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REPORT

SWMU #7 FOCUSED RISK ASSESSMENT AND CORRECTIVE MEASURES STUDY REPORT

Dewey Avenue Service Center

Buffalo, New York

Niagara Mohawk Power Corporation

Syracuse, New York

September 1995

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

Report

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Table of Contents

Page

Section 1.0 - Introduction

1.1 General 1
1.2 Background Information 1
1.3 Summary of 1995 Quarterly Ground-Water Monitoring Event Results 5
1.4 Purpose and Scope of RA and CMS 5

Section 2.0 - Focused Risk Assessment

2.1 General 6
2.2 Data Evaluation 6
2.3 Exposure Assessment 6
2.3.1 Exposure Pathways 6
2.3.2 Quantification of Exposure 7
2.4 Toxicity Assessment 10
2.5 Risk Characterization 11
2.5.1 Non-Carcinogenic Effects 11
2.5.2 Carcinogenic Effects 12
2.5.3 Uncertainty 13
2.6 Risk Assessment Conclusion 13

Section 3.0 - Corrective Measures Study

3.1 General 15
3.2 SWMU #7 Corrective Measures Objective 15
3.3 Identification of Corrective Measure Alternatives 15
3.4 Description of Evaluation Criteria 16
3.4.1 Technical Analysis 16
3.4.2 Environmental Analysis 17
3.4.3 Human Health Analysis 17
3.4.4 Institutional Analysis 17
3.4.5 Cost Analysis 18
3.5 Evaluation of Corrective Measure Alternatives 18
3.5.1 No-Action Alternative 18
3.5.2 Limited Action Alternative (Ground-Water Monitoring Program) 19
3.5.3 Containment Alternative (Slurry Cutoff Wall System) 21
3.5.4 Removal and On-Site Treatment Alternative 23
3.6 Conclusions and Recommendations 25

Section 4.0 - References 26

Table of Contents

Tables

1 Constituents of Interest in Soil
2 Constituents of Interest in Ground Water
3 USEPA Reference Toxicity Values
4 Estimation of Intakes and Risks Associated with Ingestion of Soil: Hypothetical Excavation Workers
5 Estimation of Intakes and Risks Associated with Dermal Contact with Soil: Hypothetical Excavation Workers
6 Estimation of Risks Associated with Inhalation of Dust and Vapors Released from Soil: Hypothetical Excavation Workers
7 Estimation of Intakes and Risks Associated with Dermal Contact with Ground Water: Hypothetical Excavation Workers
8 Summary of Hazard Indices and Risks for Hypothetical Excavation Workers
9 Cost Estimate - Limited Action Alternative (Ground-Water Monitoring Program)
10 Cost Estimate - Removal and On-Site Treatment Alternative
11 Summary of Corrective Measure Alternative Evaluation

Figure

1 SWMU #7 Area Site Plan

Appendices

A Volatilization from Soil
B Estimation of Dermally Absorbed Dose

Section 1.0

Introduction

1.0 - Introduction

1.1 General

This report presents the results of the Focused Risk Assessment and Corrective Measures Study for Solid Waste Management Unit (SWMU) #7 - Former Underground Waste Oil Tank, located at the Niagara Mohawk Power Corporation (NMPC) Dewey Avenue Service Center in Buffalo, New York. The Focused Risk Assessment (RA) and Corrective Measures Study (CMS) were conducted in accordance with the March 1995 New York State Department of Environmental Conservation- (NYSDEC-) approved Work Plan. The RA identifies and quantifies potential risks associated with utility worker exposure to soil and ground water in the vicinity of SWMU #7. The CMS identifies the corrective measure objective for SWMU #7 based on the results of the Focused RA, and presents a detailed evaluation of potential corrective measure alternatives to satisfy the corrective measure objective. The CMS also includes a recommendation for a feasible and cost-effective corrective measure alternative based on the evaluation.

Relevant background information regarding the Focused RA and CMS Report is presented below.

1.2 Background Information

The Dewey Avenue Service Center is located at 144 Kensington Avenue between Dewey and Kensington Avenue in the city of Buffalo, New York. The location of the Dewey Avenue Service Center is shown on Figure 1. The service center houses a former Hazardous Waste Management Facility permitted by the New York State Department of Environmental Conservation (NYSDEC) (Part 373 Permit No. 9-1402-00397/00001-0). The Hazardous Waste Management Facility was closed in December 1992 in accordance with the NYSDEC-approved Closure Plan.

In September 1992, NMPC was in the process of removing an oil/water separator at the service center when petroleum-impacted gravel was discovered. Further excavation revealed that the vent line on the underground waste oil storage tank (located adjacent to the oil/water separator) was broken. NMPC then notified the NYSDEC of the spill event on September 14, 1992.

After meeting with the NYSDEC on September 15, 1992, NMPC removed the former waste oil tank and adjacent impacted soils, including impacted ground water that entered the excavation. Following removal of the underground waste oil tank, the excavation was backfilled with clean fill materials. Four ground-water monitoring wells (ESI-1, ESI-2, ESI-3, and ESI-4) were installed in the vicinity of the former waste oil tank to supplement an existing monitoring well (MW-1) and to facilitate the collection of ground-water samples in this area. All monitoring well locations are shown on Figure 1. Periodic ground-water monitoring in the vicinity of the former underground waste oil tank has indicated that ground-water quality may have been impacted as described in a November 22, 1993 letter to NMPC from the NYSDEC.

In a February 14, 1994 letter to NMPC from the NYSDEC, the NYSDEC indicated that, based on the results of approximately two years of ground-water quality monitoring (from November 1992 through 1993) at the Dewey Avenue Service Center, SWMU #7 (the former underground waste oil tank) apparently leaked and impacted ground water. The NYSDEC stated that they intended on modifying NMPC's Part 373 permit by inclusion of a new Module III - Corrective Action Requirements, which called for the implementation of a RCRA Facility Investigation (RFI) and subsequent CMS to determine the nature and extent of the releases from SWMU #7 and to determine the appropriate corrective measure. In response to the NYSDEC's intent to have NMPC investigate SWMU #7 under the RFI/CMS process, NMPC submitted a March 15, 1994 letter to the NYSDEC requesting an alternative approach to addressing environmental impacts attributable to SWMU #7. NMPC proposed to conduct a focused RCRA Facility Assessment-(RFA-) type soil investigation and ground-water investigation in lieu of an RFI and to conduct a focused screening level Risk Assessment (RA) to identify and, if appropriate, quantify potential risks associated with human exposure to ground water. Following completion of the focused RA, NMPC proposed to conduct a focused evaluation of corrective measures to address the concerns identified by the focused RA.

In response to NMPC's proposed alternative approach for SWMU #7, the NYSDEC informed NMPC in a March 25, 1994 letter that the NYSDEC had withdrawn the Module III modifications (subject to reinstatement, if necessary) and is willing to proceed with the focused investigation of SWMU #7 as outlined in NMPC's March 15, 1994 letter.

A SWMU #7 Soil Sampling and Analysis Work Plan was prepared by Blasland, Bouck & Lee, Inc. (BB&L) and submitted to the NYSDEC for review in April 1994. Work Plan modifications, agreed to between NMPC and the NYSDEC, were presented in a May 5, 1994 letter to the NYSDEC from NMPC. A SWMU #7 Ground-Water Investigation Work Plan was prepared by BB&L and submitted to the NYSDEC for review on June 30, 1994. The NYSDEC's Work Plan comments were presented in an August 10, 1994 letter to NMPC and were incorporated into the SWMU #7 ground-water investigation.

The soil and ground-water investigation activities were conducted during the fall of 1994 by BB&L, in accordance with the Soil and Ground-Water Investigation Work Plans and associated Work Plan modifications. The results of the soil and ground-water investigation were presented in the December 1994 SWMU #7 Soil/Ground-Water Investigation Report, which was submitted to the NYSDEC in December 1994 for review. The results of the SWMU #7 soil/ground-water investigation are summarized below.

Soil Investigation Summary

- Polychlorinated biphenyls (PCBs) were not detected in any soil samples above the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4046 soil cleanup objectives;
- A limited number of soil samples contained chromium and lead at concentrations slightly above the NYSDEC TAGM #4046 soil cleanup objectives;
- A limited number of soil samples contained benzene, toluene, and xylenes at concentrations slightly above the NYSDEC TAGM #4046 soil cleanup objectives; and
- Soils associated with SWMU #7 are effectively capped with asphalt, thereby limiting precipitation from leaching through the soils into ground water. In addition, the presence of constituents in the lower sample depth intervals (the lower portion of which were observed to be damp to wet during the soil investigation) may be attributable to capillary action and contributions from the fluctuating ground-water table.

Ground-Water Investigation Summary

- A total of four new monitoring wells were installed during the Ground-Water Investigation: MW-5, MW-6, MW-7, and MW-8. The site has nine existing monitoring wells;
- Chemical constituents detected in ground-water at concentrations above NYSDEC ground-water standards or guidance values in the vicinity of SWMU #7 include benzene, toluene, ethylbenzene, and xylenes (BTEX), chloroethane, 1,1,dichloroethane, naphthalene, and PCB Aroclor 1242;
- The horizontal extent of these chemical constituents in ground-water is limited to the vicinity of SWMU #7, specifically monitoring wells ESI-1 and ESI-4, and to a lesser extent in monitoring well MW-1. These chemical constituents were not detected in the perimeter monitoring wells located hydraulically downgradient and sidegradient;
- The vertical extent of these constituents does not extend into the lower bedrock formation based on ground-water data from monitoring well MW-8. Only lead was detected in monitoring well MW-8 (34.2 ppm) at concentrations above the NYSDEC ground-water standard (25 ppb);
- Polychlorinated aromatic hydrocarbons (PAHs) and lead were detected in the ground-water samples from monitoring well ESI-3; however, these chemical constituents are not attributed to chemical

migration from SWMU #7. PAHs and lead were not detected in the ground-water sample from well ESI-1. Lead was detected in the sample from deep monitoring well MW-8, however, the concentration in the sample from well ESI-3 was an order of magnitude higher, suggesting a potential off-site source not related to SWMU #7; and

- Lead was also detected above the NYSDEC standard in the ground-water sample from well MW-3. PCB Aroclor 1248 was detected above the NYSDEC standard in the ground-water sample from well MW-5. Neither of these detections appear to be related to migration from SWMU #7.

