOCIATED WITH OU1/I NOT SHOWN AS EXISTING CONDITIONS ON THIS PLAN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. DEPTH TO GROUNDWATER DATA FOR EXTRACTION WELLS WAS NOT AVAILABLE FOR THE GROUNDWATER EVENT SHOWN. THEREFORE, GROUNDWATER CONTOURS ARE BASED ON MONITORING WELL ELEVATION DATA ONLY.

BASE MAP SOURCE:
REMCOR, APRIL 6, 1993. DRAWING NO. 92093-E124.

SCALE, FEET
100 0 100 200

TRC Boott Mills South Foot of John Street Lowell, MA 01852 978-970-5600	FIGURE 3 GROUNDWATER CONTOUR MAP JULY 15, 1999 LOW GROUNDWATER CONDITIONS OVERBURDEN WELLS
TRC PROJ. NO.: 02136-0530-02022	OLD SPRINGFIELD LANDFILL SPRINGFIELD, VERMONT
EPA CONTRACT NO.: 68-W6-0042	
RAC SUBCONTRACT NO.: 107061	Metcalf & Eddy

LEGEND:

— 375 —	CONTOUR INTERVAL 5 FEET
•	POLE OR FENCE POST
LSE3	SEEP/SPRING LOCATION AND DESIGNATION
	IDENTIFIED LIMITS OF SOLID WASTE DISPOSAL AREA
	RIVER OR CREEK
	EXISTING CULVERT
MW3 537.31	MONITORING WELL LOCATION AND DESIGNATION WITH GROUNDWATER ELEVATION DATA
EW-1	EXTRACTION WELL LOCATION
— 320	APPROX. GROUNDWATER CONTOUR

NOTES:

1. COMPLETE CONSTRUCTION ACTIVITIES ASSOCIATED WITH OU1/I NOT SHOWN AS EXISTING CONDITIONS ON THIS PLAN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. DEPTH TO GROUNDWATER DATA FOR EXTRACTION WELLS WAS NOT AVAILABLE FOR THE GROUNDWATER EVENT SHOWN. THEREFORE, GROUNDWATER CONTOURS ARE BASED ON MONITORING WELL ELEVATION DATA ONLY.

BASE MAP SOURCE:
REMCOR, APRIL 6, 1993. DRAWING NO. 92093-E124.

SCALE, FEET
100 0 100 200

TRC
Boott Mills South
Foot of John Street
Lowell, MA 01852
978-970-5600

TRC PROJ. NO.: 02136-0530-02022

EPA CONTRACT NO.: 68-W6-0042

RAC SUBCONTRACT NO.: 107061

FIGURE 4
GROUNDWATER CONTOUR MAP
JULY 15, 1999
LOW GROUNDWATER CONDITIONS
BEDROCK WELLS

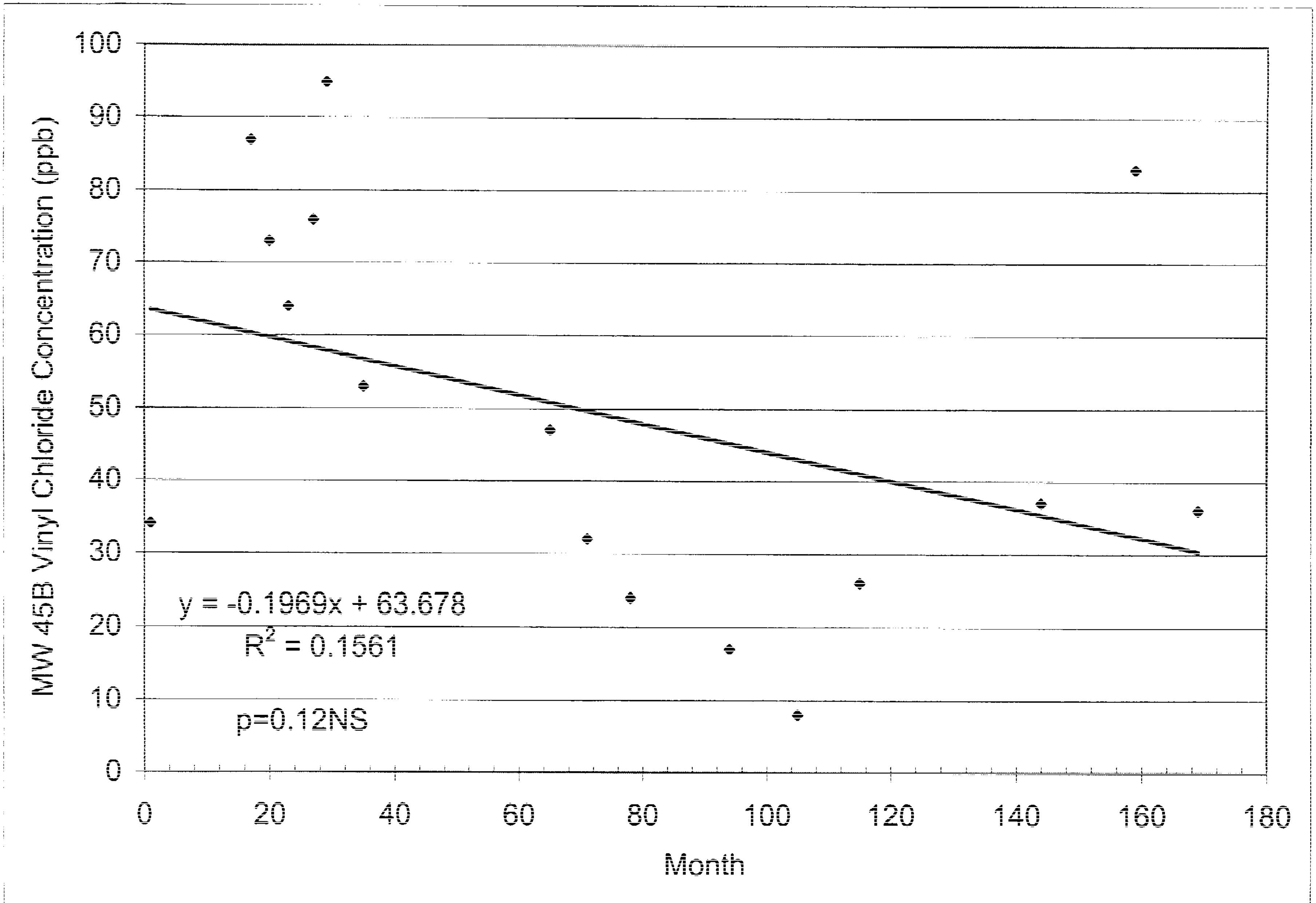
OLD SPRINGFIELD LANDFILL
SPRINGFIELD, VERMONT

