

Report.HW.738034.1999-02.R1

REPORT

**Remedial Investigation
South First Street Site
Fulton, New York**

Niagara Mohawk Power Corporation

February 1999

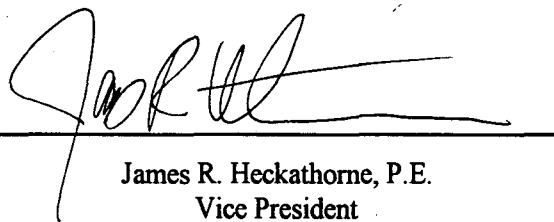


O'BRIEN & GERE
ENGINEERS, INC.

REPORT

**Remedial Investigation
South First Street
Fulton, New York**

Niagara Mohawk Power Corporation



James R. Heckathorne, P.E.
Vice President

February 1999



5000 Brittonfield Parkway
Syracuse, NY 13221

Contents

1. Introduction	1
1.1. Project background	1
1.2. Site description and history	1
1.3. Regional setting	3
1.3.1. Regional geology	3
1.3.2. Regional hydrogeology	3
1.3.3. Ground water usage in site vicinity	4
1.4. Summary of previous investigations	5
1.5. Remedial investigation objectives	5
1.6. Report organization	6
2. RI field investigation activities	7
2.1. Surface soil sampling	8
2.2. Soil vapor samples	8
2.3. Soil boring and subsurface soil sampling	8
2.4. Monitoring well installation and sampling	11
2.4.1. Ground water sampling	11
2.4.2. <i>In situ</i> hydraulic conductivity tests	12
2.5. Cultural resource assessment	12
2.6. Ground water user survey	12
3. Hydrogeologic conditions	13
4. Nature and extent of contamination	15
4.1. Soil vapor	15
4.2. Surface soil	15
4.3. Subsurface soil	16
4.4. Ground water	17
5. Risk assessment	19
5.1. Introduction and methodology	19
5.2. Identification of constituents of potential concern	20
5.2.1. Potentially exposed populations	21
5.2.2. Exposure pathways analysis	22
5.2.3. Quantification of exposure	25

5.3. Toxicity assessment	28
5.3.1. Non-carcinogenic effects	28
5.3.2. Carcinogenic effects	29
5.3.3. Toxicity summaries	29
5.4. Risk characterization	29
5.5. Results and conclusions - potential human health risks	31
5.6. Uncertainty	34
5.6.1. Exposure point concentrations	34
5.6.2. Exposure parameters	35
5.6.3. Toxicity values	35
5.6.4. Quantitative risk estimates	36
6. Conclusions	39
References	43

List of tables

- 2-1 Soil sample summary
- 2-2 Monitoring well specifications
- 4-1 Surface soil sampling results- TAL cyanide
- 4-2 Subsurface soil sampling results
- 4-3 Subsurface soil sampling results- BTEX
- 4-4 Subsurface soil sampling results- PAHs
- 4-5 Ground water sampling results- BTEX
- 4-6 Ground water sampling results- PAHs
- 5-1 Summary of detected analytes
- 5-2 COPC selection and ambient air - initial screening evaluation
- 5-3 Representative exposure point concentrations for soil, ground water, and ambient air
- 5-4 Key parameters and values for vapor migration model
- 5-5 Chronic daily intake equations
- 5-6 Chronic daily intake parameter estimates
- 5-7 Toxicological data
- 5-8 Summary of Risk to Human Receptors
- 5-9 Summary of Constituents Indicating Potential Risk - Identified by Receptor, Media, and Pathway

List of figures

- 1-1 Site location map
- 1-2 Site map
- 1-3 Historical features
- 2-1 Combined RI and PSA/IRM study sample locations
- 3-1 Hydrogeologic cross section A-A'
- 3-2 Hydrogeologic cross section B-B'
- 3-3 Ground water elevation flow map - July 16, 1998
- 4-1 Surface soil analytical results summary
- 4-2 Subsurface soil analytical results summary
- 4-3 Ground water analytical results summary - July 16, 1998

Appendices

- A Soil boring logs and monitoring well details
- B Ground water sampling logs
- C Hydraulic conductivity test plots
- D Ground water user survey summary

- E DUSR
- F Soil vapor laboratory report
- G Screening evaluation of potential subsurface volatilization and migration to ambient air (model of estimating ambient air exposure point concentrations)
- H Chronic daily intake, cancer risk and hazard quotient calculations

Exhibits

- A *Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings*. Johnson & Ettinger (1991).

1. Introduction

1.1. Project background

On December 7, 1992, Niagara Mohawk Power Corporation (NMPC) and the New York State Department of Environmental Conservation (NYSDEC) entered into an Administrative Order on Consent (AOC), Index Number DO-0001-9210. This order requires NMPC to investigate and, if necessary, remediate 20 former Manufactured Gas Plant (MGP) sites in New York. In accordance with the provisions set forth in the AOC, NMPC is required to investigate and, if necessary, remediate the site of a former location of a MGP located at the South First Street Site in Fulton, NY. In response to this order, NMPC implemented a Preliminary Site Assessment and Interim Remedial Measures (PSA/IRM) Study at the South First Street Site between July 1996 and September 1996. The results of the PSA did not indicate conditions which would warrant the completion of an IRM. However, based on the results of the PSA a focused Remedial Investigation (RI) was recommended to further evaluate horizontal and vertical extent of chemical constituents.

This focused RI Report serves to summarize the RI conducted at the South First Street Site. The elements of the RI were completed consistent with New York State Department of Environmental Conservation NYSDEC Technical and Administrative Guidance Memorandum (TAGM), the United States Environmental Protection Agencies (USEPA) *Guidance on Remedial Investigations under CERCLA*, and the NYSDEC Analytical Services Protocol (NYSDEC 1991 ASP). Results of the RI have been integrated with the results of the PSA/IRM Study to provide a comprehensive characterization of site conditions.

1.2. Site description and history

The South First Street Site, located in Fulton, NY (Figure 1-1), encompasses approximately 1.04 acres. The site is separated into two areas, Area 1 and

Area 2, which are separated by South First Street (Figure 1-2). Area 1 is located on the east side and Area 2 is located on the west side of South First Street. Presently, Area 1 is an undeveloped grass covered lot. The area is bounded by Conrail tracks to the east and residential housing to the north and south. Area 2 is occupied by the Crossroads Gospel Tabernacle Ministries Church (CGTMC) and consists of a church building and paved parking lot. The church building is constructed with a slab on grade.

Area 2 is bounded by the Oswego River to the west and residential housing to the north and south. The topography of the site is generally flat, sloping gently to the west toward the Oswego River. The Oswego River is approximately five feet below the western side of Area 2.

NMPC currently owns all of Area 1 and the northern half of Area 2 which contains the church parking area. The CGTMC owns the portion of Area 2 on which the building is located.

Prior to construction of the manufactured gas plant (MGP) in 1902, the site was generally vacant land.

In 1902, the Fulton Fuel and Light Company built the gas plant on South First Street. The gas plant itself was located on Area 2, west of South First Street. A gas holder and oil tank were located on Area 1, east of South First Street. By 1906, a gas tank was constructed on Area 1 east of the oil tank (Sanborn, 1906) (NMPC, 1996). Figure 1-3 depicts site historical features.

By 1911, two additional gas tanks, a coke shed and a small oil house were constructed on Area 2 west of the gas plant (Sanborn, 1911). At about this time a tar well, approximately 4 ft in diameter, was shown between the southern corner of the coal shed and the northern corner of the coke shed on a survey map (1903).

By 1924, the coke shed was removed in Area 2 and a concentrator house was added east of the coke shed location. In Area 1, a 30,000 cubic foot holder and second gas tank were added between the first holder and the railroad tracks (Sanborn, 1906).

In the late 1920's, natural gas was discovered locally and the gas plant was only used to supplement the peak demand periods. By 1932, a pipeline from Syracuse brought natural gas to Fulton and the gas plant ceased operation. A natural gas regulator station was located on Area 1 until 1984.

In 1947, the southern half of Area 2 was used as a used car lot. From 1958 to 1978 the southern half of Area 2 was used as Foster's Garden Center and Outdoor Power Equipment. In 1980 Area 2 was occupied by Modern Floor Covering (Fulton City Directories 1947-1980). The former Garden Center building is presently used as the CGTMC. The church was granted the right to park cars on the northern half of the property by NMPC in 1987.

In late July/early August, 1993, NMPC cleared debris, graded, and seeded the eastern half of Area 1 in response to complaints from adjacent landowners regarding the aesthetics of the site. Prior to initiating the work, the western half of Area 1 was well maintained lawn. The eastern half of Area 1 was undulating, overgrown, and contained large concrete saddles. The work consisted of the removal of the concrete saddles and general debris; grubbing of vegetation; placement of 102 cubic yards of bank-run gravel to fill low areas; placement of 36 cubic yards of topsoil; and hydro-seeding. Area 1 has subsequently been maintained as a lawn.

1.3. Regional setting

1.3.1. Regional geology

The South First Street former MGP Site is located in southwestern Oswego County, along the Oswego River approximately 10 miles south of Lake Ontario and within the glaciated hummocky lowlands of the Lake Ontario Lowland (USGS, 1982). The Lake Ontario Lowland is covered by glacial and lake deposits which are underlain by a series of sandstone and shale formations that slope gently southward at a rate of 50 feet per mile. Elongate deposits of lodgement till of varying thickness overlay bedrock predominately in the eastern part and occur to a lesser extent in the western portion of the Lake Ontario Lowland. Scattered deposits of sand and gravel, laid down by meltwaters flowing away from the ice front, are interspersed throughout the area (USGS, 1982).

1.3.2. Regional hydrogeology

Regionally, unconsolidated aquifers consist of lake sand, silt and clay; alluvial silt and sand; swamp deposits; and glacial deposits of relatively impermeable lodgement till, that directly overlay the bedrock surface throughout the area. However, distinct areas of sand and gravel glacial outwash form select segments of the aquifer system that overlies the till.

A regional unconfined aquifer system is arbitrarily defined by surface water drainage divides, because the relatively flat Lake Ontario plain contains no bedrock boundaries. Similar to the topography, the water table is relatively flat. Ground water levels rise and fall seasonally in response to fluctuations in recharge or discharge. Regionally ground water discharges into streams, the Oswego River, and Lake Neatahwanta. Ground water flows toward the Oswego River roughly parallel to the slope of the land surface.

The Oswego River flows northeast and discharges into Lake Ontario, approximately 10 miles downstream of Fulton. The ground water levels adjacent to the river are approximately the same as the river levels. In the Fulton area, which encompasses both sides of the river, the aquifers are primarily recharged through kame sand and gravel. Well yields in the Fulton area are generally less than 50 gallons per minute (gpm). However, three areas have been defined which contain highly permeable gravel that produces more than 250 gpm. These areas include Fulton Water Works, Lake Neatahwanta Municipal well field, and Great Bear Springs (USGS, 1982) and are discussed in Section 1.3.3.

Fulton is located in the vicinity of contact between shale-sandstone bedrock of the Clinton Group and a sandstone bedrock of the Albion Group and Oswego sandstone. The median yield of the sandstone-shale unit is 3 gallons per minute and yields in about 25 % of all bedrock wells in this unit are inadequate for domestic and farm supplies. The sandstone unit has a median yield of 10 gpm and most well yields are adequate for domestic and farm supplies. However, the upper 100 ft of bedrock in the vicinity of Fulton is likely to contain salty ground water (Kantrowitz 1970).

1.3.3. Ground water usage in site vicinity

The South First Street Site is located in a sole source aquifer area. The Fulton Area aquifer serves nearly 22,000 people (USGS, 1982). Residents of the City of Fulton receive public water from the City of Fulton Water Works well field, which tap one of the glacial sand and gravel units. The Fulton Water Works well field is located approximately 0.9 miles upriver (southeast) of the former site (Figure 1-1). A ridge of lake silt forms a hydraulic barrier between the river and the aquifer therefore, pumping does not draw river water into the aquifer (USGS, 1982). In addition, ground water flow at the South First Street Site is to the west and northwest away from the Water Works. Based on the Water Works location upriver and site hydrogeology, the well field is not impacted by the site.

Three other water supply sources in the vicinity of the site include the Great Bear Springs located approximately 3.5 miles southeast of the site, the Lake Neatahwanta (South Bay) Municipal Community Water System Well Fields located approximately 1 mile west of the site, and domestic wells. The Great Bear Springs and South Bay are not affected based on distance from the site and the location of the Oswego River, between the site and the well fields. As discussed in Section 2.6, private domestic wells are not located in the site area.

1.4. Summary of previous investigations

NMPC implemented a PSA/IRM Study at the South First Street Site between July 1996 and September 1996 in accordance with a NYSDEC approved PSA/IRM Study Work Plan dated June 1996.

The PSA/IRM scope of work included a site reconnaissance, test pit excavation and collection of soil samples; surface soil sampling; subsurface soil sample collection from soil/monitoring well borings; monitoring well installation; ground water sampling; soil and ground water analysis; ground water elevation monitoring; and Steps I and IIa of a Fish and Wildlife Impact Analysis (FWIA). The results of the PSA/IRM Study are presented in the PSA/IRM Study Report dated November 1997. The report was approved by the NYSDEC in December 1997.

The PSA/IRM Study results indicated that the primary constituents of concern at the site included benzene, toluene, ethyl benzene, and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), and cyanide. The PSA/IRM Study results are integrated into the nature and extent of contamination discussion presented in Section 4 of this document.

Results from the FWIA indicated that use of the site by wildlife is limited by poor habitat quality; however, complete exposure pathways were identified for resident and transient small mammals and birds for direct contact and food chain exposures to surface soils. Additionally, there is a potential for exposure of fish and wildlife through surface water and sediment of the Oswego River from ground water discharge to the surface water body.

1.5. Remedial investigation objectives

The objectives of the focused RI were to collect sufficient environmental data to address data gaps identified in the PSA/IRM Study including:

- Further evaluate the extent of cyanide found in the Area 1 surface soil sample SS-2.
- Assess the horizontal and vertical extent of chemical constituents in Area 2 subsurface soils proximal to test pit TP-4 and along the northwest to southwest portion of the site.
- Evaluate the lateral extent of site-related constituents in ground water and assess the potential for chemical constituents associated with historic site activities to migrate to the Oswego River and/or adjacent properties.
- Conduct a ground water user survey of homes located immediately adjacent to the site to verify that private domestic wells are not present.
- Complete a baseline human health risk assessment (HHRA) to help identify whether remedial actions are necessary.

1.6. Report organization

This focused RI Report is organized into sections as outlined below.

Section 1	Introduction including project background, site description and history, summary of previous investigations, and RI/FS objectives.
Section 2	RI Field investigation activities
Section 3	Hydrogeologic conditions
Section 4	Nature and extent of contamination
Section 5	Risk assessment
Section 6	Conclusions

2. RI field investigation activities

This section describes the focused RI investigation activities that were completed at the South First Street Site in Fulton, NY. The RI investigation was conducted in accordance with the Remedial Investigation/Feasibility Study Work Plan dated February 1998 and approved by the NYSDEC. The scope of work included:

- surface soil sampling and analysis
- soil vapor sampling and analysis
- subsurface soil sample collection and analysis
- monitoring well installation
- ground water sampling and analysis
- ground water usage survey
- cultural resource assessment

Field investigation procedures and activities were implemented in accordance with three companion documents previously prepared by NMPC under AOC, Index Number DO-0001-9210, specifically for MGP site investigations. The documents are listed below:

1. GQAPP for Site Investigations, NMPC, June 1996.
2. GFSP for Site Investigations, NMPC, June 1996.
3. HASP for PSA/IRM Study for the South First Street Site, City of Fulton, NY, O'Brien & Gere, June 1996.

Samples collected during the field efforts were submitted for analysis of the primary constituents of concern including BTEX, PAHs, and cyanide.

Sample chain-of-custody procedures as outlined in the work plan were adhered to. Samples were hand delivered to O'Brien & Gere Laboratories, Inc. every other day. Analyses were completed in accordance to NYSDEC analytical services protocol (ASP) with Category B Deliverables. Data were reviewed and a Data Useability Summary Report (DUSR) was prepared to verify that data were useable for achieving the RI objectives.

2.1. Surface soil sampling

Three surface soil samples (SS-7, SS-8, and SS-9) were collected from locations surrounding SS-2 as illustrated in Figure 2-1. These samples were collected to evaluate the extent of the elevated cyanide concentration found in the Area 1 surface soil sample SS-2.

The samples were collected at depths of 0 to 24 inches in accordance with the procedures described in Section 10.0 of the GFSP and were analyzed for total cyanide.

2.2. Soil vapor samples

Three soil vapor samples (SV-1, SV-2, and SV-3) were collected at the locations shown on Figure 2-1 to evaluate soil gas vapor as a potential migration pathway for chemical constituents to an adjacent residence. Soil vapor samples were collected at depths of 3 ft below surface using stainless steel probes with retractable points. The soil vapor was extracted from the ground and conveyed into Tedlar® bags using a hand held pump and a Pelican® sample box. The soil vapor samples were shipped to Performance Analytical Laboratory in Canoga Park, CA where they were analyzed for BTEX and PAHs.

2.3. Soil boring and subsurface soil sampling

Six soil borings were completed and subsurface soil samples were collected to assess the presence of MGP constituents in subsurface soils, to provide information regarding the horizontal and vertical extent of potential residues at the site, and to further assess site hydrogeologic conditions. In addition, the soil borings were converted to monitoring wells to provide ground water quality data.

Rationale for soil boring and monitoring well placement locations are as follows:

- MW-6 - vertical extent of BTEX and PAH constituents downgradient of former tar well

- MW-7 - horizontal extent of BTEX and PAH constituents downgradient of historical structures
- MW-8 - horizontal extent of BTEX and PAH constituents downgradient of historical structures
- MW-9 - lateral extent of BTEX and PAH constituents
- MW-9D - vertical extent of BTEX and PAH constituents
- MW-10 - lateral extent of BTEX and PAH constituents

Borings were advanced through the shallow unconsolidated deposits utilizing hollow-stem auger drilling techniques as described in Section 5 of the GFSP. Continuous split-spoon samples were collected from each soil boring and screened for the presence of MGP and non-MGP constituents using a photoionization detector (PID), ultraviolet light (UVL), and visual inspection. The field hydrogeologist selected the number and location of soil samples for analyses at each boring location with the intent of delineating the upper and lower boundaries of affected soils and quantifying the concentrations across the soil column.

Soil samples were selected to establish the vertical extent of impacted soils at soil boring locations where elevated PID readings, positive UVL readings, or visual observations indicated possible residuals. In borings where no PID or visual impacts were identified, a minimum of one sample was collected near the water table to characterize the unsaturated zone soil. A total of twelve subsurface soil samples were collected as summarized in Table 2-1.

Table 2-1. Soil sample summary

Location	Depth (ft)	Analysis	Rationale
MW-6	6 - 8	BTEX, PAHs	positive UVL, vadose zone
MW-6	10 - 12	BTEX, PAHs	head space PID reading 58 ppm
MW-6	16 - 18	BTEX, PAHs	head space PID reading 5.7 ppm near bottom of suspected impacted area
MW-6	24 - 24.7	BTEX, PAHs	vertical delineation of upper impacted area
MW-6	32 - 34	BTEX, PAHs	vertical delineation of upper impacted area

Table 2-1. Soil sample summary

Location	Depth (ft)	Analysis	Rationale
MW-7	4 - 6	BTEX, PAHs	no positive UV or PID indicators - characterize unsaturated zone soil
MW-8	8 - 10	BTEX, PAHs	no positive UV or PID indicators - characterize unsaturated zone soil
MW-9	10 - 12	BTEX, PAHs	no positive UV or PID indicators - characterize unsaturated zone soil
MW-9D	18 - 20	BTEX, PAHs	vertical characterization of deep aquifer zone
MW-9D	26 - 26.9	BTEX, PAHs	vertical characterization of deep aquifer zone
MW-10	6 - 8	BTEX, PAHs	no positive UV or PID indicators - characterize unsaturated zone soil
MW-10	12 - 14	BTEX, PAHs	vertical characterization of aquifer zone

Source: O'Brien & Gere Engineers, Inc.

Detailed boring logs were prepared from split spoon samples and are included in Appendix A.

Each boring was advanced to a depth of 18 ft below ground surface or shallower with the exception of MW-6 and MW-9D. Soil borings MW-7, MW-8, MW-9 and MW-10 were terminated at depths of 14 ft, 16 ft, 18 ft and 16 ft, respectively, in order to place the well screen across the water table. Boring MW-6 was terminated at 37 feet where auger/split spoon refusal was encountered and MW-9D was terminated at 30 feet below grade in an extremely dense silt/sand and gravel material. Following completion of each boring, a well was installed and constructed as described in Section 6.1 of the GFSP. Soil cuttings generated during drilling were containerized and handled in accordance with the GFSP.

2.4. Monitoring well installation and sampling

Six monitoring wells (MW-6, 7, 8, 9, 9D, and 10) were installed at the locations illustrated in Figure 2-1. Monitoring well installation and development was conducted in accordance with the procedures described in Section 6 of the GFSP. The monitoring wells were constructed with 2-inch diameter, flush joint, PVC riser pipe. Well construction details are included on the soil boring logs in Appendix A. Monitoring well specifications are summarized in Table 2-2.

Monitoring wells were developed using a bottom-loading stainless steel bailer in accordance with procedures described in Section 6.2 of the GFSP. Development was completed to optimize hydraulic connection with the adjacent aquifer and to minimize the effect of residual, formational silts and clays that could potentially interfere with chemical analysis.

2.4.1. Ground water sampling

Ground water samples were collected from wells MW-8 and MW-9 on June 17, 1998 immediately following installation to evaluate to if the horizontal extent of BTEX and PAH constituents extended off-site to the former Oswego Canal channel. The samples were analyzed by O'Brien & Gere Laboratories, Inc for 24 hour priority analysis. BTEX and PAH constituents were not detected indicating site related constituents were not migrating beyond the site boundaries.

One set of ground water samples was collected on July 16, 1998 from the eleven on-site monitoring wells to evaluate the lateral and vertical extent of BTEX and PAH constituents in ground water. The ground water sample analyses were completed by O'Brien & Gere Laboratories, Inc using NYSDEC ASP methods with Category B deliverables.

Prior to sampling, water level measurements were obtained from the eleven on-site monitoring wells for use in the assessment of ground water flow conditions at the site. Measurements of water levels were obtained using an electronic water-level probe.

Sample collection was completed in accordance with the procedures described in Section 8.0 of the GFSP. Prior to sample collection each monitoring well was purged by removing a minimum of three well volumes or at least one borehole volume if the monitoring well bailed dry, whichever was greater. Samples were collected using a stainless steel bailer. Temperature, pH, conductivity, and turbidity were measured and recorded in the field book. Ground water sampling logs are contained in Appendix B.

2.4.2. *In situ* hydraulic conductivity tests

Hydraulic conductivity tests were completed on monitoring wells MW-1, MW-6, MW-7, MW-9, and MW-9D to evaluate the range of hydraulic conductivity values across the site. Hydraulic conductivity testing was conducted in accordance with procedures described in Section 6.3 of the GFSP. The hydraulic conductivity test data were analyzed using the Bouwer and Rice method (Bouwer, 1989) for unconfined aquifers contained in the AQTESOLV™ Aquifer Test Solver program, which is a computer program designed for the reduction of *in situ* hydraulic conductivity tests Version 10 Documentation (Geraghty and Miller, Inc., 1988, 1989). Results of the hydraulic conductivity test results are included on Table 2-2, and AQTESOLV plots are contained in Appendix C.

2.5. Cultural resource assessment

A Stage 1A Cultural Resource Assessment (CRA) was performed at the South First Street Site by the Department of Anthropology at the State University of New York (SUNY) at Binghamton. The assessment included site files checks, a literature review, and site inspection. The Stage 1A Public Archaeology Facility Report was submitted under separate cover to the New York State Office of Parks, Recreation, and Historic Preservation (SHPO) on December 22, 1998.

2.6. Ground water user survey

A ground water user survey was initiated for the nearest three residences located on either side of Areas 1 and 2 to verify that private domestic wells are not located on the properties. Prior to the survey the City of Fulton Water Department verified that the twelve closest residences to the site were connected to the city water system. Respondents of the survey indicated that no domestic ground water wells were located at the residences adjacent to the site. Specific details of the survey are presented in NMPC correspondence to the NYSDEC dated July 27, 1998. A copy of this correspondence is included in Appendix D.

3. Hydrogeologic conditions

The subsurface geology in the vicinity of the South First Street Site is illustrated in two generalized geologic cross-sections A-A' and B to B'. Cross-section A-A' (Figure 3-1) extends from southwest to northeast across the site and cross-section B-B' (Figure 3-2) extends from southeast to northwest across Area 2, as illustrated on Figure 2-1. The site stratigraphy described in the PSA/IRM Study has been updated with additional subsurface data collected during the RI as described below.

The overburden deposits encountered at the site consist of four units: fill, silt and fine sand, sand and gravel, and extremely dense sand & gravel till. Surficial fill materials were found in both Area 1 and Area 2. Fill materials consist of orange brick fragments, asphalt pieces and sand and gravel. In Area 1, fill materials ranged in thickness from 1 ft in the northeast at MW-1 to 7.5 ft in the southwest of the Area 1 at MW-2. In Area 2, fill thickness ranged from 6.5 ft at P-1 to 10 ft at MW-4, which is located on the southwest site boundary near the Oswego River (Figure 3-1). The fill layer is 6.5 ft thick in MW-5 in the southeast and 8 ft thick at MW-9 to the northeast of Area 2 (Figure 3-2).

Underlying the fill is a layer of fine sand and silt which ranges in thickness from 2 ft in Area 2 at MW-4 to 6 ft in Area 1 at MW-1. The thickness of this layer generally decreases towards the river and changes to silt and clay to the southwest at MW-8 (Figure 3-1). The fine sand and silt layer thickens beneath Area 2 in the southeast and northwest to 7.5 ft and 10 ft, respectively, at MW-5 and MW-9 (Figure 3-2).

Underlying the fine sand and silt layer is a medium dense sand and gravel unit. The top of this sand and gravel unit is encountered at depths ranging from 8 ft at MW-1 to 12 ft at MW-4. The sand and gravel is thickest within the central portion of Area 2 at MW-6 and thins out in each direction (Figures 3-1 and 3-2). The sand and gravel layer was not encountered in downgradient locations at MW-8 and MW-9.

An extremely dense sand and gravel till unit overlies bedrock at the site. The extremely dense unit was encountered at depths of 14 ft in MW-1 to 24 ft below land surface (bls) at MW-3. The unit is 18 ft thick at MW-6 where

bedrock was encountered. Well MW-6 was the only location where bedrock was encountered at a depth of 37 ft.

The discussion of ground water conditions is based on the latest ground water elevations measured on July 16, 1998. Conditions are consistent with previous data. Ground water elevations are presented on Table 2-2. A ground water flow map is presented as Figure 3-3.

An unconfined overburden aquifer exists beneath the site. The ground water table was encountered within the fill unit at depths of 2.5 ft at upgradient well MW-1 to approximately 9.6 ft at MW-9. The ground water flow direction at the site is generally in a southwesterly direction towards the Oswego River under a hydraulic gradient of 0.04 ft/ft. Ground water flow direction changes from southwest to west in Area 2. Based on the ground water flow direction, monitoring wells MW-8, MW-9, and MW-10 are located downgradient of Area 2. A downward vertical hydraulic gradient of 0.061 ft/ft exists in Area 2 based on the ground water elevations in shallow well MW-9 and deep well MW-9D.

Hydraulic conductivity values in the shallow aquifer zone at the site range from 0.017 ft/day in MW-1 to 0.059 ft/day in MW-9. The deep aquifer zone hydraulic conductivities were 0.0125 ft/day in MW-6 and 0.003 ft/day in MW-9D.

4. Nature and extent of contamination

The nature and extent of contamination is evaluated with respect to the site media investigated including soil vapor, surface soil, subsurface soil, and ground water. Results from the South First Street Site PSA/IRM Study are presented in combination with the site RI investigation results.

4.1. Soil vapor

BTEX and PAH constituents were not detected in soil vapor samples SV-1, SV-2, and SV-3. The results indicate that soil gas vapor is not a migration pathway for site-related chemical constituents to the adjacent residence. The soil vapor laboratory analytical report is included in Appendix F.

4.2. Surface soil

BTEX, PAHs, and cyanide, were found to be present in both areas of the site, with Area 1 exhibiting lower concentrations than Area 2. Figure 4-1 depicts surface soil sample locations and analytical results. Site surface soils contained low levels of BTEX, PAHs, and cyanide with the exception of SS-4 in Area 2 which contained 148.8 ppm of total PAHs, and SS-2 (0-24 inches) from Area 1 which contained 810 ppm of cyanide.

Incorrectly reported

Total BTEX and PAHs were detected in background samples at concentrations up to 0.007 ppm and 0.568 ppm, respectively. The concentrations of total BTEX detected in site surface soils range from 0.00072 ppm in SS-1 to 0.0036 ppm in SS-2 and are consistent with background concentrations. Total PAH concentrations in site surface soils range from 19.77 ppm in SS-1 to 148.83 ppm in SS-4 and are elevated in comparison to background concentrations. Cyanide was not detected in background surface soil samples.

Surface soil samples SS-7, SS-8, and SS-9 were collected and analyzed to further evaluate the extent of cyanide found in the Area 1 surface soil sample SS-2. The analytical results are presented in Table 4-1. The results indicate

that the SS-2 location exhibits the highest concentration (810 ppm) of cyanide detected at the site. However, the elevated concentration of cyanide was most likely located below the ground surface because the high concentration was detected in the 0 to 2 ft interval as compared to 11 ppm detected in the SS-2 location 0 to 2 inch interval (Figure 4-1).

The extent of cyanide in surface soil in this vicinity is defined by samples SS-7 (15 ppm) and SS-8 (2.3 ppm). Cyanide in SS-9 (60 ppm) is elevated relative to other site concentrations; however, the concentration in SS-3 (2.3 ppm) defines the extent of cyanide to the southeast of sample SS-2 and SS-9 (Figure 4-1).

4.3. Subsurface soil

PAHs are the predominant site-related parameters detected in subsurface soils at the site based on the levels of detected concentrations. In Area 1, BTEX and PAH concentrations were highest in the test pits completed in the locations of the former MGP structures (Figure 4-2). Specifically, TP-3 contained the highest concentrations of PAHs and cyanide at concentrations of 232 ppm and 22 ppm, respectively. Test pit TP-1 contained the highest concentration of BTEX at a concentration of 5.5 ppm. Visibly stained soil was only noted in TP-1 immediately above the concrete foundation. Intact concrete foundations were found to be present in TP-1 and TP-2. The concentrations of BTEX and PAHs in Area 1 were below the TAGM 4046 cleanup objectives of 10 ppm and 500 ppm, respectively.

The highest concentrations of PAHs at the site were detected in Area 2 and were identified in test pit TP-4 and soil borings SB-1, MW-3, MW-6, and MW-4. The following table summarizes the highest total PAH detections at the site and associated BTEX and cyanide detections, as applicable.

Table 4-2. Subsurface soil sampling results.

Subsurface soil sample	Total PAH Concentration (ppm)	Total BTEX Concentration (ppm)	Cyanide Concentration
MW-3 (4 to 6 ft)	9442	0.026	0.9
MW-3 (22 to 24 ft)	5387	0.11	non detect
MW-4 (8 to 10 ft)	3170	7.226	2000
SB-1 (6 to 8 ft)	242.19	21.3	4.2

MW-6 (6 to 8 ft)	3973	0.564	not analyzed
TP-4	2244	non detect	5.7

Source: O'Brien & Gere Engineers, Inc.

The detections of BTEX and PAHs were limited to within the boundary of Area 2. PAHs and BTEX were not detected in soil borings MW-7, MW-8, MW-9/9D, and MW-10 which are situated around the southwest to north perimeter of Area 2. The locations where site related constituents were detected are illustrated in Figure 4-2. The RI subsurface soil BTEX and PAH analytical results are presented in Tables 4-3 and 4-4, respectively.

The vertical distribution of total BTEX and total PAHs is illustrated in hydrogeologic cross sections A-A' and B-B' on Figures 3-1 and 3-2, respectively. With the exception of PAH concentrations in MW-3 (22-24 ft), the highest PAH concentrations are present in the subsurface from 0 to 10 ft bls. This suggests that, vertically, the mass of PAHs, BTEX, and cyanide is predominantly limited to the subsurface soil above the extremely dense sand and gravel matrix till (Figures 3-1 and 3-2). Residual non-aqueous phase liquid (NAPL) was observed at one location, MW-3, at a depth interval of 18 to 22 ft bls. The TCLP analyses of residuals completed in the PSA indicated that detected constituents were not at levels characteristic of hazardous waste as specified in 40 CFR Part 261.

4.4. Ground water

Detections of BTEX and PAHs in ground water were limited to Area 2 as shown in Figure 4-3. BTEX was detected in three wells (MW-4, MW-5, and MW-6). Detected concentrations exceeded New York State (NYS) Class GA ground water standards. The highest concentration of BTEX was detected in MW-4 at 1,250 ppb. The detection of BTEX in MW-6 indicates that dissolved BTEX has migrated downward into the extremely dense sand and gravel. Stained soils were not observed in MW-6 below a depth of 10 ft. BTEX was not detected in downgradient wells MW-3, MW-8, MW-9, MW-9D, and MW-10. The BTEX analytical results are presented in Table 4-5.

PAHs were detected in Area 2 wells MW-3, MW-4, MW-5, and MW-6 as shown in Figure 4-3. Concentrations ranged from 554 ppb in MW-3 to 8,810 ppb in MW-6. With the exception of benzo(a) pyrene, applicable NYS Class GA criteria or guidance values do not exist for the detected PAH constituents. The Class GA criteria of non-detect for benzo(a) pyrene was exceeded in wells MW-3 and MW-6. The detection of PAHs in MW-6

indicates that dissolved PAHs have migrated downward. PAHs were not detected in downgradient wells MW-8, MW-9, MW-9D and MW-10. The PAH analytical results are presented in Table 4-6.

5. Risk assessment

5.1. Introduction and methodology

This section presents a human health risk assessment for the site. The objective of the risk assessment was to evaluate the risk to human health related to chemical constituents detected in soil and ground water at or originating from the site. Consistent with USEPA guidance for conducting human health risk assessments (USEPA 1989a, USEPA 1992a), the HHRA was conducted in the following phases:

1. *Conceptual Site Model (CSM)* The goal of the CSM is to qualitatively characterize the site setting with respect to its physical characteristics and identify potential human receptors. This is provided in Section 4 of this document.
2. *Selection of Constituents of Potential Concern.* The objective of this step is to identify data appropriate for use in the assessment, and to identify Constituents of Potential Concern (COPCs).
3. *Exposure Assessment.* In the exposure assessment, the pathways by which receptors may be exposed to on-site chemical substances were identified, and exposure-point concentrations of COPCs are estimated for each complete exposure pathway.
4. *Toxicity Assessment.* In the toxicity assessment, available toxicological data for site-related compounds are gathered and reviewed.
5. *Risk Characterization.* In the risk characterization step, the toxicity and exposure assessments are integrated into quantitative estimates of potential human health risk.
6. *Uncertainty Analysis.* In this section, the major uncertainties in the calculated risk estimates are discussed.

5.2. Identification of constituents of potential concern

Samples collected from site soil, and ground water during the PSA/IRM (O'Brien & Gere 1998) and the focused RI were used in the HHRA. A description of the nature and extent of site related constituents has been presented in Section 4 of this report. Inorganic constituents including metals and cyanide, and organic constituents including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides, and petroleum constituents (benzene, ethylbenzene, toluene, and xylene - BTEX) were detected in soil and ground water at the site. Analytical data is summarized in Table 5-1. A list of constituents of potential concern (COPCs) was developed from the analytical data. The list of COPCs was developed as follows:

Comparison with Risk Based Screening Values - USEPA Region III has published analyte specific risk based soil and water screening concentrations (USEPA 1998). If the maximum detected concentration of a chemical in site media is less than the published screening value, then it is highly unlikely that the chemical may represent a significant risk to human health, and may be deleted as a COPC. Consistent with previously approved risk assessments in New York State (OBG 1997), the Region III residential screening values corresponding to an excess lifetime cancer risk of 10^{-6} for carcinogens, and a Hazard Quotient of 0.1 for non-carcinogens (to account for possible additive effects) were used as a basis for comparison. If the maximum detected on-site concentration was less than the selected Region III screening level then the analyte was eliminated as a COPC.