Based on the chemical characterization of ground-water samples from monitoring wells surrounding SWMU #7, the horizontal extent of chemical migration from SWMU #7 does not extend beyond the immediate vicinity of SWMU #7, specifically monitoring wells ESI-1 and MW-1. Chemical constituents were detected at concentrations below NYSDEC ground-water standards or guidance values in the perimeter monitoring wells located to the south, west, and east of SWMU #7. The vertical extent of chemical migration from SWMU #7 was evaluated from ground-water samples at deep monitoring well MW-8. Only lead was detected in the sample from well MW-8.

NMPC received a February 13, 1995 letter from the NYSDEC which stated that the SWMU #7 Soil/Ground-Water Investigation Report had fulfilled the objectives of the soil and ground-water investigation and that no further soil or ground-water investigation is needed at this time. The NYSDEC requested that MW-5 be added to the new quarterly monitoring well network proposed in the SWMU #7 Soil/Ground-Water Investigation Report, which is comprised of monitoring wells MW-1, MW-6, and MW-7. In addition, the NYSDEC required that NMPC submit a CMS and RA for utility worker protection to the NYSDEC within 60 days of receipt of the February 13, 1995 letter.

In response to the NYSDEC's comments, NMPC submitted a February 21, 1995 letter to the NYSDEC agreeing to add MW-5 to the new quarterly ground-water monitoring network and proposing to submit a Focused RA and CMS Work Plan to the NYSDEC for review prior to initiating the Focused RA and CMS. On March 28, 1995, NMPC submitted the SWMU #7 Focused RA and CMS Work Plan to the NYSDEC for review. NMPC received a June 12, 1995 letter from the NYSDEC, which included the NYSDEC's comments regarding the Focused RA and CMS Work Plan. NMPC responded to the NYSDEC's comments in a June 27, 1995 letter to the NYSDEC. In this letter, NMPC proposed to submit the SWMU #7 Focused RA and CMS Report by September 11, 1995. The NYSDEC approved the Work Plan and NMPC's proposed submittal date for the Focused RA and CMS Report.

1.3 Summary of 1995 Ground-Water Monitoring Event Results

Quarterly ground-water monitoring events were conducted on March 30 and June 30, 1995. The events involved collecting ground-water samples from existing monitoring wells MW-1, MW-5, MW-6, and MW-7. The ground-water samples were submitted for laboratory analysis for volatile organic compounds (VOCs), PCBs, and total lead.

Results of the March 30, 1995 ground-water monitoring event indicated three chemical constituents (benzene, Aroclor 1242, and lead) were detected above NYSDEC ground-water standards or guidance values in the sample obtained from monitoring well MW-1. Chemical constituents were not detected in samples obtained from monitoring wells MW-5, MW-6, and MW-7 on March 30, 1995.

Results of the June 30, 1995 ground-water monitoring event indicated only lead was detected slightly above the NYSDEC water quality standard in the sample obtained from monitoring well MW-1. No chemical constituents were detected in samples obtained from monitoring wells MW-5, MW-6, and MW-7 on June 30, 1995.

Monitoring wells MW-6 and MW-7 are hydraulically downgradient of SWMU #7 with respect to ground-water flow direction. Based on the results of the 1995 sampling events, chemical constituents associated with SWMU #7 have not impacted ground water in the vicinity of monitoring wells MW-6 and MW-7.

1.4 Purpose and Scope of RA and CMS

The purpose of the RA and CMS is to:

- Evaluate potential risks associated with SWMU #7 based on the results of the 1994 SWMU #7 Soil/Ground-Water Investigation;

- Develop a site-specific corrective measure objective based on the results of the 1994 SWMU #7 Soil/Ground-Water Investigation and the Focused RA; and

- Complete an evaluation of potential corrective measures alternatives to determine which satisfies the corrective measure objective and best meets evaluation criteria.

The site-specific corrective measure objective developed for SWMU #7 for the NMPC Dewey Avenue facility is described in Section 3.2 following an evaluation of the impacts, if any, associated with SWMU #7.

Section 2.0

Focused Risk Assessment

2.0 - Focused Risk Assessment

2.1 General

This section presents the results of the focused screening level RA that was conducted to identify and quantify potential risks associated with utility worker exposure to soil and ground water in the vicinity of SWMU #7 during excavation activities. The USEPA "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual - Part A" (EPA/540/1-89/002) and ancillary documents were used to assess baseline risks associated with exposure to chemical constituents detected in soil and ground water for a hypothetical worker engaged in digging a trench within the area of the former underground waste oil tank at SWMU #7.

2.2 Data Evaluation

Data presented in the SWMU #7 Soil/Ground-Water Investigation Report (BB&L, December 1994) are used in this assessment. Constituents of interest in soil are determined from soil borings SB-1 through SB-5. Constituents of interest detected in these borings along with the maximum detected concentration for each constituent are shown in Table 1. Constituents of interest in ground water are determined from monitoring wells MW-1, MW-8, ESI-1 and ESI-4. The constituents of interest detected in these wells along with the maximum detected concentration of each constituent are shown in Table 2.

The constituents of interest and their associated maximum detected concentrations are carried through subsequent sections of the RA to determine potential risks to human health.

2.3 Exposure Assessment

2.3.1 Exposure Pathways

Ground water and subsurface soil are the only media potentially impacted at SWMU #7. There is no potable use of ground water either at the site or in the vicinity of the site. Future potable use of ground water is unlikely. Therefore risks associated with potable use of ground water are not evaluated in this assessment.

Soil which contains constituents of interest is beneath pavement which inhibits direct contact (oral and dermal exposure) and volatilization (inhalation exposure). Given these facts, no current exposure to subsurface soil is occurring, either for on-site workers, potential trespassers, or nearby residents.

Future exposures could occur if subsurface soil were exposed following excavation. Since there is no apparent motive for excavation beneath the asphalt other than installation of a utility trench, the only potential receptor which is evaluated in this RA is a hypothetical excavation worker. The hypothetical excavation worker would incur the greatest exposure (greater than a trespasser, nearby resident, or hypothetical on-site worker not involved in the excavation), and is thus, evaluated as the most exposed receptor. Assuming that the trench would be filled following completion of the installation, no further exposure would occur.

The hypothetical excavation worker is envisioned to be an individual involved in excavating a trench for the purpose of installing something such as an electrical conduit. The scenario assumes that the trench will be excavated to bedrock over the entire width of the SWMU, and that ground water will be present in the bottom of the trench. Workers will be exposed for three 8-hour days via the following:

- Dermal contact with ground water (hands and feet);
- Incidental ingestion of subsurface soil;
- Dermal contact with subsurface soil (hands, face and forearms); and
- Inhalation of volatiles and particulate released to air from subsurface soil.

2.3.2 Quantification of Exposure

Maximum detected concentrations in soil and ground water are used along with assumptions about contact rates and the frequency and duration of exposure to estimate human intakes for each constituent of interest and pathway of exposure. Soil and ground water concentrations (Tables 1 and 2) are used directly to estimate intakes associated with oral and dermal exposures. The maximum detected soil concentrations of inorganics and semi-volatile organics are used along with USEPA's (1994) default particulate emission factor (6.79E+08 kg/m^3) to generate chemical-specific concentrations associated with fugitive dust released to air. The maximum detected concentration of organic constituents in soil is used along with chemical-specific volatilization factors (Appendix A) to generate vapor concentrations. The vapor and dust concentrations generated by these methods are shown in Table 6.

Incidental Ingestion of Soil

Intake (mg/kg-day) associated with incidental ingestion of soil is calculated from the equation:

$$Intake = \frac{CS \times IR \times CF \times ED}{BW \times AT}$$

where:

CS = chemical concentration in soil (mg/kg);
IR = ingestion rate (100 mg soil/day);
CF = conversion factor (1E-06 kg/mg);
ED = exposure duration (3 days);
BW = body weight (70 kg);
AT = averaging time
= 3 days for non-carcinogenic effects;
= 25550 days for carcinogenic effects.

The values for ingestion rate, body weight and averaging time are recommended by USEPA (1991). The exposure duration is the value assumed to be reasonable for this exposure scenario. Different averaging times are used to estimate intakes for carcinogenic and non-carcinogenic effects because USEPA assumes that non-carcinogenic effects have thresholds of toxicity, and hence, should be evaluated over the period of exposure; while carcinogenic effects are non-threshold phenomena which are accrued over a lifetime of exposure (25550 days or 70 years).

Dermal Exposure to Soil

Due to a general lack of information on dermal absorption from soil for many constituents, USEPA Region II only quantitatively evaluates dermal exposure to PCBs, polychlorinated dibenzo(p)dioxins, polychlorinated dibenzofurans, and cadmium. Of these constituents, only PCBs are constituents of interest for this site. Hence, this assessment quantifies only dermal intake associated with exposure to PCBs in soil. The following equation is used to estimate intake (mg/kg-day):

$$Intake = \frac{CS \times SA \times ABS \times AF \times CF \times ED}{BW \times AT}$$

where

CS	=	chemical concentration in soil (mg/kg);
SA	=	skin surface area contacted (2570 cm^2);
AF	=	soil to skin adherence factor (1 mg/cm^2);
ABS	=	absorption fraction (3.3% or 0.033);
CF	=	conversion factor (1E-06 kg/mg);
ED	=	exposure duration (3 days);
BW	=	body weight (70 kg);
AT	=	averaging time
	=	3 days for non-carcinogenic effects;
	=	25550 days for carcinogenic effects.