Metcalf & Eddy

ATTACHMENT 2

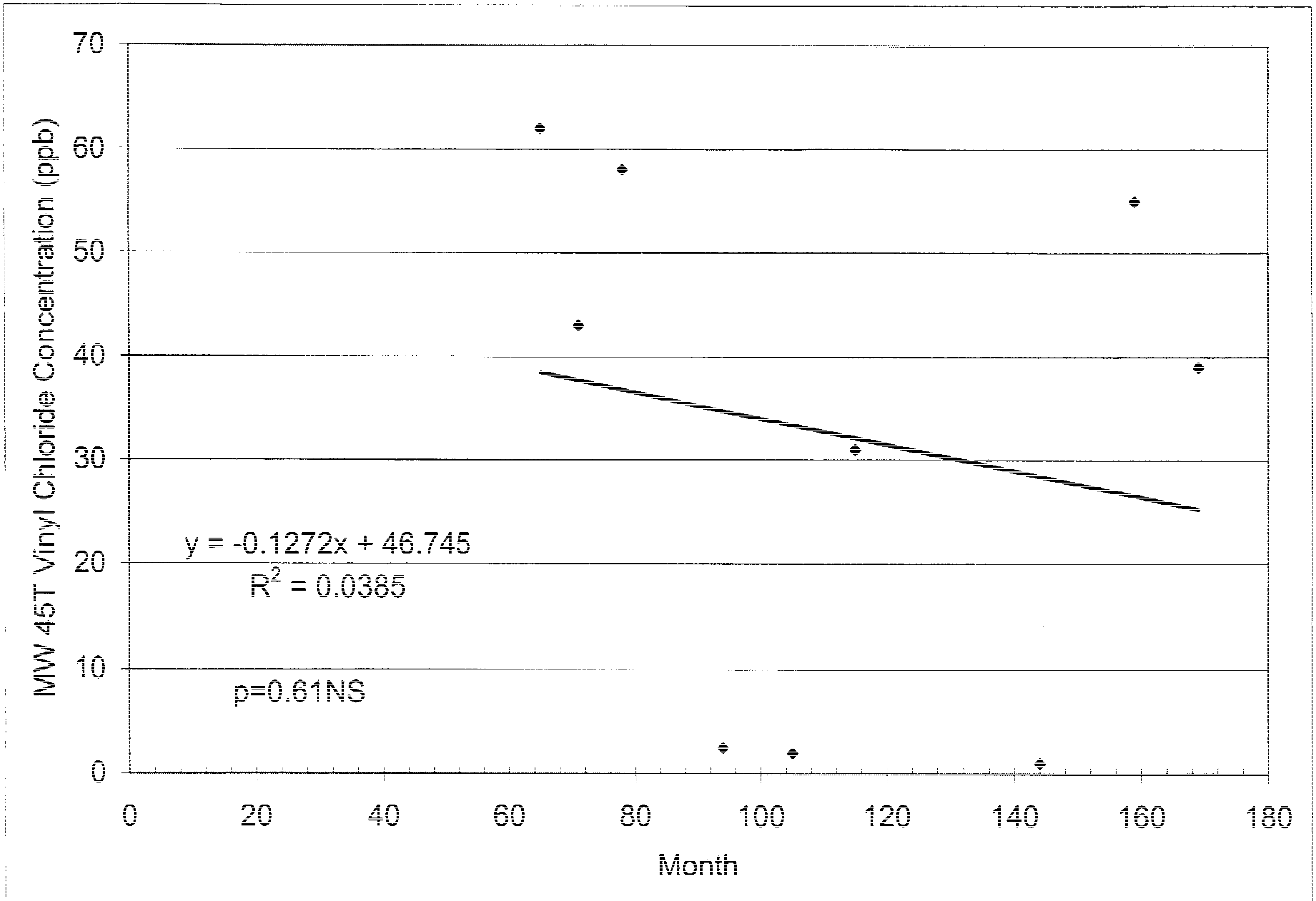
REGRESSION ANALYSIS PLOTS

Old Springfield Landfill, Springfield, VT
5-Year Review