Evaluation of lead levels - An risk-based concentration (RBC) for lead is not published. However, the USEPA has indicated a blood lead level of 10 ug/dl as being an acceptable level with respect to blood lead levels in children (USEPA 1994). USEPA has used a computer model, entitled the Integrated Exposure Uptake Biokinetic Model for Children (IEUBK) to identify soil and drinking water levels below which it would be highly unlikely that blood levels in exposed children would exceed 10 ug/dl. According to USEPA, the results of the IEUBK model indicate that average soil lead levels of 400 mg/kg or less and tap water lead levels of 15 ug/l or less would result in blood lead levels less than 10 ug/dl at the 95 % confidence level (USEPA 1994). Therefore, the maximum detected lead concentrations were compared with the 400 mg/kg or 15 ug/l health based screening levels for soil and ground water respectively to evaluate the detected lead concentrations.

Screening of Volatile Organic Constituents - In addition to screening detected levels in soil and ground water, VOCs and SVOCs were screened for potential to volatilize from the subsurface to ambient air exposure points. The extent of volatilization of a constituent is primarily dependant on its vapor pressure. Constituents with vapor pressure < 0.01 torr are unlikely to be sufficiently volatile to result in significant vapor levels in air (MADEP. 1994). Therefore detected VOCs and SVOCs with vapor pressure greater than 0.01 Torr were selected for evaluation as COPCs via the migration-to-indoor-air pathway.

Evaluation of Non-MGP Constituents - As shown on Tables 5-2a thru 5-2f, pesticide residues (e.g. DDT, DDE, Aldrin, Endosulfan) were detected in soils and ground water across the site. The detected pesticides have had widespread historical use in society, and are not related to MGP materials. Therefore, pesticides were not selected as COPCs for the risk assessment.

Summary of COPCs - Area 1 COPCs are arsenic, cyanide, metals (aluminum, barium, beryllium, cadmium, copper, iron, lead, manganese, mercury, nickel, vanadium, and zinc), and PAHs. Similarly, Area 2 COPCs are arsenic, cyanide, metals (aluminum, barium, cadmium, copper, iron, lead, manganese, nickel, and vanadium), and PAHs. In addition, several VOCs (benzene, toluene, ethylbenzene, and naphthalene) were COPCs for Area 2. A summary of site constituents and the selected COPCs is presented in Table 5-2a through 5-2f.

The methods, assumptions, and results of the exposure assessment are presented below. The following elements are described:

- 1) Potentially Exposed Populations
- 2) Exposure Pathway Analysis
- 3) Quantification of Exposure
 - a) Exposure-point concentrations
 - b) Intake equations and parameter estimates
 - c) Calculation of chemical intakes

5.2.1. Potentially exposed populations

As discussed in Section 1.2, current site land use is primarily residential/commercial with recreational opportunities at the river. The future use is likely to be the same. As such, potential current and future human receptors at the site are outlined below.

Kids playing

Area 1 Current Receptors

- no current receptors; lot is vacant, grass-covered, and is not utilized

Area 1 Future Receptors

- adult residents
- child residents
- construction workers

Area 2 Current Receptors

- church staff workers (conservative scenario for members / attendees)
- recreators (swimmers/fishermen)

Area 2 Future Receptors

- adult residents
- child residents
- construction workers
- church staff workers
- recreators (swimmers/fishermen)

5.2.2. Exposure pathways analysis

An exposure pathway describes the course a chemical takes from the source to the exposed individual. An exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure.

An exposure pathway consists of four elements:

- a source and mechanism of chemical release
- a retention or transport medium
- a point of potential human contact with the contaminated medium (referred to as the exposure-point)
- an exposure route (e.g., ingestion) at the contact point

A pathway is considered to be **complete** if **all** of the conditions listed above are satisfied for that pathway. If one or more of these conditions are not met, there is no physical means by which a receptor may be exposed to the compounds of potential concern, and the pathway is classified as **incomplete**. Incomplete pathways are not considered further in the HHRA. A discussion of the exposure pathway analysis for the site is presented below.

Surface Soil Direct Contact Exposure

Manufactured gas plant (MGP) related COPCs were identified in surface soils. Receptors may be directly exposed to site constituents. Therefore, direct contact with COPCs in surface soil is classified as complete for the future residents and construction workers.

Subsurface Soil Direct Contact Exposure

MGP related COPCs were detected in subsurface soils at a number of sampling locations at the site. These subsurface soil constituents, therefore, could be contacted in subsurface excavations during construction activities. The subsurface soil direct-contact exposure pathway, therefore, is considered complete for construction workers.

Ground Water Drinking Exposure

As discussed in Section 2.6, no ground water wells were identified in the vicinity of the site. The drinking water ingestion pathway, therefore, was considered incomplete.

Ground Water in Excavations Exposure

Ground water may infiltrate into excavations below the water table. Infiltration could result in potential exposure of construction workers to site-related ground water constituents¹. Therefore, direct contact with ground water in construction excavations is a potentially complete exposure pathway for construction workers.

Subsurface Migration to Indoor Air or to Excavation Air Exposure

Exposure to VOCs migrating from soil or ground water below building foundations to indoor air was evaluated as a potential exposure pathway. Three exposure scenarios were considered; workers within the existing church, future residents, and future construction workers excavating basements for future dwellings. Since the water table is generally less than 6 ft bls at the site, the maximum excavation depth for a future basement (and basement excavation) is assumed to be 5 ft bls (an 8 ft high basement with 3 ft of the foundation above grade) and the source of subsurface VOCs is conservatively considered to be approximately 1 ft below a basement slab. The current church foundation is slab-on-grade. As such, the source of subsurface VOCs is considered to be approximately 5 ft below the slab. Since VOC constituents are indicated to be potentially below building foundations, the air exposure pathway was considered for current church workers, construction workers and future residents.

¹ Direct contact with ground water would likely be avoided and generally might occur only occasionally when laborers repair pumps used to dewater excavations, an activity that would result in an acute exposure.

Surface Water Exposure

As discussed in Section 4.4, analytical data for ground water monitoring wells down gradient of the site (MW-7 and MW-8), between Area 2 and the Oswego River, indicate site related COPCs are not migrating to the river. The river drinking water ingestion pathway and pathways related to recreational uses of the river (swimming/fishing), therefore, are incomplete.

The exposure pathway analysis indicates several potentially complete exposure scenarios at the site. The following describes a profile for each receptor indicating complete pathways at the site:

Future Resident (Areas 1 and 2):

- Adult Resident
 - surface soil - direct contact
 - surface soil - incidental ingestion
 - migration to indoor air - inhalation of VOCs
- Child Resident
 - surface soil - direct contact
 - surface soil - incidental ingestion
 - migration to indoor air - inhalation of VOCs

Future Construction Worker (Areas 1 and 2)

- Construction Worker - (ground water ~6 ft bls)
 - surface soil - direct contact
 - surface soil - incidental ingestion
 - subsurface soil - direct contact
 - subsurface soil - incidental ingestion
 - ground water - direct contact
 - ground water - incidental ingestion
 - migration to ambient air - inhalation of VOCs

Current Church Worker (Area 2):

- Church Indoor Worker
 - migration to indoor air - inhalation of VOCs

5.2.3. Quantification of exposure

Representative exposure point concentrations were selected for surface soil, subsurface soil, ground water, and migration to indoor air. The exposure-point concentrations for these environmental media are presented in Table 5-3 for each exposure scenario at Area 1 and Area 2. Exposure-point concentrations were based on COPC analytical data or modeled screening concentrations as follows.

Surface Soil, Subsurface Soil, and Ground Water - As a conservative approach, the maximum concentration detected for COPCs in surface soil, subsurface soil, and ground water samples collected from each area (Area 1, and Area 2) at the site were considered the exposure point concentrations for the risk assessment.

Indoor Air - Future and current potential inhalation exposure point concentrations were modeled from subsurface media concentrations using the Johnson & Ettinger (1991) volatilization/migration model. The Johnson & Ettinger (1991) provides a soil migration and attenuation model including terms for advective and diffusion.

Indoor/Excavation Air Screening Concentration Development

VOCs may volatilize from soil and ground water sources into the unsaturated zone above the water table (soil vapor). If buildings are located above or near contaminated soil or ground water source, VOCs in soil vapor may infiltrate the indoor air of buildings via cracks or seams in the foundation. Soil vapor infiltration may occur via two principal mechanisms: advection or diffusion. Advection refers to the bulk movement of soil gas from the unsaturated zone to indoor air due to a pressure differential between the soil gas and the indoor space (i.e. the soil gas is "sucked" or "pushed" into the indoor space). Typically, in temperate climates, advective transport may occur during the winter months when a negative pressure environment is created indoors as a result of indoor heating in well insulated and sealed structures. Since advection requires the bulk movement of air through the soils, advective transport is negligible in very low permeability soils but may be the operative transport pathways in high permeability soils (Johnson and Ettinger 1991).

Diffusive transport reflects the movement of VOCs from the source to the indoor air due to the concentration gradient between the source and the indoor space. Since diffusive transport does not require the bulk movement of air, it may be the operative transport mechanism in low permeability soils or if there is no pressure gradient between the indoor space and the soil vapor. Since molecular diffusion of VOCs occurs

much more rapidly in air than in water, the extent of diffusive transport in soils is primarily dependant on the moisture content of the soil as well as the total porosity. VOCs volatilizing from ground water must first diffuse through the capillary fringe, which is the semi-saturated zone above the water table, before migrating to the unsaturated zone. Since the capillary fringe has a high moisture content, the height of the capillary fringe is the most important factor in determining the rate of migration of VOCs from ground water to soil gas. Low permeability "tight" soils, such as clays and silts typically have significantly larger capillary fringes as compared with high permeability soils such as sands. As such, the rate of diffusive transport is lower in low permeability soils as compared with high permeability soils (Little et al., 1992).

Since the site is located in a temperate climate, forced-air heating and cooling systems are often utilized in buildings which results in building underpressurization. Advective transport of soil gas, induced by building underpressurization, is likely to occur in current and future buildings. Specific details of the Johnson and Ettinger (1991), methodology is presented in Exhibit A.

As discussed by Johnson and Ettinger, the results of modeling are intended to be upper bound *screening* estimates. In addition, as a conservative measure, the maximum VOC or SVOC concentration detected in soil or ground water was applied as the soil or ground water source concentration respectively.

The current potential inhalation exposure point is in the Area 2 church. Analytical data for the volatile COPC benzene located beneath the building are not available. As such, maximum detected concentration analytical data from surrounding monitoring wells was used to develop an isoconcentration map which is presented on Figure G-1 located in Appendix G. The benzene concentration beneath the building was estimated using the contours provided on Figure G-1 and an area-weighted estimate of the benzene concentration in ground water beneath the church was derived. The area-weighted concentration derived is 0.55 mg/L (50% at 0.10 mg/L plus 50% at 0.010 mg/L).

A summary of the assumptions/parameters, and parameter values applied in the migration model calculations is presented in Table 5-4.

Table 5-4. Key Parameters and Values for Vapor Migration Model

Key Parameters	Parameter Value by Scenario			Comment
	Resident	Construction Worker	Church Worker	
Total Soil Porosity Fraction	0.375	0.375	0.375	Midrange value for sand (Freeze & Cherry 1979)
Volumetric Fraction of Water in Vadose Zone	0.15	0.15	0.15	Default estimate (USEPA 1996)
Soil Bulk Density	2.1 g/cm ³	2.1 g/cm ³	2.1 g/cm ³	Dense sands and gravels (Carter & Bentley 1991)
Depth to Ground Water	6 ft	6 ft	6 ft	Ground water depth is ~ 6 ft. bls (OBG 1997)
Distance to Source	1 ft	1 ft	5 ft	Basement excavation, or slab
Foundation Surface Area	9,000 ft ²	9,000 ft ²	1800 ft ²	Slab area plus wall areas (if any)
Fraction of Foundation Cracked	0.1%	~100%	0.1%	Default (USEPA 1996)
Air Exchange Rate	0.75/hr	45/hr	0.5/hr	Building Defaults: Industrial 1.0/hr Residential 0.5/hr
Length	60 ft	60 ft	80 ft	estimated
Width	30 ft	30 ft	60 ft	estimated
Height	8 ft	5 ft	8 ft	estimated
Depth of Slab	5 ft	5 ft	~0 ft	estimated

Source: O'Brien & Gere Engineers, Inc.

A comprehensive presentation of the model parameters and derived screening air concentrations is contained in Appendix G. Ambient air concentrations for the construction worker exposure were derived using the

Johnson and Ettinger model, based on modified input parameters appropriate for a outdoor basement excavation scenario².

Calculation of Chronic Daily Intakes - Chronic daily intakes (CDI) of COPCs³ were estimated for human receptors according to standard USEPA intake equations (USEPA 1989). A summary of the intake equations and input parameter estimates for current and future on-site human receptors are presented on Tables 5-5 and 5-6, respectively. The calculated CDI estimates for human receptors are presented in Appendix H.

5.3. Toxicity assessment

In the toxicity assessment, available toxicological data summaries for site-related compounds are reviewed and the relationship between the extent of exposure to a specific contaminant and the increased likelihood and/or severity of adverse effects are estimated. The potential toxicologic effects induced by a given dose of a chemical are classified according to two criteria: carcinogenic effects, and non-carcinogenic effects.

5.3.1. Non-carcinogenic effects

Chronic exposure of humans to chemicals in the environment can result in adverse non-carcinogenic health effects.

Reference Doses (RfDs) - In order to evaluate potential non-carcinogenic effects following exposure of human populations to chemicals, USEPA derives chemical-specific "reference doses" (RfDs). If the calculated intake

²Specifically, the basement migration model was modified to reflect no concrete walls or slab and an air exchange rate consistent with an average outdoor wind speed of 0.5 m.p.h.

³To streamline the exposure calculations for the air exposure pathway, the modeled air concentrations were compared to ambient air RBCs as an initial screening step. Ambient air RBCs are air concentrations below which there is no significant risk to human health, assuming a 24 hr. /day lifetime exposure scenario. Therefore, volatile COPCs for which the modeled concentrations were less than the ambient air RBCs were not included in the CDI calculations. Based on the initial screening, benzene and naphthalene were carried through the CDI calculations with respect to the air exposure pathway. A summary of this initial screening is shown in Table 5-2g and 5-2h.

of a chemical is less than the published RfD, then no adverse non-carcinogenic effects are expected in the exposed population.

5.3.2. Carcinogenic effects

The other health effect of concern in the exposure of humans to chemicals in the environment is the induction of cancer.

Weight of Evidence - USEPA classifies chemicals according to their potential to induce cancer in humans. A chemical may be classified into one of five groups with respect to the weight of evidence for human carcinogenicity. The categories are:

- Group A - Known Human Carcinogen.
- Group B - Probable Human Carcinogen.
- Group C - Possible Human Carcinogen.
- Group D - There is insufficient data available.
- Group E - There is no evidence for carcinogenic effects.

Slope Factors - For group A, B, or C chemicals, USEPA derives chemical-specific cancer slope factors. A cancer slope factor is a number which, when multiplied by the estimated chemical-specific CDI, provides an estimate of the "excess cancer risk" (CR) associated with that exposure.

5.3.3. Toxicity summaries

For each chemical of concern, chronic RfDs and cancer slope factors published by USEPA were compiled from the following hierarchy of sources:

- USEPA's Integrated Risk Information System (IRIS) database (USEPA 1997),
- Health Effects Summary Tables (HEAST),
- National Center for Environmental Assessment (NCEA) and
- Agency for Toxic Substances and Disease Registry (ATSDR).

The toxicity information selected from these sources, and used in the assessment, is summarized in Table 5-7.

5.4. Risk characterization

In this section of the HHRA, the toxicity and exposure assessments are summarized and integrated into numerical values which may be used to

evaluate the likelihood of adverse health effects in populations potentially exposed to site-related chemicals. Reasonable maximum exposure (RME) estimates of potential health risks were developed for each potentially exposed receptor.

Chronic non-cancer health effects were evaluated by comparing the chemical-specific chronic daily intakes (CDIs) with the respective chronic RfD as given below.

1. For each receptor identified during the exposure assessment, and each individual exposure pathway, the chemical-specific hazard quotients (HQs) were calculated. The HQ is given by:

$$\text{Hazard Quotient} = \text{CDI/RfD}$$

2. For each exposure pathway, the chemical-specific hazard quotients were summed to calculate the Hazard Index (HI) for that pathway. For each receptor, the pathway specific hazard indices were summed to obtain the Total HI for that receptor. A total HI of less than one indicates that it is highly unlikely that chronic non-cancer toxic effects would occur for the given receptor.

To evaluate carcinogenic effects, the incremental cancer risk associated with exposure to chemicals of concern was calculated using chemical-specific slope factors as described below.

1. For each receptor and exposure pathway identified during the exposure assessment, the chemical-specific risk is given by:

$$\text{Cancer risk} = \text{CDI} * \text{slope factor}$$

2. For each receptor the total incremental excess cancer risk was calculated by summing the pathway specific cancer risk. This calculated risk estimate was then compared with an acceptable excess cancer risk. A total Site cancer risk that is less than 1.0E-04 to 1.0E-06 is considered to be acceptable, (NCP, *Federal Register*, March 8 1990, 40 CFR 300).

5.5. Results and conclusions - potential human health risks

The results of the human health risk evaluation are summarized on Table 5-8 below for each identified receptor group at the site. A summary of the derived risk estimates for each exposure pathway, and the chemical constituents which primarily contribute to the derived risk estimates is presented on Table 5-9.

Table 5-8. Summary of Risk to Human Receptors

Receptor	Excess Cancer Risk	Hazard Index
Area 1 Future Adult Resident	1.1×10^{-04}	0.91
Area 1 Future Child Resident	1.1×10^{-04}	3.3
Area 1 Future Construction Worker	4.5×10^{-06}	0.87
Area 2 Future Adult Resident	2.8×10^{-04}	2.1
Area 2 Future Child Resident	2.6×10^{-04}	8.4
Area 2 Future Construction Worker	8.9×10^{-04}	5.1
Area 2 Current Church Worker	5.2×10^{-07}	0.54

Source: O'Brien & Gere Engineers, Inc.

Table 5-9. Summary of Constituents Indicating Potential Risk - Identified by Receptor, Media, and Pathway

Receptor	Cancer Risk			Non-cancer Effects		
Area 1 Future Adult Resident	surface soil:	PAHs Arsenic	$\sim 1.0 \times 10^{-04}$ 8.1×10^{-06}	surface soil:	Iron Manganese	0.39 0.34 <i>Total non-cancer HI is less than 1.0</i>
Area 1 Future Child Resident	surface soil:	PAHs Arsenic	$\sim 7.2 \times 10^{-05}$ 1.4×10^{-05}	surface soil:	Iron Manganese Cyanide	1.44 0.82 0.49
Area 1 Future Construction Worker	surface soil: subsurface soil:	PAHs PAHs	$\sim 2.0 \times 10^{-06}$ $\sim 2.0 \times 10^{-06}$	surface soil: ground water:	Iron Iron	0.14 0.18
Area 2 Future Adult Resident	surface soil: air:	PAHs Arsenic Benzene	$\sim 1.0 \times 10^{-04}$ 5.3×10^{-06} 1.9×10^{-05}	surface soil: air:	Iron Manganese Benzene Naphthalene	0.16 0.26 0.92 0.68
Area 2 Future Child Resident	surface soil: air:	PAHs Arsenic Benzene	$\sim 1.4 \times 10^{-04}$ 9.2×10^{-06} 9.2×10^{-05}	surface soil: air:	Iron Manganese Arsenic Benzene Naphthalene	0.84 0.70 0.24 3.8 2.8
Area 2 Future Construction Worker	surface soil: subsurface soil: ground water:	PAHs PAHs PAHs	$\sim 5.7 \times 10^{-06}$ $\sim 7.5 \times 10^{-05}$ $\sim 7.0 \times 10^{-04}$	subsurface soil: ground water: air:	Iron Arsenic PAHs Benzene Naphthalene Benzene Naphthalene	1.10 0.48 ~ 1.0 0.49 0.11 0.93 0.63
Area 2 Current Church Worker	No unacceptable risk			No unacceptable risk		
Source: O'Brien & Gere Engineers, Inc.						

A discussion of the derived estimates for each exposure area is presented below.

Area 1

The derived cancer risk estimates for Area 1 are within the 10^{-4} to 10^{-6} range for the future adult resident, future child resident, and construction worker, which is within acceptable levels with respect to the NCP. The derived HI

for the future adult resident and construction worker is less than 1. The derived total Hazard Index for future child residents exceeds 1. The derived HIs are primarily related to the maximum detected iron and manganese levels in surface soils. However, as shown on Table 5-1a, the average detected concentration of iron and manganese at the Area 1 (16,000 mg/kg and 333 mg/kg respectively) are comparable to the site specific background concentration for iron and manganese at the site (11,000 and 310 mg/kg) respectively. In addition, the maximum detected iron and manganese levels (24,000 mg/kg and 510 mg/kg) are within the range for background levels in uncontaminated soils in the eastern United States (2,000 - 550,000 mg/kg for iron, 130 - 1,560 mg/kg for manganese) and the Albany area (17,500 - 25,000 mg/kg for iron, 400 - 600 mg/kg for manganese), as reported by NYSDEC (McGovern undated).

Area 2

The derived cancer risk estimates for Area 2 exceed the 10^{-4} to 10^{-6} range for the future adult resident, future child resident. The primary constituents contributing to the calculated cancer risk values are PAHs in surface soils, and benzene in ground water, based on potential future migration to residential basements. The derived HIs for the future adult resident and future child resident exceed 1. The HIs are primarily related to the maximum detected benzene and naphthalene concentrations in ground water based on potential future migration to residential basements. As shown on Table 5-9, the calculated HQs for iron and manganese in surface soils also approach 1. However, as shown on Table 5-1d, the average detected concentration of iron and manganese in Area 2 surface soil (12,860 mg/kg and 393 mg/kg respectively) are comparable to the site specific background concentration for iron and manganese at the site (11,000 and 310 mg/kg) respectively. In addition, the maximum detected iron and manganese levels (14,000 mg/kg and 440 mg/kg) are within the range for background levels in uncontaminated soils in the eastern United States (2,000 - 550,000 mg/kg for iron, 130 - 1,560 mg/kg for manganese) and the Albany area (17,500 - 25,000 mg/kg for iron, 400 - 600 mg/kg for manganese), as reported by NYSDEC (McGovern undated).

The derived cancer risk estimates for Area 2 exceed the 10^{-4} to 10^{-6} range for the future construction worker. The primary constituents contributing to the calculated cancer risk values are PAHs and benzene in ground water. The derived cancer risk estimate for the current church worker at Area 2 is less than 10^{-6} , which is within the acceptable risk levels identified in the NCP. The calculated HI for the current church worker is less than 1. Since the HI is less than one, it is concluded that the detected constituents in

subsurface soil and ground water do not represent a health risk to current church workers.

5.6. Uncertainty

The risk measures used in this evaluation are not precise, deterministic estimates of risk, but conditional estimates controlled by a considerable number of consecutive upper-bound assumptions regarding exposure and toxicity. They are designed to estimate an upper-bound on the potential health risk value, as opposed to presenting a precise, realistic estimate of actual health risks. This is done by convention, consistent with USEPA protocols. The main sources of uncertainty relative to the assumptions, results, and conclusions of the HHRA are:

- estimation of exposure point concentrations
- evaluation of exposure parameters
- estimation of toxicity values
- calculation of quantitative risk estimates

Uncertainties related to these sources are discussed below.

5.6.1. Exposure point concentrations

Maximum detected concentrations in soil and ground water were applied as exposure point concentrations for soil excavation construction workers, and future residents. As such, it is highly unlikely that the estimated exposure point concentrations underestimate representative concentrations in site soil or ground water media.

Subsurface sample collection is not feasible beneath the existing church building in Area 2. Because the concentration of COPCs below the existing church is unknown, modeled indoor air screening concentrations were developed based on interpolation of ground water concentrations detected in Area 2. Airborne exposures point concentrations for current church workers, soil excavation construction workers, and future residents were based on a conservative migration model using maximum subsurface concentrations and conservative exposure assumptions.

5.6.2. Exposure parameters

The exposure parameters for receptors, and receptor activity factors were based on data published by USEPA or professional judgement. In this assessment USEPA guidance on identifying reasonable maximum exposure factors was applied. As such, the exposure parameters result in inherently conservative estimates of the chronic daily intake for each receptor.

5.6.3. Toxicity values

A general discussion of the uncertainties and conservatism inherent in the USEPA approach for deriving RfDs and cancer slope factors is briefly summarized below:

Reference Doses (RfDs) - For some chemicals, RfDs are derived directly from data on human exposures. Such data includes data relating to occupational exposures that are known to have no adverse effects, normal dietary levels of certain chemicals (e.g., magnesium), therapeutic doses of certain chemicals (e.g., silver), epidemiologic data relating to populations with background exposures (e.g., selenium). For most chemicals USEPA derives RfDs based on laboratory studies in which experimental animals were exposed to different concentrations of a chemical, and a no observed adverse effects level (NOAEL) is estimated. If data from several animal studies are available, USEPA seeks to identify the species that is most comparable to humans based on a knowledge of specific biologic properties. However, if adequate comparative data is not available, USEPA selects the study on the most sensitive animal species as the critical study for the basis of the NOAEL. The NOAEL is then used to derive a RfD for potential adverse effects in human populations.

RfD Uncertainty Factors - In most cases, there is considerable uncertainty regarding the extension of toxicologic data from animal studies to humans. In other words, the actual RfD for humans or sensitive sub-populations of humans would not be precisely known based on data in animal species. This uncertainty arises because there may be differences between the animal and human species regarding factors such as the metabolism of the chemical, the distribution and clearance rate of the chemical from the body, and the sensitivity of specific organ systems to the chemical. Therefore, the USEPA derives RfDs that are designed to be protective of the public at large, *including sensitive sub-populations*. The USEPA applies a series of "uncertainty" factors to calculate the final RfD values. Depending on the data, the NOAEL may be divided by an uncertainty factor ranging from 0 to 10,000. For human data, in most cases, the uncertainty factor of 10 is applied

for the application of data from the public at large to sensitive sub-populations. For animal data a minimum uncertainty factor of 100 (10 for sensitive sub-population, and 10 for animal-human extrapolation) is applied for deriving the human RfD.

Cancer Slope Factors - Additional uncertainty arises from the USEPA's use of the linearized multi-stage model for estimating the cancer slope factor. The linearized multi-stage model is one mathematical model which may describe the carcinogenic process. The model assumes that at low doses, there is a linear relationship between the dose of a chemical and the excess cancer risk. In addition, the model assumes that there is no threshold dose for the induction of cancer. However, there are many instances in which this assumption may not hold true for the carcinogenic process. Examples of such effects are chemicals that cause an increased high dose cancer incidence due to stimulated cell proliferation rates (Cohen and Ellwein 1990, Ames and Gold 1990), chemicals for which metabolic parameters limit the delivered dose to the target organ (discussed in Zeiss et al 1987), promoters, or instances where DNA repair mechanisms may be dose dependant (discussed in Zeisse 1987). In these instances, the linearized multi-stage model may provide a "plausible upper limit" of potential cancer risk (51 FR 3398). However, as acknowledged by USEPA (51 FR 3398), "such an estimate does not necessarily give a realistic prediction of the risk. The true value of the risk is unknown, and may be as low as zero".

5.6.4. Quantitative risk estimates

Non-cancer Effects

For each exposure pathway, the chemical-specific hazard quotients were summed to calculate the Hazard Index (HI) for that pathway. For each receptor, the pathway-specific hazard indexes were summed to obtain the total HI for that receptor.

The adaptivity assumption for calculating hazard indexes is based on the concept that multiple chemicals, acting on the same target organ or by the same mechanism of toxicity, will have an additive effect with respect to the potential damage that is caused to that organ. Therefore, the adaptivity assumption does not hold true for chemicals that do not act on the same target organ or by the same mechanism of toxicity. Therefore, USEPA guidance states that if the total Hazard Index for the site exceeds 1, the COPCs should be segregated according to target organ, and the HIs re-derived for each sub group of chemicals. The HIs were less than one for all

the receptors evaluated. As such, the conclusions of the risk assessments are based on conservative estimates of potential chronic non-cancer health risk.

Carcinogenic Effects

Uncertainties associated with the linearized multi-stage model for low dose cancer risk assessment have been discussed. As described, the model and associated assumptions likely result in a conservative estimate of potential lifetime excess cancer risk.

6. Conclusions

The following conclusions are drawn based on the data collected obtained during the completion of The PSA/IRM and the RI at the South First Street Site in Fulton, New York.

Hydrogeologic conditions

- The overburden deposits encountered at the site consist of four units: fill, silt and fine sand, sand and gravel, and extremely dense sand and gravel.
- An unconfined overburden aquifer exists beneath the site with a ground water flow direction to the southwest under a hydraulic gradient of 0.04 ft/ft. Ground water flow direction shifts to the west in Area 2.
- A downward vertical hydraulic gradient of 0.061 ft/ft exists in Area 2.
- Hydraulic conductivity values in the shallow aquifer zone at the site range from 0.017 ft/day to 0.059 ft/day. The deep aquifer zone hydraulic conductivities were 0.0125 ft/day and 0.003 ft/day.
- Respondents to the ground water user survey indicated that no domestic ground water wells exist at the residences adjacent to the site.

Nature and extent of contamination

Soil vapor

- BTEX and PAH constituents were not detected in soil vapor samples SV-1, SV-2, and SV-3 indicating that soil gas vapor is not a migration pathway for site-related constituents to adjacent residences.

Surface soil

- The total BTEX detected in site surface soils range from 0.00072 ppm to 0.0036 ppm and are consistent with background concentrations.

- The total PAH concentrations in site surface soils range from 19.77 ppm to 148.83 ppm and are elevated in comparison to background concentrations.
- Cyanide was detected in site surface soils at concentrations ranging from 0.9 ppm to 810 ppm in SS-2. However, the elevated concentration of cyanide was most likely located below the ground surface because the high concentration was detected in the 0 to 2 ft interval as compared to 11 ppm detected in the SS-2 location 0 to 2 inch interval. The extent of cyanide in the vicinity of SS-2 was defined with further sampling.

Subsurface soil

- The highest concentrations of PAHs, BTEX, and cyanide in subsurface soils at the site were detected in Area 2 were identified in test pit TP-4 and soil borings SB-1, MW-3, MW-6, and MW-4.
- The detection of BTEX and PAHs were limited to within the boundary of Area 2 as defined by soil borings MW-7, MW-8, MW-9/9D.
- The concentrations of BTEX and PAHs in Area 1 were highest in the test pits completed in the locations of the former MGP structures, suggesting that the impacts are limited. In addition, the concentrations of BTEX and PAHs in Area 1 were below the TAGM 4046 cleanup objectives.
- Vertically, the mass of PAHs, BTEX, and cyanide is predominantly limited to the subsurface soil above the extremely dense sand and gravel matrix till.
- With the exception of PAH concentrations in MW-3 (22-24 ft) the highest PAH concentrations are present in the subsurface from 0 to 10 ft bls.
- Residual non-aqueous phase liquid (NAPL) was observed at one location, MW-3, at a depth interval of 18 to 22 ft bls.
- The TCLP analyses of residuals completed in the PSA indicated that detected constituents not characteristic of hazardous waste as specified in 40 CFR Part 261.

Ground water

- The detection of BTEX and PAHs in site ground water is limited to Area 2. Detected concentrations exceeded New York State (NYS) Class GA ground water standards.
- BTEX was detected in three wells MW-4, MW-5, and MW-6 at concentrations ranging from 21 ppb to 1,250 ppb.
- BTEX was not detected in downgradient wells MW-3, MW-8, MW-9, and MW-10 indicating that dissolved BTEX is not migrating off-site.
- PAHs were detected in wells MW-3, MW-4, MW-5, and MW-6 at concentrations ranging from 554 ppb to 8,810 ppb.
- PAHs were not detected in downgradient wells MW-8, MW-9, MW -9D and MW-10 indicating that dissolved PAHs are not migrating off-site.
- The detection of BTEX and PAHs in deep well MW-6 indicates that dissolved site related constituents have migrated downward into the extremely dense sand and gravel.

Potential human health risk

Area 1

- Cancer Risk and Hazard Index for Area 1 are within acceptable levels with respect to the NCP for the future adult resident, future child resident, and construction worker.
- The derived Hazard Index for future child residents exceed the acceptable levels with respect to the NCP. The derived HIs are primarily related to the maximum detected iron and manganese levels in surface soils. However, the average detected concentration of iron and manganese at the Area 1 are comparable to the site specific background. In addition, the maximum detected iron and manganese levels are within the range for background levels in uncontaminated soils in the Albany, NY area and the eastern United States.

Area 2

- The derived Cancer Risk and Hazard Index estimates for Area 2 exceed the acceptable levels with respect to the NCP for the future adult resident, and future child resident. The primary constituents contributing to the

calculated Cancer Risk and Hazard Index values are PAHs in surface soils, and benzene and naphthalene via potential future migration from ground water to residential basements.

- The derived Cancer Risk estimates for Area 2 exceeds the acceptable level with respect to the NCP for the future construction worker. The primary constituents contributing to the calculated cancer risk values are PAHs and benzene in ground water.
- The derived Cancer Risk estimate for the current church worker at Area 2 is within the acceptable risk levels identified in the NCP.
- For the current church worker at Area 2, the Hazard Index is less than one. It is concluded, therefore, that the modeled indoor air screening values do not represent a health risk to current church workers.

Recommendation:
Mw 4, 5 & 6 Elevated levels indicated.

References

ASTDR. 1997. *Toxicological Profiles*. U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry.

ASTM. 1996. *Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites*. E 1739 - 95e1.

Carter, M. and Bentley, S.P. 1991, *Correlations of Soil Properties*, Pentech Press, London. p.39-40. 130pp.

EHRAV. 1995. *Electronic Handbook of Risk Assessment Values*. Volume 4, Issue 9. 1995 Electronic Handbook Publishers, Inc. 15 September 1995.

Environmental Research & Technology and Koppers Company, September 1984, Handbook on Manufactured Gas Plant Sites.

Epstein, C.M. Undated - circa 1993. *The Hydrology of New Jersey Wetlands*, Cook College with Stockton State College. Stockton State College Pomona, NJ.

Fulton Public Library, 1947-1980, Fulton City Directories.

Fulton Water Works. 1998. Personal communication from Mr. Florek.. Telecon 10/1/98 with LA Kobor of O'Brien & Gere.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold Company, Inc. New York, New York.

IRIS. 1997. *Integrated Risk Information Systems*. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH.

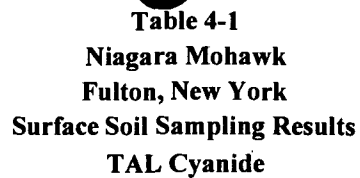
Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. *Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings*. Environ. Sci. Technol., 25, 1445-1452.