The values for skin surface area, adherence factor, absorption fraction, body weight and averaging time are those recommended by USEPA (1992). The absorption fraction is the mid-point of USEPA's (1992) recommended range for PCBs (3,3'4,4'-tetrachlorbiphenyl).

Inhalation Exposure (Vapors and Dust)

The toxicity criteria used to evaluate inhalation exposure [i.e., reference concentration (RfCs) and unit risk factors] are reported in units of concentration (i.e., mg/m^3 and $(ug/m^3)^{-1}$). Conversion of these concentrations to corresponding inhaled doses is possible, but not recommended by USEPA. For this reason, intakes for dust and vapor inhalation exposure are not calculated in this assessment. Instead, dust and vapor air concentrations from soil are used in unmodified form to estimate non-carcinogenic hazard indices. Air concentrations used to estimate carcinogenic risk are normalized over the average lifespan (e.g., 3 days/25550 days x air concentration). These concentrations (shown in Table 6) are then used directly with USEPA reference toxicity values to estimate non-carcinogenic hazard indices and carcinogenic risk.

Dermal Exposure to Ground Water

Dermal intakes for the organic constituents of interest detected in ground water are calculated by:

$$Intake = \frac{DA \times SA \times EV \times ED}{BW \times AT}$$

where:

DA = Dermally absorbed dose (mg/cm^2-event)(Appendix B);
SA = Skin surface area exposed (1960 cm^2);
EV = Events per day (1);
ED = Exposure duration (3 days);
BW = body weight (70 kg);
AT = averaging time
= 3 days for non-carcinogenic effects;
= 25550 days for carcinogenic effects.

The equations and variables used to estimate dermally absorbed dose are presented in Appendix B. Dermal absorption of inorganics is considered negligible and is not quantified. The value for skin surface area is derived for hands and feet from data presented in USEPA (1992). Values for other variables are as described previously.

2.4 Toxicity Assessment

The toxicity assessment identifies the potential health effects associated with route-specific exposure to a given chemical by reviewing relevant human and animal studies; and quantifies these effects through analysis of dose-response relationships. USEPA toxicity assessments and the resultant toxicity criteria are used in the human health RA to evaluate both the carcinogenic and non-carcinogenic risks associated with each chemical of interest and route of exposure.

USEPA toxicity criteria used in this assessment include: chronic reference dose (RfDs) (non-carcinogenic effects, oral exposure); chronic RfCs (non-carcinogenic effects, inhalation exposure); carcinogenic slope factors (carcinogenic effects, oral exposure); and carcinogenic unit risk factors (carcinogenic effects, inhalation exposure).

The chronic RfD or RfC for a chemical is ideally based on studies where either animal or human populations were exposed to a given chemical by a given route of exposure for the major portion of the lifespan (referred to as a chronic study). RfDs are reported as doses in milligrams of chemical per kilogram body weight per day (mg/kg-day). RfCs are reported as concentrations in milligrams of chemical per cubic meter of air (mg/m^3). RfDs and RfCs represent thresholds toxicity. They are derived such that human lifetime exposure to a given chemical at a dose at or below the RfD or RfC should not result in adverse health effects, even for the most sensitive members of the population.

Carcinogenic slope factors and unit risk factors are route-specific values derived only for chemicals that have been shown to cause an increased incidence of tumors in either human or animal studies. Slope factors and unit risk factors are upper 95 percent confidence limits on lifetime risk, and are determined by low-dose extrapolation using data from human or animal studies. Slope factors are reported as risk per dose (mg/kg-day)$^{-1}$. Inhalation unit risk factors are reported in units of risk per concentration (ug/m^3)$^{-1}$.

The available USEPA RfDs, RfCs, unit risks, and carcinogenic slope factors used in this assessment are presented in Table 3. Due to the lack of scientific studies to quantify dermal toxicity and carcinogenic potential for a number of the chemicals of interest, no toxicity criteria for dermal exposure are currently available. In the absence of dermal reference toxicity criteria, USEPA (1989) suggests that in some cases it may be possible to modify an oral reference toxicity value (RfD or. slope factor) to reflect dermal absorption. This requires an assumption that both oral and dermal exposure result in the same toxic endpoints, and that quantitative estimates for both oral and dermal absorption of the chemical are available. This information is generally not available for most constituents. As a consequence, any estimation of the contribution of dermal exposure to overall risk is likely conservative and needs to be viewed as highly tentative at best.

2.5 Risk Characterization

This section is the last step of the focused screening level RA and involves integrating human intakes or air concentrations with USEPA reference toxicity values to characterize risk. Carcinogenic and non-carcinogenic effects are characterized separately.

2.5.1 Non-Carcinogenic Effects

A hazard index (HI) approach is used to characterize the overall potential for non-carcinogenic effects associated with exposure to multiple chemicals. This approach assumes that simultaneous sub-threshold chronic exposures to multiple chemicals are additive. The HI is calculated as follows:

$$HI = E1/Rf1 + E2/Rf2 + ...Ei/Rfi$$

where:

Ei	=	exposure intake or concentration for the "ith" chemical;
Rfi	=	RfD (oral) or RfC (inhalation) for the "ith" chemical; and
Ei/Rfi	=	Hazard Quotient (HQ).

Calculation of a HI in excess of one indicates the potential for adverse health effects. Calculations of HIs for each pathway of exposure are presented in Tables 4 (incidental ingestion of soil), 6 (inhalation of dust and vapor released from soil), and 7 (dermal contact with ground water). A summary of HIs by pathway, as well as the overall HI is given in Table 8.

As shown in Table 8, the total HI as well as individual HIs for each pathway of exposure are less than one, indicating that adverse effects from current exposures to soil associated with SWMU #7 are unlikely. No HI is calculated for dermal exposure to soil because 1) dermal exposure can be quantified only for PCBs per USEPA Region II guidance; and 2) there is no USEPA RfD for PCBs as a class. However, potential carcinogenic effects associated with dermal exposure to PCBs are quantified and discussed (Section 2.5.2).

2.5.2 Carcinogenic Effects

Carcinogenic risk is expressed as a probability of developing cancer as a result of lifetime exposure. For a given chemical and route of exposure, carcinogenic risk is calculated as follows:

$$\textbf{Risk} = E_i \times SF_i \text{ or } URF_i$$

where:

E_i	=	exposure intake (CDI) or concentration for the "ith" chemical;
SF_i	=	oral slope factor for the "ith" chemical; and
URF_i	=	inhalation unit risk factor for the "ith" chemical.

For exposure to multiple carcinogens, USEPA assumes that the total risk is equivalent to the sum of the individual risks. USEPA's acceptable target range for total carcinogenic risk associated with Superfund sites is one-in-ten-thousand (1E-04) to one-in-one-million (1E-06). USEPA has stated that remediation is generally not warranted at Superfund sites where the total carcinogenic risks for current and hypothetical conditions is less than 1E-04, unless non-carcinogenic Hazard Indices exceed one, ARARs (Applicable or Relevant and Appropriate Requirements) have been exceeded, and/or adverse environmental impacts have been observed (USEPA OSWER Directive No. 9355.0, April 22, 1991).

Carcinogenic risks have been calculated in this assessment for each chemical and pathway of exposure. These calculations are presented in Table 4 (incidental ingestion of soil), Table 5 (dermal contact with soil), Table 6 (inhalation of dust and vapors released from soil), and Table 7 (dermal contact with ground water). Total cancer risks for each pathway and the overall cancer risk for hypothetical excavation workers are summarized in Table 8.

As shown in these tables, estimates of carcinogenic risk for each potential exposure pathway as well as the cumulative carcinogenic risk for hypothetical future excavation workers are less than 1E-06.

2.5.3 Uncertainty

Several sources of uncertainty in the risk calculations exist. These include uncertainties associated with exposure scenarios, exposure point concentrations, and reference toxicity criteria.

The exposure scenarios used in this assessment are conservative (health-protective) "standard" scenarios which are likely to overestimate risk. If they occur, actual exposures are expected to deviate from those calculated due to differences in exposure frequencies, contact rates, absorption efficiencies (dermal exposure), exposure duration, body weight, lifespan, concentrations, and other factors.

Although the data which serve as the basis for the risk assessment have met quality assurance (QA) standards, they provide information on chemicals present at the site for only a brief moment in time. Concentrations to which receptors may be exposed could vary from the values observed during the focused CMS. The exposure point concentrations used in this assessment are maximum concentrations for each medium sampled. It is unlikely that a receptor would be exposed simultaneously to the maximum concentrations of all of the constituents of interest detected.

The reference toxicity criteria used in this assessment are the most current values approved by USEPA. Reference toxicity criteria are not available for all of the chemicals to which one could be exposed at the site, nor for all routes of exposure. In particular, the use of oral toxicity criteria in the estimation of dermal toxicity creates a great deal of uncertainty. Finally, chronic RfDs and RfCs have been used to assess potential non-carcinogenic effects. The period of exposure for a hypothetical excavation worker is actually acute (3 days) rather than chronic (greater than 7 years for a human), since the dose associated with adverse effects is generally inversely proportional to the duration of exposure, acute RfDs or RfCs, if derived would be much higher than the RfDs used in this assessment. However, there is no point in determining acute toxicity values because comparing intakes to chronic RfDs failed to indicate potential risks.