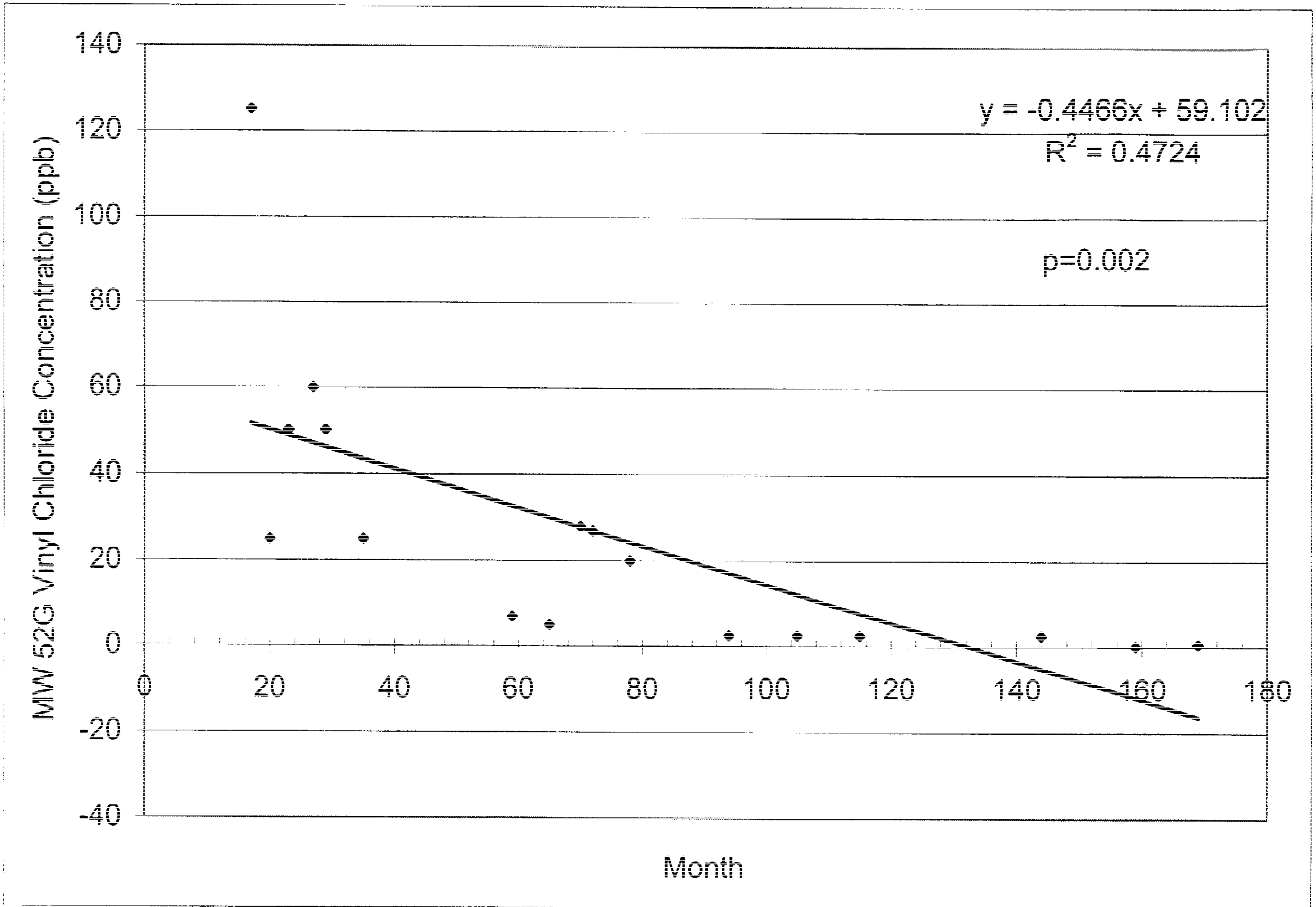
7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



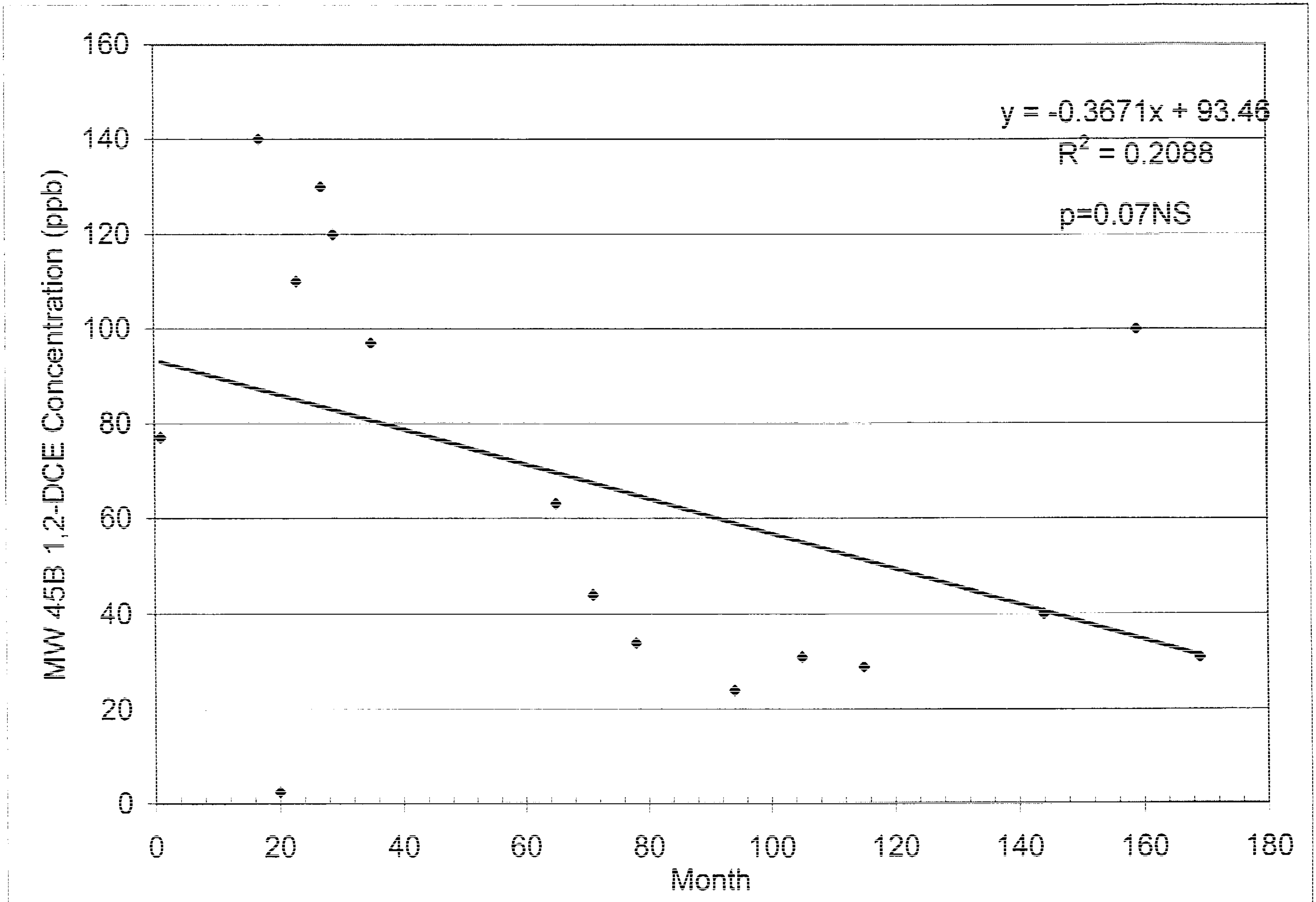
7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