- Kantrowitz, I.H., Ground-Water Resources in The Eastern Oswego River Basin, New York, Prepared for The Eastern Oswego Regional Water Resources Planning Board, State of New York Conservation Department Water Resources Commission, Basin Planning Report ORB-2, 1970
- Little, J.C., Daisey, J.M. and Nazaroff, W.W. 1992. Transport of subsurface contaminants into buildings. Environ. Sci. Technol. 26. 11.
- MADEP. 1994a. *Background Documentation for the Development of the MCP Numerical Standards*. MADEP Office of Research and Standards and ABB Environmental Services, April 1994.
- NYSDEC. undated. *Background Concentrations of 20 Elements in Soils with regard for New York State*. New York State Department of Environmental Conservation, Wildlife Pathology Unit. Delmar, NY.
- Niagara Mohawk, 1998. *Ground Water Well Survey* letter report of July 27, 1998 from Mr. Charles Willard of Niagara Mohawk to Mr. Gardiner Cross of the NYS DEC.
- Niagara Mohawk, June 1996, Final Work Plan For The Preliminary Site Assessment/Interim Remedial Measures (PSA/IRM) Study At The South First Street Site, City of Fulton, New York.
- Niagara Mohawk, June 1996, Generic Quality Assurance Project Plan and Field Sampling Plan For Site Investigations.
- O'Brien & Gere Engineers, Inc., May 1996, Preliminary Site Assessment/Interim Remedial Measure Study at The South First Street MGP Site, City of Fulton, NY.
- O'Brien & Gere Engineers, Inc. 1997. *Preliminary Site Assessment Interim Remedial Measures (PSA/IRM) Study, South First Street City of Fulton, NY - Niagara Mohawk Power corporation*.
- United States Geological Survey, 1982, Atlas of Seven Selected Aquifers in New York State, pgs 215-236.
- USEPA. 1986. *Guidelines for Carcinogen Risk Assessment*. 51 FR 33992.

- USEPA. 1989a. *Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A) Interim Final*. EPA/540/1089/002.
- USEPA. 1991. *Risk Assessment Guidance for Superfund Volume 1, Human Health Supplemental Guidance Standard Default Exposure Factors*.
- USEPA. 1992a. *Guidance for Data Useability in Risk Assessment*. Final. April 1992, EPA/9285/7/09A
- USEPA. 1992b. *Guidelines for Exposure Assessment*. 57 FR 104, May 29, 1992.
- USEPA. 1992c. *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B
- USEPA. 1992d. *Assessing Potential Indoor Air Impacts for Superfund Sites*.
- USEPA. 1994. *Revised Interim Soil Lead Guidance for CERCLA sites and RCRA Corrective Action Facilities, OSWER Directive # 9355.4-12*.
- USEPA. 1995. *Guidance for Risk Characterization*. March 1995.
- USEPA. 1996. *Soil Screening Guidance*. April 1996.
- USEPA. 1997. *Region III Risk Based Concentrations Table*. October 1997.
- USEPA. 1997. *Exposure Factors Handbook*. August 1997.
- USGS. 1998. E-mail communication of 9/21/98 from B Worobey of USGS to LA Kobor of O'Brien & Gere.
- Zeiss. 1987. *Dose Response Relationships for Carcinogens: A Review*. Environmental Health Perspectives 73:259-308.

Table 2-2
Monitoring Well Specifications
South First Street Site
Fulton, New York
Niagara Mohawk Power Corporation

Well No.	Ground	Top of PVC	Well	Screen	Hydraulic	Ground Water Elevations (ft)		
	Elevation (ft)	Casing Elevation (ft)	Depth (ft bgs)	Interval (ft bgs)	Conductivity (ft/day)	7/24/96	9/4/96	07/16/98
MW-1	367.24	369.69	17	352.24 - 362.24	0.017	365.43	363.91	364.7
MW-2	361.00	360.80	15	348.50 - 358.50	NA	357.64	356.43	357.05
MW-3	358.74	361.13	16	344.74 - 354.74	NA	350.10	349.21	349.73
MW-4	359.96	359.74	16	345.96 - 355.96	NA	351.88	350.92	351.54
MW-5	359.70	359.51	16	345.70 - 355.70	NA	352.53	351.39	352.03
MW-6	359.39	359.00	37	322.39 - 332.39	0.013	NI	NI	351.84
MW-7	361.48	361.33	14	347.48 - 357.48	0.046	NI	NI	352.43
MW-8	360.81	360.78	16	344.81 - 354.81	NA	NI	NI	351.35
MW-9	358.11	357.04	16	342.11 - 352.11	0.059	NI	NI	348.48
MW-9D	358.38	358.21	30	328.38 - 338.38	0.003	NI	NI	347.64
MW-10	359.51	359.15	15	344.51 - 354.51	NA	NI	NI	351.24
PZ-1	360.19	359.88	16	346.69 - 356.69	NA	354.59	353.59	NI



TAL Cyanide

Date Printed: 02/24/99 15:26:51
DBF File: E:\PROJECTS\1118081\NIMO\NIMO0698.DBF
FXP File: E:\PROJECTS\1118081\NIMO\3352S2.FXP

**Niagara Mohawk**

Fulton, New York

Subsurface Soil Sampling Results - BTEX (ppm)

[illegible]



Table 4-4
Niagara Mohawk
Fulton, New York

Subsurface Soil Sampling Results - PAHs (ppm)

Date Printed: 02/24/99 15:26:40
DBF File: E:\PROJECTS\1118081\NIMO\NIMO0698.DBF
FXP File: E:\PROJECTS\1118081\NIMO\8270S.FXP



Table 4-5

Niagara Mohawk

Fulton, New York

Ground Water Sampling Results - BTEX

NOTES: Data Qualifier Definitions: NC - No criteria established, U - Not detected, J - Estimated, B - Blank contaminated, N - tentitively identified.

Table 4-6
Niagara Mohawk
Fulton, New York
Ground Water Sampling Results - PAHs

Compound	NYS Class GA Standards (3/98) ug/L	MW-4DL	MW-5	MW-5DL	MW-6	MW-6DL	MW-7	MW-8	MW-9
		07/16/98	07/16/98	07/16/98	07/16/98	07/16/98	07/16/98	07/16/98	07/16/98
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
2-Chloronaphthalene	NC	200 U	10 U	1000 U	100 U	1000 U	10 U	10 U	10 U
2-Methylnaphthalene	NC	200 U	160 J	160 J	530	620	10 U	10 U	10 U
Acenaphthene	NC	37 J	19	1000 U	240	270 J	10 U	10 U	10 U
Acenaphthylene	NC	200 U	61	1000 U	250	270 J	10 U	10 U	10 U
Anthracene	NC	28 J	5 J	1000 U	210	220 J	10 U	10 U	10 U
Benzo(a)anthracene	NC	200 U	10 U	1000 U	180	200 J	10 U	10 U	10 U
Benzo(a)pyrene	ND	200 U	10 U	1000 U	180	190 J	10 U	10 U	10 U
Benzo(b)fluoranthene	NC	200 U	10 U	1000 U	200	190 J	10 U	10 U	10 U
Benzo(ghi)perylene	NC	200 U	10 U	1000 U	100 J	130 J	10 U	10 U	10 U
Benzo(k)fluoranthene	NC	200 U	10 U	1000 U	72	1000 U	10 U	10 U	10 U
Chrysene	NC	200 U	10 U	1000 U	160	180 J	10 U	10 U	10 U
Dibenzo(a,h)anthracene	NC	200 U	10 U	1000 U	100 U	1000 U	10 U	10 U	10 U
Fluoranthene	NC	24 J	2 J	1000 U	430	530	10 U	10 U	10 U
Fluorene	NC	57 J	34	1000 U	250	290 J	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	NC	200 U	10 U	1000 U	88	110 J	10 U	10 U	10 U
Naphthalene	NC	1200	4500	4500	4800	4800	10 U	10 U	10 U
Phenanthrene	NC	56 J	32	1000 U	680	860	10 U	10 U	10 U
Pyrene	NC	22 J	2 J	1000 U	440	440 J	10 U	10 U	10 U
PAHs (total)	NC	1424	4815	4660	8810	9300	---	---	---

NOTES: Data Qualifier Definitions: NC - No criteria established, U - Not detected, J - Estimated, B - Blank contaminated, N - tentitively identified.

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Summary of Detected Analytes**

Table 5-1a. AREA 1 Surface Soil

NAME	Number Analyzed	Number Detected	Frequency of Detection	Mean of Detections mg/kg	Mean with Non-detects mg/kg	Minimum Detection mg/kg	Maximum Detection mg/kg	Maximum Detection Limit mg/kg
1,1,1-Trichloroethane	6	1	17%	0.0008	0.0053	0.0008	0.0008	0.013
2-Methylnaphthalene	6	3	50%	0.0077	3.41	0.005	0.013	40
4,4'-DDD	6	3	50%	0.0214	0.0118	0.0031	0.049	0.0046
4,4'-DDE	6	2	33%	0.0040	0.0058	0.0023	0.0058	0.041
4,4'-DDT	6	3	50%	0.0176	0.0205	0.0079	0.033	0.12
Acenaphthene	6	2	33%	0.005	3.44	0.005	0.005	40
Acenaphthylene	6	5	83%	0.0994	3.42	0.004	0.41	40
Alpha-chlordane	6	2	33%	0.0021	0.0029	0.0018	0.0024	0.02
Aluminum	6	6	100%	6,917	6,917	3,900	9,600	
Anthracene	6	5	83%	0.027	3.36	0.013	0.039	40
Arsenic	6	6	100%	5.3	5.3	4	9	
Barium	6	6	100%	73	73	60	100	
Benzene	6	4	67%	0.0010	0.0027	0.0007	0.0017	0.012
Benzo[a]anthracene	6	6	100%	1.6	1.6	0.6	3	
Benzo[a]pyrene	6	6	100%	2.2	2.2	0.63	4	
Benzo[b]fluoranthene	6	6	100%	11	11	0.88	50	
Benzo[g,h,i]perylene	6	6	100%	2.4	2.4	0.81	4.7	
Benzo[k]fluoranthene	6	6	100%	1.2	1.2	0.027	2.1	
Calcium	6	6	100%	3,367	3,367	2,000	4,800	
Carbazole	6	5	83%	0.0068	3.339	0.004	0.009	40
Chromium	6	6	100%	10	10	9	13	
Chrysene	6	6	100%	2.3	2.3	0.69	4.5	
Copper	6	6	100%	33	33	16	62	
Di-n-butyl phthalate	6	2	33%	0.012	3.45	0.009	0.015	40
Dibenzofuran	6	2	33%	0.0065	3.44	0.006	0.007	40
Endosulfan II	6	2	33%	0.0069	0.0072	0.0008	0.013	0.04
Endosulfan sulfate	6	1	17%	0.042	0.0090	0.042	0.042	0.007
Endrin	6	1	17%	0.046	0.0392	0.046	0.046	0.32
Endrin Ketone	6	4	67%	0.0160	0.0123	0.0025	0.0435	0.015
Fluoranthene	6	6	100%	2.4	2.4	1	5.7	
Fluorene	6	4	67%	0.0105	3.37	0.007	0.013	40
Gamma-chlordane	6	2	33%	0.0058	0.0053	0.0016	0.01	0.034
Indeno[1,2,3-cd]pyrene	6	6	100%	2.1	2.1	0.027	4.4	
Iron	6	6	100%	16,333	16,333	13,000	24,000	
Lead	6	6	100%	72	72	27	120	
Lindane	6	1	17%	0.003	0.0029	0.003	0.003	0.02
Magnesium	6	6	100%	1,867	1,867	1,200	2,400	
Manganese	6	6	100%	333	333	220	510	
Mercury	6	5	83%	0.26	0.225	0.1	0.7	0.1
Methoxychlor	6	2	33%	0.0272	0.0313	0.0064	0.048	0.21
Naphthalene	6	4	67%	0.0173	3.38	0.007	0.035	40
Nickel	6	1	17%	10	5.83	10	10	10
Phenanthrene	6	6	100%	1.1	1.1	0.51	2.1	
Pyrene	6	6	100%	3	3	1.2	8.2	
Selenium	6	6	100%	1.7	1.7	1	3	
Toluene	6	2	33%	0.0011	0.0044	0.0009	0.0013	0.013
Total Organic Carbon	4	4	100%	52,613	52,613	23,680	111,056	
Vanadium	6	6	100%	13	13	10	20	
Xylene (total)	6	1	17%	0.0007	0.0053	0.0007	0.0007	0.013
Zinc	6	6	100%	74	74	53	110	
Total cyanide-CLP-B	10	10	100%	97	97	0.9	810	

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Summary of Detected Analytes**

Table 5-1b. AREA 1 Subsurface Soil

NAME	Number Analyzed	Number Detected	Frequency of Detection	Mean of Detections mg/kg	Mean with Non-detects mg/kg	Minimum Detection mg/kg	Maximum Detection mg/kg	Maximum Detection Limit mg/kg
4,4'-DDE	2	1	50%	0.0005	0.0013	0.0005	0.0005	0.0041
Acenaphthene	9	1	11%	3.5	3.09	3.5	3.5	46
Acenaphthylene	9	2	22%	0.48	0.26	0.15	0.81	0.41
Aluminum	2	2	100%	5,350	5,350	4,200	6,500	
Anthracene	9	3	33%	1.43	0.60	0.006	3.4	0.41
Arsenic	2	2	100%	2.5	2.5	1	4	
Barium	2	2	100%	90	90	40	140	
Benzo[a]anthracene	9	4	44%	1.48	0.764	0.006	3.6	0.41
Benzo[a]pyrene	9	5	56%	0.90	0.59	0.004	3.8	0.41
Benzo[b]fluoranthene	9	6	67%	10	7.032	0.004	62	0.41
Benzo[g,h,i]perylene	9	6	67%	0.58	0.45	0.005	3.3	0.41
Benzo[k]fluoranthene	9	4	44%	0.57	0.36	0.005	2.2	0.41
Calcium	2	2	100%	5100	5100	4,100	6,100	
Chromium	2	2	100%	9.5	9.5	7	12	
Chrysene	9	5	56%	1.37	0.84	0.005	4.4	0.41
Copper	2	2	100%	14.5	14.5	14	15	
Cyanide	10	3	30%	8.6	2.79	0.8	22	0.6
Di-n-butyl phthalate	2	1	50%	0.015	0.11	0.015	0.015	0.41
Dibenz[a,h]anthracene	9	1	11%	0.021	2.71	0.021	0.021	46
Ethylbenzene	9	1	11%	3.3	0.37	3.3	3.3	0.059
Fluoranthene	9	5	56%	16	8.77	0.006	73	0.41
Fluorene	9	1	11%	3.3	3.07	3.3	3.3	46
Indeno[1,2,3-cd]pyrene	9	5	56%	0.70	0.48	0.005	3.4	0.41
Iron	2	2	100%	14,000	14,000	11,000	17,000	
Lead	2	2	100%	3.4	3.4	2.8	4	
Magnesium	2	2	100%	3,400	3,400	3,000	3,800	
Manganese	2	2	100%	415	415	330	500	
Naphthalene	9	1	11%	0.2	2.73	0.2	0.2	46
Nickel	2	1	50%	10	7.5	10	10	10
Phenanthrene	9	4	44%	4.38	2.05	0.005	14	0.41
Pyrene	9	5	56%	16	9.16	0.008	72	0.41
Tetrachloroethene	2	1	50%	0.0026	0.0161	0.0026	0.0026	0.059
Total Organic Carbon	2	2	100%	4,150	4,150	2,757	5,542	
Vanadium	2	1	50%	10	7.5	10	10	10
Xylene (total)	9	1	11%	2.2	0.25	2.2	2.2	0.059
Zinc	2	2	100%	25	25	21	29	

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Summary of Detected Analytes**

Table 5-1c. AREA 1 Ground Water

NAME	Number Analyzed	Number Detected	Frequency of Detection	Mean of Detections	Mean with Non-detects	Minimum Detection	Maximum Detection	Maximum Detection Limit
Inorganics (mg/L)								
Aluminum	5	5	100%	55	55	11	170	
Arsenic	5	3	60%	0.05	0.03	0.026	0.1	0.01
Barium	5	5	100%	1.56	1.56	0.4	4.9	
Beryllium	5	1	20%	0.008	0.004	0.008	0.008	0.005
Cadmium	5	2	40%	0.019	0.009	0.007	0.031	0.005
Calcium	5	5	100%	223	223	86	570	
Chromium	5	5	100%	0.12	0.12	0.03	0.35	
Cobalt	5	1	20%	0.13	0.046	0.13	0.13	0.05
Copper	5	5	100%	0.19	0.19	0.04	0.65	
Cyanide	5	5	100%	0.42	0.42	0.14	0.601	
Iron	5	5	100%	103	103	22	320	
Lead	5	5	100%	0.074	0.074	0.012	0.26	
Magnesium	5	5	100%	58	58	29	140	
Manganese	5	5	100%	5.40	5.40	2.1	15	
Mercury	5	2	40%	0.001	0.001	0.0005	0.0021	0.0002
Nickel	5	3	60%	0.15	0.098	0.07	0.27	0.04
Potassium	5	5	100%	15	15	7	32	
Selenium	5	2	40%	0.006	0.004	0.005	0.007	0.005
Sodium	5	5	100%	56	56	38	84	
Vanadium	5	3	60%	0.13	0.09	0.06	0.27	0.05
Zinc	5	5	100%	0.252	0.252	0.06	0.8	
Organics (ug/L)								
4,4'-DDT	4	1	25%	0.004	0.041	0.004	0.004	0.11
Alpha-BHC	4	1	25%	0.007	0.022	0.007	0.007	0.058
Aroclor 1242	4	1	25%	1.4	0.7625	1.4	1.4	1.1
Endosulfan II	4	1	25%	0.003	0.035	0.003	0.003	0.11
Fluoranthene	6	1	17%	1.3	4.47	1.3	1.3	11
Heptachlor	4	1	25%	0.009	0.022	0.009	0.009	0.053
Heptachlor epoxide	4	1	25%	0.007	0.021	0.007	0.007	0.053
Pyrene	6	2	33%	1.7	3.9	1.3	2.1	10

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Summary of Detected Analytes**

Table 5-1d. AREA 2 Surface Soil

NAME	Number Analyzed	Number Detected	Frequency of Detection	Mean of Detections mg/kg	Mean with Non-detects mg/kg	Minimum Detection mg/kg	Maximum Detection mg/kg	Maximum Detection Limit mg/kg
Lindane	2	1	50%	0.00095	0.004975	0.00095	0.00095	0.018
Methoxychlor	2	1	50%	0.052	0.071	0.052	0.052	0.18
4,4'-DDT	2	1	50%	0.046	0.03375	0.046	0.046	0.043
4,4'-DDE	2	1	50%	0.0043	0.0114	0.0043	0.0043	0.037
Dieldrin	2	1	50%	0.048	0.0375	0.048	0.048	0.054
Dibenzofuran	2	1	50%	0.062	0.956	0.062	0.062	3.7
Alpha-BHC	2	1	50%	0.018	0.0135	0.018	0.018	0.018
4,4'-DDD	2	1	50%	0.022	0.02025	0.022	0.022	0.037
Fluorene	3	1	33%	0.067	0.699	0.067	0.067	3.7
Heptachlor	2	1	50%	0.002	0.0055	0.002	0.002	0.018
2-Methylnaphthalene	3	1	33%	0.059	0.70	0.059	0.059	3.7
Carbazole	2	1	50%	0.09	0.97	0.09	0.09	3.7
Anthracene	3	2	67%	0.16	0.168	0.064	0.26	0.36
Alpha-chlordane	2	2	100%	0.035	0.035	0.009	0.061	
Total Organic Carbon	2	2	100%	43,348	43,348	33,330	53,366	
Naphthalene	3	2	67%	0.13	0.14	0.091	0.16	0.36
Endosulfan II	2	2	100%	0.0215	0.0215	0.019	0.024	
Endrin Ketone	2	2	100%	0.05	0.05	0.044	0.056	
Gamma-chlordane	2	2	100%	0.058	0.058	0.044	0.072	
Acenaphthylene	3	2	67%	0.135	0.15	0.08	0.19	0.36
Aldrin	2	2	100%	0.00415	0.00415	0.0026	0.0057	
Barium	3	3	100%	62	62	57	70	
Benzo[a]anthracene	3	3	100%	6.37	6.37	0.015	14	
Benzo[a]pyrene	3	3	100%	8.84	8.84	0.014	19	
Arsenic	3	3	100%	5.66	5.66	5	6	
Zinc	3	3	100%	91	91	74	110	
Vanadium	3	3	100%	11	11	10	11.52	
Aluminum	3	3	100%	5,654	5,654	5,263	5,900	
Benzo[b]fluoranthene	3	3	100%	11	11	0.021	22	
Manganese	3	3	100%	393	393	340	440	
Magnesium	3	3	100%	3,745	3,745	2,900	5,335	
Cyanide	4	3	75%	4.17	3.19	1.9	5.52	0.5
Mercury	3	3	100%	0.68	0.68	0.44	1.1	
Indeno[1,2,3-cd]pyrene	3	3	100%	5.17	5.17	0.007	11	
Fluoranthene	3	3	100%	8.71	8.71	0.021	19	
Lead	3	3	100%	105	105	75	150	
Iron	3	3	100%	12,868	12,868	11,604	14,000	
Copper	3	3	100%	40	40	38	42	
Benzo[k]fluoranthene	3	3	100%	2.83	2.83	0.008	8.2	
Calcium	3	3	100%	41,022	41,022	20,000	80,066	
Benzo[g,h,i]perylene	3	3	100%	5.30	5.30	0.008	11	
Pyrene	3	3	100%	9.88	9.88	0.033	22	
Nickel	3	3	100%	9.27	9.27	8.82	10	
Chrysene	3	3	100%	6.37	6.37	0.016	14	
Phenanthrene	3	3	100%	2.71	2.71	0.014	7.9	
Chromium	3	3	100%	8.83	8.83	7.50	10	

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Summary of Detected Analytes**

Table 5-1e. AREA 2 Subsurface Soil

NAME	Number Analyzed	Number Detected	Frequency of Detection	Mean of Detections mg/kg	Mean with Non-detects mg/kg	Minimum Detection mg/kg	Maximum Detection mg/kg	Maximum Detection Limit mg/kg
2,4-Dimethylphenol	6	1	17%	0.081	63	0.081	0.081	670
2-Butanone	6	4	67%	0.529	6.77	0.043	1.9	70
2-Methylnaphthalene	30	16	53%	36	36	0.004	230	670
2-Methylphenol	6	1	17%	0.047	63	0.047	0.047	670
4,4'-DDE	6	1	17%	0.029	0.069	0.029	0.029	0.68
4,4'-DDT	6	2	33%	0.766	0.263	0.032	1.5	0.047
4-Methylphenol	6	1	17%	0.097	63	0.097	0.097	670
Acenaphthene	30	12	40%	65	44	0.016	450	670
Acenaphthylene	30	11	37%	6	15	0.004	57	670
Acetone	6	1	17%	4.2	2.48	4.2	4.2	7.6
Aldrin	6	1	17%	0.005	0.033	0.005	0.005	0.34
Alpha-chlordane	6	1	17%	0.007	0.033	0.007	0.007	0.34
Aluminum	7	7	100%	2,501	2,501	390	4,800	
Anthracene	30	18	60%	46	28	0.007	340	0.4
Arsenic	7	7	100%	24	24	2	86	
Barium	7	7	100%	71	71	47	110	
Benzene	30	7	23%	0.104	1.55	0.002	0.47	70
Benzo[a]anthracene	30	19	63%	85	54	0.016	950	0.4
Benzo[a]pyrene	30	19	63%	74	47	0.013	770	0.4
Benzo[b]fluoranthene	30	19	63%	88	56	0.016	910	0.4
Benzo[g,h,i]perylene	30	17	57%	45	26	0.006	440	16
Benzo[k]fluoranthene	30	17	57%	40	23	0.005	410	16
Calcium	7	7	100%	9,130	9,130	1,900	22,000	
Carbazole	6	4	67%	14	66	0.021	47	670
Chromium	7	7	100%	9.67	9.67	4	22	
Chrysene	30	19	63%	81	51	0.014	900	0.4
Copper	7	7	100%	30	30	5	80	
Cyanide	24	11	46%	375	172	0.7	2,104	0.7
Dibenz[a,h]anthracene	30	1	3%	19	20	19	19	670
Dibenzofuran	6	4	67%	58	96	0.023	160	670
Dieldrin	6	2	33%	0.05	0.08	0.047	0.053	0.68
Endosulfan II	6	2	33%	0.01	0.13	0.0059	0.021	1.4
Endosulfan sulfate	6	1	17%	0.034	0.069	0.034	0.034	0.68
Endrin	6	1	17%	0.02	0.067	0.02	0.02	0.68
Ethylbenzene	30	10	33%	1.46	0.52	0.013	7.1	1.8
Fluoranthene	30	25	83%	196	163	0.004	1800	0.4
Fluorene	30	17	57%	27	27	0.004	180	670
Gamma-chlordane	6	1	17%	0.006	0.049	0.0062	0.0062	0.34
Indeno[1,2,3-cd]pyrene	30	17	57%	42	24	0.006	430	16
Iron	7	7	100%	39,146	39,146	4,500	128,521	
Lead	7	7	100%	220	220	1.1	590	
Magnesium	7	5	71%	2,920	2,143	400	6,400	409
Manganese	7	7	100%	211	211	60	430	
Mercury	7	2	29%	0.69	0.23	0.69	0.7	0.1
Methoxychlor	6	1	17%	4.7	0.98	4.7	4.7	1.9
Methylene chloride	6	1	17%	0.91	1.93	0.91	0.91	7.6
Naphthalene	30	18	60%	161	108	0.019	1,600	670
Phenanthrene	30	24	80%	131	105	0.004	970	0.4
Pyrene	30	24	80%	201	161	0.005	1,600	0.4
Selenium	7	2	29%	12	3.87	12	13	1
Toluene	30	7	23%	0.039	1.49	0.002	0.15	70
Total Organic Carbon	6	6	100%	57,904	57,904	2,277	285,965	
Vanadium	7	2	29%	80	26	70	89	10
Xylene (total)	30	7	23%	5.29	1.45	0.012	21	7
Zinc	6	6	100%	51	51	14	115	

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Summary of Detected Analytes**

Table 5-1f. AREA 2 Ground Water

NAME	Number Analyzed	Number Detected	Frequency of Detection	Mean of Detections	Mean with Non-detects	Minimum Detection	Maximum Detection	Maximum Detection Limit
Inorganics mg/L								
Aluminum	9	9	100%	87	87	27	143	
Arsenic	9	9	100%	0.04	0.04	0.015	0.072	
Barium	9	9	100%	1.89	1.89	0.5	3	
Beryllium	9	4	44%	0.00585	0.003989	0.005	0.0064	0.005
Cadmium	9	1	11%	0.007	0.003	0.007	0.007	0.005
Calcium	9	9	100%	332	332	140	500	
Chromium	9	9	100%	0.16	0.16	0.05	0.29	
Cobalt	9	4	44%	0.08	0.05	0.06	0.09	0.05
Copper	9	9	100%	0.22	0.22	0.06	0.44	
Cyanide	9	9	100%	1.91	1.91	0.22	5.3	
Iron	9	9	100%	185	185	72	351	
Lead	9	9	100%	0.177	0.177	0.045	0.377	
Magnesium	9	9	100%	73	73	27	110	
Manganese	9	9	100%	5.79	5.79	3.3	7.99	
Mercury	9	5	56%	0.00046	0.0003	0.0002	0.0007	0.0002
Nickel	9	8	89%	0.13	0.12	0.06	0.2	0.04
Potassium	9	9	100%	15	15	6	22	
Selenium	9	7	78%	0.01	0.01	0.005	0.0155	0.005
Sodium	9	9	100%	50	50	28	75	
Vanadium	9	8	89%	0.16	0.14	0.07	0.24	0.05
Zinc	9	9	100%	0.34	0.34	0.11	0.61	
Organics ug/L								
2,4-Dimethylphenol	8	4	50%	74	40	1	150	11
2,4-Dinitrotoluene	8	1	13%	1	13	1	1	100
2-Methylnaphthalene	13	10	77%	128	99	3	530	10
2-Methylphenol	8	1	13%	1	10	1	1	100
4,4'-DDE	8	3	38%	0.01	0.04	0.0065	0.022	0.11
4,4'-DDT	8	2	25%	0.02	0.05	0.012	0.032	0.11
4-Methylphenol	8	3	38%	10	13	1.5	23	100
Acenaphthene	13	10	77%	160	128	4	460	100
Acenaphthylene	13	11	85%	35	31	1	250	10
Aldrin	8	2	25%	0.0056	0.02	0.0032	0.008	0.054
Anthracene	13	11	85%	40	38	1	210	100
Benzene	13	9	69%	253	176	0.77	980	10
Benzo[a]anthracene	13	7	54%	39	30	2.5	180	100
Benzo[a]pyrene	13	6	46%	44	30	4.3	180	100
Benzo[b]fluoranthene	13	7	54%	43	32	1.6	200	100
Benzo[g,h,i]perylene	13	6	46%	24	20	2	100	100
Benzo[k]fluoranthene	13	6	46%	18	18	2	72	100
Carbazole	8	8	100%	25	25	1	73	
Chrysene	13	8	62%	32	26	2.8	160	100
Dibenzofuran	8	7	88%	49	49	3	120	100
Dieldrin	8	3	38%	0.01	0.03	0.0074	0.015	0.11
Endosulfan I	8	1	13%	0.03	0.03	0.033	0.033	0.059
Endosulfan II	8	4	50%	0.05	0.05	0.012	0.099	0.12
Endosulfan sulfate	8	1	13%	0.05	0.05	0.045	0.045	0.12
Endrin Aldehyde	8	1	13%	0.0042	0.05	0.0042	0.0042	0.12
Endrin Ketone	8	2	25%	0.0215	0.046	0.02	0.023	0.11
Ethylbenzene	13	9	69%	246	172	20	590	10
Fluoranthene	13	11	85%	78	70	2	430	100
Fluorene	13	11	85%	82	74	14	250	100
Heptachlor	8	1	13%	0.011	0.02	0.011	0.011	0.054
Heptachlor epoxide	8	2	25%	0.03	0.03	0.0065	0.051	0.059
Indeno(1,2,3-cd)pyrene	13	6	46%	21	19	2.1	88	100
Lindane	8	1	13%	0.0078	0.024475	0.0078	0.0078	0.059
Methoxychlor	8	1	13%	0.22	0.26	0.22	0.22	0.59
Methylene chloride	8	1	13%	0.88	8.55	0.88	0.88	50
Naphthalene	13	11	85%	1,842	1,559	1	4,800	10
Phenanthrene	13	11	85%	164	143	17	680	100
Phenol	8	2	25%	17	5	9.6	24	10
Pyrene	13	11	85%	75	68	2	440	100
Styrene	8	1	13%	7.3	8.41	7.3	7.3	50
Toluene	13	9	69%	42	30	1.4	93	10
Xylene (total)	13	9	69%	371	258	51	800	10
bis(2-Ethylhexyl)phthalate	8	2	25%	1.3	12.45	1.2	1.4	100

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
COPC Selection**

Table 5-2a. AREA 1 Surface Soil

NAME	Background Concentration mg/kg	Max. Detected Concentration mg/Kg	Sample Location	Residential Soil RBC mg/Kg	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC mg/Kg	Exceeds Background? yes/no	Exceeds RBC? yes/no	COPC? yes/no	Notes	Selected as Volatilization and Migration COPC?
Aluminum	6000	9,600	SS-1	78,000	N	7800	yes	yes	yes		
Arsenic	4.00	9.0	SS-2	0.43	C	0.43	yes	yes	yes		
Benzo[a]anthracene	0.018	3.0	SS-1	0.87	C	0.87	yes	yes	yes		
Benzo[a]pyrene	0.017	4.0	SS-1	0.087	C	0.087	yes	yes	yes		
Benzo[b]fluoranthene	0.027	50	SS-2	0.87	C	0.87	yes	yes	yes		
Cyanide	NA	810	SS-2	1,600	N	160	yes	yes	yes		
Indeno[1,2,3-cd]pyrene	0.006	4.4	SS-1	0.87	C	0.87	yes	yes	yes		
Iron	11000	24,000	SS-2	23,000	N	2300	yes	yes	yes		
Manganese	310	510	SS-1	1,600	N	160	yes	yes	yes		
1,1,1-Trichloroethane	NA	0.001	SS-2	1,600	C	1600	yes	no	no		yes, VOC
2-Methylnaphthalene	NA	0.013	SS-2	3,100	N	310	yes	no	no		
4,4'-DDD	0.0011	0.049	SS-2	2.7	C	2.7	yes	no	no		
4,4'-DDE	0.0013	0.006	SS-3	1.9	C	1.9	yes	no	no		
Acenaphthene	NA	0.005	SS-1	4,700	N	470	yes	no	no		
Acenaphthylene	NA	0.410	SS-2	2,300	N	230	yes	no	no	as pyrene	yes, SVOC v.p. >0.01 Torr
Alpha-chlordane	0.0011	0.002	SS-1	18	C	18	yes	no	no	as chlordane - not source related	
Anthracene		0.039	SS-1	23,000	N	2300	yes	no	no		
Benzene	0.0037	0.002	SS-2	22	C	22	no	no	no		yes, VOC
Benzo[g,h,i]perylene	NA	4.7	SS-1	2,300	N	230	yes	no	no	as pyrene	
Benzo[k]fluoranthene	NA	2.1	SS-2	8.7	C	8.7	yes	no	no		
Calcium	1800	4,800	SS-1	NA	NA	NA	yes	no	no	essential nutrient	
Carbazole	NA	0.009	SS-1	32		32	yes	no	no		
Chromium	8	13	SS-1	78,000	N	7800	yes	no	no		
Chrysene	0.02	4.5	SS-1	87	C	87	yes	no	no		
Copper	22	62	SS-2	3,100	N	310	yes	no	no		
Di-n-butyl phthalate	0.009	0.015	SS-3	7,800	N	780	yes	no	no		
Dibenzofuran	NA	0.007	SS-2	310	N	31	yes	no	no		
Endosulfan II	0.00065	0.013	SS-2	4,700	N	470	yes	no	no	as endosulfan - not source related	
Endosulfan sulfate	NA	0.042	SS-2	4,700	N	470	yes	no	no	as endosulfan - not source related	
Endrin	NA	0.046	SS-1	23	N	2.3	yes	no	no		
Endrin Ketone	0.0025	0.044	SS-2	23	N	2.3	yes	no	no	as endrin - not source related	
Fluoranthene	0.41	5.7	SS-1	3,100	N	310	yes	no	no		
Fluorene	NA	0.013	SS-1	3,100	N	310	yes	no	no		
Gamma-chlordane	NA	0.010	SS-1	18	N	1.8	yes	no	no	as chlordane - not source related	
Lead	36	120	SS-2	400	N	400	yes	no	no	action level	
Lindane	NA	0.003	SS-2	0.49	N	0.049	yes	no	no		
Magnesium	1700	2,400	SS-1	NA	NA	NA	yes	no	no	essential nutrient	
Mercury	0.2	0.700	SS-2	23	N	2.3	yes	no	no		
Methoxychlor	0.0056	0.048	SS-2	390	N	39	yes	no	no		
Naphthalene	NA	0.035	SS-2	3,100	N	310	yes	no	no		yes, SVOC v.p. >0.01 Torr
Nickel	10	10	SS-2	1,600	N	160	yes	no	no		
Phenanthrene	0.02	2.1	SS-1	2,300	N	230	yes	no	no	as pyrene	
Pyrene	0.033	8.2	SS-1	2,300	N	230	yes	no	no		
Selenium	NA	3.0	SS-2	390	N	39	yes	no	no		
Toluene	0.0026	0.001	SS-2	16,000	N	1600	no	no	no		yes, VOC
Vanadium	10	20	SS-1	550	N	55	yes	no	no		
Xylene (total)	0.00077	0.001	SS-2	160,000	N	16000	no	no	no		yes, VOC
Zinc	120	110	SS-3	23,000	N	2300	no	no	no		

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects. (The lead action level was not adjusted.)