2.6 Risk Assessment Conclusions

Ground water and soil are the only media potentially impacted at SWMU #7. Currently, there is no potable use of ground water in the vicinity of the site, nor is future ground water use likely. Recent ground-water monitoring results indicate that impacted ground water associated with SWMU #7 has not migrated off-site. There is no exposure to constituents in subsurface soil due to the presence of pavement, which inhibits direct contact (oral and dermal exposure) and volatilization (inhalation exposure).

The only hypothetical receptor which is likely to be exposed to the constituents in ground water or subsurface soils is an on-site excavation worker, since the only apparent motive for excavation beneath the asphalt would be installation of a utility trench. Using the maximum detected concentrations of constituents detected in ground water and subsurface soil, USEPA reference toxicity criteria, and standard default exposure assumptions, calculated risks for these receptors fall below the USEPA target levels for acceptable risk (total excess lifetime cancer risk of 1E-06 to 1E-04 and total non-carcinogenic hazard index less than one).

In conclusion, the soil and ground water associated with SWMU #7 does not pose risks to human health under either the current conditions (impacted ground water is contained within the site and no on-site potable use of ground water exists) or hypothetical conditions of use and exposure.

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Should have
safety measures
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notification
for workers
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Section 3.0

Corrective Measures Study

3.0 - Corrective Measures Study

3.1 General

This section of the report presents the results of a CMS conducted to identify the corrective measure objective for SWMU #7 and evaluate potential corrective measure alternatives to satisfy this objective. The CMS will result in the recommendation of a feasible and cost-effective remedial alternative that best meets the evaluation criteria and satisfies the corrective measure objective.

3.2 SWMU #7 Corrective Measure Objective

This subsection presents the corrective measure objective for SWMU #7. The corrective measure objective is based on the results of the 1994 Soil/Ground-Water Investigation, the Focused RA, and the corrective action requirements outlined in NMPC's NYCRR Part 373 permit. The corrective measure objective is used in the identification and evaluation of the corrective measure alternatives as a basis for determining the anticipated effectiveness of each alternative.

The conclusions of the Focused RA indicate that chemical constituents present in SWMU #7 area subsurface soils and ground water pose no risk to human health under current conditions and the relevant exposure scenarios evaluated. The results of the 1994 Soil/Ground-Water Investigation indicate that chemical constituents have been detected in subsurface soil and ground water in the immediate vicinity of SWMU #7 at concentrations slightly above NYSDEC standards. However, the impacted soil associated with SWMU #7 is effectively capped by an existing pavement surface. Also, chemical constituents have not been detected in site ground water at the hydraulically downgradient monitoring wells, MW-6 and MW-7. This indicates that off-site migration of impacted ground water associated with SWMU #7 has not occurred. Therefore, the corrective measure objective is to control the potential future off-site migration of ground water containing chemical constituents at concentrations greater than the NYSDEC water quality standards.

3.3 Identification of Corrective Measure Alternatives

The corrective measure identification process involved a review of available literature, including published documents and vendor information to identify potentially applicable alternatives to address the SWMU #7 area ground water. A focused list of four potential corrective measure alternatives were identified and evaluated. Presented below is a brief description of each alternative. A more detailed description of each alternative is presented in Section 3.5.

1. No-Action Alternative

Under the no-action alternative, no corrective measure activities associated with the ground water would be implemented.

2. Limited Action Alternative (Ground-Water Monitoring Program)

Under the limited action alternative, a ground-water monitoring program would be implemented to monitor the potential migration of impacted ground water associated with SWMU #7. This alternative would include a re-evaluation of additional corrective measure alternatives, if results from ground-water monitoring events indicate further corrective action is necessary to satisfy the corrective measure objective.

3. Containment Alternative (Slurry Cutoff Wall System)

This alternative involves the construction of a slurry cutoff wall in the overburden to prevent the off-site migration of impacted ground water. The cutoff wall system would consist of soil-bentonite walls which extend from ground surface and key into a subsurface bedrock or low permeability unit. The existing SWMU #7 pavement surface would be utilized as a low-impermeability cap. The slurry wall would be constructed so that the impacted ground water was surrounded and further migration could not occur.

4. Removal and On-Site Treatment Alternative

This alternative involves pumping ground water from the vicinity of SWMU #7, treating the extracted ground water at a new on-site treatment facility, and discharging the treated ground water into the existing sanitary sewer in accordance with an appropriate sewer discharge permit.

3.4 Description of Evaluation Criteria

3.4.1 Technical Analysis

The technical analysis of each alternative is primarily a descriptive process by which technical feasibility is assessed based on performance, reliability, ease of implementation, and safety. The evaluation of an alternative's performance will be based on the effectiveness and useful life of the corrective measure. Reliability will include a discussion of the alternative's operation and maintenance requirements and its demonstrated reliability. The implementability of each corrective measure alternative will include a discussion of each corrective measure alternative's ease of installation (constructability), the time required to implement the corrective measure, and the time it takes to see beneficial results. Safety, including threats to nearby communities and environments, as well as those to on-site workers, will be evaluated for each alternative.

3.4.2 Environmental Analysis

The environmental analysis will include an assessment of possible effects on the environment resulting from the implementation of each of the remaining alternatives. The objective of environmental analysis is to delineate the "net" effects of each alternative response so that consideration for environment risk is explicitly incorporated into the ultimate selection of the preferred alternative. The no-action alternative will serve as the baseline from which "net" effects can be determined. The environmental analysis will evaluate the following for each alternative:

1. Changes in release of contaminants and final environmental conditions;
2. Improvements in the physical environment; and
3. Adverse effects of the responses.

For each alternative with identified potential adverse environmental impacts, a list of mitigative measures to eliminate or minimize the impacts will be developed.

3.4.3 Public Health Analysis

A human health analysis of the corrective measure alternative(s) will be conducted to assess the extent that implementation of each alternative will affect the potential for exposure and associated risk to human health.

As with the environmental analysis, the no-action alternative will be fully evaluated during the human health analysis activities. This will involve a review of existing conditions in terms of utility worker risks, as discussed in the Focused RA. The human health analysis of the no-action alternative will serve as the baseline to which comparisons of the risks associated with other alternatives can be made.

3.4.4 Institutional Analysis

The institutional analysis will evaluate each of the corrective measure alternatives with respect to local, state, and federal requirements. In the process of this analysis, permitting requirements will be identified for the implementation of each alternative (if applicable) and permitting schedules under which each alternative could be implemented will be defined.

3.4.5 Cost Analysis

The cost analysis will be performed to identify present worth costs for each alternative. The purpose of this analysis is to evaluate the corrective measure alternatives in terms of aggregate costs, including capital, operation, and maintenance costs. Capital costs will include direct (construction) and indirect (engineering, legal, and contingency) costs.

The cost analysis will use readily available information to estimate the expense of the items. The cost analysis will result in the identification of all costs associated with each alternative and the presentation of those costs over time.

3.5 Evaluation of Corrective Measure Alternatives

3.5.1 No-Action Alternative

Technical Analysis

The no-action alternative serves as a baseline for comparison of the overall effectiveness of each corrective measure alternative. The no-action alternative would not utilize any remedial or monitoring technologies for the containment or treatment of the SWMU #7 impacted ground water. The site would remain in its current condition and no effort would be made to change the current site conditions.

No corrective action would be implemented under this alternative, therefore the performance and reliability of this alternative cannot be evaluated. Because there would be no need for construction activities nor the implementation of technologies, the no-action alternative would be easily implemented. The safety of nearby communities and environments, as well as on-site workers, would not be affected by the implementation of the no-action alternative.

Environmental Analysis

Implementation of this alternative would not directly reduce the concentrations of constituents in the site ground water, nor would it affect the overall environmental conditions at the site. No immediate adverse effects on the environment would result from the implementation of this alternative, however, potential off-site migration of impacted ground water would not be monitored or mitigated, if necessary.

Human Health Analysis

Results of the Focused RA indicated that, at the present time, there are no direct human health risks posed by the SWMU #7 ground water because the site ground water is not used as a potable water source, and off-site migration of ground-water constituents has not occurred. Implementation of the no-action alternative would have no immediate effects on human health risks. However, implementation of this alternative would not prevent potential future health risks associated with the off-site migration of the impacted ground water.

Institutional Analysis

Implementation of the no-action alternative would not control the potential for constituents in the SWMU #7 area ground water from migrating off-site and therefore would not satisfy the corrective measure objective. No specific permits would be required to implement this alternative.

Cost Analysis

This alternative does not require any actions to be taken; therefore, there are no costs associated with this alternative.

3.5.2 Limited Action Alternative (Ground-Water Monitoring Program)

Technical Analysis

This alternative involves the implementation of a ground-water monitoring program, which would include biannual ground-water sampling of existing monitoring wells located in the vicinity of SWMU #7. The locations of all existing site monitoring wells are shown on Figure 1. The proposed ground-water monitoring program would involve collecting ground-water samples from monitoring wells MW-1, MW-5, MW-6, and MW-7 in April and October of each year. Ground-water samples would also be collected from monitoring wells MW-8, ESI-1, ESI-2, and ESI-3 in October of each year. All samples would be submitted for laboratory analysis for VOCs, PCBs, and total lead.

The purpose of the ground-water monitoring program would be to monitor the migration of the impacted ground water associated with SWMU #7. Analytical results obtained from each sampling event would be evaluated to determine the extent and concentration of constituents in the site ground water. Monitoring wells MW-6 and MW-7 would be monitored because these wells are hydraulically downgradient of SWMU #7, and the detection of elevated constituent concentrations at either of these wells would indicate potential off-site migration of the impacted ground water. The remaining monitoring wells included in the monitoring program would be sampled to indicate any changes in ground-water conditions.