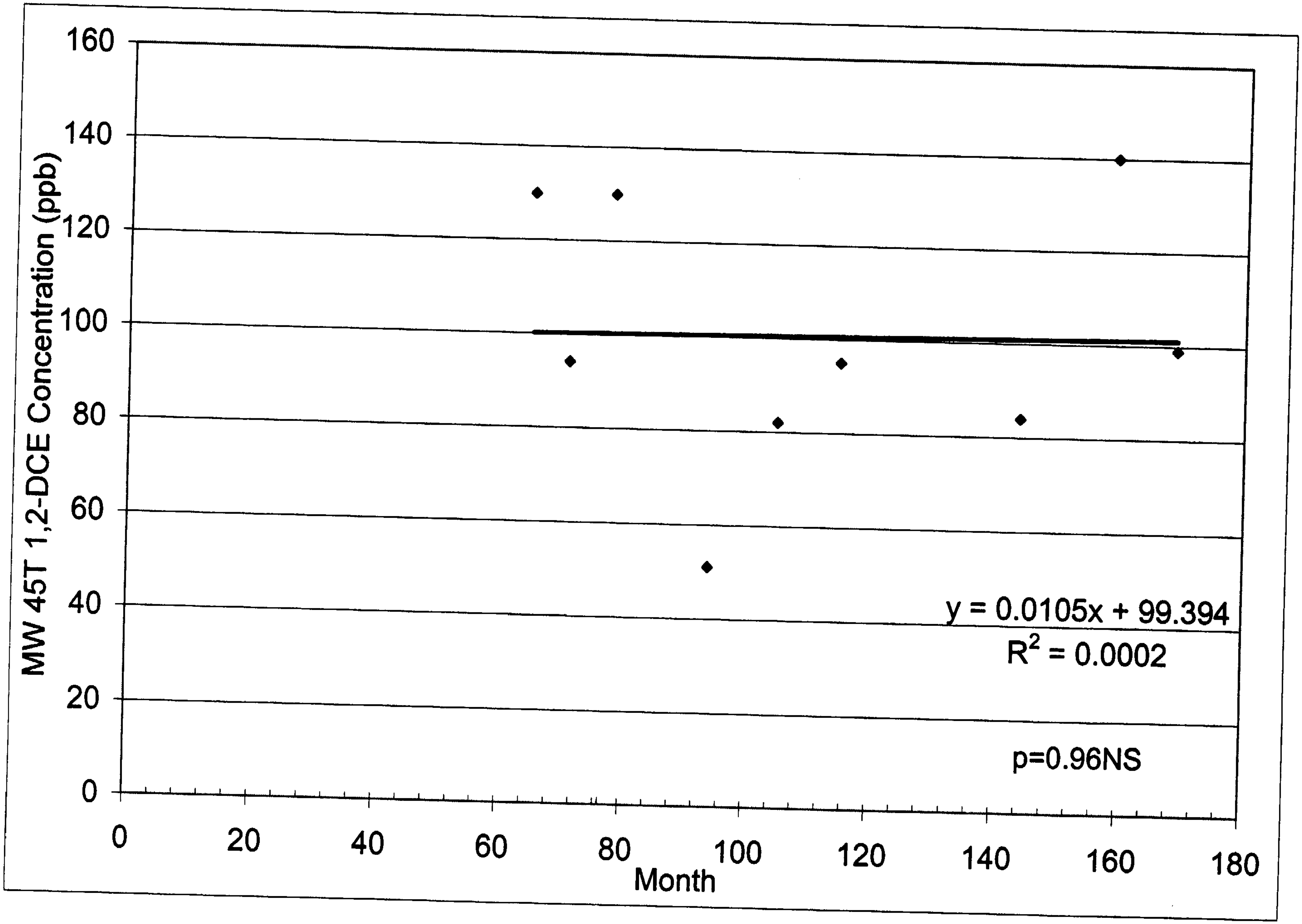
7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



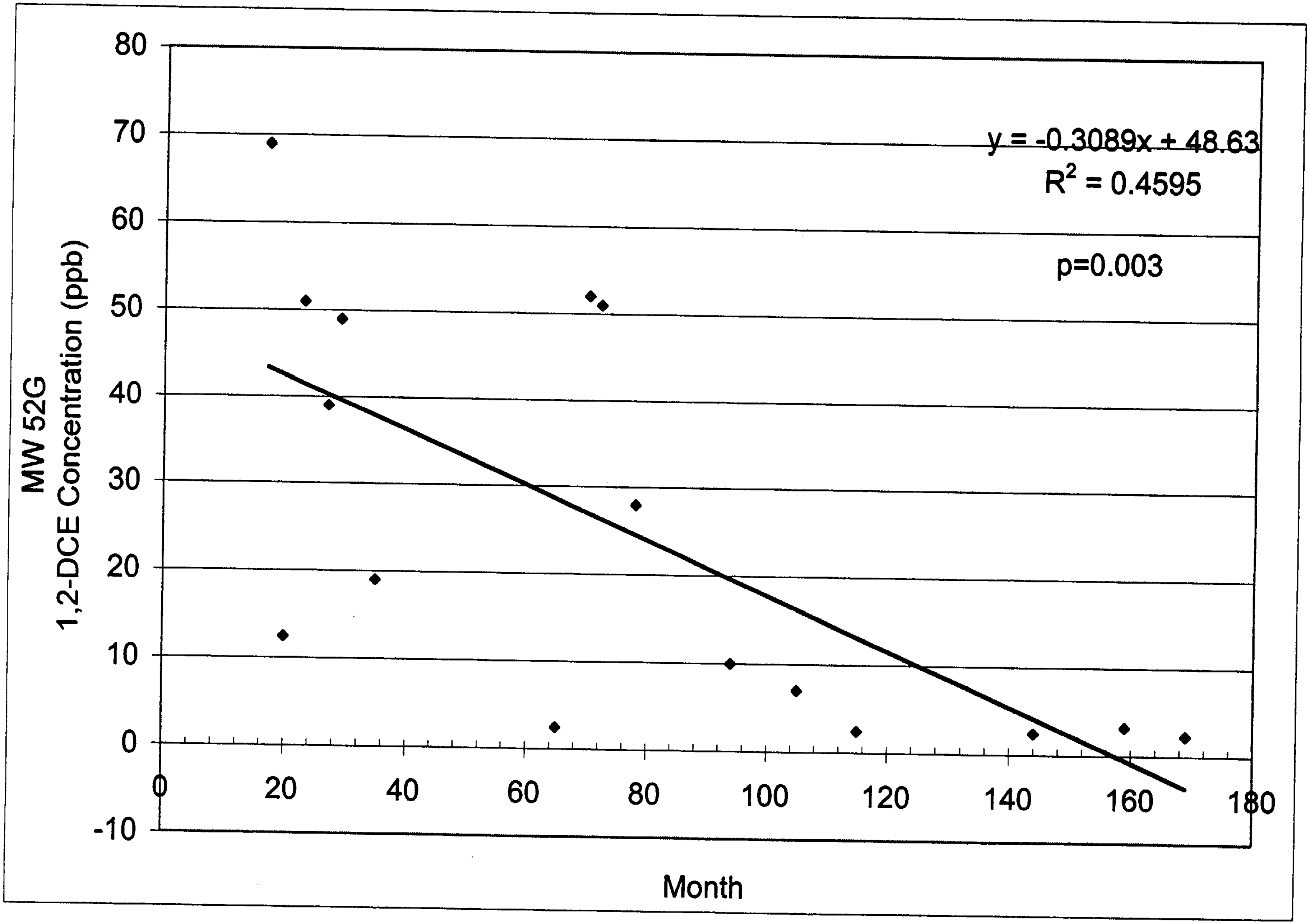
7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