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Torr. (Based on MA DEP MCP 19

action level - RBC is not available, therefore level was compared to the default action level

essential nutrient - element is an essential nutrient and is not considered a human health risk

not source related - pesticide which may exceed the RBC level, yet is unrelated to the MGP source

as chlordane - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endosulfan - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endrin - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as pyrene - RBC is not available concentration is, therefore, compared to RBC for analogous compound

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
COPC Selection**

Table 5-2b. AREA 1 Subsurface Soil

NAME	Max. Detected Concentration mg/Kg	Sample Location	Residential Soil RBC mg/Kg	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC mg/Kg	Exceeds RBC? yes/no	COPC? yes/no	Notes	Selected as Volatilization and Migration COPC?
Arsenic	4.0	MW-1	0.430	C	0.43	yes	yes		
Benzo[a]anthracene	3.6	TP-3	0.870	C	0.87	yes	yes		
Benzo[a]pyrene	3.8	TP-3	0.087	C	0.087	yes	yes		
Benzo[b]fluoranthene	62	TP-3	0.870	C	0.87	yes	yes		
Indeno[1,2,3-cd]pyrene	3.4	TP-3	0.870	C	0.87	yes	yes		
Iron	17,000	MW-1	23,000	N	2300	yes	yes		
Manganese	500	MW-2	1,600	N	160	yes	yes		
Zinc	29	MW-1	23	N	2.3	yes	yes		
4,4'-DDE	4.85E-04	MW-2	1.9	C	1.9	no	no		
Acenaphthene	3.5	TP-1	4,700	N	470	no	no		
Acenaphthylene	0.810	TP-3	23,000	N	2300	no	no	as pyrene	yes, SVOC v.p. >0.01 Torr
Aluminum	6,500	MW-1	78,000	N	7800	no	no		
Anthracene	3.4	TP-1	23,000	N	2300	no	no		
Barium	140	MW-1	5,500	N	550	no	no		
Benzo[g,h,i]perylene	3.3	TP-3	23,000	N	2300	no	no	as pyrene	
Benzo[k]fluoranthene	2.2	TP-3	8.7	C	8.7	no	no		
Calcium	6,100	MW-2	NA	NA	NA	no	no	essential nutrient	
Chromium	12	MW-1	78,000	N	7800	no	no		
Chrysene	4.4	TP-3	87	C	87	no	no		
Copper	15	MW-1	3,100	N	310	no	no		
Cyanide	22	TP-3	1,600	N	160	no	no		
Di-n-butyl phthalate	0.015	MW-2	7,800	N	780	no	no		
Dibenz[a,h]anthracene	0.021	TP-1	0.087	C	0.087	no	no		
Ethylbenzene	3.3	TP-1	7,800	N	780	no	no		yes, VOC
Fluoranthene	73	TP-3	3,100	N	310	no	no		
Fluorene	3.3	TP-1	3,100	N	310	no	no		
Lead	4.0	MW-1	400	N	400	no	no	action level	
Magnesium	3,800	MW-1	NA	NA	NA	no	no	essential nutrient	
Naphthalene	0.200	TP-1	3,100	N	310	no	no		yes, SVOC v.p. >0.01 Torr
Nickel	10	MW-1	1,600	N	160	no	no		
Phenanthrene	14	TP-1	23,000	N	2300	no	no	as pyrene	
Tetrachloroethene	0.003	MW-1	12	C	12	no	no		yes, VOC
Vanadium	10	MW-1	550	N	55	no	no		

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects. (The lead action level was not adjusted.)

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Torr. (Based on MA DEP MCP action level - RBC is not available, therefore level was compared to the default action level)

essential nutrient - element is an essential nutrient and is not considered a human health risk

not source related - pesticide which may exceed the RBC level, yet is unrelated to the MGP source

as chlordane - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endosulfan - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endrin - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as pyrene - RBC is not available concentration is, therefore, compared to RBC for analogous compound

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
COPC Selection**

Table 5-2c. AREA 1 Ground Water

NAME	Max. Detected Concentration ug/L	Sample Location	Tap Water RBC ug/L	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC ug/L	Exceeds RBC? yes/no	COPC? yes/no	Notes	Selected as Volatilization and Migration COPC?
Aluminum	170,000	MW-2	37,000	N	3700	yes	yes		
Aroclor 1242	1.4	MW-1	0.033	C	0.033	yes	yes		
Arsenic	100	MW-2	0.045	C	0.045	yes	yes		
Barium	4,900	MW-2	2,600	N	260	yes	yes		
Beryllium	8.0	MW-2	73	N	7.3	yes	yes		
Cadmium	31	MW-2	18	N	1.8	yes	yes		
Copper	650	MW-2	1,500	N	150	yes	yes		
Cyanide	601	MW-1	730	N	73	yes	yes		
Iron	320,000	MW-2	11,000	N	1100	yes	yes		
Lead	260	MW-2	15	N	15	yes	yes	action level	
Manganese	15,000	MW-2	730	N	73	yes	yes		
Mercury	2.1	MW-2	11	N	1.1	yes	yes	10/97	
Nickel	270	MW-2	730	N	73	yes	yes		
Vanadium	270	MW-2	260	N	26	yes	yes		
4,4'-DDT	0.004	MW-2	0.20	C	0.20	no	no		
Alpha-BHC	0.007	MW-2	0.011	C	0.011	no	no		
Calcium	570,000	MW-2	NA	NA	NA	no	no	essential nutrient	
Chromium	350	MW-2	37,000	N	3,700	no	no		
Cobalt	130	MW-2	2,200	N	220	no	no		
Endosulfan II	0.003	MW-2	220	N	22	no	no	as endosulfan - not source related	
Heptachlor	0.009	MW-1	0.002	C	0.0023	yes	no	not source related	
Heptachlor epoxide	0.007	MW-1	0.0012	C	0.0012	yes	no	not source related	
Magnesium	140,000	MW-2	NA	N	0	no	no	essential nutrient	
Potassium	32,000	MW-2	NA	NA	NA	no	no	essential nutrient	
Pyrene	2.1	MW-2	1,100	N	110	no	no		
Selenium	7.0	MW-2	180	N	18	no	no		
Sodium	84,000	MW-2	NA	NA	NA	no	no	essential nutrient	

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects. (The lead action level was not adjusted.)

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Torr. (Based on MA DEP MCP

action level - RBC is not available, therefore level was compared to the default action level

essential nutrient - element is an essential nutrient and is not considered a human health risk

not source related - pesticide which may exceed the RBC level, yet is unrelated to the MGP source

as endosulfan - RBC is not available concentration is, therefore, compared to RBC for analogous compound

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
COPC Selection**

Table 5-2d. AREA 2 Surface Soil

NAME	Background Concentration mg/kg	Max. Detected Concentration mg/Kg	Sample Location	Residential Soil RBC mg/Kg	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC mg/Kg	Exceeds Background? yes/no	Exceeds RBC? yes/no	COPC? yes/no	Notes	Selected as Volatilization and Migration COPC?
Arsenic	4.00	6.0	SS-4	0.43	C	0.43	yes	yes	yes		
Benzo[a]anthracene	0.018	14	SS-4	0.870	C	0.87	yes	yes	yes		
Benzo[a]pyrene	0.017	19	SS-4	0.087	C	0.087	yes	yes	yes		
Benzo[b]fluoranthene	0.027	22	SS-4	0.870	C	0.87	yes	yes	yes		
Indeno[1,2,3-cd]pyrene	0.006	11	SS-4	0.870	C	0.87	yes	yes	yes		
Iron	11000	14,000	SS-4	23,000	N	2300	yes	yes	yes		
Manganese	310	440	SS-4	1,600	N	160	yes	yes	yes		
2-Methylnaphthalene	NA	0.059	SS-4	3,100	N	310	yes	no	no		
4,4'-DDD	0.0011	0.022	SS-4	2.7	C	2.7	yes	no	no		
4,4'-DDE	0.0013	0.004	SS-4	1.9	C	1.9	yes	no	no		
4,4'-DDT	0.0017	0.046	SS-4	1.9	C	1.9	yes	no	no		
Acenaphthylene	NA	0.190	SS-4	2,300	N	230	yes	no	no	as pyrene	yes, SVOC v.p. >0.01 Torr
Aldrin	NA	0.006	SS-4	0.038	C	0.038	yes	no	no		
Alpha-BHC	NA	0.018	SS-4	0.100	C	0.1	yes	no	no		
Alpha-chlordane	0.0011	0.061	SS-4	0.490	C	0.49	yes	no	no	as chlordane - not source related	
Aluminum	6000	5,900	SS-4	78,000	N	7800	no	no	no		
Anthracene	NA	0.260	SS-4	23,000	N	2300	yes	no	no		
Barium	60	70	SS-4	5,500	N	550	yes	no	no		
Benzo[g,h,i]perylene	0.018	11	SS-4	2,300	N	230	yes	no	no	as pyrene	
Calcium	1800	80,066	SS-4	NA	NA	NA	yes	no	no	essential nutrient	
Carbazole	NA	0.090	SS-4	32		32	yes	no	no		
Chromium	8	10	SS-4	78,000	N	7800	yes	no	no		
Copper	22	42	SS-4	3,100	N	310	yes	no	no		
Cyanide	NA	5.5	SS-4	1,600	N	160	yes	no	no		
Dibenzofuran	NA	0.062	SS-4	310	N	31	yes	no	no		
Dieldrin	NA	0.048	SS-4	0.040	N	0.004	yes	yes	no	not source related	
Endosulfan II	0.00065	0.024	SS-4	470	N	47	yes	no	no	as endosulfan - not source related	
Endrin Ketone	0.0025	0.056	SS-4	23	N	2.3	yes	no	no	as endrin - not source related	
Fluoranthene	0.41	19	SS-4	3,100	N	310	yes	no	no		
Fluorene	NA	0.067	SS-4	3,100	N	310	yes	no	no		
Gamma-chlordane	NA	0.072	SS-4	0.490	N	0.049	yes	yes	no	as chlordane - not source related	
Heptachlor	NA	0.002	SS-4	0.140	N	0.014	yes	no	no		
Lindane	NA	0.001	SS-4	0.490	C	0.49	yes	no	no		
Lead	36	150	SS-4	400	N	400	yes	no	no	action level	
Magnesium	1700	5,335	SS-4	NA	NA	NA	yes	no	no	essential nutrient	
Mercury	0.2	1.1	SS-4	23	N	2.3	yes	no	no		
Methoxychlor	0.0056	0.052	SS-4	390	N	39	yes	no	no		
Naphthalene	NA	0.160	SS-4	3,100	N	310	yes	no	no		yes, SVOC v.p. >0.01 Torr
Nickel	10	10	SS-4	1,600	N	160	yes	no	no		
Phenanthrene	0.02	7.9	SS-4	2,300	N	230	yes	no	no	as pyrene	
Pyrene	0.033	22	SS-4	2,300	N	230	yes	no	no		
Vanadium	10	12	SS-4	550	N	55	yes	no	no		
Zinc	120	110	SS-4	23,000	N	2300	no	no	no		

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects. (The lead action level was not adjusted.)

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Torr. (Based on MA DEP MCP

action level - RBC is not available, therefore level was compared to the default action level

essential nutrient - element is an essential nutrient and is not considered a human health risk

not source related - pesticide which may exceed the RBC level, yet is unrelated to the MGP source

as chlordane - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endosulfan - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endrin - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as pyrene - RBC is not available concentration is, therefore, compared to RBC for analogous compound

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
COPC Selection**

Table 5-2e. AREA 2 Subsurface Soil

NAME	Max. Detected Concentration mg/Kg	Sample Location	Residential Soil RBC mg/Kg	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC mg/Kg	Exceeds RBC? yes/no	COPC? yes/no	Notes	Selected as Volatilization and Migration COPC?
Arsenic	86	MW-4	0.430	C	0.43	yes	yes		
Benzo[a]anthracene	950	MW-3	0.870	C	0.87	yes	yes		
Benzo[a]pyrene	770	MW-3	0.087	C	0.087	yes	yes		
Benzo[b]fluoranthene	910	MW-3	0.870	C	0.87	yes	yes		
Benzo[k]fluoranthene	410	MW-3	8.70	C	8.7	yes	yes		
Chrysene	900	MW-3	87	C	87	yes	yes		
Cyanide	2,104	MW-4	1,600	N	160	yes	yes		
Dibenz[a,h]anthracene	19	MW-6	0.087	C	0.087	yes	yes		
Fluoranthene	1,800	MW-3	3,100	N	310	yes	yes		
Indeno[1,2,3-cd]pyrene	430	MW-3	0.870	C	0.87	yes	yes		
Iron	128,521	MW-4	23,000	N	2300	yes	yes		
Lead	590	MW-4	400	N	400	yes	yes		
Manganese	430	PZ-1	1,600	N	160	yes	yes		
Naphthalene	1,600	MW-3	3,100	N	310	yes	yes		yes, SVOC v.p. >0.01 Torr
Pyrene	1,600	MW-3	2,300	N	230	yes	yes		
Vanadium	89	MW-4	550	N	55	yes	yes		
2,4-Dimethylphenol	0.081	MW-5	1,600	N	160	no	no		
2-Butanone (MEK)	1.90	MW-4	47,000	N	4700	no	no		yes, VOC
2-Methylnaphthalene	230	MW-3	3,100	N	310	no	no		
2-Methylphenol	0.047	MW-5	3,900	N	390	no	no		
4,4'-DDE	0.029	SB-1 DUP	1,900	C	1.9	no	no		
4,4'-DDT	1.50	MW-4	1,900	C	1.9	no	no		
4-Methylphenol	0.097000	MW-5	390	N	39	no	no		
Acenaphthene	450	MW-3	4,700	N	470	no	no		
Acenaphthylene	57	MW-6	23,000	N	2300	no	no	as pyrene	yes, SVOC v.p. >0.01 Torr
Acetone	4.20	SB-1 DUP	7,800	N	780	no	no		yes, VOC
Aldrin	0.005	SB-1 DUP	0.038	C	0.038	no	no	not source related	
Alpha-chlordane	0.007	SB-1 DUP	18	C	18	no	no	as chlordane - not source related	
Aluminum	4,800	PZ-1	78,000	N	7800	no	no		
Anthracene	340	MW-3	23,000	N	2300	no	no		
Barium	110	SB-1 DUP	5,500	N	550	no	no		
Benzene	0.47	MW-6	22	C	22	no	no		
Benzo[g,h,i]perylene	440	MW-3	23,000	C	23000.00	no	no	as pyrene	
Calcium	22,000	PZ-1	NA	NA	NA	no	no	essential nutrient	
Carbazole	47	MW-3	32		32	yes	no	not source related	
Chromium	22	MW-4	78,000	N	7800	no	no		
Copper	80	MW-4	3,100	N	310	no	no		
Dibenzofuran	160	MW-3	310	N	31	yes	no	not source related	
Dieldrin	0.053	SB-1	0.040	N	0.004	yes	no	not source related	
Endosulfan II	0.021	SB-1 DUP	4,700	N	470	no	no	as endosulfan - not source related	
Endosulfan sulfate	0.034	SB-1 DUP	4,700	N	470	no	no	as endosulfan - not source related	
Endrin	0.020	SB-1 DUP	23	N	2.3	no	no		
Ethylbenzene	7.10	MW-4	7,800	N	780	no	no		yes, VOC
Fluorene	180	MW-3	3,100	N	310	no	no		
Gamma-chlordane	0.006	MW-5	18	C	18	no	no	as chlordane - not source related	
Magnesium	6,400	PZ-1	NA	NA	NA	no	no	essential nutrient	
Mercury	0.700	MW-4	23	N	2.3	no	no		
Methoxychlor	4.70	MW-4	390	N	39	no	no		
Methylene chloride	0.910	SB-1 DUP	85	C	85	no	no		yes, VOC
Phenanthrene	970	MW-3	23,000	N	2300	no	no	as pyrene	
Selenium	13	MW-4	390	N	39	no	no		
Toluene	0.150	MW-6	16,000	N	1600	no	no		yes, VOC
Xylene (total)	21	SB-1	160,000	N	16000	no	no		yes, VOC
Zinc	115	MW-4	23,000	N	2300	no	no		

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects. (The lead action level was not adjusted.)

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Torr. (Based on MA DEP MCP action level - RBC is not available, therefore level was compared to the default action level

essential nutrient - element is an essential nutrient and is not considered a human health risk

not source related - pesticide which may exceed the RBC level, yet is unrelated to the MGP source

as chlordane - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endosulfan - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as pyrene - RBC is not available concentration is, therefore, compared to RBC for analogous compound

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
COPC Selection**

Table 5-2f. AREA 2 Ground Water

NAME	Max. Detected Concentration ug/L	Sample Location	Tap Water RBC ug/L	Cancer or Non-cancer Effects	Adjusted RBC ug/L	Exceeds RBC? yes/no	COPC? yes/no	Notes	Selected as Volatilization and Migration COPC?
2,4-Dimethylphenol	150	MW-4	730	N	73	yes	yes		
2-Methylnaphthalene	530	MW-6	1,500	N	150	yes	yes		
4-Methylphenol	23	MW-5	180	N	18	yes	yes		
Acenaphthene	460	MW-3	2,200	N	220	yes	yes		
Acenaphthylene	250	MW-6	1,100	N	110	yes	yes	as pyrene	yes, SVOC v.p. >0.01 Torr
Aluminum	142,700	MW-4	37,000	N	3700	yes	yes		
Arsenic	0.072	MW-4	0.045	C	0.045	yes	yes		
Barium	3,000	MW-4	2,600	N	260	yes	yes		
Benzene	980	MW-4	0.360	C	0.36	yes	yes		yes, VOC
Benzo[a]anthracene	180	MW-6	0.092	C	0.092	yes	yes		
Benzo[a]pyrene	180	MW-6	0.009	C	0.0092	yes	yes		
Benzo[b]fluoranthene	200	MW-6	0.092	C	0.092	yes	yes		
Benzo[k]fluoranthene	72	MW-6	0.920	C	0.92	yes	yes		
Cadmium	7	MW-4	18	N	1.8	yes	yes		
Chrysene	160	MW-6	9.2	C	9.2	yes	yes		
Copper	440	MW-4	1,500	N	150	yes	yes		
Cyanide	5,300	MW-4	730	N	73	yes	yes		
Ethylbenzene	590	MW-4	1,300	N	130	yes	yes		yes, VOC
Fluoranthene	430	MW-6	1,500	N	150	yes	yes		
Fluorene	250	MW-6	1,500	N	150	yes	yes		
Iron	350,540	MW-4	11,000	N	1100	yes	yes		
Lead	377	MW-4	15	N	15	yes	yes	action level	
Manganese	7,987	MW-4	730	N	73	yes	yes		
Naphthalene	4,800	MW-6	1,500	N	150	yes	yes		yes, SVOC v.p. >0.01 Torr
Nickel	200	MW-4	730	N	73	yes	yes		
Phenanthrene	680	MW-6	1,100	N	110	yes	yes	as pyrene	
Pyrene	440	MW-6	1,100	N	110	yes	yes		
Toluene	93	MW-4	750	N	75	yes	yes		
Vanadium	240	MW-4	260	N	26	yes	yes		
2,4-Dinitrotoluene	1.0	MW-4	73	N	7.3	no	no		
2-Methylphenol	1.0	MW-4	1,800	N	180	no	no		
4,4'-DDE	0.022	MW-3 DUP	0.200	C	0.2	no	no		
4,4'-DDT	0.032	MW-5	0.200	C	0.2	no	no		
Anthracene	210	MW-6	11,000	N	1100	no	no		
Benzo[g,h,i]perylene	100	MW-6	1,100	C	1100	no	no	as pyrene	
Beryllium	6	MW-4	73	N	7.3	no	no		
Calcium	500,000	MW-3	NA	NA	NA	no	no	essential nutrient	
Carbazole	73	MW-3	3.3		3.3	yes	no	not source related	
Chromium	290	MW-4	37,000	N	3700	no	no		
Cobalt	90	MW-4	2,200	N	220	no	no		
Dibenzofuran	120	MW-3	24	N	2.4	yes	no	not source related	
Dieldrin	0.015	MW-3	0.004	C	0.0042	yes	no	not source related	
Endosulfan I	0.033	MW-4	220	N	22	no	no	as endosulfan - not source related	
Endosulfan II	0.099	MW-4	220	N	22	no	no	as endosulfan - not source related	
Endosulfan sulfate	0.045	MW-3 DUP	220	N	22	no	no	as endosulfan - not source related	
Endrin Aldehyde	0.004	MW-3 DUP	11	N	1.1	no	no	as endrin - not source related	
Endrin Ketone	0.023	MW-3 DUP	11	N	1.1	no	no	as endrin - not source related	
Heptachlor	0.011	MW-3 DUP	0.002	C	0.0023	yes	no	not source related	
Heptachlor epoxide	0.051	MW-4	0.001	C	0.0012	yes	no	not source related	
Lindane	0.008	MW-3 DUP	0.052	C	0.052	no	no		
Magnesium	110,000	MW-3	NA	NA	NA	no	no	essential nutrient	
Mercury	1	MW-4	11	N	1.1	no	no		
Methoxychlor	0.220	MW-4	180	N	18	no	no		
Methylene chloride	0.880	MW-3 DUP	4.1	C	4.1	no	no		yes, VOC
Phenol	24	MW-4	22,000	N	2200	no	no		yes, SVOC v.p. >0.01 Torr
Potassium	22,000	MW-4	NA	NA	NA	no	no	essential nutrient	
Selenium	16	MW-4	180	N	18	no	no		
Sodium	75,260	MW-4	NA	NA	NA	no	no	essential nutrient	
Styrene	7.3	MW-5	1,600	N	160	no	no		yes, VOC
Xylene (total)	800	MW-5	12,000	N	1200	no	no		yes, VOC
Zinc	610	MW-4	11,000	N	1100	no	no		
bis(2-Ethylhexyl)phthalate	1.4	MW-3 DUP	4.8	C	4.8	no	no		

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects. (The lead action level was not adjusted.)

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Torr. (Based on MA DEP MCP 19

action level - RBC is not available, therefore level was compared to the default action level

essential nutrient - element is an essential nutrient and is not considered a human health risk

not source related - pesticide which may exceed the RBC level, yet is unrelated to the MGP source

as endosulfan - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as endrin - RBC is not available concentration is, therefore, compared to RBC for analogous compound

as pyrene - RBC is not available concentration is, therefore, compared to RBC for analogous compound

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Ambient Air - Initial Screening Evaluation**

Table 5-2g. AREA 1 Ambient Air COPCs

Residential Indoor Air:								
NAME	Air Concentration via Soil ug/m3	Air Concentration via Ground Water ug/m3	Screening Indoor Air Concentration ug/m3	SS, SBS or GW Media?	Ambient Air RBC ug/m3	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC ug/m3	Indoor Air Quantitative Evaluation?
1,1,1-Trichloroethane	1.98E-04	ND	1.98E-04	SS	1.00E-03	C	0.001	no
Acenaphthylene	3.63E-05	ND	3.63E-05	SBS	1.10E+01	N	1.10E+00	no
Benzene	1.28E-04	ND	1.28E-04	SS	2.20E-01	C	0.22	no
Ethylbenzene	1.24E-01	ND	1.24E-01	SBS	1.10E+03	N	110	no
Tetrachloroethene	1.96E-04	ND	1.96E-04	SBS	3.10E+00	C	3.1	no
Toluene	5.85E-05	ND	5.85E-05	SS	4.20E+02	N	42	no
Xylene (total)	2.11E-05	ND	2.11E-05	SS	7.30E+03	N	730	no
Excavation Outdoor Air:								
NAME	Air Concentration via Soil ug/m3	Air Concentration via Ground Water ug/m3	Screening Excavation Air Concentration ug/m3	SS, SBS or GW Media?	Ambient Air RBC ug/m3	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC ug/m3	Excavation Air Quantitative Evaluation?
1,1,1-Trichloroethane	9.46E-05	ND	9.46E-05	SS	1.00E-03	C	0.001	no
Acenaphthylene	1.6E-05	ND	1.60E-05	SBS	1.10E+01	N	1.10E+00	no
Benzene	6.56E-05	ND	6.56E-05	SS	2.20E-01	C	0.22	no
Ethylbenzene	5.44E-02	ND	5.44E-02	SBS	1.10E+03	N	110	no
Tetrachloroethene	9.05E-05	ND	9.05E-05	SBS	3.10E+00	C	3.1	no
Toluene	2.78E-05	ND	2.78E-05	SS	4.20E+02	N	42	no
Xylene (total)	9.59E-06	ND	9.59E-06	SS	7.30E+03	N	730	no

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects.

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Torr. (Based on MA DEP

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment
Ambient Air - Initial Screening Evaluation**

Table 5-2h. AREA 2 Ambient Air COPCs

Residential Indoor Air:								
NAME	Air Concentration via Soil ug/m3	Air Concentration via Ground Water ug/m3	Screening Indoor Air Concentration ug/m3	SS, SBS or GW Media?	Ambient Air RBC ug/m3	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC ug/m3	Indoor Air Quantitative Evaluation?
2-Butanone (MEK)	1.60E-04	ND	1.60E-04	SBS	1.00E+03	N	1.00E+02	no
Acenaphthylene (as pyrene)	ND	3.35E-01	3.35E-01	GW	1.10E+02	N	1.10E+01	no
Acetone	2.07E-03	ND	2.07E-03	SBS	7.80E+03	N	7.80E+02	no
Benzene	3.01E-02	6.29E+01	6.29E+01	GW	2.20E-01	C	2.20E-01	yes
Ethylbenzene	2.67E-01	5.84E+01	5.87E+01	SBS,GW	1.10E+03	N	1.10E+02	no
Methylene Chloride	2.56E-02	2.69E-02	5.25E-02	SBS,GW	3.80E+00	C	3.80E+00	no
Naphthalene	ND	2.37E+01	2.37E+01	GW	3.70E-01	N	3.70E-02	yes
Phenol	ND	1.11E-04	1.11E-04	GW	2.20E+03	N	2.20E+02	no
Styrene	ND	3.43E-01	3.43E-01	GW	1.00E+03	N	1.00E+02	no
Toluene	8.78E-03	7.21E+00	7.22E+00	SBS,GW	4.20E+02	N	4.20E+01	no
Xylene (total)	4.43E-01	4.60E+01	4.64E+01	SBS,GW	7.30E+03	N	7.30E+02	no
Excavation Outdoor Air:								
NAME	Air Concentration via Soil ug/m3	Air Concentration via Ground Water ug/m3	Screening Excavation Air Concentration ug/m3	SS, SBS or GW Media?	Ambient Air RBC ug/m3	Cancer or Non-cancer Effects	Non-cancer Adjusted RBC ug/m3	Excavation Air Quantitative Evaluation?
2-Butanone (MEK)	8.06E-05	ND	8.06E-05	SBS	1.00E+03	N	1.00E+02	no
Acenaphthylene (as pyrene)	ND	1.71E-01	1.71E-01	GW	1.10E+02	N	1.10E+01	no
Acetone	1.14E-03	ND	1.14E-03	SBS	7.80E+03	N	7.80E+02	no
Benzene	6.27E-03	3.22E+01	3.22E+01	GW	2.20E-01	C	2.20E-01	yes
Ethylbenzene	8.07E-05	2.99E+01	2.99E+01	SBS	1.10E+03	N	1.10E+02	no
Methylene Chloride	1.27E-02	1.38E-02	2.65E-02	SBS,GW	3.80E+00	C	3.80E+00	no
Naphthalene	ND	1.21E+01	1.21E+01	GW	3.70E-01	N	3.70E-02	yes
Phenol	ND	5.70E-05	5.70E-05	GW	2.20E-03	N	2.20E-04	no
Styrene	ND	1.76E-01	1.76E-01	GW	1.00E+03	N	1.00E+02	no
Toluene	3.86E-04	3.69E+00	3.69E+00	SBS,GW	4.20E+02	N	4.20E+01	no
Xylene (total)	1.78E-04	2.36E+01	2.36E+01	SBS,GW	7.30E+03	N	7.30E+02	no

Notes:

RBC - USEPA Region III Risk Based Concentration (4/15/98).

Adjusted RBC - A safety factor of 0.10 was applied to any RBCs which were developed based on non-cancer effects.

Constituents selected for evaluation via the volatilization/migration pathway are the detected VOCs, and the detected SVOCs which have a vapor pressure greater than or equal to 0.01 Tor

Niagara Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Representative Exposure Point Concentrations for Soil, Ground Water, and Ambient Air

Table 5-3a. Area 1 Residential Scenario Exposure Point Concentrations

NAME	Surface Soil ug/kg
ALUMINUM	9,600
ARSENIC	9
BENZO(A)PYRENE	4
BENZO(B)FLUORANTHENE	50
BENZ(A)ANTHRACENE	3
CYANIDE (FREE)	810
INDENO(1,2,3-C,D)PYRENE	4.4
IRON	24,000
LEAD	120
MANGANESE-NONFOOD	510

Table 5-3b. Area 1 Construction Scenario Exposure Point Concentrations

NAME	Surface Soil ug/kg	Subsurface Soil ug/kg	Ground Water ug/L
ALUMINUM	9,600		170,000
AROCLO-1242			1.4
ARSENIC	9	4	100
BARIUM			4,900
BENZO(A)PYRENE	4	3.8	
BENZO(B)FLUORANTHENE	50	62	
BENZ(A)ANTHRACENE	3	3.6	
BERYLLIUM			8
CADMIUM-WATER			31
COPPER			650
CYANIDE (FREE)	810		601
INDENO(1,2,3-C,D)PYRENE	4.4	3.4	
IRON	24,000	17,000	320,000
LEAD			260
MANGANESE-NONFOOD	510	500	15,000
MERCURY (inorganic)			2.1
NICKEL			270
VANADIUM			270
ZINC		29	

Niagara Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Representative Exposure Point Concentrations for Soil, Ground Water, and Ambient Air

Table 5-3c. Area 2 Residential Scenario Exposure Point Concentrations

NAME	Surface Soil ug/kg	Indoor Air ug/m3
ARSENIC	6	
BENZENE		7.5
BENZO(A)PYRENE	19	
BENZO(B)FLUORANTHENE	22	
BENZ(A)ANTHRACENE	14	
INDENO(1,2,3-C,D)PYRENE	11	
IRON	14,000	
MANGANESE-NONFOOD	440	
NAPHTHALENE		2.6 *

* - Modeled Indoor Air (basement) concentrations were adjusted by 0.1 to reflect in-home dilution.

Table 5-3d. Area 2 Construction Scenario Exposure Point Concentrations

NAME	Surface Soil ug/kg	Subsurface Soil ug/kg	Ground Water ug/L	Ambient Air ug/m3
2,4-DIMETHYLPHENOL			150	
2-METHYLNAPHTHALENE			530	
4-METHYLPHENOL			23	
ACENAPHTHENE			460	
ACENAPHTHYLENE			250	
ALUMINUM			142000	
ARSENIC	6	86	0.072	
BARIUM			3000	
BENZENE			980	50
BENZO(A)PYRENE	19	770	180	
BENZO(B)FLUORANTHENE	22	910	200	
BENZO(K)FLUORANTHENE		410	72	
BENZ(A)ANTHRACENE	14	950	180	
CADMIUM			7	
COPPER			440	
CHRYSENE		900	160	
CYANIDE			5300	
DIBENZ(A,H)ANTHRACENE		19		
ETHYLBENZENE			590	
FLUORANTHENE		1,800	430	
FLUORENE			250	
INDENO(1,2,3-C,D)PYRENE	11	430		
IRON	14,000	128,521	350540	
LEAD		590	377	
MANGANESE-NONFOOD	440	430	7987	
NAPHTHALENE		1,600	4,800	17
NICKEL			200	
PHENANTHRENE			680	
PYRENE		1,600	440	
TOLUENE			93	
VANADIUM		89	240	

Table 5-3e. Area 2 Church Scenario Exposure Point Concentrations

NAME	Indoor Air ug/m3
BENZENE	1.26
NAPHTHALENE	11

Table 5-5. Chronic daily intake equations.

Pathway	Equation* to Calculate Chronic Daily Intake (CDI)
Incidental Ingestion of Soil or Sediment	$CDI = \frac{C_{soil} * IR * FI * EF * ED * 1E-6 \text{ kg/mg}}{BW * AT}$
Dermal Contact with Soil or Sediment	$CDI = \frac{C_{soil} * SA * ABS * AF * EF * ED * 1E-6 \text{ kg/mg}}{BW * AT}$
Incidental Ingestion of Water	$CDI = \frac{C_{sw} * IR * ET * EF * ED}{BW * AT}$
Dermal Contact with Water	$CDI = \frac{C_{sw} * SA * PC * ET * EF * ED * 0.001 \text{ l/ml}}{BW * AT}$
Inhalation of Ambient Air	$CDI = \frac{C_{air} * IR * ET * EF * ED}{BW * AT}$

* - The acronyms for the chronic daily intake parameters that are presented in this table are defined in Tables 5-6a through 5-6d.

Table 5-6a. Chronic daily intake parameter estimates - adult resident.

Pathway	Parameter	Description	Value	Justification	Reference
General	EF	Exposure Frequency (days/year)	350	Conservative Estimate	
	ED	Exposure Duration (years)	30	Average and upper 95 percentile for time spent at a given residence for the United States population	a
	BW	Body Weight (kg)	70	USEPA recommended value for adults	b
	AT	Averaging time (non-cancer) (days)	10,950	USEPA recommended value	b
	AT	Averaging Time (cancer) (days)	25,550	USEPA recommended value	b
Incidental Ingestion of, and Dermal Contact with Soils	C _{soil}	Concentration in Soil (mg/kg)	Chem. Spec.	Based on analytical data	Chem. Spec.
	IR _{soil}	Soil Ingestion Rate (mg/day)	100	USEPA recommended value	c
	SA	Skin Surface Area Available (cm ² /day)	5800	The value is 25% of the upper 95th percentile total skin surface area for adults in the United States.	d
	AF	Soil to Skin Adherence Factor (mg/cm ²)	0.82	USEPA value for Gardeners No.1	USEPA 1997 Table 6-12
	ABS	Absorption Constant (no units)	Chem. Spec.	Value obtained from literature review	Chem. Spec.
Inhalation of Ambient Air		Concentration in air (mg/m ³)	Chem./Site Specific	The air concentrations for VOCs were calculated using chemical and site specific data.	e
	IR _{air}	Inhalation rate (m ³ /hour)	1.02	The rate reflects USEPA inhalation rate for medium activities.	USEPA 1997 Table 5-2
	ET	Exposure time (hours)	16	Conservative Judgement. The value represents the time likely spent indoors during the day.	

February 10, 1999

I:\DIV76\PROJECTS\1118081\5_RPTS\HHRA\CDI-AR.TBL

Table 5-6b. Chronic daily intake parameter estimates - child resident.

Pathway	Parameter	Description	Value	Justification	Reference
General	EF	Exposure Frequency (days/year)	350	Conservative Estimate	
	ED	Exposure Duration (years)	6	Default ED for child	e
	BW	Body Weight (kg)	16	Default body weight for child	e
	AT	Averaging time (non-cancer) (days)	2190	USEPA recommended value	a
	AT	Averaging Time (cancer) (days)	25,550	USEPA recommended value	a
Incidental Ingestion of, and Dermal Contact with Soils	C _{soil}	Concentration in Soil (mg/kg)	Chem. Spec.	Based on analytical data	Chem. Spec.
	IR _{soil}	Soil Ingestion Rate (mg/day)	200	USEPA recommended value	e
	SA	Skin Surface Area Available (cm ² /day)	2300	The value is 25% of the upper 95th percentile total skin surface area for children aged 6 years or under in the United States.	d, b
	AF	Soil to Skin Adherence Factor (mg/cm ²)	0.433	The rate reflects USEPA inhalation rate for elementary children for fast activities.	USEPA 1997 Table 6-12
	ABS	Absorbtion Constant (no units)	Chem. Spec.	Value obtained from literature.	Chem. Spec.
Inhalation of Ambient Air		Concentration in air (mg/m ³)	Chem./Site Specific	The air concentrations for VOCs were calculated using chemical and site specific data.	c
	IR _{air}	Inhalation rate (m ³ /hour)	0.96	The rate reflects USEPA inhalation rate elementary children for medium activities.	USEPA 1997 Table 5-2
	ET	Exposure time (hours/day)	16	Conservative Judgement. The value represents the time likely spent indoors during the day.	

February 10, 1999

I:\DIV76\PROJECTS\1118081\5_RPTS\HHRA\CDI-CR.TBL

Table 5-6c. Chronic daily intake parameter estimates - construction worker.