To ensure that off-site migration of impacted ground water does not occur, this alternative includes the following feature. If the results from two consecutive sampling events indicate constituent concentrations in monitoring wells MW-6 or MW-7 that exceed the NYSDEC ground-water quality standards, an evaluation of additional remedial alternatives will be initiated. Based on the results of the evaluation, a more aggressive corrective measure (one that involves the active containment or removal of ground-water constituents) will be implemented in addition to the ground-water monitoring program.

Implementation of the limited action alternative involving a ground-water monitoring program and potential further corrective measures evaluation would be an effective and reliable method to mitigate off-site migration of impacted ground water. The limited action alternative involves no construction activities or remedial technologies and therefore is technically feasible and would be easily implemented. The safety of nearby communities and environments, as well as on-site workers, would not be affected by the implementation of the limited action alternative. For evaluation purposes, a lifetime of 30 years has been chosen for this alternative.

Environmental Analysis

Implementation of this alternative would not directly reduce the concentrations of constituents in the site ground water, nor would it affect the overall environmental conditions at the site. However, constituents of concern in the SWMU #7 ground water are expected to attenuate to concentrations below the NYSDEC ground-water quality standards. Potential off-site migration of the impacted ground water would be mitigated under this alternative through biannual ground-water monitoring and an evaluation of additional corrective measures, if results from monitoring events indicate off-site migration of ground water containing constituents at concentrations which exceed NYSDEC ground-water quality standards is imminent.

Public Health Analysis

Results of the Focused RA indicated that at the present time, there are no direct human health risks posed by the SWMU #7 ground water because the site ground water is not used as a potable water source, and off-site migration of ground-water constituents has not occurred. In addition, results of the Focused RA indicate that no unacceptable human health risks would be posed under the potential future scenario of utility workers installing a trench in the immediate vicinity of SWMU #7. Implementation of the limited action alternative would have no immediate effects on human health risks. However, implementation of this alternative, unlike the no-action alternative, would prevent potential future health risks associated with off-site migration of the impacted ground water.

Institutional Analysis

Implementation of the limited action alternative would control the off-site migration of impacted ground water through ground-water monitoring and evaluation of additional corrective measures, if necessary. Therefore, this alternative would satisfy the corrective measure objective. No specific permits would be required to implement this alternative.

Cost Analysis

Capital costs incurred under the limited action alternative would include costs associated with ground-water sampling activities, laboratory analysis of samples, and the evaluation and reporting of sampling results. The 30-year present worth cost of this alternative has been estimated at $372,500. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 9.

3.5.3 Containment Alternative (Slurry Cutoff Wall System)

Technical Analysis

This alternative involves the construction of a ground-water cutoff wall encompassing the impacted ground water associated with SWMU #7. The cutoff wall would control the migration of impacted ground water and prevent the potential off-site migration of chemical constituents. This alternative would usually include the construction of an impermeable cap over the area of impacted ground water. However, the construction of a cap would not be necessary in this case due to the presence of an existing pavement surface overlying SWMU #7. The existing pavement surface prevents precipitation from infiltrating into the soils in the area over the impacted ground water.

The proposed ground-water cutoff wall would consist of a soil-bentonite mixture installed in a trench that surrounds the area of impacted ground water. The soil-bentonite cutoff wall would be constructed by the slurry trench method and would provide a permeability of 1×10^{-7} cm/sec or less. The slurry trench method consists of trench excavation under a bentonite-water slurry to maintain trench stability. As excavation proceeds, a soil-bentonite backfill mixture is installed at the initial point of excavation which displaces the slurry forward within the excavated trench. This procedure is followed until the entire trench contains only the soil-bentonite mixture forming the ground-water cutoff wall. The remaining slurry, which has been in contact with the site ground water, would require disposal in accordance with applicable regulations. The cutoff wall would be tied into the existing pavement cap and would extend from the ground surface to a subsurface bedrock unit or low permeability confining layer. Hydraulic controls (removal of a portion of the impacted ground water from within the area encircled by the cutoff wall) would be required to maintain an inward gradient for ground water within the encapsulated area. The construction of a new on-site treatment system would be required to treat the removed ground water prior to discharge.

Once the slurry wall has been constructed, a ground-water monitoring program would be implemented to ensure that the slurry wall is providing adequate containment of the SWMU #7 impacted ground water. This monitoring program would be the same program proposed under the limited action alternative and is discussed in detail in Section 3.5.2.

Based on previous experience, the implementation of this alternative is a reliable and effective means of containing impacted ground water and preventing potential future off-site migration. However, the corrective measure objective for SWMU #7 ground water could be satisfied through the implementation of a ground-water removal and treatment system alone. Because this alternative requires ground-water removal and treatment in addition to the construction of a slurry wall, this alternative is technically impractical. Also, the cost associated with constructing a slurry wall into bedrock is extreme when compared to the relative value of the slurry wall when ground-water extraction and treatment is also required. Therefore, this alternative will not be further evaluated as a potential corrective measure alternative.

A ground-water removal and treatment alternative is evaluated in Section 3.5.4.

3.5.4 Removal and On-Site Treatment Alternative

Technical Analysis

This alternative involves the extraction of ground water from the SWMU #7 area of the site via a ground-water extraction system, the treatment of the extracted ground water at a new on-site treatment facility, and discharge of the treated ground water into the existing sanitary sewer in accordance with an appropriate discharge permit.

The actual design of the ground-water extraction system including number, location, and configuration of wells would be performed during the remedial design. At that time, it will also be determined whether existing monitoring wells may be incorporated into the extraction system or whether the installation of additional wells is necessary. Pump tests and ground-water modeling would be required for the design of the ground-water extraction system.

The new on-site treatment facility would consist of two liquid phase activated carbon units to remove organic constituents (i.e., VOCs and PCBs) from the ground-water. Carbon adsorption is a process by which organic molecules in a waste stream are selectively attracted to the internal pores of granular activated carbon (GAC). The treatment facility will also consist of one ion exchange unit to remove inorganic constituents (i.e., lead) from the ground water. The ion exchange treatment process involves the use of ion exchange resins to treat extracted water. The principles of ion exchange treatment are based on the transfer of ionic components (lead cations) in solution to a receptive medium (resins) in exchange for non-hazardous ionic components (hydrogen cations).

For the purposes of estimating the cost of this alternative, it has been assumed that the treatment system would be designed to accommodate a maximum operational flow of 5 gallons per minute (gpm). Extracted ground water would be sent through a series of three drum-type treatment units; an ion exchange resin unit preceded and followed by activated carbon units. Based on experience, this order of treatment is the most effective design for constituent removal through carbon adsorption and ion exchange. Following treatment, the ground water would be discharged to the existing sanitary sewer system in accordance with a Buffalo Pollution Discharge Elimination System (BPDES) permit.

To ensure adequate treatment of the ground water, this alternative includes the implementation of the ground-water monitoring program proposed in Section 3.5.2 of this report under the limited action alternative. In addition, effluent from the treatment facility would be monitored monthly to ensure that the treated ground water meets the discharge requirements specified in a BPDES permit. Ground-water withdrawal followed by on-site treatment at a new treatment facility would be a feasible, reliable, and effective means of treating and mitigating potential off-site migration of the SWMU #7 ground water. Ground-water withdrawal and construction of a new on-site treatment facility may be implemented within one year. For evaluation purposes, a lifetime of 30 years has been chosen for this alternative.

Potential risks to on-site workers during the implementation of this alternative include injuries related to construction and system operation activities. These risks will be mitigated by developing an alternative-specific Health and Safety Plan (based on NMPC's existing Health and Safety Plan) that would be adhered to during implementation of this alternative. In addition, precautions will be taken in the operation of the new on-site treatment facility to mitigate potential risks related to operation of the facility, such as the use of properly trained operators, implementation of NMPC's Health and Safety Plan, implementation of equipment inspection and maintenance programs, and the implementation of monitoring programs.

Environmental Analysis

Implementation of this alternative would result in improved environmental conditions at the site due to the reduction of chemical constituents in the SWMU #7 area ground water. Potential off-site migration of impacted water would also be mitigated under this alternative. However, this alternative would result in the transfer of constituents of concern from the ground water to other media (resin and GAC) which would then require special handling and disposal. This may present additional long-term environmental liabilities.

Human Health Analysis

Results of the Focused RA indicated that at this time there are no direct human health risks posed by the SWMU #7 ground water. Therefore, implementation of this ground-water removal and treatment alternative would not affect on-site human health risks. However, this alternative would reduce the concentrations of constituents in the site ground water and would prevent future health risks associated with the potential off-site migration of the impacted ground water.

Institutional Analysis

Implementation of this alternative would control the off-site migration of impacted ground water by reducing the concentrations of constituents in the ground water and monitoring the effectiveness of the treatment activities. Therefore, this alternative would satisfy the corrective measure objective. Implementation of this alternative would require obtaining a BPDES permit from the Buffalo Sewer Authority (BSA). The quantity and quality of the treatment facility discharge into the sanitary sewer system would be set by a BPDES permit. Within 90 days of receiving an acceptable application, the BSA will issue a BPDES permit or will notify the applicant that a permit is not required for discharge. Permits issued by the BSA are rated for a period of three years.

Cost Analysis

The capital costs associated with the implementation of this alternative include construction of the ground-water extraction system and construction of the treatment system. Future site maintenance and monitoring activities would include ground-water monitoring and continuous operation and maintenance of the treatment system. The present worth cost has been calculated assuming that water is pumped and treated at a rate of 5 gpm, and all monitoring and maintenance operations are continued for 30 years. The estimated total 30-year present worth cost for this alternative is $1,500,000. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 10.