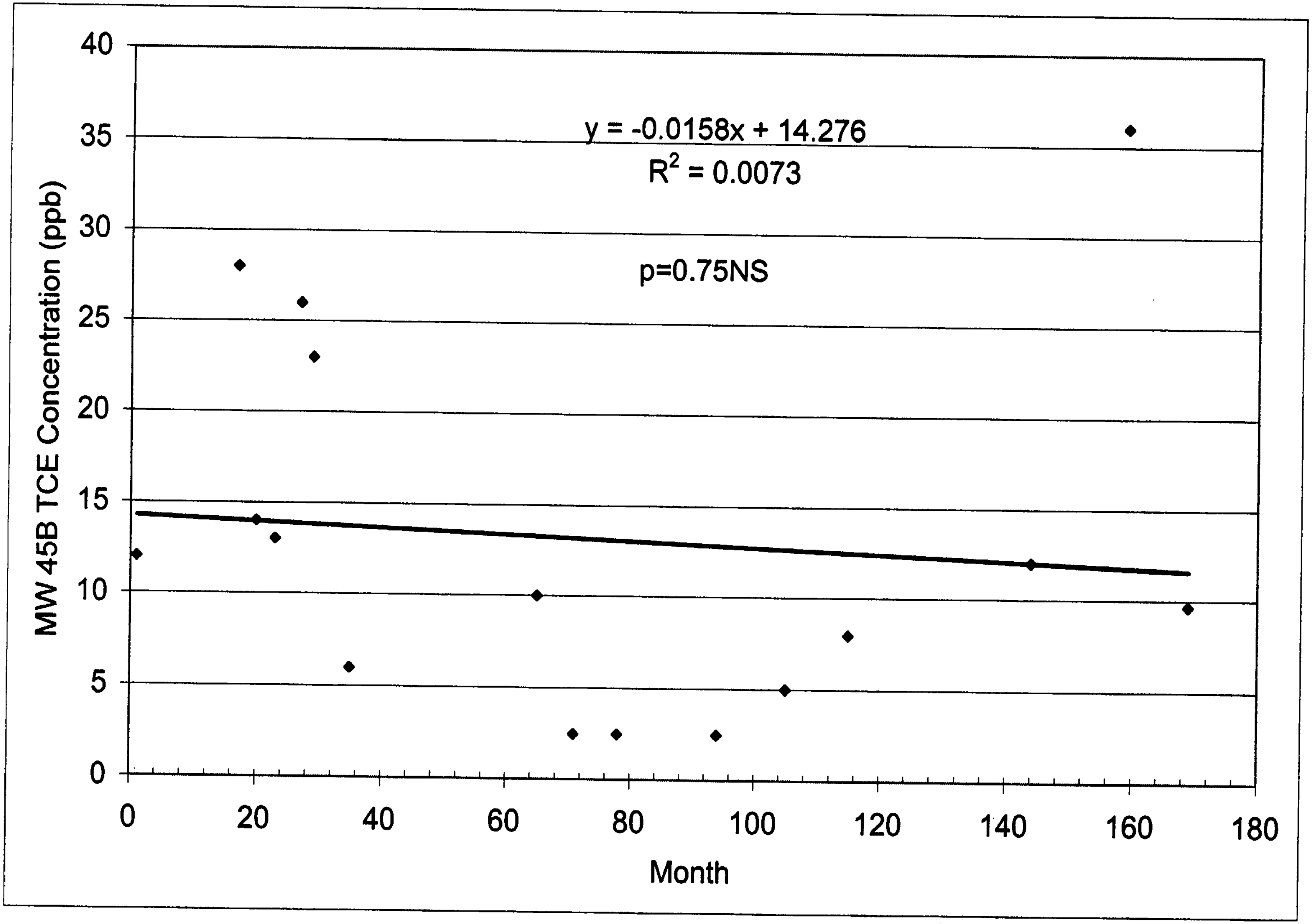
7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