Pathway	Parameter	Description	Value	Justification	Reference
General	EF	Exposure Frequency (days/year)	60	Judgement for estimated duration of construction activities	
	ED	Exposure Duration (years)	1	Judgement	
	BW	Body Weight (kg)	70	USEPA recommended value for adults	b
	AT	Averaging time (non-cancer) (days)	365		b
	AT	Averaging Time (cancer) (days)	25,550	USEPA recommended value	b
Incidental Ingestion of, and Dermal Contact with Surface/Sub-Surface Soils	C _{soil}	Concentration in Soil (mg/kg)	Chem. Spec.	Based on analytical data	Chem. Spec.
	IR _{soil}	Soil Ingestion Rate (mg/day)	480	USEPA recommended value	c
	SA	Skin Surface Area Available (cm ² /day)	5800	The value is 25% of the upper 95th percentile total skin surface area for adults in the United States.	d
	AF	Soil to Skin Adherence Factor (mg/cm ²)	0.433	Adherence Factor value for construction workers	USEPA 1997 Table 6-12
	ABS	Absorption Constant (no units)	Chem. Spec.	Value obtained from literature review	Chem. Spec.
Incidental Ingestion of, and Dermal Contact with Shallow Ground Water	C _{gw}	Concentration in Ground Water (mg/l)	Chem. Spec.	Based on analytical data	Chem. Spec.
	IR _{gw}	Ground Water Ingestion Rate (l/hour)	0.01	USEPA recommended value is 50 ml/hour for swimming. Contact with groundwater during construction activities result in less incidental ingestion relative to swimming. Thus, 10 ml/hour was used.	b
	ET	Exposure Time (hours/day)	1	Conservative estimates of possible contact time with groundwater during construction activities	
	SA	Skin Surface Area Available (cm ²)	5800	The value is 25% of the upper 95th percentile total skin surface area for adults in the United States.	d
	PC	Permeability Constant (cm/hour)	Chem. Spec.	Value obtained from literature review	d
Inhalation of Outdoor Air	C _{air}	Concentration in air (mg/m ³)	Chem./Site Specific	The air concentrations for VOCs were calculated using chemical and site specific data.	e
	IR _{dust}	Inhalation Rate (m ³ /hour)	1.68	The rate reflects average inhalation rate for fast activities.	USEPA 1997 Table 5-2
	ET	Exposure Time (hours/day)	8	The upper bound value represents the number of hours in the typical work day.	c

February 10, 1999

I:\DIV76\PROJECTS\1118081\5_RPTS\HHRA\CDI-CWA.TBL

Table 5-6d. Chronic daily intake parameter estimates - church staff workers.

Pathway	Parameter	Description	Value	Justification	Reference
General	EF	Exposure Frequency (days/year)	250	Judgment	c
	ED	Exposure Duration (years)	25	Average and upper 95th percentile for the time spent working at one location by an individual in the United States	c,f
	BW	Body Weight (kg)	70	USEPA recommended value for adults	b
	AT	Averaging time (non-cancer) (days)	9,125	USEPA recommended value	b
	AT	Averaging Time (cancer) (days)	25550	USEPA recommended value	b
Inhalation of Ambient Air		Concentration in air (mg/m ³)	Chem./Site Specific	The air concentrations for VOCs were calculated using chemical and site specific data.	e
	C _{air}				
	IR _{air}	Inhalation rate (m ³ /hour)	1.02	The average and upper bound rates reflect USEPAs recommended inhalation rates for medium activities.	USEPA 1997 Table 6-12
	ET	Exposure time (hours)	4	Judgement - The assumed number of hours per day worked by a part-time clerical worker.	

Notes and References to Table 5-6a through 5-d:

- a) U.S. EPA 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) Interim Final, EPA/540/1089/002
- b) U.S. EPA 1989, Exposure Factors Handbook, EPA/600/8-89/043
- c) U.S. EPA, 1991 Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part B) Interim Final
- d) U.S. EPA, 1992, Dermal Exposure Assessment: Principles and Applications EPA/600/8-91/011B
- e) USEPA 1991, Risk Assessment Guidance for Superfund, Supplement Guidance, Standard Default Exposure Factors.
- f) US Department of Labor Statistics, 1990
- g) U.S. EPA 1997, Exposure Factors Handbook

February 10, 1999

I:\DIV76\PROJECTS\1118081\5_RPTS\HHRA\CDI-CS.TBL

Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment

Table 5-7. Toxicological Data

Chemical	Oral RfD mg/kg-day	Oral RfD Source	Inhalation RfD mg/kg-day	Inhalation RfD Source	Confidence Level	Critical Effect	Non-cancer Notes / Basis mg/kg-day	Uncertainty / Modifying Source	Oral Slope Factor mg/kg-day	Oral Slope Factor Source	Inhalation Slope Factor mg/kg-day	Inhalation Slope Factor Source	Weight of Evidence mg/kg-day	Weight of Evidence Source	Cancer Type mg/kg-day	Cancer Basis / Notes
1,1,1-TRICHLOROETHANE	2.00E-02	EPA-NCEA	2.86E-01	EPA-NCEA												
2,4-DIMETHYLPHENOL	2.00E-02	IRIS														
2-METHYLNAPHTHALENE	4.00E-02	EPA-NCEA														
2-METHYLPHENOL	5.00E-02	IRIS														
4-METHYLPHENOL	5.00E-03	EPA-NCEA														
ACENAPHTHENE	6.00E-02	IRIS														
ACETONE	1.00E-01	IRIS														
ALUMINUM	1.00E+00	EPA-NCEA	1.00E-03	EPA-NCEA												
ANTHRACENE	3.00E-01	IRIS														
AROCOLOR-1242 (values for Aroclor 1254)																
Arsenic	3.00E-04	IRIS			med	keratosis, pigmentation	subchronic	3, 1	2.00E+00	IRIS	2.00E+00	IRIS	B2	(PCBs) IRIS		(PCBs) liver tumors in female rats
BARIUM	7.00E-02	IRIS	1.40E-04	HEAST Alt	med	increased blood pressure	human study	3, 1	1.50E+00	IRIS	1.51E+01	IRIS	A	IRIS	lung	sufficient evidence in human data
BENZENE	3.00E-03	EPA-NCEA	1.70E-03	EPA-NCEA					2.90E-02	IRIS	2.90E-02	IRIS	A	IRIS	leukemia	human studies
BENZO[A]PYRENE									7.30E+00	IRIS	3.10E+00	EPA-NCEA	B2	IRIS		multiple animal studies, inadequate human data
BENZO[B]FLUORANTHENE									7.30E-01	EPA-NCEA			B2	IRIS		sufficient animal bioassays, no human data
BENZO[K]FLUORANTHENE									7.30E-02	EPA-NCEA			B2	IRIS		sufficient animal bioassays, no human data
BENZO[A]ANTHRACENE									7.30E-01	EPA-NCEA			B2	IRIS		sufficient animal bioassays, no human data
BERYLLIUM	2.00E-03	IRIS	5.70E-06	IRIS							8.40E+00	IRIS				
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E-02	IRIS							1.40E-02	IRIS		1.40E-02	EPA-NCEA			
CADMIUM-WATER	5.00E-04	IRIS			high	significant proteinuria		10, 1			8.30E+00	IRIS	B1	IRIS		occupational epidemiological studies
CHRYSENE									7.30E-03	EPA-NCEA			B2	IRIS		sufficient animal bioassays, no human data
COPPER	4.00E-02	EPA-NCEA														
CYANIDE (FREE)	2.00E-02	IRIS			med	rat chronic oral study		100, 5					D	IRIS		lack of data
DIBENZO[A,H]ANTHRACENE									7.30E+00	EPA-NCEA			B2	IRIS		sufficient animal bioassays, no human data
ETHYLBENZENE	1.00E-01	IRIS	2.90E-01	IRIS	low	liver and kidney toxicity		1000, 1					D	IRIS		lack of animal bioassays and human studies
FLUORANTHENE	4.00E-02	IRIS														
FLUORENE	4.00E-02	IRIS														
INDENO[1,2,3-C,D]PYRENE									7.30E-01	EPA-NCEA			B2	IRIS		sufficient animal bioassays, no human data
IRON	3.00E-01	EPA-NCEA														
MANGANESE-NONFOOD	2.00E-02	IRIS	1.43E-05	IRIS	med	CNS effects		1, 1					D	IRIS		inadequate data
Mercury (inorganic - as chloride)	3.00E-04	IRIS	8.57E-05	HEAST Alt									D	IRIS 9/97		inadequate data
METHYL ETHYL KETONE (2-BUTANONE)	6.00E-01	IRIS	2.86E-01	IRIS												
METHYLENE CHLORIDE	6.00E-02	IRIS	8.60E-01	EPA-NCEA					7.50E-03	IRIS	1.65E-03	IRIS				
NAPHTHALENE	4.00E-02	EPA-NCEA	1.00E-04	EPA-NCEA									D	IRIS		no human data, inadequate animal bioassays
PHENOL	6.00E-01	IRIS														
POLYCHLORINATED BIPHENYLS									2.00E+00	IRIS	2.00E+00	IRIS				
PYRENE	3.00E-02	IRIS														
SELENIUM	5.00E-03	IRIS														
STYRENE	2.00E-01	IRIS	2.86E-01	IRIS	med	liver and red blood cell		1000, 1								
TETRACHLOROETHENE	1.00E-02	IRIS	1.40E-01	EPA-NCEA					5.20E-02	EPA-NCEA	2.00E-03	EPA-NCEA				
TOLUENE	2.00E-01	IRIS	1.14E-01	IRIS	med	liver and kidney weight loss		1000, 1					D	IRIS		no human data, inadequate animal data
TRICHLOROETHENE	6.00E-03	EPA-NCEA							1.10E-02	EPA-NCEA	8.00E-03	EPA-NCEA				
VANADIUM	7.00E-03	EPA-NCEA														
XYLENES	2.00E+00	IRIS			(o-Xylene) med	(o-Xylene) hyperactivity		(o-Xylene) 100, 1					D	IRIS		inadequate animal data, no human data
ZINC	3.00E-01	IRIS														

Notes:

IRIS - Integrated Risk Information System

EPA-NCEA - USEPA National Center for Environmental Assessment

HEAST - USEPA Health Effects Summary Table

HEAST Alt - USEPA Health Effects Summary Table alternate value

EPA 1991 - U.S. Environmental Protection Agency (USEPA). 1991. Letter to P. VanLeeuwen from P.F. Hurst, RE: Oral and Dermal Absorption Factors. August 6, 1991.

EPA 1992a - U.S. Environmental Protection Agency (USEPA). 1992. Letter to K. Warren from J.S. Dollarhide, RE: Dermal Absorption Factors for multiple chemicals. December 15, 1992.

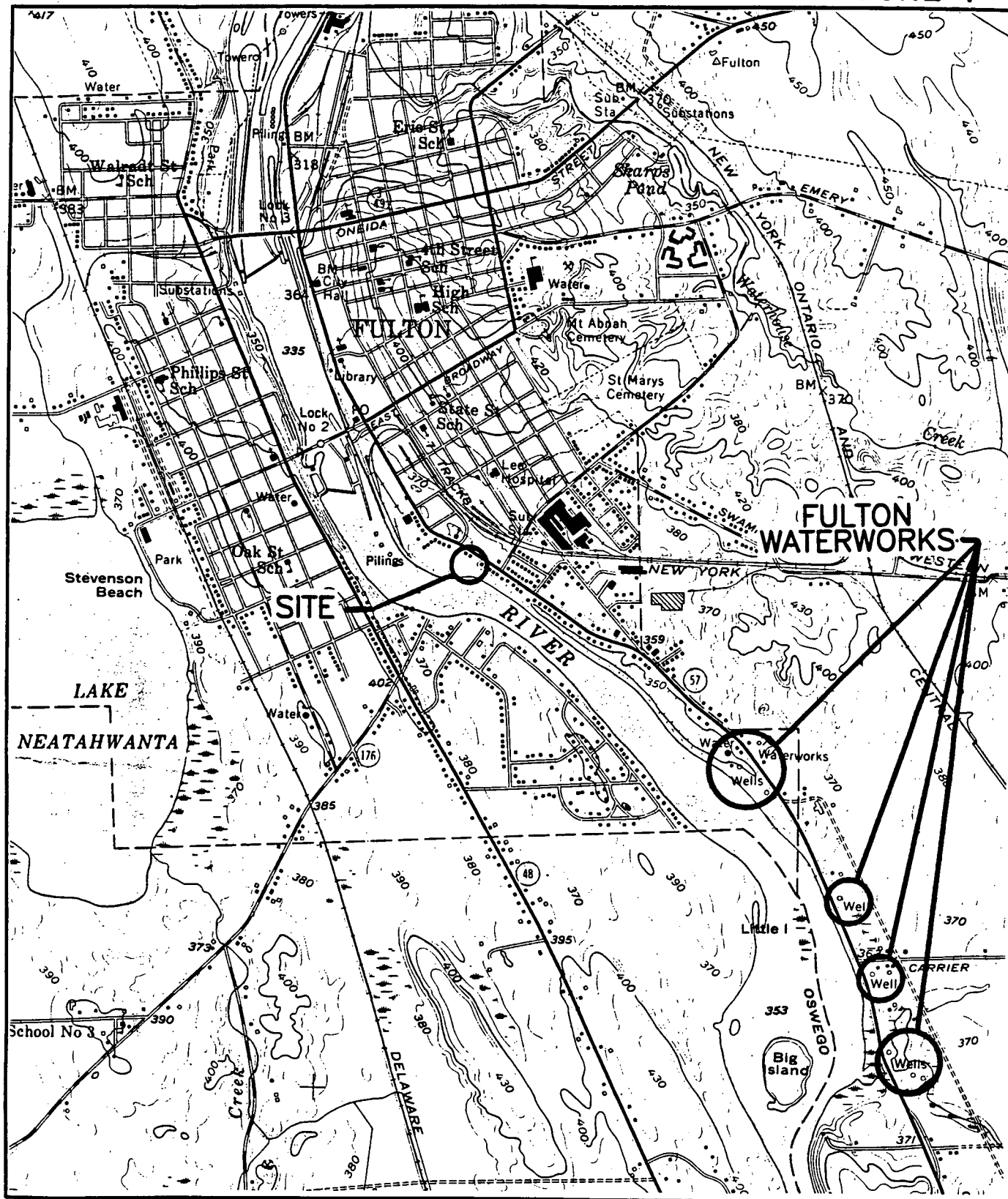
EPA 1992b - U.S. Environmental Protection Agency (USEPA). 1992. Dermal Exposure Assessment: Principles and Applications, Interim Report. Office of Research and Development. EPA/600/8-91/011B. January.

EPA Reg V 1994 - U.S. Environmental Protection Agency, Region V (USEPA, Region V). 1994. Letter to J.A. Heimbuch from E.J. Hanlon RE: Floodplains/Wetland Cleanup Goals Issue, Fields Brook Superfund Site. October 20, 1994.

**Niagara Mohawk Power Corporation
South First Street Site - Fulton, NY
Human Health Risk Assessment**

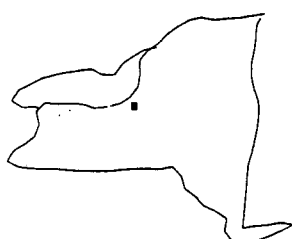
Table 5-7. Toxicological Data

Chemical	Dermal		Dermal		Gastrointestinal		Gastrointestinal		Permeability		Permeability		VOC	Tap Water		Ambient Air		Soil			
	Absorption Factor mg/kg-day	Source	Absorption Factor mg/kg-day	Source	Absorption Factor mg/kg-day	Source	Constant mg/kg-day	Source	Constant mg/kg-day	Source	Constant mg/kg-day	Source		ug/l	Effect	ug/m3	Effect	Industrial		Residential	
																		mg/kg	Effect	mg/kg	Effect
1,1,1-TRICHLOROETHANE	0.0005	EPA 1992a	1	EPA 1992a	0.017	EPA 1992b	y	5.4E+02	N	1.0E+03	N	4.1E+04	N	1.6E+03	N	1.6E+03	N	1.6E+03	N	1.6E+03	N
2,4-DIMETHYLPHENOL	0.1	Ryan, 1987	0.5	Ryan, 1987	0.11	EPA 1992b	y	7.3E+02	N	7.3E+01	N	4.1E+04	N	1.6E+03	N	1.6E+03	N	1.6E+03	N	1.6E+03	N
2-METHYLNAPHTHALENE	0.1	Default value	0.5	Default value				1.5E+03	N	1.5E+02	N	8.2E+04	N	3.1E+03	N	3.1E+03	N	3.1E+03	N	3.1E+03	N
2-METHYLPHENOL	0.1	Ryan, 1987	0.5	Ryan, 1987	0.11	EPA 1992b	y	1.8E+03	N	1.8E+02	N	1.0E+05	N	3.9E+03	N	3.9E+03	N	3.9E+03	N	3.9E+03	N
4-METHYLPHENOL	0.25	EPA RegV, 1994	1	EPA RegV, 1994	0.11	EPA 1992b	y	1.8E+02	N	1.8E+01	N	1.0E+04	N	3.9E+02	N	3.9E+02	N	3.9E+02	N	3.9E+02	N
ACENAPHTHENE	0.03	EPA RegV, 1994	1	EPA RegV, 1994	0.13	EPA 1992b	y	2.2E+03	N	2.2E+02	N	1.2E+05	N	4.7E+03	N	4.7E+03	N	4.7E+03	N	4.7E+03	N
ACETONE	0.0005	EPA 1992a	0.83	EPA 1992a	0.00057	EPA 1992b	y	3.7E+03	N	3.7E+02	N	2.0E+05	N	7.8E+03	N	7.8E+03	N	7.8E+03	N	7.8E+03	N
ALUMINUM	0.01	ATSDR, 1990a	0.05	EPA 1991	0.001	EPA 1992b	y	3.7E+04	N	3.7E+00	N	2.0E+06	N	7.8E+04	N	7.8E+04	N	7.8E+04	N	7.8E+04	N
ANTHRACENE	0.03	EPA RegV, 1994	0.50	EPA RegV, 1994	0.26	EPA 1992b	y	1.1E+04	N	1.1E+03	N	6.1E+05	N	2.3E+04	N	2.3E+04	N	2.3E+04	N	2.3E+04	N
AROCOR-1242 (values for Aroclor 1254)	0.06	EPA RegV, 1994	0.95	EPA RegV, 1994	1.60	EPA 1992b	y	3.3E-02	C	3.1E-03	C	2.9E+00	C	3.2E-01	C	3.2E-01	C	3.2E-01	C	3.2E-01	C
Arsenic	0.001	EPA 1992a	0.95	EPA 1991	0.001	EPA 1992b	y	4.5E-02	C	4.1E-04	C	3.8E+00	C	4.3E-01	C	4.3E-01	C	4.3E-01	C	4.3E-01	C
BARIIUM	0.001	EPA RegV, 1994	0.05	EPA 1991	0.001	EPA 1992b	y	2.6E+03	N	5.1E-01	N	1.4E+05	N	5.5E+03	N	5.5E+03	N	5.5E+03	N	5.5E+03	N
BENZENE	0.0005	EPA 1992a	1	EPA 1991	0.11	EPA 1992b	y	3.6E-01	C	2.2E-01	C	2.0E+02	C	2.2E+01	C	2.2E+01	C	2.2E+01	C	2.2E+01	C
BENZO[A]PYRENE	0.03	EPA RegV, 1994	0.5	EPA Reg V, 1994	1.2	EPA 1992b	y	9.2E-03	C	2.0E-03	C	7.8E-01	C	8.7E-02	C	8.7E-02	C	8.7E-02	C	8.7E-02	C
BENZO[B]FLUORANTHENE	0.03	EPA RegV, 1994	0.5	EPA Reg V, 1994	1.2	EPA 1992b	y	9.2E-02	C	8.6E-03	C	7.8E+00	C	8.7E-01	C	8.7E-01	C	8.7E-01	C	8.7E-01	C
BENZO[K]FLUORANTHENE	0.03	EPA RegV, 1994	0.5	EPA Reg V, 1994	1.1	EPA 1992b	y	9.2E-01	C	8.6E-02	C	7.8E+01	C	8.7E+00	C	8.7E+00	C	8.7E+00	C	8.7E+00	C
BENZ[A]ANTHRACENE	0.03	EPA RegV, 1994	0.5	EPA Reg V, 1994	0.81	EPA 1992b	y	9.2E-02	C	8.6E-03	C	7.8E+00	C	8.7E-01	C	8.7E-01	C	8.7E-01	C	8.7E-01	C
BERYLLIUM	0.001	EPA RegV, 1994	0.01	EPA 1991	0.001	EPA 1992b	y	7.3E+01	N	7.5E-04	C	4.1E+03	N	1.6E+02	N	1.6E+02	N	1.6E+02	N	1.6E+02	N
BIS(2-ETHYLHEXYL)PHTHALATE	0.25	EPA RegV, 1994	0.25	EPA RegV, 1994	0.033	EPA 1992b	y	4.8E+00	C	4.5E-01	C	4.1E+02	C	4.6E+01	C	4.6E+01	C	4.6E+01	C	4.6E+01	C
CADMIUM-WATER	0.001	EPA RegV, 1994	0.025	EPA 1997	0.001	EPA 1992b	y	1.8E+01	N	9.9E-04	C	1.0E+03	N	3.9E+01	N	3.9E+01	N	3.9E+01	N	3.9E+01	N
CHRYSENE	0.03	EPA RegV, 1994	0.5	EPA Reg V, 1994	0.81	EPA 1992b	y	9.2E+00	C	8.6E-01	C	7.8E+02	C	8.7E+01	C	8.7E+01	C	8.7E+01	C	8.7E+01	C
COPPER	0.001	EPA 1992a	0.6	EPA Reg V, 1994	0.001	EPA 1992b	y	1.5E+03	N	1.5E+02	N	8.2E+04	N	3.1E+03	N	3.1E+03	N	3.1E+03	N	3.1E+03	N
CYANIDE (FREE)	0.001	EPA Reg V, 1994	0.72	EPA Reg V, 1994	0.001	EPA 1992b	y	7.3E+02	N	7.3E+01	N	4.1E+04	N	1.6E+03	N	1.6E+03	N	1.6E+03	N	1.6E+03	N
DIBENZO[A,H]ANTHRACENE	0.03	EPA RegV, 1994	0.5	EPA Reg V, 1994	2.7	EPA 1992b	y	9.2E-03	C	8.6E-04	C	7.8E-01	C	8.7E-02	C	8.7E-02	C	8.7E-02	C	8.7E-02	C
ETHYLBENZENE	0.03	EPA 1992a	0.9	EPA 1991	1	EPA 1992b	y	1.3E+03	N	1.1E+03	N	2.0E+05	N	7.8E+03	N	7.8E+03	N	7.8E+03	N	7.8E+03	N
FLUORANTHENE	0.03	EPA RegV, 1994	0.5	EPA RegV, 1994	0.38	EPA 1992b	y	1.5E+03	N	1.5E+02	N	8.2E+04	N	3.1E+03	N	3.1E+03	N	3.1E+03	N	3.1E+03	N
FLUORENE	0.03	EPA RegV, 1994	1	EPA RegV, 1994	0.17	EPA 1992b	y	1.5E+03	N	1.5E+02	N	8.2E+04	N	3.1E+03	N	3.1E+03	N	3.1E+03	N	3.1E+03	N
INDENO[1,2,3-C,D]PYRENE	0.03	EPA RegV, 1994	0.5	EPA Reg V, 1994	1.9	EPA 1992b	y	9.2E-02	C	8.6E-03	C	7.8E+00	C	8.7E-01	C	8.7E-01	C	8.7E-01	C	8.7E-01	C
IRON	0.01	Ryan, 1987	0.1	NRC, 1989	0.001	EPA 1992b	y	1.1E+04	N	1.1E+03	N	6.1E+05	N	2.3E+04	N	2.3E+04	N	2.3E+04	N	2.3E+04	N
MANGANESE-NONFOOD	0.01	EPA 1992a	0.03	EPA Reg V, 1994	0.001	EPA 1992b	y	7.3E+02	N	5.2E-02	N	4.1E+04	N	1.6E+03	N	1.6E+03	N	1.6E+03	N	1.6E+03	N
Mercury (inorganic - as chloride)	0.001	EPA RegV, 1994	0.15	EPA RegV, 1994	0.001	EPA 1992b	y	1.1E+01	N	3.1E-01	N	6.1E+02	N	2.3E+01	N	2.3E+01	N	2.3E+01	N	2.3E+01	N
METHYLETHYL KETONE (2-BUTANONE)	0.01	Default value	0.8	Default value	y	1.9E+03	N	1.0E+03	N	1.2E+06	N	4.7E+04	N	4.7E+04	N	4.7E+04	N	4.7E+04	N	4.7E+04	N
METHYLENE CHLORIDE	0.05	EPA RegV, 1994	1	EPA 1991	0.0045	EPA 1992b	y	4.1E+00	C	3.8E+00	C	7.6E+02	C	8.5E+01	C	8.5E+01	C	8.5E+01	C	8.5E+01	C
NAPHTHALENE	0.25	EPA RegV, 1994	1	EPA Reg V, 1994	0.07	EPA 1992b	y	1.5E+03	N	3.7E-01	N	8.2E+04	N	3.1E+03	N	3.1E+03	N	3.1E+03	N	3.1E+03	N
PHENOL	1	EPA 1992a	0.9	EPA 1991	0.0082	EPA 1992b	y	2.2E+04	N	2.2E+03	N	1.2E+06	N	4.7E+04	N	4.7E+04	N	4.7E+04	N	4.7E+04	N
POLYCHLORINATED BIPHENYLS	0.06	EPA RegV, 1994	0.95	EPA RegV, 1994	1.6	EPA 1992b	y	3.3E-02	C	3.1E-03	C	2.9E+00	C	3.2E-01	C	3.2E-01	C	3.2E-01	C	3.2E-01	C
PYRENE	0.03	EPA RegV, 1994	0.6	EPA RegV, 1994	0.53	EPA 1992b	y	1.1E+03	N	1.1E+02	N	6.1E+04	N	2.3E+03	N	2.3E+03	N	2.3E+03	N	2.3E+03	N
SELENIUM	0.001	EPA RegV, 1994	0.95	EPA RegV, 1994	0.001	EPA 1992b	y	1.8E+02	N	1.8E+01	N	1.0E+04	N	3.9E+02	N	3.9E+02	N	3.9E+02	N	3.9E+02	N
STYRENE	0.1	Default value	0.5	Default value	y	1.6E+03	N	1.0E+03	N	4.1E+05	N	1.6E+04	N	1.6E+04	N	1.6E+04	N	1.6E+04	N	1.6E+04	N
TETRACHLOROETHENE	0.03	EPA 1992a	1	EPA 1991	0.37	EPA 1992b	y	1.1E+00	C	3.1E+00	C	1.1E+02	C	1.2E+01	C	1.2E+01	C	1.2E+01	C	1.2E+01	C
TOLUENE	0.03	EPA 1992a	1	EPA 1991	1	EPA 1992b	y	7.5E+02	N	4.2E+02	N	4.1E+05	N	1.6E+04	N	1.6E+04	N	1.6E+04	N	1.6E+04	N
TRICHLOROETHENE	0.0005	EPA 1992a	1	EPA 1991	0.23	EPA 1992b	y	1.6E+00	C	1.0E+00	C	5.2E+02	C	5.6E+01	C	5.6E+01	C	5.6E+01	C	5.6E+01	C
VANADIUM	0.001	EPA RegV, 1994	0.01	EPA 1991	0.001	EPA 1992b	y	2.6E+02	N	2.6E+01	N	1.4E+04	N	5.5E+02	N	5.5E+02	N	5.5E+02	N	5.5E+02	N
XYLENES	0.03	EPA 1992a	0.9	EPA 1991	0.08	EPA 1992b	y	1.2E+04	N	7.3E+03	N	4.1E+06	N	1.6E+05	N	1.6E+05	N	1.6E+05	N	1.6E+05	N
ZINC	0.001	EPA RegV, 1994	0.3	EPA RegV, 1994	0.001	EPA 1992b	y	1.1E+04	N	1.1E+03	N	6.1E+05	N	2.3E+04	N	2.3E+04	N	2.3E+04	N	2.3E+04	N



NIAGARA MOHAWK
SOUTH FIRST STREET SITE
FULTON, NEW YORK

SITE LOCATION MAP



QUADRANGLE LOCATION

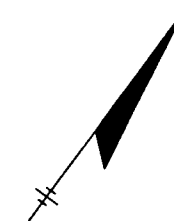
2000 0 2000



SCALE IN FEET



LEGEND



NIAGARA MOHAWK
SOUTH FIRST STREET SITE
FULTON, NEW YORK

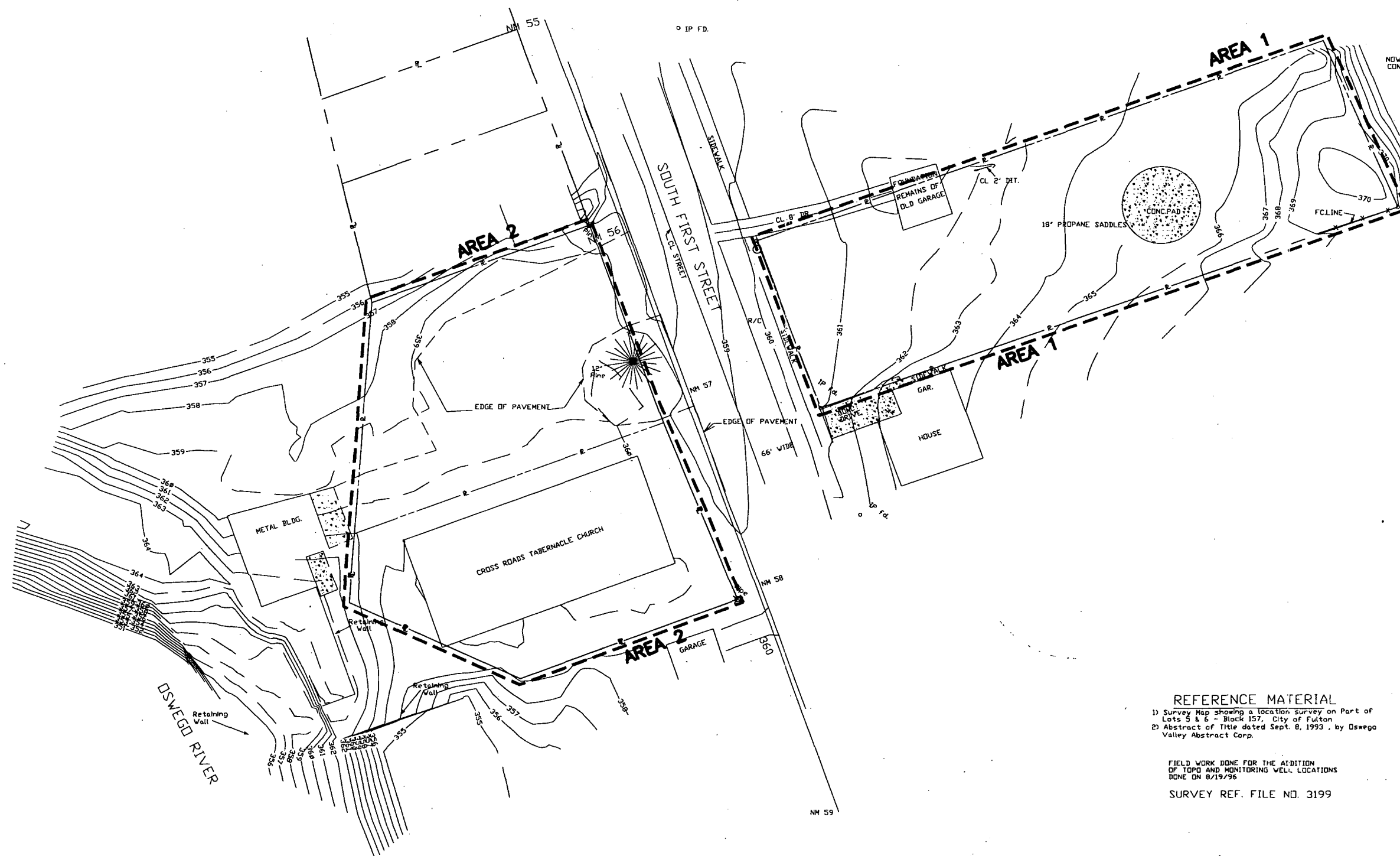
SITE MAP

1) Survey Map showing a location survey on Part of
Lots 5 & 6 - Block 157, City of Fulton
2) Abstract of Title dated Sept. 8, 1993, by Oswego
Valley Abstract Corp.