3.6 Conclusions and Recommendations

The positive and negative aspects of each corrective measure alternative evaluated are presented in Table 11. Based on the results of the detailed evaluation of the ground-water corrective measure alternatives presented in this section, the limited action alternative (implementation of a ground-water monitoring program) will adequately meet the corrective measure objective of mitigating the off-site migration of impacted ground water. Although the no-action alternative is the most inexpensive alternative to implement, it does not satisfy the corrective measure objective. The containment alternative is technically impractical, and therefore is not a potential corrective measure alternative to be evaluated. The removal and treatment alternative satisfies the corrective measure objective, however, the cost of this alternative is significantly more than the limited action alternative. Also, the limited action alternative best meets the environmental evaluation criteria. Under the limited action alternative, the constituents of concern in the SWMU #7 ground water at the present time pose no unacceptable risks and are expected to attenuate to concentrations below NYSDEC ground-water quality standards. Under the removal and on-site treatment alternative, the constituents removed from the SWMU #7 ground water would be transferred to other media that would require special handling and disposal. This may present additional long-term environmental liabilities. Therefore, the limited action alternative involving the implementation of a ground-water monitoring program represents the most cost-effective ground-water corrective measure alternative for achieving the corrective measure objective, and is the recommended corrective measure alternative to be implemented at the NMPC Dewey Avenue Service Center.

Section 4.0

References

4.0 - References

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Tables

Table 1

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Constituents of Interest in Soil (1)

Constituent	Maximum Detected Concentration (mg/kg) (2)
1,2,4-Trimethylbenzene	11
1,3,5-Trimethylbenzene	1
Benzene	1
Chromium	27.7
Ethylbenzene	3.4
Lead	34.2
Naphthalene	2.9
PCBs (total)	6.6
Toluene	4.8
Xylenes (total)	17

Notes:
(1) Based on Data presented in the SWMU #7 Investigation Report (BB&L, December, 1994).

(2) Based on soil borings SB-1 through SB-5

Table 2

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

<u>Constituents of Interest in Ground Water (1)</u>

Constituent	Maximum Detected Concentration (mg/l) (2)
1,1-Dichloroethane	1.40E-02
1,1,1-Trichloroethane	3.00E-03
Benzene	8.10E-02
Bis(2-ethylhexyl)phthalate	4.00E-03
Carbon Disulfide	2.20E-02
Chloroethane	4.50E-02
Chloroform	2.00E-03
Ethylbenzene	5.30E-02
Lead	3.42E-02
PCBs (Aroclor 1242)	2.40E-03
Phenanthrene	1.00E-03
Toluene	2.10E-02
Xlylene (m,p-)	5.30E-02
Xylene (o-)	3.00E-02

Notes:
(1) Based on Data presented in the SWMU #7 Investigation Report (BB&L, December, 1994).

(2) Based on samples taken from MW-1, MW-8, ESI-1 and ESI-4

Table 3

Niagara Mohawk Power Corporation
Dewey Avenue

USEPA Reference Toxicity Values (1)

Chemical Name	Oral RfD (mg/kg−day)	Source	Inhalation RfC (mg/m3)	Source	Weight−of Evidence [2]	Source	Oral SF (mg/kg−day)−1	Inhalation Unit Risk (ug/m3)−1	Source
1,1−dichloroethane	0.1	HEAST (07/93)	0.5	HEAST (07/93)	C	IRIS (1994)			NA
1,1,1−trichloroethane		NA		NA	NA	NA			NA
1,2,4−trimethyhlbenzene		NA		NA	NA	NA			NA
1,3,5−trimethylbenzene		NA		NA	NA	NA			NA
benzene		NA		NA	A	IRIS (1994)	0.029	8.3000000E−06	IRIS (1994)
bis(2−ethylhexyl)phthalate	0.02	IRIS (1994)		NA	B2	IRIS (1994)	0.014		NA
carbon disulfide	0.1	IRIS (1994)	0.01	HEAST (07/93)	NA	NA			NA
chloroethane		NA		NA	NA	NA			NA
chloroform	0.01	IRIS (1994)		NA	B2	IRIS (1994)	0.0061	0.000023	IRIS (1994)
chromium (hexavalent)	0.005	IRIS (1994)		NA	A	IRIS (1994)		0.012	IRIS (1994)
ethylbenzene	0.1	IRIS (1994)	1	IRIS (1994)	D	IRIS (1994)			NA
lead		NA		NA	B2	IRIS (1994)			NA
naphthalene		HEAST (07/93)		NA	D	IRIS (1994)			NA
PCBs		NA		NA	B2	IRIS (1994)	7.7		NA
phenanthrene	DIFQRA	HEAST (07/93)	DIFQRA	HEAST (07/93)	D	IRIS (1994)			NA
toluene	0.2	IRIS (1994)	0.4	IRIS (1994)	D	IRIS (1994)			NA
xylene, m−	2	HEAST (07/93)		NA	NA	NA			NA
xylene, mixture	2	IRIS (1994)		NA	D	IRIS (1994)			NA
xylene, o−	2	HEAST (07/93)		NA	NA	NA			NA
xylene, p−		NA	Not Verifiable	HEAST (12/11/91)	NA	NA			NA

Notes:
(1) Source is Electronic Handbook of Risk Assessment Values (EHRAV), 1995
(2) USEPA Human Health Evaluation Group Classifications with regard to carcinogenicity. A = Known human carcinogen; B = probable human carcinogen; C = possible human carcinogen; D = not classified
NA = Not Applicable
DIFQRA = Data Insufficient for Quantitative Risk Assessment

Table 4

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Estimation of Intakes and Risks Associated with Ingestion of Soil: Hypothetical Excavation Workers

Constituent	Noncarcinogenic Intake (mg/kg-day)	Carcinogenic Intake (mg/kg-day)	Oral RfD (mg/kg-day)	Oral SF 1/(mg/kg-day)	Hazard Quotient	Carcinogenic Risk
1,2,4-Trimethylbenzene	1.6E-05	1.8E-09	ND	NA	-	
1,3,5-Trimethylbenzene	1.4E-06	1.7E-10	ND	NA	-	
Benzene	1.4E-06	1.7E-10	ND	0.029	-	5E-12
Chromium	4.0E-05	4.6E-09	0.005 (1)	NA	8E-03	
Ethylbenzene	4.9E-06	5.7E-10	0.1	NA	5E-05	
Lead	4.9E-05	5.7E-09	ND	ND	-	
Naphthalene	4.1E-06	4.9E-10	ND	NA	-	
PCBs (total)	9.4E-06	1.1E-09	ND	7.7	-	9E-09
Toluene	6.9E-06	8.1E-10	0.2	NA	3E-05	
Xylenes (total)	2.4E-05	2.9E-09	2	NA	1E-05	
					Hazard Index 8E-03	**Total Risk 9E-09**

Notes:
(1) Assumed hexavalent

ND = No Data
NA = Not Applicable

Table 5

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Estimation of Intakes and Risks Associated with Dermal Contact with Soil: Hypothetical Excavation Workers

Constituent	Noncarcinogenic Intake (mg/kg-day)	Carcinogenic Intake (mg/kg-day)	Oral RfD (mg/kg-day)	Oral SF 1/(mg/kg-day)	Hazard Quotient	Carcinogenic Risk
1,2,4-Trimethylbenzene	NA	NA	ND	NA	-	-
1,3,5-Trimethylbenzene	NA	NA	ND	NA	-	-
Benzene	NA	NA	ND	0.029	-	-
Chromium	NA	NA	0.005 (1)	NA	-	-
Ethylbenzene	NA	NA	0.1	NA	-	-
Lead	NA	NA	ND	ND	-	-
Naphthalene	NA	NA	ND	NA	-	-
PCBs (total)	8.0E-07	9.4E-11	ND	7.7	-	7E-10
Toluene	NA	NA	0.2	NA	-	-
Xylenes (total)	NA	NA	2	NA	-	-
					Hazard Index NQ	**Total Risk 7E-10**

Notes:
(1) Assumed hexavalent

ND = No Data
NA = Not Applicable
NQ = Not quantifiable

Table 6

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Estimation of Risks Associated with Inhalation of Dust and Vapors Released fromSoil: Hypothetical Excavation Workers

Constituent	Vapor Concentration (mg/m3)	Dust Concentration (mg/m3)	Noncarcinogenic Concentrtion (mg/m3)	Carcinogenic Concentration (mg/m3)	Inhalation RfC (mg/m3)	Inhalation URF 1/(ug/m3)	Hazard Quotient	Carcinogenic Risk
1,2,4-Trimethylbenzene	4.11E-04	NA	4.11E-04	NA	ND	NA	–	–
1,3,5-Trimethylbenzene	7.70E-05	NA	7.70E-05	NA	ND	NA	–	–
Benzene	2.74E-04	NA	2.74E-04	3.2E-08	ND	8.3E-06	–	3E-10
Chromium (1)	NA	4.08E-08	4.08E-08	4.8E-12	ND	0.012	–	6E-11
Ethylbenzene	5.32E-04	NA	5.32E-04	NA	1	NA	5E-04	–
Lead	NA	5.04E-08	5.04E-08	5.9E-12	ND	ND	–	–
Naphthalene	5.44E-05	4.27E-09	5.44E-05	NA	ND	NA	–	–
PCBs (total)	2.92E-05	9.72E-09	2.92E-05	3.4E-09	ND	2.2E-03 (2)	–	8E-09
Toluene	9.76E-04	NA	9.76E-04	NA	0.4	NA	2E-03	–
Xylenes (total)	2.40E-03	NA	2.40E-03	NA	ND	NA	–	–
							Hazard Index = 3E-03	Total Risk = 8E-09

Notes:
(1) Assumed hexavalent
(2) Based on oral SF per common use
ND = No Data
NA = Not Applicable

Table 7

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Estimation of Intakes and Risks Associated with Dermal Contact with Ground Water: Hypothetical Excavation Workers