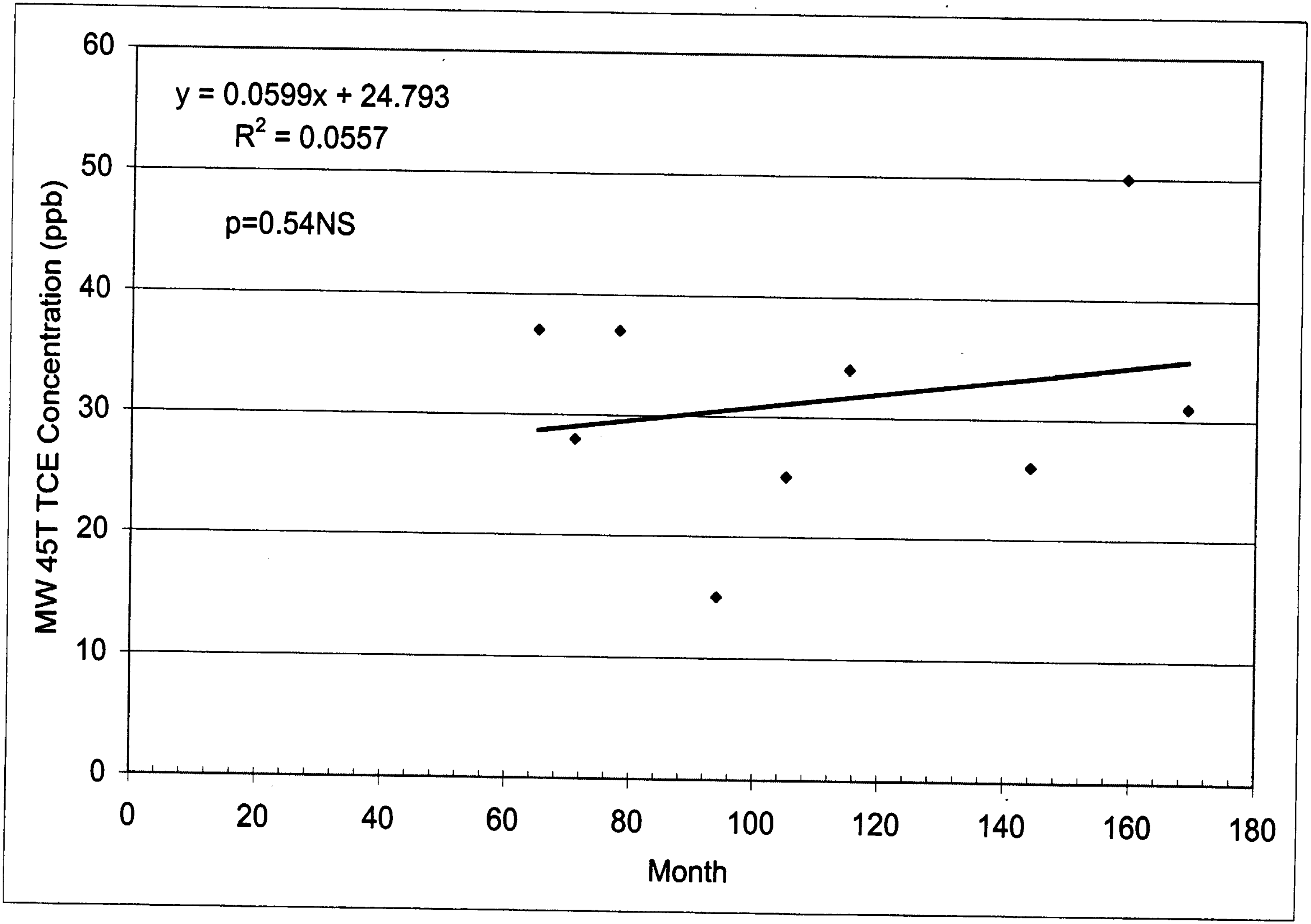
7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



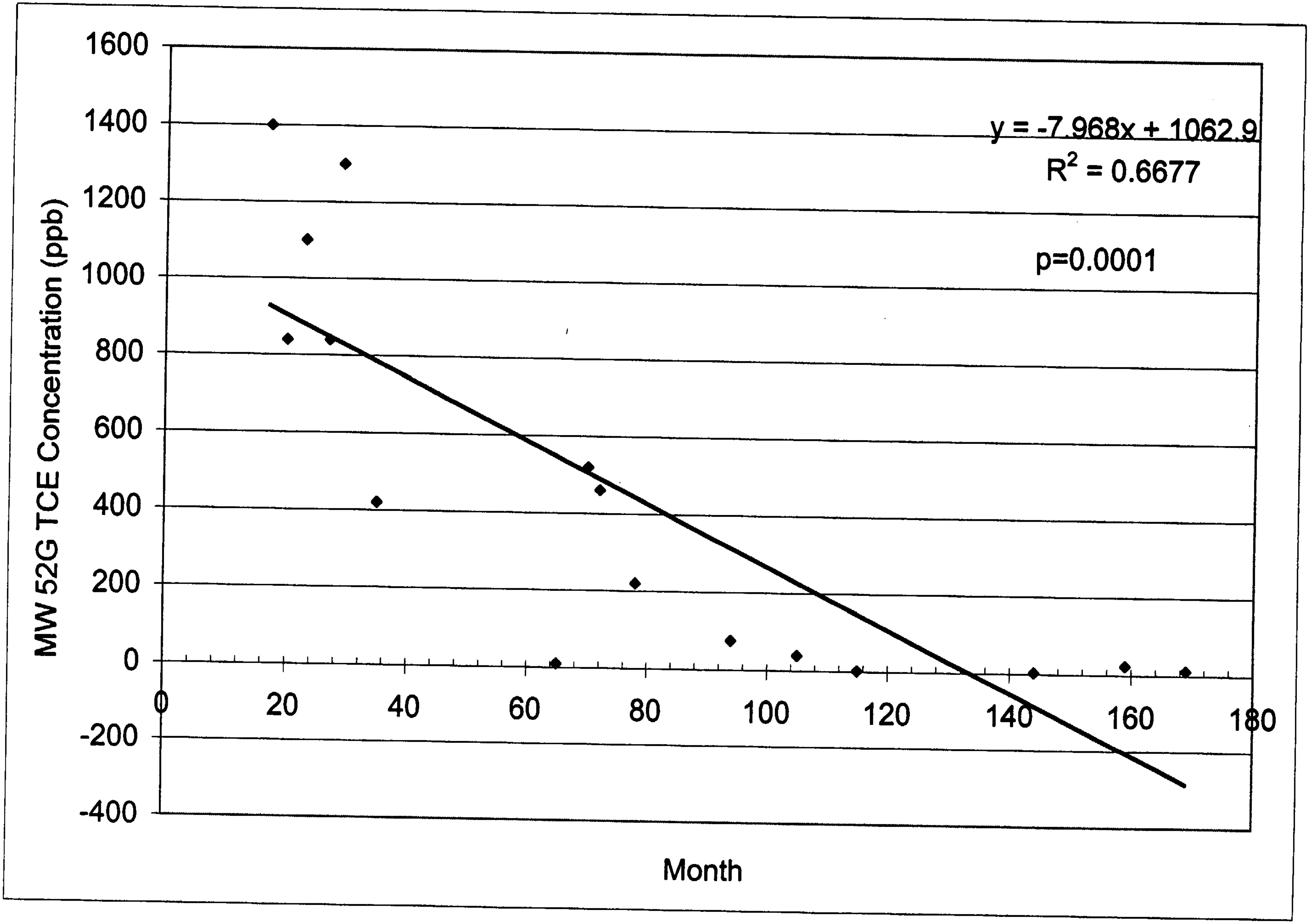
7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