FIELD WORK DONE FOR THE ADDITION
OF TOPO AND MONITORING WELL LOCATIONS
DONE ON 8/19/96

SURVEY REF. FILE NO. 3199

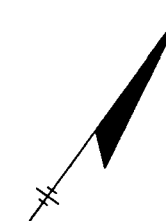
1118.081-01



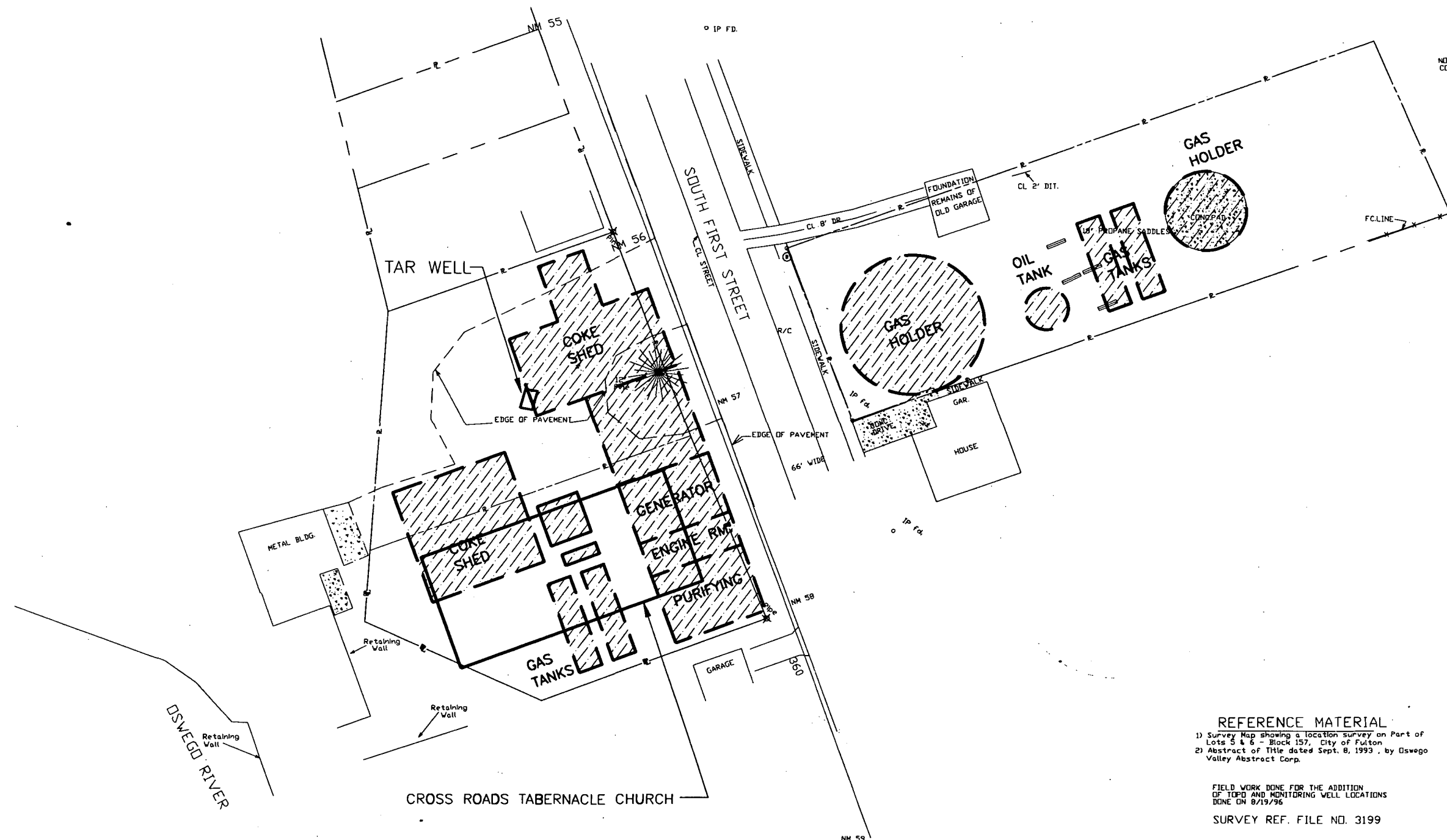
50 FT. 0 50

Feb/4/98

FIGURE 1-3



- LEGEND**
- R- SITE BOUNDARY PER RRT STIPULATION
 - [Hatched Box] HISTORICAL STRUCTURE



NIAGARA MOHAWK
SOUTH FIRST STREET SITE
FULTON, NEW YORK

HISTORICAL FEATURES

1118.081-02

50 FT. 0 50



Feb/8/99

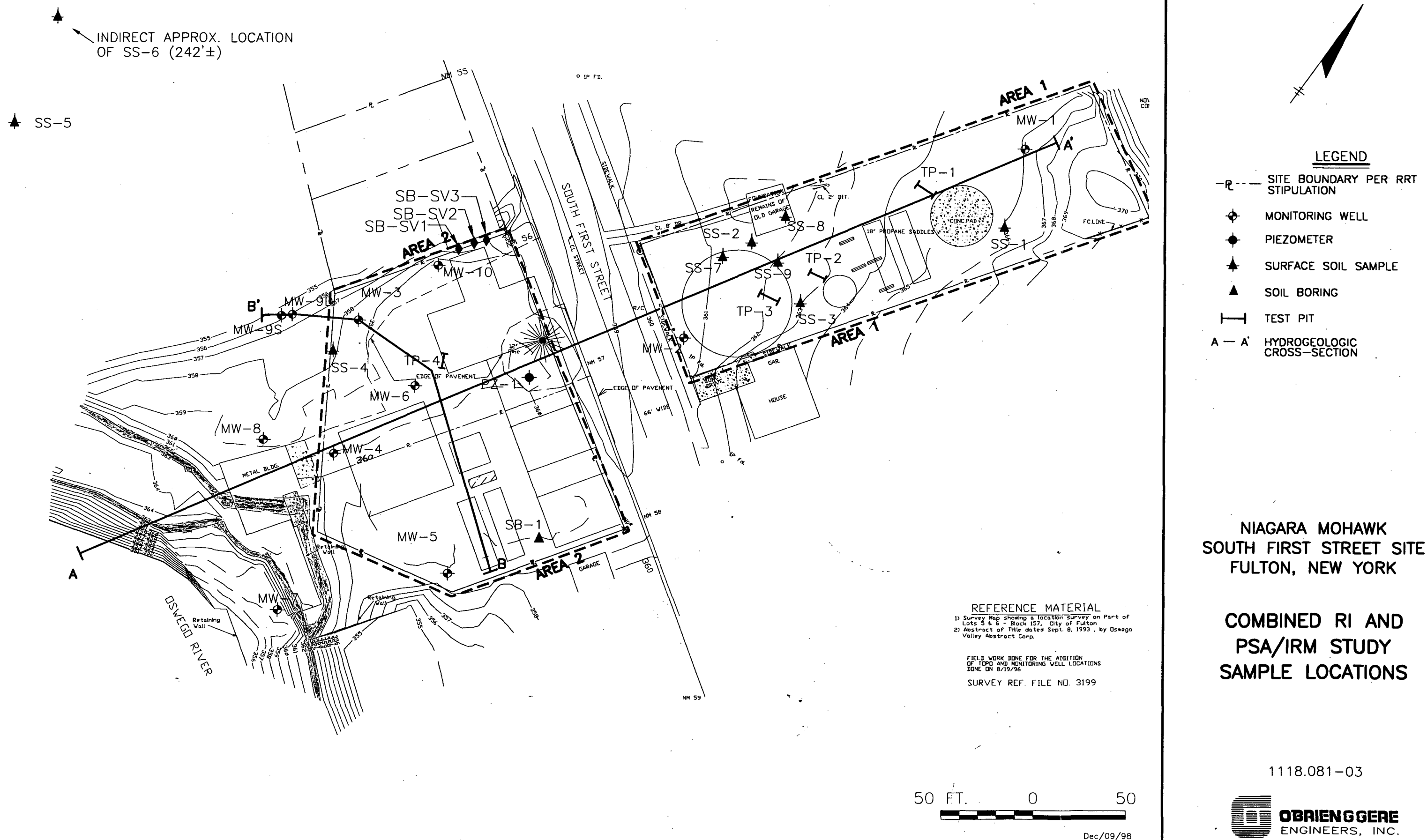


FIGURE 3-1

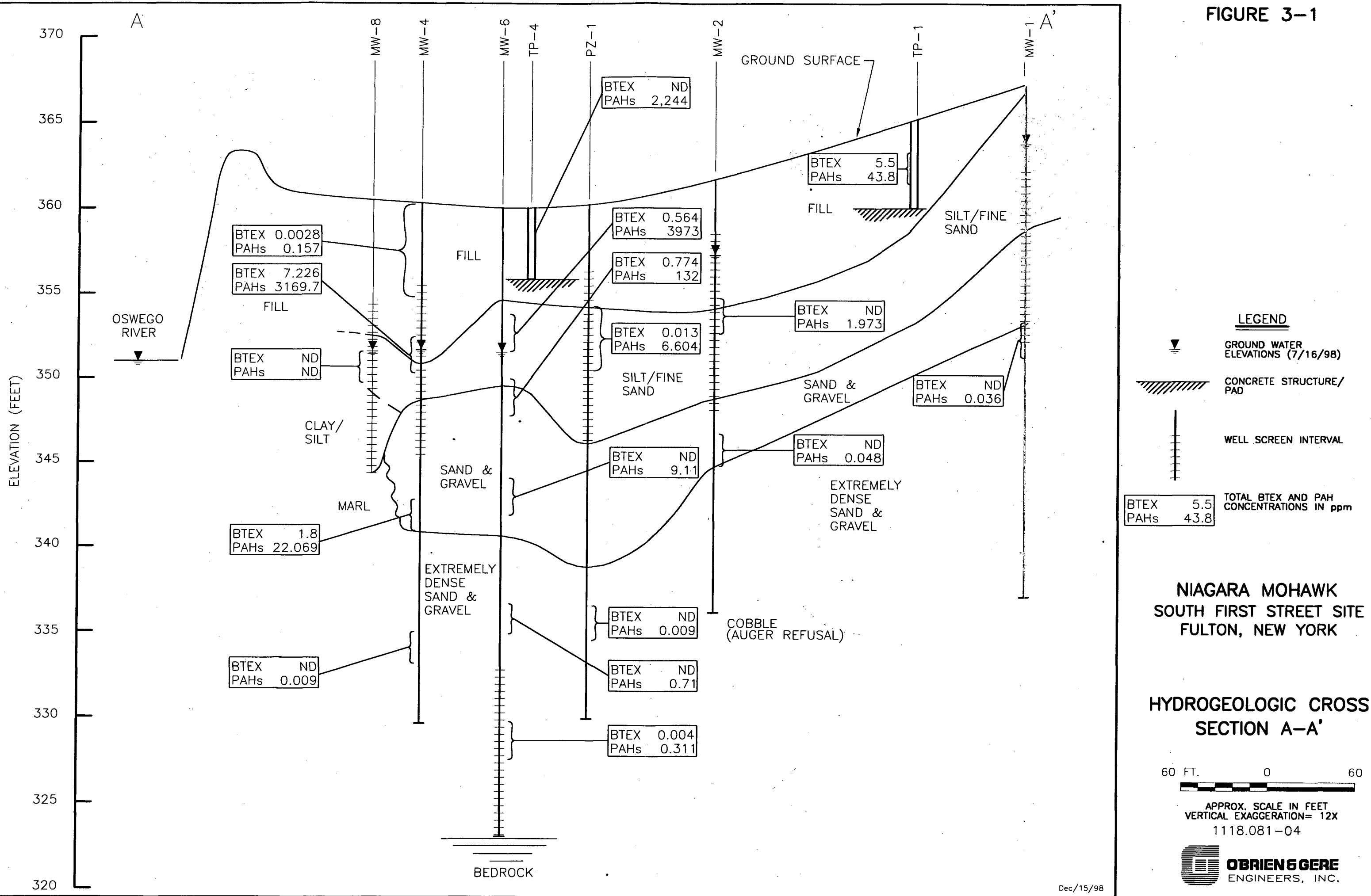
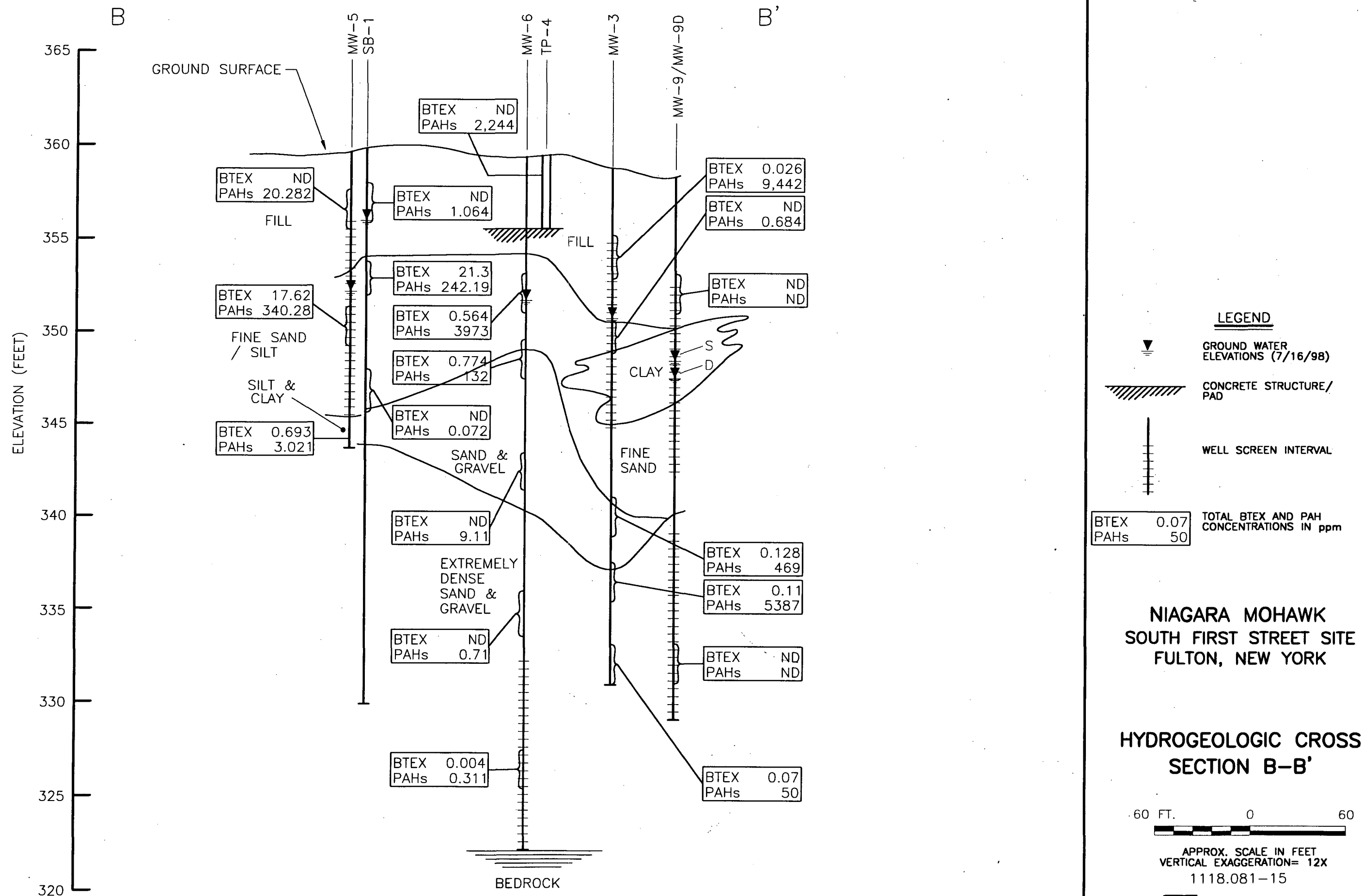
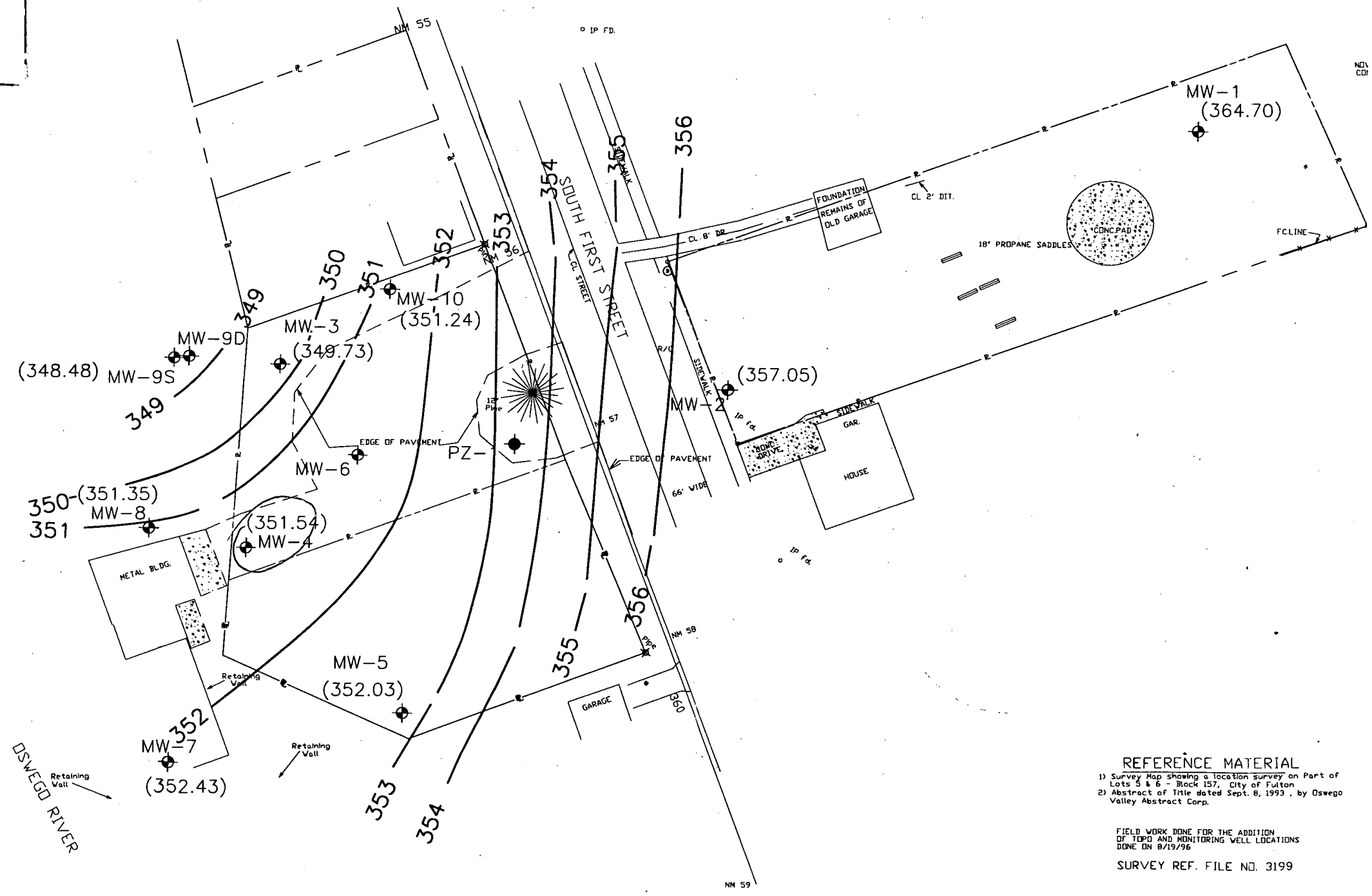


FIGURE 3-2



Arrow not indicated.

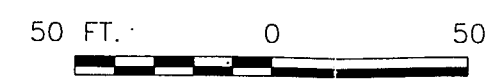
FIGURE 3-3



NIAGARA MOHAWK
SOUTH FIRST STREET SITE
FULTON, NEW YORK

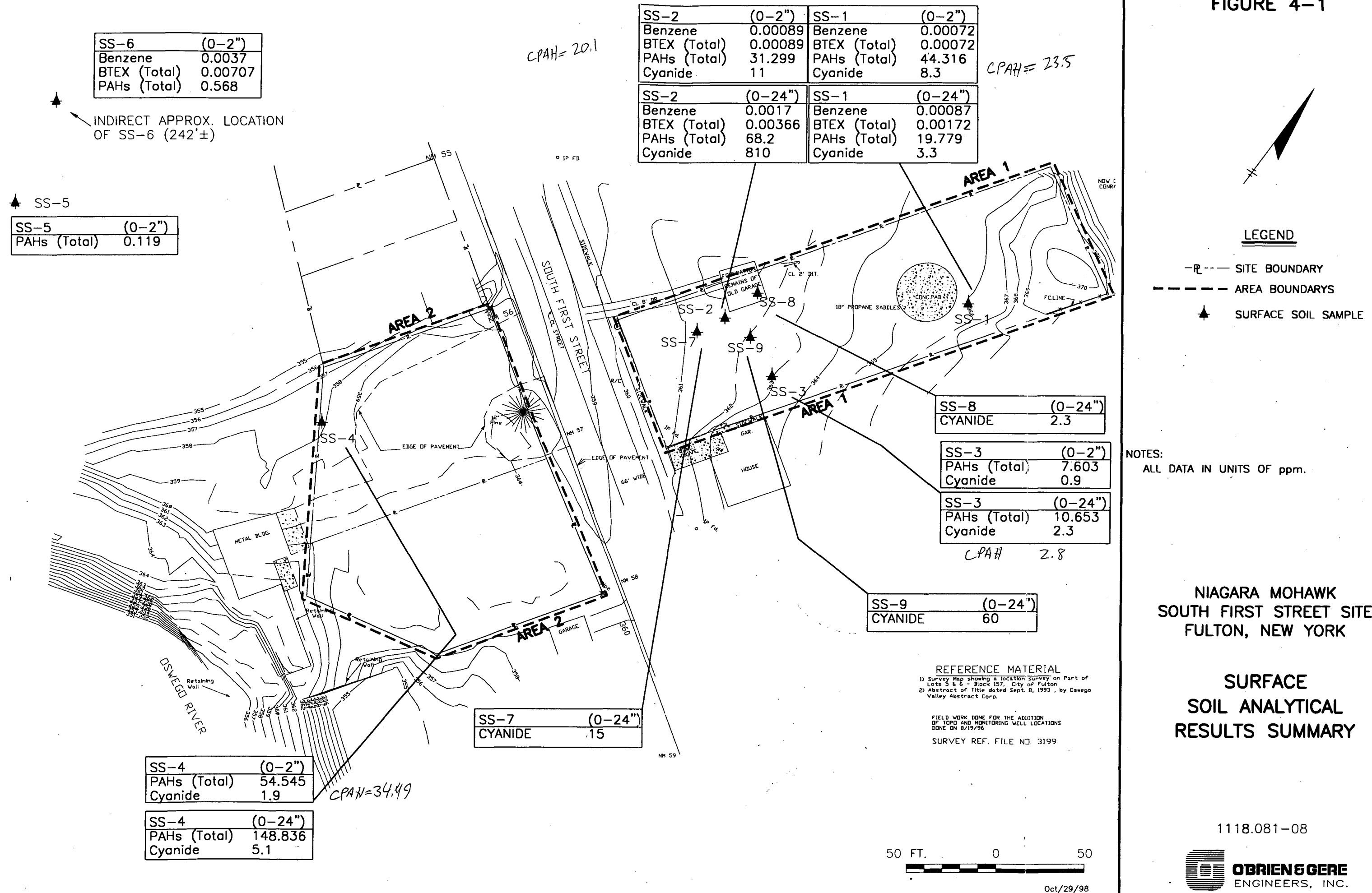
JULY 16, 1998
GROUND WATER ELEVATION
FLOW MAP

1118.081-013



Dec/09/98

FIGURE 4-1



I:\DIV76\PROJECTS\1118081\DWGS\MASTER.DWG
PLOT DATE: 12/9/98

FIGURE 4-2

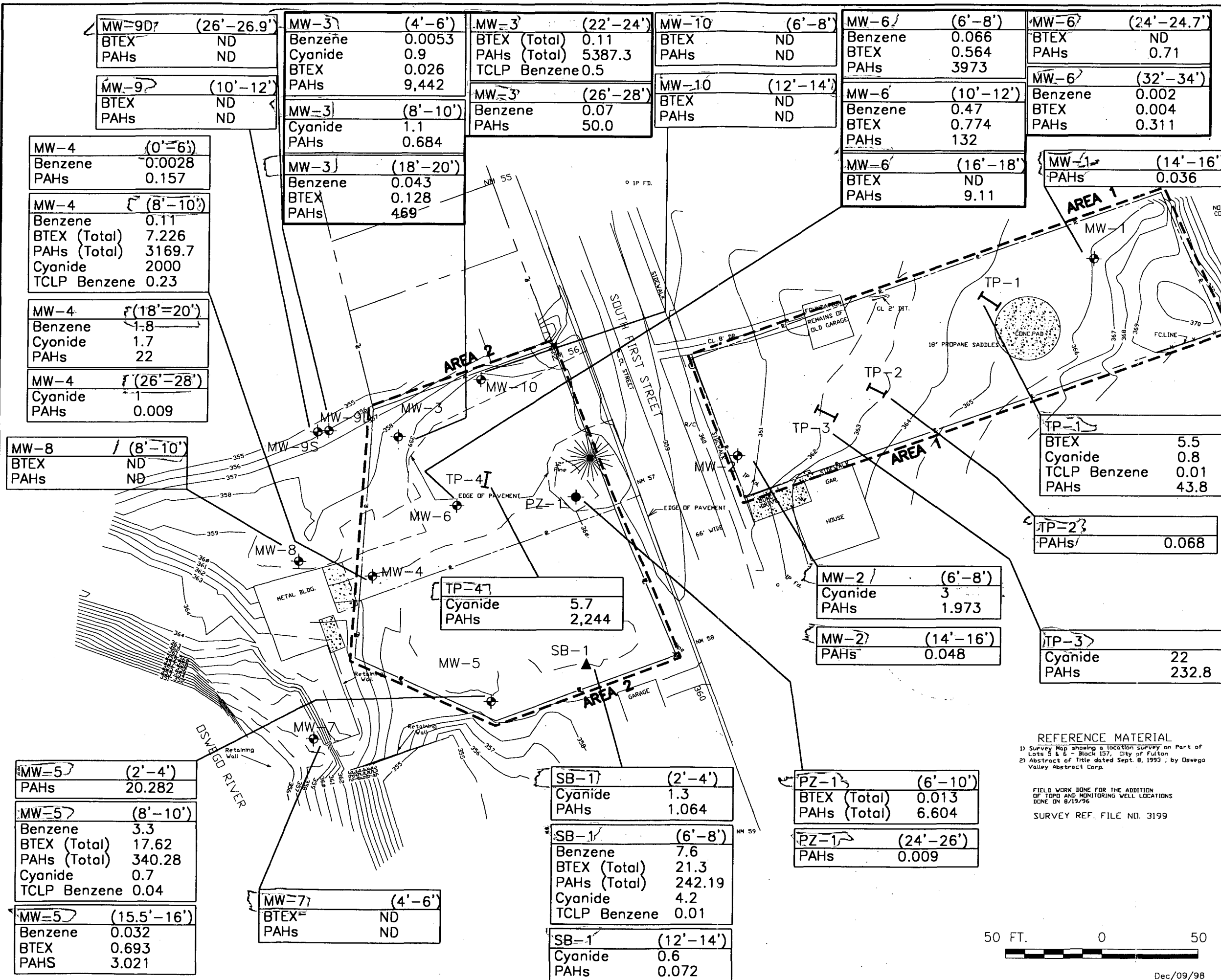
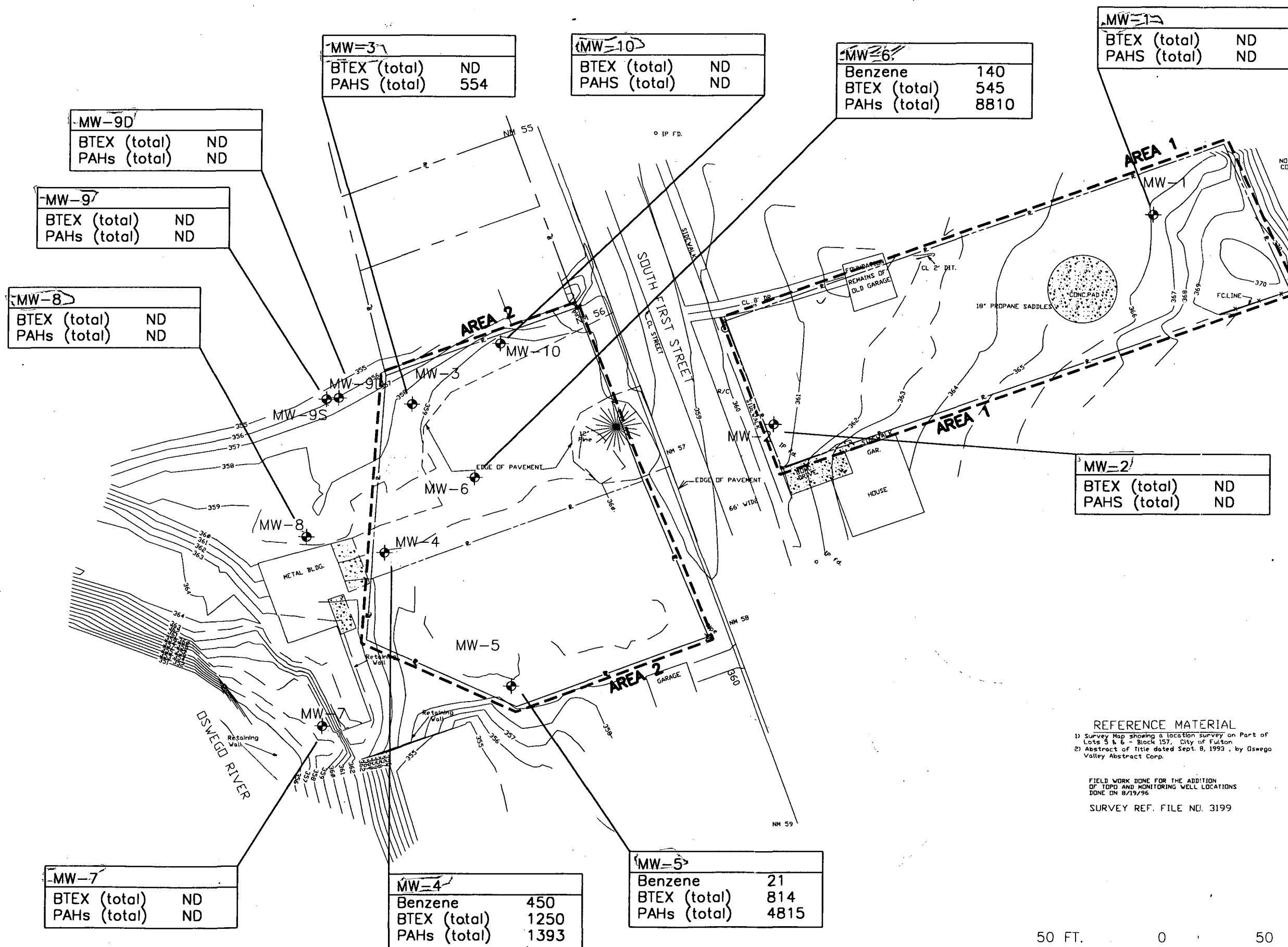


FIGURE 4-3



LEGEND

- SITE BOUNDARY
- AREA BOUNDARIES
- MONITORING WELL

NOTES:
ALL DATA IN UNITS OF ppb.

NIAGARA MOHAWK
SOUTH FIRST STREET SITE
FULTON, NEW YORK

GROUND WATER
ANALYTICAL
RESULTS SUMMARY
JULY 16, 1998

1118.081-014

O BRIEN GERE
ENGINEERS, INC.

Dec/09/98

APPENDICES

APPENDIX A

Soil boring logs and monitoring well details

O'BRIEN & GERE ENGINEERS, INC.						TEST BORING LOG		REPORT OF BORING MW-1			
Client: Niagara Mohawk						Sampler: 2" Split Spoon		Page 1 of 2			
Proj. Loc: Fulton, NY						Hammer: 140 lbs.		Location:			
File No.: 1118.081						Fall: 30"		Start Date: 7/9/96 End Date: 7/9/96			
Boring Company: Parratt Wolff, Inc. Foreman: Brian Waters OBG Geologist: Chawn O'Dell						Screen Riser		Grout Sand Pack Bentonite			
Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	Stratum Change General Descript	Equip. Installed	Field Testing PID Over Spoon (PPM)		Jar Head Space (PPM)
0						Augered to 4 ft., due to the test pit excavation.					
	1	4-6	3-4 3-8	2'/2'	7	Pale moderate yellowish brown (10YR 6/2), and medium light gray (N6), mottling, moist to wet, loose SILT, some fine sand, little medium sand, well sorted.			0.0	0.0	
5											
	2	6-8	18-50 50/0.2	1.2'/1.2'	50(+)	Pale moderate yellowish brown (10YR 6/2), and medium light gray (N6), mottling, moist to wet, loose SILT, some fine sand, little medium sand, well sorted.			0.0	0.0	
	3	8-10	21-15 23-25	2'/0.3'	38	Light brownish gray (5YR 6/1), saturated, hard, fine SAND, some silt, little cobbles. (Cobble driven with the split spoon - poor recovery).			0.0 (Dup 0.0)	0.0	
10											
	4	10-12	5-10 8-9	2'/2'	18	Dark yellowish brown (10YR 4/2), saturated, medium dense, fine to medium, subrounded to subangular SAND, little fine angular gravel, trace silt.			0.0	0.0	
	5	12-14	7-8 15-14	2'/2'	23	Dark yellowish brown (10YR 4/2), saturated, medium dense, fine to medium, subrounded to subangular SAND, little fine angular gravel, trace silt.			0.0	0.0 (Dup 0.0)	
15											
	6	14-16	13-28 44-51	2'/2'	72	Dark yellowish brown (10YR 4/2), moist to wet, extremely dense, subrounded to subangular, fine to coarse SAND, some subangular to subrounded, fine gravel, little silt and clay.			0.0	0.0	
	7	16-18	24-50/0.4	0.9/0.9'	50(+)	Dark yellowish brown (10YR 4/2), wet, extremely dense, subrounded to subangular, medium SAND, some fine sand, little silt, trace subrounded to subangular gravel.			0.0	0.0	
	8	18-20	27-32 37-34	2.0/2.0'	69	Pale brown (5YR 5/2), saturated, extremely dense, subrounded to subangular medium SAND, some fine sand, little subrounded to subangular fine gravel, trace silt and clay.			0.0 (Dup 0.0)	0.0 (Dup 0.0)	
20											
	9	20-22	16-38 51-51	2.0/2.0'	89	Pale brown (5YR 5/2), saturated, extremely dense, subrounded to subangular fine to medium SAND, some silt, little subrounded to subangular fine gravel, trace clay.			0.0	0.0	

O'BRIEN & GERE ENGINEERS, INC.						TEST BORING LOG	REPORT OF BORING MW-2				
Client: Niagara Mohawk						Sampler: 2" Split Spoon		Page 1 of 2			
Proj. Loc: Fulton, NY						Hammer: 140 lbs.		Location:			
File No.: 1118.081						Fall: 30"		Start Date: 7/10/96 End Date: 7/10/96			
Boring Company: Parratt Wolff, Inc.						Screen =		Grout			
Foreman: Brian Waters						Riser =		Sand Pack			
OBG Geologist: Chawn O'Dell								Bentonite			
Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	Stratum Change General Descript	Equip. installed	Field Testing PID Over Spoon (PPM)		Jar Head Space (PPM)
0	1	0-2	2-4 4-2	2/1.3'	8	Moderate yellowish brown (10YR 5/4), damp, loose, fine to medim SAND, some silt, little subrounded to subangular fine gravel.				0.0	0.0
	2	2-4	2-3 2-5	2/1.6'	5	Pale yellowish brown (10YR 6/2), damp, loose, SILT and fine SAND, little medium sand, trace fine angular gravel, trace asphalt pieces.				0.0	0.0
5	3	4-6	2-2 2-2	2/0.2'	4	Dark yellowish brown (10YR 2/2), saturated, loose, medium SAND, little fine sand and silt, trace subrounded gravel.				0.0	0.0
	4	6-8	1-2 3-3	2/1.1'	5	Pale yellowish brown (10YR 6/2), saturated, loose, SILT and fine SAND, little medium sand.				1.3 (Dup 1.2)	2.6 Dup 2.4
10	5	8-10	2-4 7-4	2/0.5'	11	Dark yellowish brown (10YR 4/2), saturated, medium dense, fine SAND, some medium sand, little silt.				0.0	1.9
	6	10-12	6-9 9-7	2/0.2'	18	Dark yellowish brown (10YR 4/2), saturated, medium dense, fine SAND little subrounded to subangular fine to coarse gravel.				0.0	2.9
	7	12-14	9-6 7-9	2/0.2'	13	Dark yellowish brown (10YR 4/2), saturated, medium dense, fine SAND, some medium sand, little subrounded to subangular fine to coarse gravel.				0.0	1.7
	8	14-16	10-9 16-18	2/17'	25	Moderate yellowish brown (10YR 5/4), saturated, medium dense, subrounded to subangular fine to medium SAND, little subrounded to angular fine to coarse gravel, trace silt.				0.0	2.0
15	9	16-18	49-50/0.3	0.8/0.8'	50(+)	Moderate brown (5YR 4/4), saturated, extremely dense, subrounded to angular, fine to coarse SAND and GRAVEL, little silt.				1.2 (Dup 1.1)	1.1 (Dup 1.0)
	10	18-20	54-50/0.2	0.7/0.7'	50(+)	Moderate yellowish brown (5YR 4/4), saturated, extremely dense, subrounded to subangular fine to coarse SAND and GRAVEL.				0.0	0.0
20	11	20-22	50/0.3	0.3/0.3'	50(+)	Moderate brown (5YR 4/4), saturated, extremely dense, fine to medium SAND, little silt, trace fine angular gravel.				0.0	0.0

O'BRIEN & GERE ENGINEERS, INC.						TEST BORING LOG	REPORT OF BORING MW-3				
Client: Niagara Mohawk						Sampler: 2" Split Spoon		Page 1 of 2			
Proj. Loc: Fulton, NY						Hammer: 140 lbs.		Location:			
File No.: 1118.081						Fall: 30"		Start Date: 7/12/96 End Date: 7/12/96			
Boring Company: Parratt Wolff, Inc.						Screen		Grout			
Foreman: Brian Waters						Riser		Sand Pack			
OBG Geologist: Chawn O'Dell								Bentonite			
Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	Stratum Change General Descript	Equip. Installe	PID Over Spoon (PPM)	Jar Head Space (PPM)	
0	1	0-2	4-4 4-3	2/0.3'	8	Moderate yellowish brown (10YR 5/4), dry, loose, fine to medium SAND, little coarse sand, trace subangular, fine gravel.			0.0	0.0	
	2	2-4	2-4 14-15	2/1.2'	18	Moderate yellowish brown (10YR 5/4), moist, medium dense, medium SAND, some coarse sand, little fine subangular gravel, little ash and asphalt fragments, trace orange brick fragments.			0.0	0.0	
	3	4-6	3-2 3-2	2/0.5'	5	Dusky yellowish brown (10YR 2/2), moist, loose, asphalt (hard chunks), some fine to coarse sand, little ash.			0.0	0.0	
5	4	6-8	3-2 2-1	2/0.3'	4	Dusky yellowish brown (10YR 2/2), moist, loose, asphalt (hard chunks), some fine to coarse sand, little ash.			0.0	0.0	
	5	8-10	3-3 4-7	2/1.2'	7	Moderate yellowish brown (10YR 5/4), wet, loose, fine SAND, little medium sand, trace clay.			0.0	0.0	
10	6	10-12	5-11 14-15	2/1.7'	25	Pale yellowish brown (10YR 6/2), moist, hard, CLAY, little silt, trace fine sand.			0.0	0.0	
	7	12-14	7-10 9-14	2/2'	19	Pale yellowish brown (10YR 6/2), moist hard, CLAY, some silt, little fine sand.			0.0 (Dup. 0.0)	0.0 (Dup. 0.0)	
15	8	14-16	5-6 6-7	2/2'	12	Pale yellowish brown (10YR 6/2), saturated, medium dense, very fine SAND, some silt, little clay.			0.0	0.0	
	9	16-18	9-11 11-12	2/1.6'	22	Pale yellowish brown (10YR 6/2), saturated, very fine SAND, some silt, little clay.			0.0	0.0	
	10	18-20	15-9 14-5	2/0.4'	23	Pale brown (5YR 5/2), saturated, medium dense, fine to coarse, subrounded to angular, SAND and GRAVEL. Sheen- free product (strong odor).			5.6	210	
20	11	20-22	5-6 10-9	2/0.7	16	Pale brown (5YR 5/2), saturated, medium dense, fine to coarse, subrounded to angular, SAND and GRAVEL. (Sheen - strong odor).			3.2	270	