Constituent	Noncarcinogenic Intake (mg/kg–day)	Carcinogenic Intake (mg/kg–day)	Oral RfD (mg/kg–day)	Oral SF 1/(mg/kg–day)	Hazard Quotient	Carcinogenic Risk
1,1–Dichloroethane	4.5E–06	5.3E–10	0.1	ND	5E–05	–
1,1,1–Trichloroethane	1.3E–06	NA	ND	NA	–	–
Benzene	3.0E–05	3.5E–09	ND	0.029	–	1E–10
Bis(2–ethylhexyl)phthalate	2.1E–06	2.5E–10	0.02	0.014	1E–04	3E–12
Carbon Disulfide	9.5E–06	NA	0.1	NA	9E–05	–
Chloroethane	5.8E–06	6.9E–10	ND	NA	–	–
Chloroform	4.2E–07	5.0E–11	0.01	0.0061	4E–05	3E–13
Ethylbenzene	8.5E–05	NA	0.1	NA	8E–04	–
Lead	NA	NA	ND	ND	–	–
PCBs (Aroclor 1242)	2.2E–04	2.6E–08	ND	7.7	–	2E–07
Phenanthrene	8.4E–06	NA	ND	NA	–	–
Toluene	1.9E–05	NA	0.2	NA	9E–05	–
Xlylene (m,p–)	9.2E–05	NA	2	NA	5E–05	–
Xylene (o–)	5.2E–05	NA	2	NA	3E–05	–
					Hazard Index 1E–03	**Total Risk 2E–07**

Notes:
ND = No Data
NA = Not Applicable

Table 8

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Summary of Hazard Indices and Risks for Hypothetical Excavation Workers

Exposure Pathway	HI	Risk
Incidental Ingestion of Soil	8E−03	9E−09
Dermal Contact with Soil	NQ	7E−10
Inhalation of Dust/Vapor	3E−03	8E−09
Dermal Contact with Ground Water	1E−03	2E−07
Total	1E−02	2E−07

Notes:

NQ = Not Quantifiable

Table 9

Niagara Mohawk Power Corporation
Dewey Avenue Service Center

Cost Estimate

Limited Action Alternative (Ground-Water Monitoring Program)

Item No.	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab.	Estimated Amount
Capital Costs					
1	Engineering Services	1	LS	$30,000	$30,000
				Subtotal Capital Cost	$30,000
				Contingency (25%)	7,500
				Administration (10%)	3,000
				Total Capital Cost	$40,500
Annual Operation and Maintenance Costs					
2	Biannual Sampling Analysis and Reporting	1	LS	--	$15,000
3	Pro-Rated Annual Well Replacement	1	LS	--	1,000
				Subtotal Annual O&M Costs	$16,000
				Contingency (25%)	4,000
				Administration and Engineering (10%)	1,600
				Total Annual O&M Costs	21,600
				Present Worth Factor (30 Years, 5%)	15.37
				Total 30-Year O&M Present Worth Costs	$331,992
				Total 30-Year Cost Estimate	$372,492
				Rounded To	$372,500

Assumptions:

1. Cost estimate includes costs for Work Plan development.
2. Cost estimate includes:
    - Labor and materials for biannual ground-water sampling;
    - Analytical cost for two rounds of ground-water samples from MW-1, MW-5, MW-6, and MW-7, and one round of ground-water samples from MW-8, ESI-1, ESI-2, and ESI-3 for VOCs, PCBs, and total lead; and
    - Cost for the preparation of two ground-water monitoring event reports.
3. Cost estimate includes costs for one well replacement every four years.

Table 10

Niagara Mohawk Power Corporation
Dewey Avenue Service Center

Cost Estimate

Removal and On-Site Treatment Alternative

Item No.	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab.	Estimated Amount
Capital Costs					
1	TIGG Cansorb C-15	2	each	$3,000	$6,000
2	Amberlite Resin Unit	1	each	5,000	5,000
3	Well Pump	1	each	2,500	2,500
4	Well Pump Control System	1	each	2,500	2,500
5	Treatment Area Preparation	--	LS	10,000	10,000
6	Autodialer System	1	each	3,000	3,000
7	Totalizing Flow Meter	1	each	3,000	3,000
8	Miscellaneous Electrical	--	LS	28,000	28,000
9	Miscellaneous Piping	--	LS	40,000	40,000
				Subtotal Capital Cost	$100,000
				Contingency (25%)	25,000
				Administration (10%)	10,000
				Total Capital Cost	$135,000
Annual Operation and Maintenance Costs					
10	Treatment System Operator	416	hours	$ 45	$18,720
11	Equipment Maintenance	--	LS	3,000	3,000
12	Liquid Phase GAC Replacement, Transportation, and Disposal	--	LS	5,000	5,000
13	Power	--	LS	1,000	1,000
14	Effluent Sampling and Analysis	--	LS	18,000	18,000
				Subtotal Annual O&M Costs	$45,720
				Contingency (25%)	11,430
				Administration and Engineering (10%)	4,572
				Total Annual O&M Costs	$61,722
				Present Worth Factor (30 Years, 5%)	15.37
				Total 30-Year O&M Present Worth Costs	$948,667

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Table 10
(Cont'd)

Niagara Mohawk Power Corporation
Dewey Avenue Service Center

Cost Estimate

Removal and On-Site Treatment Alternative

Item No.	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab.	Estimated Amount
Ground-Water Monitoring Program					
15	Total 30-Year Cost Estimate (see Table 9)				$372,500
	Total 30-Year Cost Estimate				$1,456,167
	Rounded To				$1,500,000

Assumptions:

1. Cost estimate assumes TIGG Corporation Model Cansorb C-15 canisters would be utilized. Each 65-gallon canister contains 150 pounds of carbon.
2. Cost estimate assumes TIGG Corporation Model Cansorb C-15 canister would be utilized. The canister contains 5.5 cubic feet of Amberlite resin.
3. Cost estimate based on past experience.
4. Cost estimate based on past experience.
5. Cost estimate includes all costs associated with the preparation of existing Building #13 for the installation of the treatment system.
6. Cost estimate based on past experience.
7. Cost estimate based on past experience.
8. Cost estimate based on past experience.
9. Cost estimate based on past experience.
10. Operator to work 8 hours per week, 52 weeks per year.
11. Cost estimate based on past experience.
12. Cost estimate assumes the replacement and disposal of each carbon unit each month.
13. Cost estimate based on past experience.
14. Cost estimate includes all costs associated with the monthly sampling of treatment system discharge for PCBs, VOCs, and total lead.
15. See assumptions on Table 9.

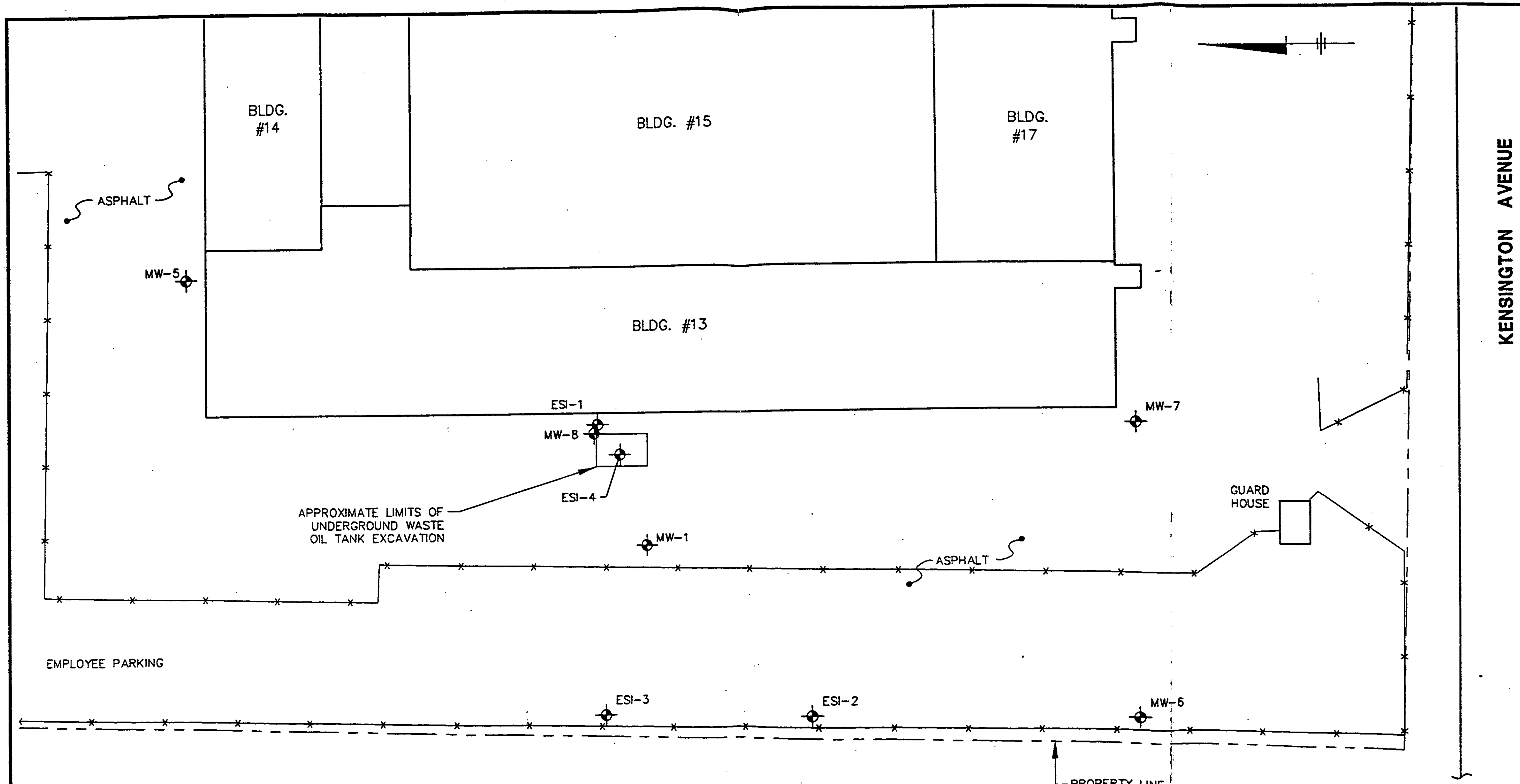
Table 11

SWMU #7 Focused Risk Assessment and Corrective Measures Study Report
Dewey Avenue Service Center
Buffalo, New York