7/24/2003

Old Springfield Landfill, Springfield, VT
5-Year Review



7/24/2003

ATTACHMENT 3

"LOWER BLACK RIVER ASSESSMENT REPORT"; AND "MINOR TRIBUTARIES - LOWER BLACK RIVER ASSESSMENT REPORT" (EPA, 1999)

Lower Black River
Assessment Report

Waterbody No: VT10-11 **Assessment Date** 1999
River Length (mi.): 8.6 **Date Last Updated:** 12/8/1999
Description: Black River mainstem from mouth to dam at North Springfield Reservoir

Location

ANR Enforcement District: 2 **NRCS District:** 9
Fish and Wildlife District: 1 **Regional Planning Commission:** SOW

Assessment Information

Monitored 8.6 **Assessment**
Evaluated (mi.): 0.0 Land use information and location of sources
Non-fixed station chemical/physical monitoring-conventional pollutants
On 303(d) List? Y
RBP III or equivalent benthos surveys
Monitored for Modeling
Toxics Testing Discharger self-monitoring data (effluent)

Waste Management Zone - **Description**

Assessment Comments

NON-SUPPORT MILES
Black River: 2.8 - from mouth upstream - non-support of contact recreation and aesthetics due to organic and nutrient enrichment, pathogens and thick algae growth from CSOs, municipal WWTF, and road runoff. c(900,1200,1700,2210) s(200,400,4500)

PARTIAL SUPPORT MILES
Black River: 3.2 - from North Springfield flood control dam downstream to Fellows dam - partial support of aquatic habitat and secondary contact recreation due to fluctuating flows, temperature increases and siltation from the dam and its impoundment. c(1100,1400,1500) s(7350,7400)

THREATENED MILES
Black River: 2.8 - from mouth upstream (same miles as in non-support) - threats to aquatic biota/habitat, contact recreation, secondary contact recreation and drinking water supply due to nutrient and organic enrichment, suspended solids, pH and toxic compounds from CSOs, WWTF, urban and road runoff and a hazardous waste site. c(900,1000,1200,2100,2210) s(200,400,4500)
Black River: 2.6 - from 2.8 to 5.4 miles above the mouth - threats to aquatic biota/habitat, aesthetics, and contact recreation from nutrients, sediments, temperature increases, oil, grease and metals from urban runoff, road runoff, land development, CSOs, and an impoundment. c(500,900,1100,1400,1900) s(400,3200,4000,4500,7350)

Black River:0.2 - below Springfield Landfill (subset of lowest 2.8 miles) - threats to drinking water and aquatic biota due to priority organics in seep from Old Springfield Landfill. c(300) s(6300)

COMMENTS
Springfield WWTF issues: combined sewer overflows result in discharges of raw sewage from as many as 26 locations in Springfield. Likewise, pump station overflows cause similar impairment. There were permit violations for TRC, settable solids, total suspended solids, and E. coli during 1996-1997. There were 149 days with pH violations from Sept 1997 to June 1998.

Phosphorus samples were taken three times in the summer of 1999 from three stations on the lower Black River. The total phosphorus results were as follows: upstream site (above WWTF & near fire station) = .012mg/liter, .027mg/liter and .018 mg/liter; midway site (below the WWTF about 1/2 mile) = 0.115mg/liter, 0.127mg/liter and .101mg/liter; and downstream site (just upstream of Route 5 bridge)= .086mg/liter, .108mg/liter and.101mg/liter. These results were used as to check the ballpark accuracy of estimated upstream and downstream concentrations that were generated using the WWTF effluent phosphorus concentrations, effluent flows, and river flows. Results from the modeling are available from the Water Quality Division.

Macroinvertebrate sampling at milepoint 2.4 resulted in the following community assessments: 1986-fair; 1989-good; 1991-fair; 1992-good/fair; 1995-good; 1997-good; 1999-good. In 1999, a site above the WWTF as well as site 2.4 below were sampled. "The Richness, EPT, PPCS-F and the Bio Index metrics all do indicate that moderate changes have occurred to the macroinvertebrate community at both sites. The richness and EPT index from both sites was just above the Class B biocriteria for VAL (higher order, lower elevation, large rivers or streams) streams. These relatively low values for the numbers of taxa present at both sites indicates a moderate level of impairment to the community." Some level of toxic urban impact is suspected because a moderately enriched community would normally have an increased number of taxa and and increase in algal shredders and scrapes whereas the shredder functional groups were absent from this sample. Flow fluctuations and other impacts from the North Springfield flood control dam are listed for 3.2 miles from the dam to the first dam in Springfield. Likely the impacts continue on downstream but other pollutants and impacts come into play in Springfield and these are the problems listed from the Fellows dam downstream.

The Jones & Lamson site in Springfield had contaminants of concern including PCBs, VOC, lead, and #6 fuel on its 2 sites in Springfield. Some clean-up work has been done but it is not clear if the floor drains from one of the plants have been cleaned and sealed. These drains presumably connected to outfall pipes are one of the potential sources of pollution to the Black River.

INFORMATION SOURCES Gilman Hydro - Hydropower Dam - Priv - R
Steve Fiske, Vermont DEC Water Quality Division Biomonitoring Section - macroinvertebrate monitoring data from 1989 to 1999 and analysis of macroinvertebrate community integrity (1992, 1999)
Ken Cox, Vermont Dept of Fish & Wildlife - impacts from North Springfield flood control dam (1996, 1999)
Connecticut River Watch - data from 1990, 1992, and 1993 included violations of E. coli standards in most samples. Samples taken in the lower 3 miles consistently ranged between 300-10,000 counts/100 ml over the 1992-1993 sampling periods (1994).
NH DES Ambient Monitoring Program - high E coli numbers in 92-93 seasons (1994).
George Desch, Vt. DEC Hazardous Materials - noted that remediation has occurred at the Old Springfield Landfill this past season (1993). The landfill has been capped and there is a groundwater intercept pump and treatment system in place (1994).
Matt Germon - noted that a seep with volatiles and semi-volatiles was not addressed by the remediation. Contains vinyl chloride (13 ppb) and other organics. About 300 feet from the Black River. Most probably volatilize before reaching the river. (1994)
Vermont Waste Management Division Sites Management Section files, 1998
Jerry McArdle, Vermont DEC Water Quality Division - field assessment of the Lower Black River in Autumn 1998, (1999)