O'BRIEN & GERE ENGINEERS, INC.						TEST BORING LOG	REPORT OF BORING MW-4				
Client: Niagara Mohawk						Sampler: 2" Split Spoon		Page 1 of 2			
Proj. Loc: Fulton, NY						Hammer: 140 lbs.		Location:			
File No.: 1118.081						Fall: 30"		Start Date: 7/11/96 End Date: 7/11/96			
Boring Company: Parratt Wolff, Inc.						Screen		Grout			
Foreman: Brian Waters						Riser		Sand Pack			
OBG Geologist: Chawn O'Dell								Bentonite			
Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	Stratum Change General Descript	Equip. Installed	PID Over Spoon (PPM)	Jar Head Space (PPM)	
0	1	0-2	6	1.5/1.5'	10	Grayish brown (5YR 3/2), damp, medium dense, medium to coarse SAND, some angular fine to coarse gravel, little silt to fine sand. (0-0.5' asphalt and gravel).			0.0	0.0	
			4-9								
	2	2-4	5-9	2/1.4'	12	Grayish brown (5YR 3/2), moist, medium dense, medium SAND, some subrounded to angular, coarse sand and fine to medium gravel, little orange brick fragments.			0.0	0.0	
			3-4								
	3	4-6	41-10	2/0.4'	15	Light brown (5YR 6/4), moist, medium dense, fine to coarse subrounded to angular SAND and GRAVEL, some orange brick fragments.			0.0	0.0	
			5-5								
	4	6-8	47-100/0.3	0.8/0.5'	100+	Moderate reddish brown (10YR 4/6), damp, extremely dense BRICKS.			0.0	2.1	
			0.3								
	5	8-10	12-4	2/1.6'	7	Grayish black (N2), saturated, loose, fine to coarse, subrounded to angular SAND and GRAVEL, little silt, trace brick and concrete fragments, strong odor.			14.3	19.4	
			3-4						(Dup. 14.1)	(Dup. 18.9)	
	6	10-12	2-3	2/1.5'	10	Brownish black (5YR 2/1), saturated, medium dense, SILT and fine SAND, little medium sand, trace clay moderate odor.			15.2	21.2	
			7-6								
	7	12-14	10-11	2/1.3'	26	Brownish gray (5YR 4/1), saturated, medium dense, subrounded to angular, fine, to coarse SAND and GRAVEL, little silt, moderate odor.			6.1	8.3	
			15-27								
	8	14-16	3-7	2/0.6'	44	Brownish gray (5YR 4/1), saturated, dense, subrounded to angular, fine to coarse SAND and GRAVEL, little silt, moderate odor.			5.2	7.6	
			37-49								
	9	16-18'	50/0.2'	0.2/0.0		No Recovery.			N.A	N/A	
	10	18-20	3-5	2/1.2'	17	Light brownish gray (5YR 6/1), saturated, extremely dense, medium to coarse SAND, some fine to angular gravel, little silt, slight odor.			1.3	3.2	
			12-12								
	11	20-22	21-42	2/0.9'	79	Light brownish gray (5YR 6/1), saturated, extremely dense, medium to coarse SAND, some fine to angular gravel, little silt, slight odor.			1.7	3.6	
			37-46						(Dup. 1.5)	(Dup. 3.6)	
	12	22-24	5.0/0.4	0.4/0.4'	50(+)	Brownish black (5YR 2/1), saturated, extremely dense, fine to coarse subangular to angular SAND and GRAVEL, little silt, slight odor.			0.8	1.2	

REPORT OF BORING MW-6

Client: Niagara Mohawk Power Corporation
South Fulton Street Site
Proj. Loc: Fulton, NY

Drill Method: Hollow Stem Auger
Sampler: 2-inch Split Spoon
Hammer: 140 lbs

Page 2 of 2
Location:

Start Date: 6/17/98
End Date: 6/18/98

File No.: 1118.081

Fall: 30 inches

Boring Company:	Parratt/Wolff, Inc.
Foreman:	Glen Lansing
Drill Rig:	Inger Soll-Rand A-300
OBG Geologist:	Chawn O'Dell

Screen	=		\	Grout
Riser				Sand Pack
Steel	//			Bentonite

[illegible]

Notes: Well Installation: 2-inch x 0.020 inch slotted PVC Screen: 37- 27 ft Bentonite Seal: 24-22 ft
Sand Pack (1 Morie): 37-25 ft Sand Choke (00 Morie): 22-21 ft
Sand Choke (00 Morie): 25-24 ft Grout: to 0.5 ft

Finished as a flush mount well

CPO:ers/div76/4 notes/borings/2mw-6

REPORT OF BORING MW-7

Start Date: 6/17/98
End Date: 6/17/98

Screen	=		\	Grout
Riser				Sand Pack
Steel	//			Bentonite

CPO:ers/div76/4 notes/borings/rmw-7

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING

MW-8

Client: Niagara Mohawk Power Corporation
South Fulton Street Site
Proj. Loc: Fulton, NY

Drill Method: Hollow Stem Auger
Sampler: 2-inch Split Spoon
Hammer: 140 lbs

Page 1 of 1
Location:

Start Date: 6/16/98
End Date: 6/16/98

File No.: 1118.081

Fall: 30 inches

Boring Company: Parratt/Wolff, inc.
Foreman: Glen Lansing
Drill Rig: Inger Soli-Rand A-300
OBG Geologist: Chawn O'Dell

Screen =
Riser
Steel //

Grout
Sand Pack
Bentonite

Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	PID Head Space (ppm)	Equip. Installed	Field Testing PID (ppm)	UV Ligh
0	1	0-2	2-3	2.0/0.4	4	Dark yellowish brown (10YR 4/2), damp, loose, SILT, little fine to coarse gravel (subrounded), trace fine to medium sand, trace organic matter	0.0		0.0	Neg
1			1-1							
2	2	2-4	1-3	2.0/0.3	8	(Poor recovery) Grayish brown (5YR 3/2), damp, loose, fine to medium SAND, little silt, little coarse to fine gravel (subrounded), trace brick fragments	0.0		0.0	Neg
3			5-11							
4	3	4-6	5-6	2.0/0.4	13	(Poor recovery) Grayish brown (5YR 3/2), damp to wet (~5 ft), medium dense, coarse to fine cobble, brick fragments (subangular) little silt to coarse sand	0.0		0.0	Neg.
5			7-11							
6	4	6-8	5-11	2.0/0.7	47	Grayish brown (5YR 3/2), damp to wet, dense, fine to coarse GRAVEL/COBBLE FRAGMENTS (subrounded to subangular), little fine to coarse sand, trace brick fragments	0.0	=	0.0	Neg.
7			36-8					=		
8	5	8-10	3-2	2.0/1.5	5	Dusky brown (5YR 2/2), saturated, loose, SILT, little organics, trace fine sand	0.0	=	0.0	Neg
9			3-5					=		
10	6	10-12	4-4	2.0/1.8	12	Moderate yellowish brown (10YR 5/4), and dark gray (N3) mottling, wet, stiff CLAY, some silt, little very fine sand	0.0	=	0.0	Neg.
11			8-8					=		
12	7	12-14	4-9	2.0/1.7	18	Moderate yellowish brown (10YR 5/4), and dark gray (N3) mottling, wet, hard CLAY, some silt, little very fine sand	0.0	=	0.0	Neg.
13			9-11					=		
14	8	14-16	3-4	2.0/1.8	8	Moderate yellowish brown (10YR 5/4), and dark gray (N3) mottling, wet, stiff CLAY, some silt, little very fine sand to approx. 15 ft, then olive gray (5Y 4/1), saturated, stiff, silt and fine sand, little organic matter, little shells/shell fragments	0.0	=	0.0	Neg.
15			4-4					=		
16								=		
						Bottom of boring at 16 ft		=		

Notes: Well Installation: 2-inch x 0.020 inch slotted PVC Screen: 16-6 ft Bentonite Seal: 5-4.5 ft
Sand Pack (1 Morie): 6-5.5 ft Sand Choke (00 Morie): 4.5 -4 ft
Sand Choke (00 Morie): 5.5-5 ft Grout to surface

Finished as a stickup well

CPO:ers/div76/4_notes/borings/MW-8

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING MW-9

Client: Niagara Mohawk Power Corporation
South Fulton Street Site
Proj. Loc: Fulton, NY

Drill Method: Hollow Stem Auger
Sampler: 2-inch Split Spoon
Hammer: 140 lbs

Page 1 of 1
Location:

File No.: 1118.081

Fall: 30 inches

Start Date: 6/16/98
End Date: 6/16/98

Boring Company: Parratt/Wolff, Inc.
Foreman: Glen Lansing
Drill Rig: Inger Soli-Rand A-300
OBG Geologist: Chawn O'Dell

Screen	=		Grout
Riser			Sand Pack
Steel	//		Bentonite

Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	PID Head Space (ppm)	Equip. Installed	Field Testing PID (ppm)	
0	1	0-2	4-3	2.0/0.5	5	Brownish gray (5YR 4/1), damp, loose, fine to coarse SAND, some silt, little fine to medium gravel (sub-angular), trace brick fragments, trace organics	0.0	\	0.0	Neg
			2-9					\		
1								\		
2	2	2-4	14-8	2.0/0.6	17	Grayish brown (5YR 3/2), damp, medium dense, fine to coarse SAND, little fine to medium gravel (subangular), trace brick fragments	0.0	\	0.0	Neg
			9-9					\		
3								\		
4	3	4-6	4-4	2.0/1.8	8	Dark yellowish brown (10YR 4/2), damp to wet, loose, fine to medium SAND, little fine to medium gravel	0.0	\	0.0	Neg.
			4-4							
5										
6	4	6-8	2-2	2.0/2.0	6	Moderate yellowish brown (10YR 5/4), damp, firm, SILT, some clay, trace fine sand	0.0	=	0.0	Neg.
			4-6					=		
7								=		
8	5	8-10	2-4	2.0/2.0	9	Moderate yellowish brown (10YR 5/4), and dark gray (N3) mottling, damp to wet, stiff, CLAY, some silt	0.0	=	0.0	Neg.
			5-8					=		
9								=		
10	6	10-12	2-3	2.0/1.5	7	Moderate yellowish brown (10YR 5/4), and dark gray (N3) mottling, damp to wet, firm, CLAY, some silt to approx. 11.8 ft, then olive gray (5Y 4/1), saturated, firm, SILT and fine SAND, little organics matter, little shells/shell fragments	0.0	=	0.0	Neg.
			4-4					=		
11								=		
12	7	12-14	4-6	2.0/2.0	12	Moderate reddish brown (10R 4/6), saturated, medium dense, fine to medium SAND, little coarse sand to fine gravel (subangular)	0.0	=	0.0	Neg.
			6-9					=		
13								=		
14	8	14-16	4-5	2.0/2.0	9	Moderate reddish brown (10R 4/6), saturated, loose, fine to medium SAND, little coarse sand to fine gravel (subangular)	0.0	=	0.0	Neg.
			4-4					=		
15								=		
16	9	16-18	WOH-WOH	2.0/2.0	7	Grayish red (10R 4/2), saturated, loose, fine SAND, trace fine gravel (subangular)	0.0	=	0.0	Neg.
			7-9					=		
17								=		
18						Augers advanced to 16 ft, split spoon collected to 18 ft Bottom of boring at 18 ft	0.0	=		

Notes: Well Installation: 2-inch x 0.020 inch slotted PVC Screen: 16-6 ft Bentonite Seal: 5-4.5 ft
Sand Pack (1 Morie): 16-5.5 ft Grout to surface
Sand Choke (00 Morie): 5.5-4 ft Finished as a stickup well

CPO:ers/div76/4_notes/borings/mw-9

[illegible]**Notes:**

CPO:ers/div76/4 notes/borings/mw-10

O'BRIEN & GERE ENGINEERS, INC.						TEST BORING LOG		REPORT OF BORING PZ-1			
Client: Niagara Mohawk						Sampler: 2" Split Spoon		Page 1 of 2			
Proj. Loc: Fulton, NY						Hammer: 140 lbs		Location:			
File No.: 1118.081						Fall: 30"		Start Date: 7/10/96 End Date: 7/10/96			
Boring Company: Parratt Wolff, Inc.						Screen		=		Grout	
Foreman: Brian Waters						Riser		=		Sand Pack	
OBG Geologist: Chawn O'Dell								=		Bentonite	
Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	Stratum Change General Descript	Equip. Installed	PID Ove Spoon (PPM)	Jar Head Space (PPM)	
0	1	0-2	3-10	2'/1.3'	17	Dusky yellowish brown (10YR 2/2), medium dense, fine to medium SAND, some silt, little course sand, trace orange brick fragments.			0.0	0.0	
1			7-7								
2	2	2-4	8-10	2'/1.5'	18	Moderate reddish brown (10R 4/6), moist to wet, medium dense, medium subrounded to subangular SAND and orange brick fragments, little fine sand, trace coarse sand			0.0	0.0	
3			8-3								
4	3	4-6	13-50/ 0.2	0.7/0.3	50+	Moderate reddish brown (10R 4/6), damp, extremely dense, bricks and brick fragments			0.0	0.0	
5											
6	4	6-8	10-3	2'/0.6'	6	Brown gray (5YR 4/1), saturated, loose, SILT and fine SAND, little clay, trace fine, sub-rounded gravel			5.3	9.6	
7			3-4								
8	5	8-10	4-9	2'/1.7'	18	Light brownish gray (5YR 4/1), saturated, medium dense, fine SAND, some silt, little clay			1.3	3.7	
			9-10								
10	6	10-12	4-8	2'/1.2'	20	Light brownish gray (5YR 4/1), saturated, medium dense, fine SAND, some SILT, little clay, trace fine subrounded to subangular gravel			0.0	1.2	
11			12-9								
12	7	12-14	9-10	2'/1.5'	21	Light brownish gray (5YR 4/1), saturated, medium dense, fine SAND, some silt, little clay, trace subrounded to subangular fine gravel			0.0	0.0	
13			11-14								
14	8	14-16	16-14	2'/1.9'	26	Moderate brown (5YR 4/4), saturated, medium dense, fine to coarse subrounded to subangular SAND and GRAVEL			0.0	0.0	
15			12-10								
16	9	16-18	6-9	2'/2'	21	Moderate brown (5YR 4/4), saturated, medium dense, fine to coarse subrounded to subangular SAND and GRAVEL			0.0	0.0	
17			12-17								
18	10	18-20	12-18	2'/1.6'	35	Moderate brown (5YR 4/4), saturated, dense, subrounded to subangular, medium to coarse SAND, some fine gravel, little silt to fine sand			0.0	0.0	
19			17-15								
20	11	20-22	12-18	2'/0.5'	38	Moderate brown (5YR 4/4), saturated, dense, medium to coarse SAND, some fine sub-rounded to angular gravel, little fine sand			0.0 (Dup 0.0)	0.0 (Dup 0.0)	
21			20-17								

[illegible]

CPO:ers/4_n&d/PZ-1(2)

O'BRIEN & GERE ENGINEERS, INC.						TEST BORING LOG	REPORT OF BORING SB-1				
Client: Niagara Mohawk						Sampler: 2" Split Spoon		Page 1 of 2			
Proj. Loc: Fulton, NY						Hammer: 140 lbs		Location:			
File No.: 1118.081						Fall: 30"		Start Date: 7/12/96 End Date: 7/12/96			
Boring Company: Parratt Wolff, Inc.						Screen		=		Grout	
Foreman: Brian Waters						Riser				Sand Pack	
OBG Geologist: Chawn O'Dell										Bentonite	
Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description	Stratum Change General Descript	Equip. Installed	Field Testing PID Over Spoon (PPM)	Jar Head Space (PPM)	
0	1	0-2	-18	1.5'/0.1'	40	Dense, coarse angular GRAVEL, lodged in split spoon tip			0.0	0.0	
			22-5								
1											
2	2	2-4	3-1	2'/1.2'	6	Light brown (5YR 5/6), moist, loose, fine to medium SAND			0.0	0.0	
			5-6								
3											
4	3	4-6	7-7	2'/0.8'	17	Moderate yellowish brown (10YR 5/4), wet medium dense, fine SAND, little silt, trace medium sand			0.0	0.0	
			10-10								
5											
6	4	6-8	8-5	2'/1.3'	9	Moderate yellowish brown (10YR 5/4), saturated, loose fine to medium SAND, little silt, strong odor			65	275	
			4-7						(Dup-64)	(Dup-272)	
7											
8	5	8-10	8-10	2'/1.5'	20	Moderate yellowish brown (10YR 5/4), saturated, medium dense fine SAND, some silt			1.5	6.8	
			10-10								
9											
10	6	10-12	5-7	2'/0.0'	17	No recovery					
			10-8								
11											
12	7	12-14	10-11	2'/1.5'	23	Pale yellowish brown (10YR 6/2), saturated, medium dense, fine SAND, some very fine sand, little silt			0.0	2.2	
			12-10								
13											
14	8	14-16	6-7	2'/0.8'	18	Light brown (5YR 5/6), wet, medium dense, medium to coarse SAND, some subrounded to subangular fine to medium gravel, little fine sand to silt			0.0	2.9	
			11-7								
15											
16	9	16-18	20-25	2'/1.5'	60	Light brown (5YR 5/6), moist to wet, extremely dense, fine to medium SAND, some subrounded to subangular fine to coarse gravel, little coarse sand and silt			0.0	0.0	
			35-29								
17											
18	10	18-20	12-26	1.4'/0.9'	50+	Light brown (5YR 5/6), extremely dense, fine to medium SAND, some silt, little fine to coarse angular gravel, trace coarse sand			0.0	0.0	
			50/0.4'								
19											
20	11	20-22	27-45	1.9'/1.5'	50+	Light brown (5YR 5/6), extremely dense, fine to medium SAND, some silt, little fine to coarse angular gravel, trace coarse sand			0.0	0.0	
			49-50/0.4								
21											

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING SB-1

Client:	Niagara Mohawk
Proj. Loc:	Fulton, NY
File No.:	1118.081

Sampler: 2" Split Spoon
Hammer: 140 lbs
Fall: 30"

Page 2 of 2
Location:
Start Date: 7/12/96
End Date: 7/12/96

Start Date: 7/12/96

End Date: 7/12/96

Boring Company: Parratt Wolff, Inc.
Foreman: Brian Waters
OBG Geologist: Chawn O'Dell

Screen Riser

Stratum Change General Descript	Equip. Installed	Field Testing	
		PID Over Spoon (PPM)	Jar Head Space (PPM)

Depth Below Grade	No.	Depth (feet)	Blows /6"	Penetr/ Recovery	"N" Value	Sample Description

[illegible]

0.0	0.0

						fine to medium SAND, some silt, little fine to

						fine to medium SAND, some silt, little fine to

						fine to medium SAND, some silt, little fine to

						fine to medium SAND, some silt, little fine to

[illegible]

[illegible]

The borehole was backfilled to the surface with cement/bentonite grout. The asphalt was repaired with asphalt patch.

CPO:ers/4_n&d/sb-1(2)

[illegible]

[illegible]

[illegible]

[illegible][illegible]

Ground water sampling logs

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998Site Name Niagara MohawkLocation Fulton, NYProject No 1118.081.013.130Personnel James A. MooreWeather Sunny 90°Well # MW - 1Evacuation Metho Bottom Loading Stainless Steel BailorSampling Method Bottom Loading Stainless Steel Bailor

Well Information:

Depth of Well * 19.13 ft.Depth to Water * 4.99 ft.Length of Water Column 14.14 ft.Volume of Water in Well 2.30 gal.(s)3X Volume of Water in Well 6.90 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling 4 gal.(s)Did well go dry? Yes

* Measurements taken from

☒ x

Well Casing

☐

Protective Casing

☐

(Other, Specify)

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.507.0 Standard 7.0110.0 Standard 9.99

Conductivity Standard Readings

84 S Standard 1413 S Standard 1470 @ 25°

Water parameters:

Gallons
Removedinitial 65
2
84
3

 Temperature
Readingsinitial 23.2
16.8
16.2

 pH
Readingsinitial 7.94
7.81
7.76

 Conductivity
Readings uS/cminitial 399
672
687

 Turbidity
Readings NTUinitial 654
1152
>1000

Water Sample:

Time Collected 1530

Physical Appearance at Start

Color ColorlessOdor NoneTurbidity (> 100 NTU) 65.4Sheen/Free Product None

Physical Appearance at Sampling

Color Am/BrownOdor NoneTurbidity (> 100 NTU) >1000Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40ml</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>NONE</u>	<u> </u>
<u>1L TUB</u>	<u>AMBER GLASS</u>	<u>2</u>	<u>NO</u>	<u>NONE</u>	<u> </u>

Notes:

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998Site Name Niagara MohawkLocation Fulton, NYProject No 1118.081.013.130Personnel James A. MooreWeather SUNNY 90°FWell # MW - 2Evacuation Metho Bottom Loading Stainless Steel BailerSampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 13.38 ft.Depth to Water * 3.75 ft.Length of Water Column 9.63 ft.Volume of Water in Well 1.57 gal.(s)3X Volume of Water in Well 4.71 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling 5 gal.(s)Did well go dry? NO

(Other, Specify)

* Measurements taken from

☒ x

Well Casing

☐

Protective Casing

☐

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.007.0 Standard 7.0110.0 Standard 9.99

Conductivity Standard Readings

84 S Standard —1413 S Standard 1470 @ 27°C

Water parameters:

Gallons
Removedinitial 0.5
2
4
5

 Temperature
Readingsinitial 22.8
20.5
19.6
19.6

 pH
Readingsinitial 6.81
6.84
6.97
6.95

 Conductivity
Readings uS/cminitial 1032
1124
1071
1064

 Turbidity
Readings NTUinitial 27.8
1089
>1000
>1000

Water Sample:

Time Collected 1500

Physical Appearance at Start

Color ColorlessOdor SweetTurbidity (> 100 NTU) 27.8Sheen/Free Product None

Physical Appearance at Sampling

Color tanOdor SweetTurbidity (> 100 NTU) >1000Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40mL</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>None</u>	<u> </u>
<u>1L</u>	<u>GLASS</u>	<u>2</u>	<u>NO</u>	<u>None</u>	<u> </u>

Notes:

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998
 Site Name Niagara Mohawk
 Location Fulton, NY
 Project No 1118.081.013.130
 Personnel James A. Moore

Weather SUNNY 90°F
 Well # MW-3
 Evacuation Metho Bottom Loading Stainless Steel Bailer
 Sampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 18.93 ft.
 Depth to Water * 11.40 ft.
 Length of Water Column 7.53 ft.
 Volume of Water in Well 1.23 gal.(s)
 3X Volume of Water in Well 3.69 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC
 4" Diameter Well = 0.653 X LWC
 6" Diameter Well = 1.469 X LWC

Volume removed before sampling 4 gal.(s)
 Did well go dry? No

* Measurements taken from ☒ Well Casing ☐ Protective Casing ☐ (Other, Specify)

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.00
 7.0 Standard 7.01
 10.0 Standard 9.99

Conductivity Standard Readings

84 S Standard 1470 @ 27°C
 1413 S Standard

Water parameters:

Gallons Removed	Temperature Readings	pH Readings	Conductivity Readings uS/cm	Turbidity Readings NTU
initial <u>0.5</u>	initial <u>19.1</u>	initial <u>7.69</u>	initial <u>840</u>	initial <u>35.6</u>
<u>1.5</u>	<u>16.8</u>	<u>7.16</u>	<u>877</u>	<u>1,130</u>
<u>25</u>	<u>16.6</u>	<u>7.16</u>	<u>776</u>	<u>1,645</u>
<u>4</u>	<u>16.5</u>	<u>7.12</u>	<u>812</u>	<u>1,549</u>

Water Sample:

Time Collected 1100

Physical Appearance at Start

Color Colorless
 Odor None
 Turbidity (> 100 NTU) 35.6
 Sheen/Free Product None

Physical Appearance at Sampling

Color Brown
 Odor sewage
 Turbidity (> 100 NTU) 1,549
 Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40ml</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>None</u>	<u>—</u>
<u>1 Liter</u>	<u>GLASS</u>	<u>2</u>	<u>NO</u>	<u>None</u>	<u>—</u>

Notes:

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998
 Site Name Niagara Mohawk
 Location Fulton, NY
 Project No 1118.081.013.130
 Personnel James A. Moore

Weather SUNNY 90° F
 Well # MW - 4
 Evacuation Metho Bottom Loading Stainless Steel Bailer
 Sampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 15.98 ft.
 Depth to Water * 8.20 ft.
 Length of Water Column 7.78 ft.
 Volume of Water in Well 1.27 gal.(s)
 3X Volume of Water in Well 3.81 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling 4 gal.(s)
 Did well go dry? No

* Measurements taken from ☒ Well Casing ☐ Protective Casing ☐ (Other, Specify)

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.00
 7.0 Standard 7.01
 10.0 Standard 9.99

Conductivity Standard Readings

84 S Standard 1470 @ 27°C
 1413 S Standard 1470 @ 27°C

Water parameters:

Gallons
Removed

initial 0.5
1.5
3
4

Temperature
Readings

initial 23.4
19.1
18.0
17.9

pH
Readings

initial 6.97
6.49
6.39
6.40

Conductivity
Readings uS/cm

initial 933
1,130
1,100
1,110

Turbidity
Readings NTU

initial 220
694
812
613

Water Sample:

Time Collected 1245

Physical Appearance at Start

Color Yellow
 Odor Sweet
 Turbidity (> 100 NTU) 220
 Sheen/Free Product None

Physical Appearance at Sampling

Color Brown
 Odor Sweet
 Turbidity (> 100 NTU) 613
 Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40mL</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>None</u>	<u>—</u>
<u>1L</u>	<u>GLASS</u>	<u>2</u>	<u>NO</u>	<u>None</u>	<u>—</u>

Notes:

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998Site Name Niagara MohawkLocation Fulton, NYProject No 1118.081.013.130Personnel James A. Moore

Weather

OVERCAST 90°F

Well #

MW - 5Evacuation Metho Bottom Loading Stainless Steel BailerSampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 15.81 ft.Depth to Water * 7.48 ft.Length of Water Column 8.33 ft.Volume of Water in Well 1.36 gal.(s)3X Volume of Water in Well 4.08 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling

4.5 gal.(s)

Did well go dry?

N/A

(Other, Specify)

* Measurements taken from

☒ x

Well Casing

☐

Protective Casing

☐

Instrument Calibration:

pH Buffer Readings

4.0 Standard

4.00

7.0 Standard

7.01

10.0 Standard

9.99

Conductivity Standard Readings

84 S Standard

1413 S Standard

1470 @ 27°C

Water parameters:

Gallons
Removedinitial 0.5
1.5
3
4.5Temperature
Readingsinitial 21.8
18.1
16.9
16.8pH
Readingsinitial 6.80
6.67
6.59
6.54Conductivity
Readings uS/cminitial 655
781
887
907Turbidity
Readings NTUinitial 172
347
698
752

Water Sample:

Time Collected

1400

Physical Appearance at Start

Color

Odor

Turbidity (> 100 NTU)

Sheen/Free Product

tanSweet172None

Physical Appearance at Sampling

Color

Odor

Turbidity (> 100 NTU)

Sheen/Free Product

tan/brownSweet752None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40ml</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>NONE</u>	<u>---</u>
<u>1Ltr</u>	<u>GLASS</u>	<u>2</u>	<u>NO</u>	<u>NONE</u>	<u>---</u>

Notes: BAILEREQUIPMENT BLANK COLLECTED @ 1415 AFTER MW-5

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998
 Site Name Niagara Mohawk
 Location Fulton, NY
 Project No 1118.081.013.130
 Personnel James A. Moore

Weather Sunny 90°F
 Well # MW - 6
 Evacuation Method Bottom Loading Stainless Steel Bailer
 Sampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 36.62 ft.
 Depth to Water * 7.16 ft.
 Length of Water Column 29.46 ft.
 Volume of Water in Well 4.80 gal.(s)
 3X Volume of Water in Well 14.40 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC
 4" Diameter Well = 0.653 X LWC
 6" Diameter Well = 1.469 X LWC

Volume removed before sampling
 Did well go dry?

9.5 gal.(s)
Yes

* Measurements taken from ☒ Well Casing ☐ Protective Casing ☐ (Other, Specify)

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.00
 7.0 Standard 7.01
 10.0 Standard 9.99

Conductivity Standard Readings

84 S Standard
 1413 S Standard 1470 @ 27°C

Water parameters:

Gallons Removed	Temperature Readings	pH Readings	Conductivity Readings uS/cm	Turbidity Readings NTU
initial <u>0.5</u>	initial <u>26.1</u>	initial <u>7.45</u>	initial <u>447</u>	initial <u>39.7</u>
<u>5</u>	<u>16.7</u>	<u>7.61</u>	<u>469</u>	<u>760</u>
<u>X 9.004</u>	<u>16.6</u>	<u>7.75</u>	<u>483</u>	<u>> 1000</u>
<u>15</u>				

Water Sample:

Time Collected 1130

Physical Appearance at Start

Color Colorless
 Odor Slight Sweet
 Turbidity (> 100 NTU) 39.7
 Sheen/Free Product NONE

Physical Appearance at Sampling

Color Dark Brown
 Odor Slight Sweet
 Turbidity (> 100 NTU) None
 Sheen/Free Product Slight

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40ml</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>NONE</u>	<u>—</u>
<u>60ml</u>	<u>GLASS</u>	<u>2</u>	<u>NO</u>	<u>NONE</u>	<u>—</u>

Notes:

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998Site Name Niagara MohawkLocation Fulton, NYProject No 1118.081.013.130Personnel James A. MooreWeather SUNNY 90°Well # MW - 7Evacuation Metho Bottom Loading Stainless Steel BailerSampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 16.44 ft.Depth to Water * 8.90 ft.Length of Water Column 7.54 ft.Volume of Water in Well 1.23 gal.(s)3X Volume of Water in Well 3.69 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling 4 gal.(s)Did well go dry? NO

* Measurements taken from

☒ x

Well Casing

☐ Protective Casing

(Other, Specify)

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.007.0 Standard 7.0110.0 Standard 9.99

Conductivity Standard Readings

84 S Standard 14700.271413 S Standard 14700.27

Water parameters:

Gallons
Removedinitial 0.5
1.5
3
4Temperature
Readingsinitial 21.4
18.9
17.7
17.5pH
Readingsinitial 6.63
6.70
6.71
6.76Conductivity
Readings uS/cminitial 671
672
729
707Turbidity
Readings NTUinitial 12.3
154
422
701

Water Sample:

Time Collected 1330

Physical Appearance at Start

Color ColorlessOdor SLIGHTLY SWEETTurbidity (> 100 NTU) 12.3Sheen/Free Product None

Physical Appearance at Sampling

Color Thin / BrownOdor SLIGHTLY SWEETTurbidity (> 100 NTU) 701Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40ml</u>	<u>GLASS</u>	<u>9</u>	<u>NO</u>	<u>None</u>	<u>—</u>
<u>1Ltr</u>	<u>GLASS</u>	<u>10</u>	<u>NO</u>	<u>None</u>	<u>—</u>

Notes:

MS & MSD COLLECTED

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998
 Site Name Niagara Mohawk
 Location Fulton, NY
 Project No 1118.081.013.130
 Personnel James A. Moore

Weather SUNNY 85°F
 Well # MW - 8
 Evacuation Metho Bottom Loading Stainless Steel Bailer
 Sampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 18.02 ft.
 Depth to Water * 9.43 ft.
 Length of Water Column 8.59 ft.
 Volume of Water in Well 1.40 gal.(s)
 3X Volume of Water in Well 4.20 gal.(s)

Water Volume /ft. for:
 x 2" Diameter Well = 0.163 X LWC
 4" Diameter Well = 0.653 X LWC
 6" Diameter Well = 1.469 X LWC

Volume removed before sampling 45 gal.(s)
 Did well go dry? NO

* Measurements taken from ☒ Well Casing ☐ Protective Casing ☐ (Other, Specify)

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.00
 7.0 Standard 7.01
 10.0 Standard 9.99

Conductivity Standard Readings

84 S Standard 1470 @ 27°C
 1413 S Standard

Water parameters:

Gallons Removed

initial 0.3
1.5
3
4.5

Temperature Readings

initial 18.0
16.6
15.5
15.4

pH Readings

initial 5.48
6.06
6.19
6.27

Conductivity Readings uS/cm

initial 688
689
696
702

Turbidity Readings NTU

initial 15.2
46.9
34.7
36.8

Water Sample:

Time Collected 0930

Physical Appearance at Start

Color Colorless
 Odor None
 Turbidity (> 100 NTU) 15.2
 Sheen/Free Product None

Physical Appearance at Sampling

Color Colorless
 Odor None
 Turbidity (> 100 NTU) 36.8
 Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40 mL</u>	<u>GLASS</u>	<u>36</u>	<u>NO</u>	<u>None</u>	<u>—</u>
<u>1 Ltr</u>	<u>GLASS</u>	<u>24</u>	<u>NO</u>	<u>None</u>	<u>—</u>

Notes: FIELD DUPLICATION

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998Site Name Niagara MohawkLocation Fulton, NYProject No 1118.081.013.130Personnel James A. MooreWeather Sunny 85°FWell # MW-9Evacuation Metho Bottom Loading Stainless Steel BailerSampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 18.04 ft.Depth to Water * 8.56 ft.Length of Water Column 9.48 ft.Volume of Water in Well 1.55 gal.(s)3X Volume of Water in Well 4.65 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling 5 gal.(s)Did well go dry? NO

(Other, Specify)

* Measurements taken from

☒ x

Well Casing

☐

Protective Casing

☐

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.007.0 Standard 7.0110.0 Standard 9.99

Conductivity Standard Readings

84 S Standard 8491413 S Standard 1470 @ 27°

Water parameters:

Gallons
Removedinitial 0.5
2
4
5

Temperature
Readingsinitial 20.6
17.4
16.4
16.1

pH
Readingsinitial 6.93
6.88
6.84
6.80

Conductivity
Readings uS/cminitial 791
849
814
807

Turbidity
Readings NTUinitial 184
1114
946
831

Water Sample:

Time Collected 1000

Physical Appearance at Start

Color MILKYOdor NoneTurbidity (> 100 NTU) 184Sheen/Free Product None

Physical Appearance at Sampling

Color BrownOdor NoneTurbidity (> 100 NTU) 831Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40m</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>None</u>	<u>—</u>
<u>Liter</u>	<u>GLASS</u>	<u>2</u>	<u>NO</u>	<u>None</u>	<u>—</u>

Notes:

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998Site Name Niagara MohawkLocation Fulton, NYProject No 1118.081.013.130Personnel James A. MooreWeather SUNNY 90°FWell # MW - 90Evacuation Metho Bottom Loading Stainless Steel BailerSampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 31.80 ft.Depth to Water * 10.57 ft.Length of Water Column 21.23 ft.Volume of Water in Well 3.46 gal.(s)3X Volume of Water in Well 10.38 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling 10.5 gal.(s)Did well go dry? NO (None)

(Other, Specify)

* Measurements taken from

☒

Well Casing

☐

Protective Casing

☐

Instrument Calibration:

pH Buffer Readings

4.0 Standard 4.007.0 Standard 7.0110.0 Standard 9.99

Conductivity Standard Readings

84 S Standard 14701413 S Standard 1470

Water parameters:

Gallons
RemovedTemperature
ReadingspH
ReadingsConductivity
Readings uS/cmTurbidity
Readings NTUinitial 0.53710.5initial 19.215.815.315.1initial 6.817.247.317.19initial 1162138015162360initial 4.4454.2316647

Water Sample:

Time Collected 1030

Physical Appearance at Start

Color ColorlessOdor NoneTurbidity (> 100 NTU) 4.44Sheen/Free Product None

Physical Appearance at Sampling

Color BrownOdor NoneTurbidity (> 100 NTU) 447Sheen/Free Product None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40mL</u>	<u>GLASS</u>	<u>3</u>	<u>NO</u>	<u>None</u>	<u>—</u>
<u>1 Liter</u>	<u>GLASS</u>	<u>2</u>	<u>NO</u>	<u>None</u>	<u>—</u>

Notes:

O'Brien & Gere Engineers, Inc.