Summary of Corrective Measure Alternative Evaluation

Corrective Measure Alternative	Positive Aspects	Negative Aspects
No-Action Alternative	• Insignificant costs associated with implementation	• Does not satisfy corrective measure objective
Limited Action Alternative (Ground-Water Monitoring Program)	• Satisfies corrective measure objective • Low costs associated with implementation	
Containment Alternative (Slurry Cutoff Wall System)	• Satisfies corrective measure objective	• Technically impractical
Removal and On-Site Treatment Alternative	• Satisfies corrective measure objective	• High costs associated with implementation • Residual materials containing constituents of concern require special handling and disposal

Figures



LEGEND

ESI-2 APPROXIMATE LOCATION OF MONITORING WELL

—x———x— CHAIN LINK FENCE

GENERAL NOTES:

1. BASE MAP SUPPLIED BY NIAGARA MOHAWK POWER CORPORATION, COMPILED BY FIELD SURVEY METHODS ON 9/6/94 AT AN ORIGINAL SCALE OF 1" = 20'.
2. LIMITS OF WASTE OIL TANK EXCAVATION BASED ON FIELD MEASUREMENTS BY BLASLAND, BOUCK & LEE, INC.
3. ALL LOCATIONS ARE APPROXIMATE AND REQUIRE FIELD VERIFICATION.

0 40' 80'

APPROXIMATE SCALE: 1"=40'

4/27/95 54-DMW, PGL
3644511R/36445SM1.DWG

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

NIAGARA MOHAWK POWER CORPORATION
DEWEY AVENUE SERVICE CENTER

SWMU #7 AREA SITE PLAN

FIGURE 1

Appendices

APPENDIX A

Volatilization from Soil

APPENDIX A

Volatilization from Soil

This appendix provides equations and assumptions to determine Volatilization factors (VF) and air concentrations for organics constituents which volatilize from soil to air. The method presented here is recommended by USEPA (1994).

USEPA uses the following equations to calculate VF for a volatile constituent of interest in soil.

$$VF = Q/C \times \frac{(3.14 \times \alpha \times T)^{0.5}}{2 \times D_{ei} \times \theta_a \times K_{as}} \times 10^{-4}\ m^2/cm^2$$

Where

$$\alpha = \frac{D_{ei} \times \theta_a}{\theta_a + (\rho_s)(1-\theta_a)/K_{as}}$$

and other variables are defined as:

Variable		Default Used
VF	Volatilization Factor (m^3/kg)	--
Q/C	Inverse of mean concentration at the center of a 30-acre source (g/m^2-s per kg/m^3)	35.10
T	Exposure interval(s)	9.5×10^8
D_{ei}	Effective diffusivity (cm^2/s)	$D_i (\theta_a^{3.33}/n^2)$
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	0.28 or $n - w\rho_b$
D_i	Diffusivity in air (cm^2/s)	Chemical-specific
n	Total soil porosity	0.43 (loam)
w	Average soil moisture content (g_{water}/g_{soil})	0.1 (10%)
ρ_b	Soil bulk density (g/cm^3)	1.5 or $(1-n)\rho_s$
ρ_s	Soil particle density (g/cm^3)	2.65
K_{as}	Soil - air partition coefficient (g-soil/cm^3-air)	$(H/K_d) \times 41$
H	Henry's Law Constant (atm-m^3/mal)	$K_{oc} \times F_{oc}$

Variable		Default Used
K_d	Soil - water partition coefficient (cm^3/g)	Chemical-specific
F_{oc}	Organic carbon content of soil (g/g)	0.006 (0.6%)

Default variables are recommended by USEPA (1994) to represent typical values encountered at a variety of sites. Chemical-specific values are presented in Table A-1. These values are taken from Electronic Handbook of Risk Assessment Values (EHRAV), 1995 (June 1995 update).

Estimated vapor concentrations for each organic constituent of interest in soil are shown in Table A-1.

References

USEPA, 1994. Soil Screening Guidance. Office of Solid Waste and Emergency Response. EPA/540/R-94/101. PB95-963529. December 1994.

Electronic Handbook of Risk Assessment Values (EHRAV). 1995. Electronic Handbook Publishers, Bellvue, Washington. June 1995.

Table A-1

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Chemical-Specific Values (1) Necessary to Calculate Volatilization Factors and Air Concentrations

Chemical Name	Diffusivity (cm2/s)	Henry's Law (atm-m3/mol)	Koc (cm3/g)	Kas (g soil/cm3 air)	a (cm2/sec)	VF (m3/kg)	Concentration (mg/m3)
1,2,4-Trimethylbenzene	0.0642	0.00616	2712	1.55E-02	3.68E-05	2.67E+04	4.11E-04
1,3,5-Trimethylbenzene	0.0663	0.00616	661	6.37E-02	1.56E-04	1.30E+04	7.70E-05
Aroclor 1242 (PCBs)	0.05829	0.00022	6300	2.39E-04	5.14E-07	2.26E+05	2.92E-05
Benzene	0.0932	0.00546	65	5.74E-01	1.98E-03	3.65E+03	2.74E-04
Ethyl Benzene	0.06667	0.00843	220	2.62E-01	6.45E-04	6.39E+03	5.32E-04
Naphthalene	0.08205	0.00042	940	3.05E-03	9.26E-06	5.33E+04	5.44E-05
Toluene	0.07828	0.0066	120	3.76E-01	1.09E-03	4.92E+03	9.76E-04
m-Xylene (xylenes)	0.07164	0.0069	238	1.98E-01	5.25E-04	7.08E+03	2.40E-03

Notes:

(1) Source of Diffusivity, Hernry's Law and Koc values is Electronic Handbook of Risk Assessment Values (EHRAV), 1995.

APPENDIX B

Estimation of Dermally Absorbed Dose

APPENDIX B

Estimation of Dermally Absorbed Dose

In order to assess dermal exposure to chemicals present in water, a compound's dermal absorption is estimated. For such an estimation, the amount of chemical in an aqueous solution that will pass through the skin layer over a period of time is assessed. The value used to represent a chemical's dermal absorption is the permeability coefficient (K_p). A complete discussion of this value, and the factors affecting the K_p of a compound, can be found in USEPA (1992). USEPA (1992) recommends K_p values for a number of organic chemicals, as well as methods for determining dermally absorbed doses of these chemicals.

Estimating the Dermally Absorbed Dose per Exposure Event

The method used here is a nonsteady-state approach for estimating a dermally absorbed dose from water. The method is currently believed to be the most accurate reflection of normal human exposure conditions, since the short contact times associated with bathing and swimming generally mean that steady state will not occur. The method also accounts for the dose that can occur after the actual exposure event, due to absorption of contaminants stored in skin lipids. However, the approach is only applicable to organics which exhibit octanol-water partitioning (USEPA, 1992). Since inorganics do not exhibit octanol-water partitioning, the method is not applicable to inorganics.

In order to estimate dermally absorbed dose (DA) the following equation is used:

$$DA = 2\ K_p \frac{C_w}{CF} (6\ r\ t_{event} / \pi)^{1/2}$$

Where:

DA	=	dermally absorbed dose per event (mgcm^2-event);
K_p	=	permeability coefficient from water 2.45E-03 (cm/hour);
C_w	=	chemical concentration in water (mg/L);
CF	=	conversion factor (1000 cm$_3$/L;
r	=	chemical-specific constant = (hrs); and
t_{event}	=	time of exposure event (0.2 hour).

Table B-1 provides the necessary input variables for the equation and dermal absorbed doses calculated for each of the chemicals of interest. The calculated dermally absorbed dose is then used to estimate intakes from dermal exposure.

Reference

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B. January 1992. Interim Report.

Table B-1

Niagara Mohawk Power Corporation
Dewey Avenue
Buffalo, New York

Estimation of Dermally Absorbed Dose from Ground Water (1)

Constituent	Maximum Detected Concentration (mg/l) (2)	Kp (cm/hr)	r (hour)	DA (mg/cm2-event)
1,1-Dichloroethane	1.40E-02	0.016	0.34	1.61E-07
1,1,1-Trichloroethane	3.00E-03	0.017	0.57	4.76E-08
Benzene	8.10E-02	0.021	0.26	1.07E-06
Bis(2-ethylhexyl)phthalate	4.00E-03	0.033	0.21	7.48E-08
Carbon Disulfide	2.20E-02	0.024	0.27	3.39E-07
Chloroethane	4.50E-02	0.008	0.22	2.09E-07
Chloroform	2.00E-03	0.0089	0.47	1.51E-08
Ethylbenzene	5.30E-02	0.074	0.39	3.03E-06
Lead	3.42E-02	NA	NA	NA
PCBs (Aroclor 1242)	2.40E-03	0.71	14	7.88E-06
Phenanthrene	1.00E-03	0.23	1.1	2.98E-07
Toluene	2.10E-02	0.045	0.32	6.61E-07
Xlylene (m,p-)	5.30E-02	0.08	0.39	3.27E-06
Xylene (o-)	3.00E-02	0.08	0.39	1.85E-06

Notes:

(1) Kp and r values reported by USEPA, 1992.
(2) Based on concentrations detected in MW-1, MW-8, ESI-1, and ESI-4.

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