Lower Black River

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	VT10-11 Not Assessed
01	Overall	0.0	2.6	3.2	2.8	0.0
20	Aquatic biota/habitat	0.0	5.4	3.2	0.0	0.0
21	Fish consumption	0.0	8.6	0.0	0.0	0.0
42	Contact recreation	3.2	2.6	0.0	2.8	0.0
44	Noncontact recreation	2.6	2.8	3.2	0.0	0.0
50	Drinking water supply	0.0	0.2	0.0	0.0	8.4
62	Aesthetics	3.2	2.6	0.0	2.8	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	8.6

Impairment	Magnitude	Size (mi.)
Priority organics	T	0.20
Nutrients	M	2.80
Nutrients	T	5.40
Siltation	M	3.20
Siltation	T	2.60
Organic enrichment/Low D.O.	M	2.80
Thermal modifications	M	3.20
Thermal modifications	T	2.60
Flow alterations	M	3.20
Pathogens	M	2.80
Oil and grease	T	2.60
Suspended solids	T	2.80

Impairment	Magnitude	Size (mi.)
Municipal point sources	M	2.80
Combined sewer overflows	M	2.80
Land development	T	2.60
Urban/developed land runoff	T	2.60
Highway/road/bridge runoff	S	2.80
Highway/road/bridge runoff	T	2.60
Landfills	T	0.20
Upstream impoundment	M	3.20
Flow regulation/modification	M	3.20

Permit No.	Point or Nonpoint Source
VT0100374	Springfield WWTF 2.20mgd
VT0100374	Springfield WWTF bypass
VT0000272	Springfield Electroplating
3-0313	Springfield Mun Swimming Pool
1-1081	Springfield Elderly Housing Project
1-1115	Community College of Vermont
1-1211	Grappone Industrial Facility
1-1303	Springfield State Office Building
	Springfield CSO - CSO - Black River - 21
	Comtu Falls Hydro - Hydropower Dam - Pri
	Lovejoy Hydro - Hydropower Dam - Priv -
	N. Springfield Dam - Flood control dam -
	Slack Dam Hydro - Hydropower Dam - Priv
	Fellows Dam Hydro - Hydropower Dam - Pri
	Old Sprgfld Lndfl - Hazardous Waste Site

Minor Tribs - Lower Black
Assessment Report

Waterbody No: VT10-12
River Length (mi.): 29
Assessment Date Last Updated: 1999
12/13/1999

Description: Tributaries draining into lower Black River including Great, Schoolhouse, Chester and Seaver Brooks

Location

ANR Enforcement District: 2
Fish and Wildlife District: 1
NRCS District: 9
Regional Planning Commission: SOW

Assessment Information

Monitored 0.0
Evaluated (mi.): 29.0
On 303(d) List? N
Monitored for Y

Assessment

Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Toxics Testing

Pesticides in sediments

Metals in sediments

Waste Management Zone - **Description**

Assessment

THREATENED MILES
Great Brook: 6.0 - upstream from mouth - threats to aquatic biota/habitat due to sedimentation from road runoff, encroaching residential yards and homes, channel alterations. c(1100), s(3200,7100,8300)
Spoonerville Brook: 3.0 - threats to aquatic biota/habitat due to sedimentation, turbidity from periodic industrial site discharges (concrete production and storage). c(1100), s(4000)
Chester Brook: 3.0 - threats to aquatic biota/habitat due to sedimentation and turbidity from bank erosion, road runoff, encroaching development. c(1100), s(3200,4500,7700)
Seaver Brook: 3.5 - threats to aquatic biota/habitat due to sedimentation from encroaching development. c(1100), s(3200)
Tribs east of Black River: 6.0 - threats to aquatic biota/habitat due to sedimentation from erosion due to ag runoff, urban runoff, private ponds. c(1100), s(1000,4000)

COMMENTS
Sediment samples were taken by EPA consultants in Baltimore Brook (a trib. to the Black River in North Springfield) as part of sampling program for Johnson & Dix site. One pesticide (29 ppb methoxychlor) was found as well as cobalt (4.9 ppm), silver (1.5 ppm) and sodium (111 ppm). Not likely related to the Johnson & Dix site.
Great Brook appears fairly well shaded in the length observed (approximately 4 miles from North Springfield upstream) due to tree cover or overhanging alder. However, numerous yards, lawns, and residential activity encroach on the riparian zone up to the streambank top or to the brook's edge. From

its headwaters to North Springfield, roads cross the brook sixteen times (DeLorme Vermont Atlas & Gazetteer Ninth Edition 1996) and at three places where roads off Route 10 crossed the brook, there were concrete bridges with no edge or barrier to keep sand, debris or other substances from going directly to the brook.

INFORMATION SOURCES

Ken Cox, Vermont Dept of Fish & Wildlife - noted potential impacts from land development, road runoff... on brooks listed above. (9401) (1998)

Mike Young - Vt. DEC Hazardous Materials Division - Site Inspection Final Report, March 1993 for Johnson & Dix Site, Springfield, Vt.

Cathy Kashanski, Vermont DEC Water Quality Division - field observations of Great Brook. (1998)

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	7.5	21.5	0.0	0.0	0.0
20	Aquatic biota/habitat	7.5	21.5	0.0	0.0	0.0
21	Fish consumption	0.0	29.0	0.0	0.0	0.0
42	Contact recreation	29.0	0.0	0.0	0.0	0.0
44	Noncontact recreation	29.0	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	29.0
62	Aesthetics	29.0	0.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	29.0

Impairment	Magnitude	Size (mi.)
Siltation	T	21.50

Impairment	Magnitude	Size (mi.)
Agriculture	T	6.00
Land development	T	12.50
Urban/developed land runoff	T	9.00
Highway/road/bridge runoff	T	9.00
Channelization	T	6.00
Streambank modification/destabilization	T	3.00

Permit No.	Point or Nonpoint Source	Receiving Water
VT0020907	Fellows Corp-non-contact CW - UT Great	
1-0537	Double Four Orchards Subdiv- UT Black R	
1-0866	Pine Brook Town House Dev-UT Baltimore	
1-0986	Residential Subdiv-Great Brook& UT Black	
1-1118	Pine Brook Condos - UT Baltimore Brook	
	Springfield CSO - CSO - Valley St Brook	