Standard Ground Water Sampling Log

Date July 16, 1998Site Name Niagara MohawkLocation Fulton, NYProject No 1118.081.013.130Personnel James A. MooreWeather Sunny 90°FWell # MW - 10Evacuation Metho Bottom Loading Stainless Steel BailerSampling Method Bottom Loading Stainless Steel Bailer

Well Information:

Depth of Well * 14.92 ft.Depth to Water * 7.91 ft.Length of Water Column 7.01 ft.Volume of Water in Well 1.14 gal.(s)3X Volume of Water in Well 3.42 gal.(s)

Water Volume /ft. for:

x 2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling

Did well go dry?

35

gal.(s)

No

(Other, Specify)

* Measurements taken from

☒ x

Well Casing

☐

Protective Casing

☐

Instrument Calibration:

pH Buffer Readings

4.0 Standard

7.0 Standard

10.0 Standard

4.007.019.99

Conductivity Standard Readings

84 S Standard

1413 S Standard

1470.25

Water parameters:

Gallons
RemovedTemperature
ReadingspH
ReadingsConductivity
Readings uS/cmTurbidity
Readings NTU

initial

0.51.52.53.5

initial

20.118.117.817.7

initial

7.317.047.147.03

initial

2060205020602070

initial

19.7948389266

Water Sample:

Time Collected

1215

Physical Appearance at Start

Color

Odor

Turbidity (> 100 NTU)

Sheen/Free Product

ColorlessNone19.7None

Physical Appearance at Sampling

Color

Odor

Turbidity (> 100 NTU)

Sheen/Free Product

BrownNone266None

Samples collected:

Container Size	Container Type	# Collected	Field Filtered	Preservative	Container pH
<u>40ml</u>	<u>GLASS</u>	<u>3</u>	<u>AD</u>	<u>None</u>	<u>—</u>
<u>1L</u>	<u>GLASS</u>	<u>2</u>	<u>AD</u>	<u>None</u>	<u>—</u>

Notes:

Hydraulic conductivity test plots

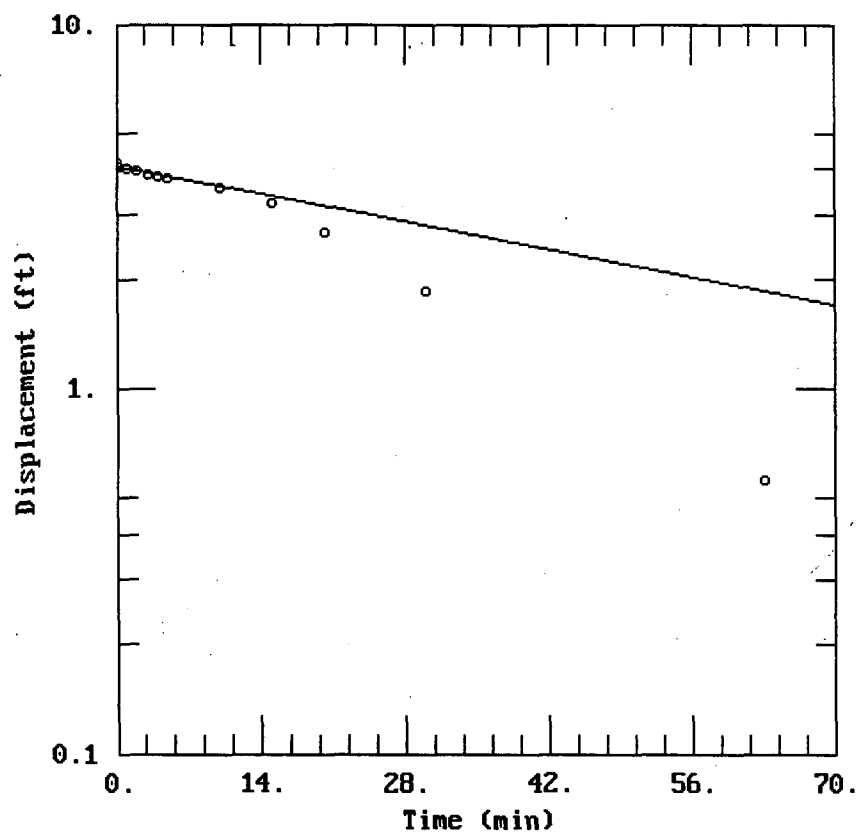
CLIENT: Niagara Mohawk Power Corp.

COMPANY: O'Brien & Gere Engineers, Inc.

LOCATION: Pulton, NY (MGP Site)

PROJECT: 1118.081

MW-1



DATA SET:
NMFMW1.DAT
08/21/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
 $H_0 = 4.14$ ft
 $r_c = 0.083$ ft
 $r_w = 0.33$ ft
 $L = 10.$ ft
 $b = 14.14$ ft
 $H = 14.14$ ft

PARAMETER ESTIMATES:
 $K = 6.03E-06$ cm/sec
 $y_0 = 4.039$ ft

0.0171 ft/day

AQTESOLV

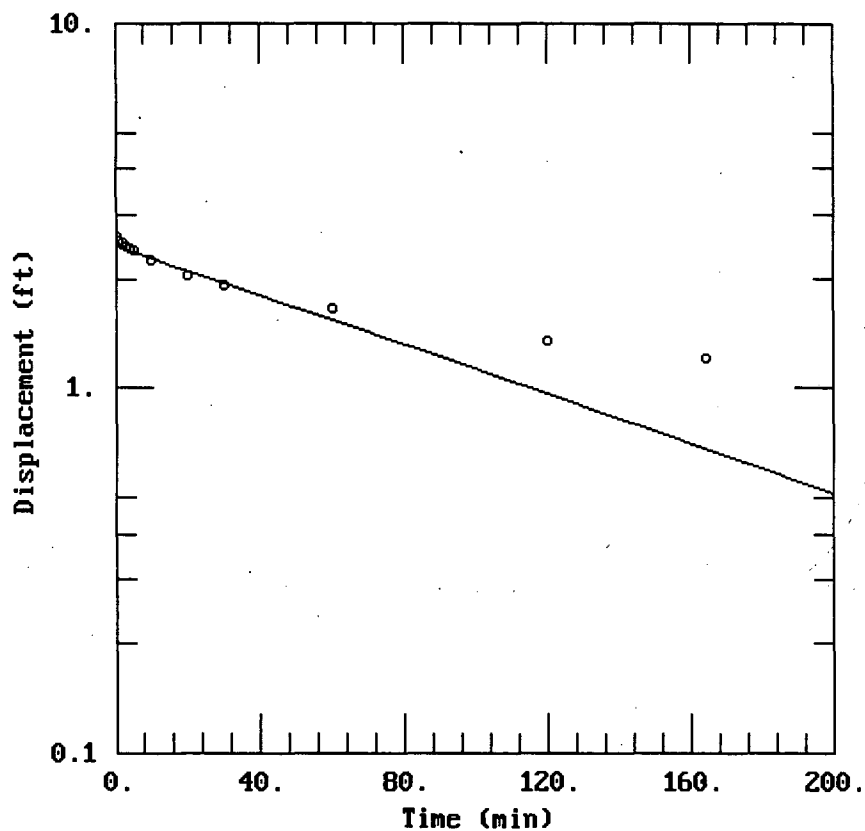
CLIENT: Niagara Mohawk Power Corp.

COMPANY: O'Brien & Gere Engineers, Inc.

LOCATION: Pulton, NY (MGP Site)

PROJECT: 1118.081

MW-6



DATA SET:
MMFW6.DAT
08/21/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
 $H_0 = 2.6$ ft
 $r_c = 0.083$ ft
 $r_w = 0.33$ ft
 $L = 10.$ ft
 $b = 29.46$ ft
 $H = 29.46$ ft

PARAMETER ESTIMATES:
 $K = 4.406E-06$ cm/sec
 $y_0 = 2.448$ ft

0.0125 ft/day

AQTESOLV

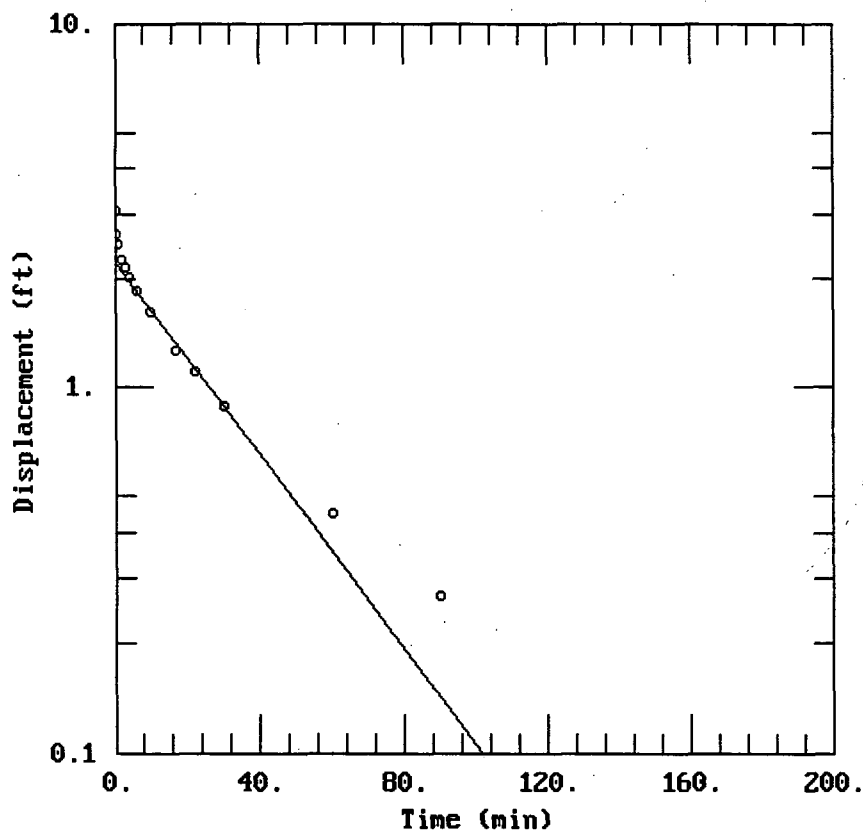
CLIENT: Niagara Mohawk Power Corp.

COMPANY: O'Brien & Gere Engineers, Inc.

LOCATION: Fulton, NY (NGP Site)

PROJECT: 1118.081

MW-7



DATA SET:
MMFMW7.DAT
08/21/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
 $H_0 = 3.06$ ft
 $r_c = 0.083$ ft
 $r_w = 0.33$ ft
 $L = 7.61$ ft
 $b = 7.61$ ft
 $H = 7.61$ ft

PARAMETER ESTIMATES:
 $K = 1.645E-05$ cm/sec
 $y_0 = 2.204$ ft

0.046 ft/day

AQTESOLV

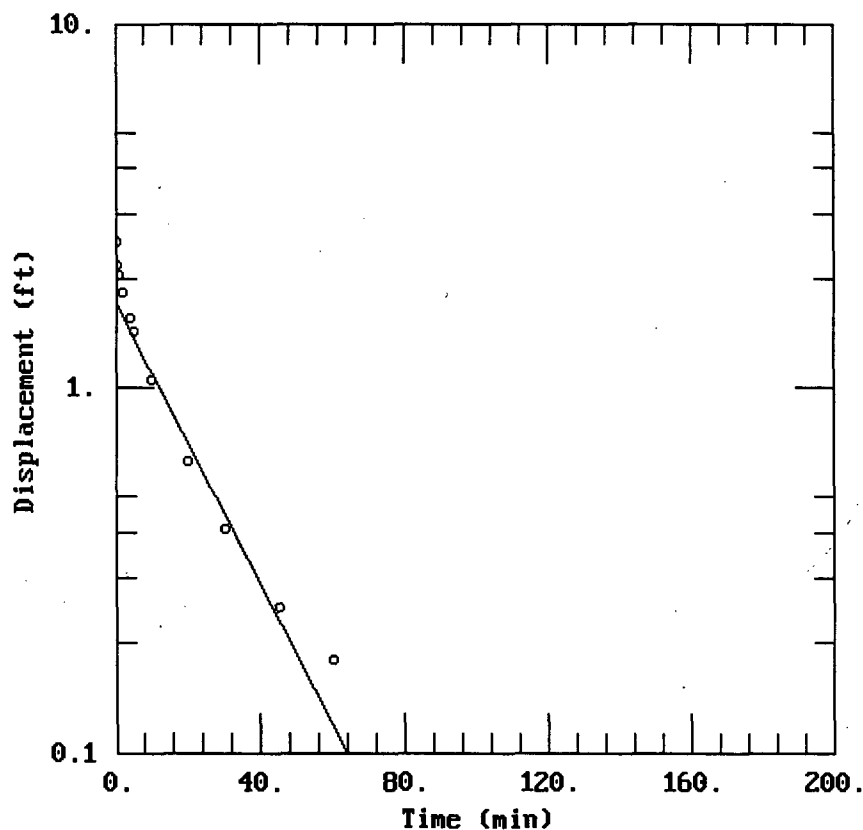
CLIENT: Niagara Mohawk Power Corp.

COMPANY: O'Brien & Gere Engineers, Inc.

LOCATION: Pulton, NY (MGP Site)

PROJECT: 1118.081

MW-9



DATA SET:
NNFMW9.DAT
08/21/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
 $H_0 = 2.52$ ft
 $r_c = 0.083$ ft
 $r_w = 0.33$ ft
 $L = 9.54$ ft
 $b = 9.54$ ft
 $H = 9.54$ ft

PARAMETER ESTIMATES:
 $K = 2.066E-05$ cm/sec
 $y_0 = 1.696$ ft

0.0586 ft/day

AQTESOLV

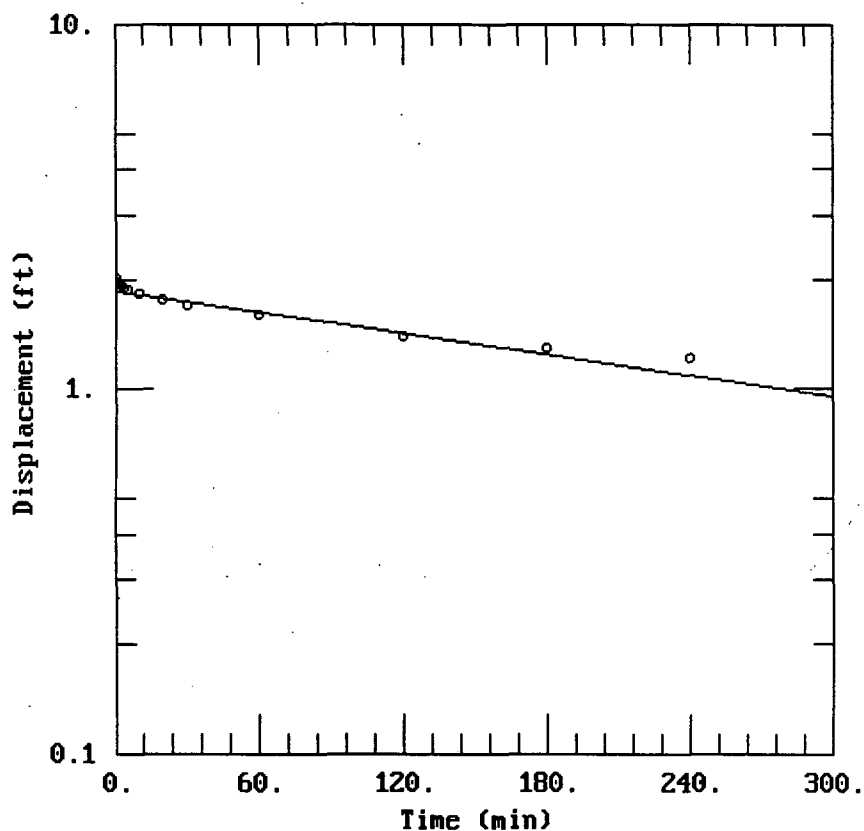
CLIENT: Niagara Mohawk Power Corp.

COMPANY: O'Brien & Gere Engineers, Inc.

LOCATION: Pulton, NY (MGP Site)

PROJECT: 1118.081

MW-9D



DATA SET:
NMFMW9D.DAT
08/21/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
 $H_0 = 2.01$ ft
 $r_c = 0.083$ ft
 $r_w = 0.33$ ft
 $L = 10.$ ft
 $b = 20.32$ ft
 $H = 20.32$ ft

PARAMETER ESTIMATES:
 $K = 1.149E-06$ cm/sec
 $y_0 = 1.841$ ft

0.0033

AQTESOLV

APPENDIX D

Ground water user survey summary

July 27, 1998

Mr. Gardiner Cross
Division of Environmental Remediation
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233-7010

RE: Groundwater Well Survey
Fulton (S. First St.) Site

Dear Mr. Cross:

Niagara Mohawk has substantially completed the monitoring well survey of property owners adjacent to the Fulton (S. First St.) Site as required by the focused RI/FS work plan. The purpose of the well survey was to determine if any domestic wells exist on the closest 12 properties adjacent to the site. A summary of the survey activities and the survey results are presented below:

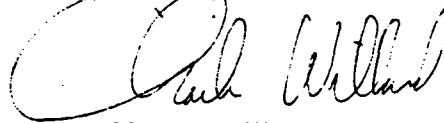
- The City of Fulton Water Department was contacted on April 8, 1998. Mr. Roger Parsons confirmed that all 12 adjacent properties are connected to the city water supply.
- A well survey questionnaire was sent to the 12 property owners on May 26, 1998. Seven property owners responded to the questionnaire. Copies of the responses are attached. All seven owners indicated that a well did not exist on their property.
- A second letter was sent to property owners and tenants on June 10, 1998. The letter presented the preliminary results of the questionnaire and provided responses to property owner comments.
- On June 29, Mr. Gary Robinson of the NYS Department of Health and I attempted to interview the five property owners that did not respond to the questionnaire. The property owners of 555 and 562 South First St. were interviewed and indicated that no well was present on their property. A vacancy notice was posted at the residence at 575 South First Street. Following the interviews, Mr. Robinson indicated that the remaining two property owners could be interviewed by telephone.
- The telephone numbers for the two remaining residences are not published in the telephone directory. The property at 580 South First St. is located two lots away from the site on the East (upgradient) Side of South First Street. The property owner resides in Davenport, Iowa. The property at 557 South First St. is located on the West Side of South First Street three lots

away from the site. This residence is located on the opposite side (south) of the site from the former canal bed.

- Mr. Gary Robinson was verbally provided the results of the well survey on July 27, 1998 and expressed his satisfaction with the survey results.

Please contact me (315)428-5015 if you have any questions or comments regarding the results of the well survey.

Sincerely,

A handwritten signature in cursive script, appearing to read "Charles Willard".

Charles Willard
Environmental Affairs Department

cc: Mr. Gary Robinson (NYSDOH, Syracuse)
Ms. D. Wright (OBG)
Internal Distribution List

**GROUNDWATER WELL SURVEY
CITY OF FULTON
SOUTH FIRST STREET**

Neighbor: Ray LaFrate

Residence: 579 S. First St., Fulton, NY 13069

The City of Fulton Water Department has advised Niagara Mohawk that your residence is connected to the city water supply system. Please indicate if you operate a groundwater well at your residence by marking the appropriate box below:

☐ YES, I operate a well at my residence in addition to receiving my city-supplied water.

☒ NO, I do not operate a well at my residence in addition to receiving my city-supplied water.

☐ I would feel more comfortable speaking to you in person to provide my response. Please contact me to arrange a personal interview.

If you have any comments or concerns regarding this questionnaire, please provide them in the space below, or attach an additional sheet if needed:

*Would this in any way affect
our drinking water - or any water
that we use?*

If you do not complete and return this questionnaire, it will be assumed that you desire a personal interview.

**GROUNDWATER WELL SURVEY
CITY OF FULTON
SOUTH FIRST STREET**

Neighbor: Rev. John Coleman

Residence: 2578 Co Rt 57, Fulton, NY 13069; as owner of 578 S. First St., Fulton, NY 13069

The City of Fulton Water Department has advised Niagara Mohawk that your residence is connected to the city water supply system. Please indicate if you operate a groundwater well at your residence by marking the appropriate box below:

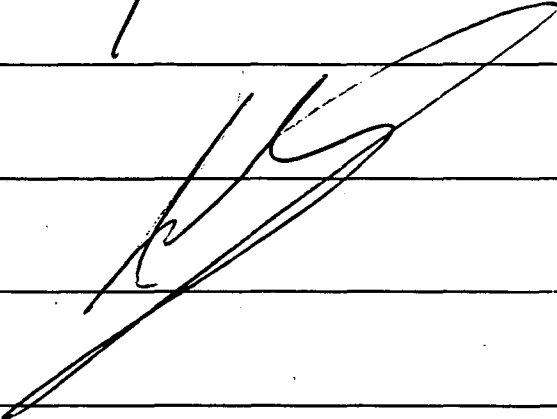
☐ YES, I operate a well at my residence in addition to receiving my city-supplied water.

☒ NO, I do not operate a well at my residence in addition to receiving my city-supplied water.

☐ I would feel more comfortable speaking to you in person to provide my response. Please contact me to arrange a personal interview.

If you have any comments or concerns regarding this questionnaire, please provide them in the space below, or attach an additional sheet if needed:

Thank you



If you do not complete and return this questionnaire, it will be assumed that you desire a personal interview.

**GROUNDWATER WELL SURVEY
CITY OF FULTON
SOUTH FIRST STREET**

Neighbor: The Crossroads Tabernacle Church
Residence: 576 S. First St., Fulton, NY 13069

The City of Fulton Water Department has advised Niagara Mohawk that your residence is connected to the city water supply system. Please indicate if you operate a groundwater well at your residence by marking the appropriate box below:

☐ YES, I operate a well at my residence in addition to receiving my city-supplied water.

☒ NO, I do not operate a well at my residence in addition to receiving my city-supplied water.

☐ I would feel more comfortable speaking to you in person to provide my response. Please contact me to arrange a personal interview.

If you have any comments or concerns regarding this questionnaire, please provide them in the space below, or attach an additional sheet if needed:

No Questions

Well Informed

Thanks

[Signature]

If you do not complete and return this questionnaire, it will be assumed that you desire a personal interview.

**GROUNDWATER WELL SURVEY
CITY OF FULTON
SOUTH FIRST STREET**

Neighbor: Nick Taranto

Residence: 556 S. First St., Fulton, NY 13069

The City of Fulton Water Department has advised Niagara Mohawk that your residence is connected to the city water supply system. Please indicate if you operate a groundwater well at your residence by marking the appropriate box below:

☐ YES, I operate a well at my residence in addition to receiving my city-supplied water.

☒ NO, I do not operate a well at my residence in addition to receiving my city-supplied water.

☐ I would feel more comfortable speaking to you in person to provide my response. Please contact me to arrange a personal interview.

If you have any comments or concerns regarding this questionnaire, please provide them in the space below, or attach an additional sheet if needed:

If you do not complete and return this questionnaire, it will be assumed that you desire a personal interview.

**GROUNDWATER WELL SURVEY
CITY OF FULTON
SOUTH FIRST STREET**

Neighbor: Joseph or Judy Catalone
Residence: 573 S. First St., Fulton, NY 13069

The City of Fulton Water Department has advised Niagara Mohawk that your residence is connected to the city water supply system. Please indicate if you operate a groundwater well at your residence by marking the appropriate box below:

☐ YES, I operate a well at my residence in addition to receiving my city-supplied water.

☒ NO, I do not operate a well at my residence in addition to receiving my city-supplied water.

☐ I would feel more comfortable speaking to you in person to provide my response. Please contact me to arrange a personal interview.

If you have any comments or concerns regarding this questionnaire, please provide them in the space below, or attach an additional sheet if needed:

If you do not complete and return this questionnaire, it will be assumed that you desire a personal interview.

**GROUNDWATER WELL SURVEY
CITY OF FULTON
SOUTH FIRST STREET**

Neighbor: Paul Lewchanin

Residence: 562 S. First St., Fulton, NY 13069

The City of Fulton Water Department has advised Niagara Mohawk that your residence is connected to the city water supply system. Please indicate if you operate a groundwater well at your residence by marking the appropriate box below:

☐ YES, I operate a well at my residence in addition to receiving my city-supplied water.

☒ NO, I do not operate a well at my residence in addition to receiving my city-supplied water.

☐ I would feel more comfortable speaking to you in person to provide my response. Please contact me to arrange a personal interview.

If you have any comments or concerns regarding this questionnaire, please provide them in the space below, or attach an additional sheet if needed:

If you do not complete and return this questionnaire, it will be assumed that you desire a personal interview.

**GROUNDWATER WELL SURVEY
CITY OF FULTON
SOUTH FIRST STREET**

Neighbor: George Ashby

Residence: 564 S. First St., Fulton, NY 13069

The City of Fulton Water Department has advised Niagara Mohawk that your residence is connected to the city water supply system. Please indicate if you operate a groundwater well at your residence by marking the appropriate box below:

☐ YES, I operate a well at my residence in addition to receiving my city-supplied water.

☒ NO, I do not operate a well at my residence in addition to receiving my city-supplied water.

☐ I would feel more comfortable speaking to you in person to provide my response. Please contact me to arrange a personal interview.

If you have any comments or concerns regarding this questionnaire, please provide them in the space below, or attach an additional sheet if needed:

NO COMMENTS. THANK YOU

If you do not complete and return this questionnaire, it will be assumed that you desire a personal interview.

APPENDIX E

DUSR

Data Validation Services

120 Cobble Creek Road P. O. Box 208

North Creek, N. Y. 12853

Phone 518-251-4429

1118.081

NiMO Fulton St

September 4, 1998

Timothy Eddy
O'Brien & Gere Engineers
5000 Brittonfield Parkway
Syracuse, NY 13221

RE: Data Usability Summary Report for NMPC-Fulton Site Data Packages
OBG Labs data packages for samples collected 6/16/98 through 7/16/98

Dear Mr. Eddy:

Review has been completed for the data packages generated by O'Brien and Gere Laboratories, pertaining to samples collected at the Niagara Mohawk Fulton Site. Twelve aqueous and fourteen soil field samples were analysed for BTEX and PAH. Four additional surface soil samples were processed for cyanide. Matrix spikes/duplicates, and equipment/trip blanks were also processed. Methodologies utilized are those of the 1995 NYSDEC ASP/SW846.

The data packages submitted contained full deliverables for validation, but this usability report is generated from review of the summary form information, with some review of associated raw data. Full validation has not been performed; however, the reported summary tables have been reviewed for application of validation qualifiers per USEPA Region II SOPs HW-2 and HW-6. All conclusions are based upon assumption of accurate reported values on the QC summary forms, and compliance in sample processing. The following items were reviewed:

- * Laboratory Narrative Discussion
- * Custody Documentation
- * Holding Times
- * Surrogate and Internal Standard Recoveries
- * Matrix Spike Recoveries/Duplicate Correlations
- * Field Duplicate Correlations
- * Preparation/Calibration Blanks
- * Control Spike/Laboratory Control Samples
- * Instrumental Tunes
- * Calibration Standards
- * Instrument IDLs
- * Method Compliance

Those items listed above which show deficiency are discussed within the text of this narrative. All other items were determined to be acceptable.

Attached to this narrative are client hardcopy spreadsheets of sample results, with validation qualifiers applied in red ink. Copies of laboratory case narratives and laboratory NYSDEC Sample Preparation and Analysis Summary Forms are attached to this text, and should be reviewed in conjunction with this report. No laboratory resubmissions were required.

The following text discusses quality issues of concern.

In summary, the sample results were generated from acceptable processing, and are usable with respect to project goals, with minor modifications/qualifications. The only item of concern is possible nonhomogeneity in samples exhibiting concentrations of target analytes (see Soil BTEX discussion).

SOIL SAMPLES

General

Field duplicate correlations were performed on samples MW-10(12-14) and SS-9 (cyanide only). All correlations were acceptable.

Accuracy and precision evaluations were performed on MW-6(10-12).

BTEX Analyses

The matrix spikes of MW-6(10-12) and the sample itself showed large inconsistencies in the concentrations of the target analytes (i.e. benzene and toluene recoveries out of range, and the ethylbenzene and xylene concentrations in the matrix spikes were ten times that of the sample). These variances are supported by the raw data. Sample nonhomogeneity is suspected. Results for the sample are considered estimated, and those for sample MW-6(6-8) (which also showed detections) should be used with similar caution. Variance was not observed in the PAH fractions of the sample.

Field duplicate correlation was acceptable.

The detection of benzene in MW-6(16-18) is rejected as possible carryover from the previous analysis. Results are edited to nondetection at the CRDL.

Semivolatile Analyses

All accuracy and precision values were acceptable except the precision of acenaphthene, which was slightly elevated. No qualification to results is indicated.

Field duplicate correlation was acceptable.

Sample MW-6(6-8) required a dilution of 1:500 to bring target analytes into calibration range. Due to the excessive analyte concentrations, the solvency of the extraction may have been exceeded, and results for this sample are considered estimated, possibly biased low.

Sample MW-6(6-8) and MW-6(10-12) showed matrix effect on internal standard recovery, and the appropriate qualifications (as estimated) to analytes has been made on the attached tables.

Cyanide Analyses

Processing was acceptable; no qualifications are indicated.

AQUEOUS SAMPLES

General

Field duplicate correlations were performed on sample MW-8. All correlations were acceptable.

Accuracy and precision evaluations were performed on MW-7.

Volatile Analyses

Accuracy and precision evaluations were acceptable.

Field duplicate correlation was acceptable.

No qualifications are indicated.

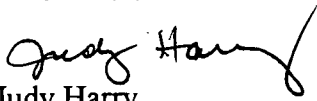
Semivolatile Analyses

Matrix spike recoveries, and laboratory and field duplicate correlations were acceptable.

Due to outlying standard response, benzo(g,h,i)perylene results in MW-3 and MW-6 are considered slightly estimated.

Please do not hesitate to contact me if questions or comments arise during your review of this report.

Very truly yours,


Judy Harry

Att.

DATA QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the national qualifiers assigned to results in the data review process. If the Regions choose to use additional qualifiers, a complete explanation of those qualifiers should accompany the data review.

- U** - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
- J** - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- N** - The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
- NJ** - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
- UJ** - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- R** - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

NARRATIVE

INTRODUCTION/ANALYTICAL RESULTS

This report summarizes the laboratory results for samples from the Niagara Mohawk Power Corporation - Fulton, NY Site.

CONDITION UPON RECEIPT/CHAIN OF CUSTODY

The coolers were received intact. When the coolers were received by the laboratory, the sample custodian(s) opened and inspected the shipments for damage, custody inconsistencies and proper preservation. Chain of custody documenting receipt are presented in the chain of custody section. Each sample was assigned a unique laboratory number and a custody file created. The samples were placed in a secured walk-in cooler and signed in and out by the chemists performing the tests. The sign out record, or lab chronicle, is presented in the chain of custody section.

No discrepancies were noted upon receipt. The cooler temperatures were 3 and 4°C.

METHODOLOGY

The following methods were used to perform the analyses:

PARAMETER	METHOD	REFERENCE
Volatile Organics (BTEX)	8260A	1
Semivolatile Organics (PAHs)	8270B	1

- 1) New York State Department of Environmental Conservation Analytical Services Protocol, October 1995.

QUALITY CONTROL

The quality control for this program includes internal standards, surrogates, matrix spike (MS), matrix spike duplicate (MSD), laboratory duplicate (D), blind duplicate, equipment blank, laboratory control sample (LCS), prep blank and QC trip blank samples. QA/QC results are summarized in the Laboratory Report and are also included in the raw data.

Volatile Organics

The GC/MS Volatile instruments used a J&W DB-VRX, 60 m x 0.25 mm ID capillary column and a Vocab 3000 trap.

There were no excursions to note. All QC results were within established control limits.

Semivolatile Organics

The GC/MS Semivolatile instruments used a J&W DB-5MS, 30 m X 0.25 mm ID capillary column.

Holding Times

All samples were prepared and analyzed within the method and/or QAPP specified holding time requirements.

Laboratory Control Sample

All spike recoveries met method and/or project specific QC requirements.

MS/MSD

All spike recovery and RPD data met method and/or project specific QC criteria.

Surrogates

The following sample(s) did not meet surrogate recovery criteria:

Sample Description	Sample #	Surrogate	Corrective Action
MW-4	J1806	Nitrobenzene-d5	1
MW-4	J1806DL	Nitrobenzene-d5	1
MW-5	J1808	Nitrobenzene-d5	1

1. Two (2) of the three (3) base/neutral and/or acid extractable surrogate recoveries passed laboratory criteria. In-house laboratory policy requires no further corrective action.

Internal Standard Areas

All internal standard areas met method and/or project specific QC criteria.

Calibrations

The following continuing calibration compound(s) exceeded method percent difference criteria:

Calibration Date	Instrument	Compound	Corrective Action
7/24/98	MS#6	Benzo[g,h,i]perylene	1
7/28/98	MS#6	Indeno[1,2,3]perylene	1
		Dibenz[a,h]anthracene	1
		Benzo[g,h,i]perylene	1

1. Method allows up to four excursions on continuing calibration verification as long as 40%D is not exceeded.

Preparation Blanks

All preparation blanks met method and/or project specific QC criteria.

RAW DATA

The raw data is organized according to the NYS DEC Contract Laboratory Program Category B order of data requirements.

NARRATIVE

INTRODUCTION/ANALYTICAL RESULTS

This report summarizes the laboratory results for samples from the Niagara Mohawk Power Corporation - Fulton, NY Site.

CONDITION UPON RECEIPT/CHAIN OF CUSTODY

The coolers were received intact. When the coolers were received by the laboratory, the sample custodian(s) opened and inspected the shipments for damage, custody inconsistencies and proper preservation. Chain of custody documenting receipt are presented in the chain of custody section. Each sample was assigned a unique laboratory number and a custody file created. The samples were placed in a secured walk-in cooler and signed in and out by the chemists performing the tests. The sign out record, or lab chronicle, is presented in the chain of custody section.

Discrepancies noted upon receipt are documented on the telephone conversation memo form included in the chain of custody section. The cooler temperatures were 4 and 5°C.

METHODOLOGY

The following methods were used to perform the analyses:

PARAMETER	METHOD	REFERENCE
Volatile Organics (BTEX)	8260A	1
Semivolatile Organics (PAHs)	8270B	1
Total Cyanide	335.2	1
Percent Total Solids	2540-G	2

- 1) New York State Department of Environmental Conservation Analytical Services Protocol, October 1995.
- 2) Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992.

QUALITY CONTROL

The quality control for this program includes internal standards, surrogates, matrix spike (MS), matrix spike duplicate (MSD), laboratory duplicate (D), blind duplicate, equipment blank, laboratory control sample (LCS), prep blank and QC trip blank samples. QA/QC results are summarized in the Laboratory Report and are also included in the raw data.

Volatile Organics

The GC/MS Volatile instruments used a J&W DB-VRX, 75 m x 0.45 mm ID capillary column and a Vocab 3000 trap.

Holding Times and Sample Preservation

All samples were prepared and analyzed within the method and/or QAPP specified holding time requirements.

Laboratory Control Sample

All spike recoveries met method and/or project specific QC criteria.

MS/MSD

The following compounds did not meet matrix spike/matrix spike duplicate percent recovery and/or RPD criteria:

Sample Description	Sample #	Compound	% REC	RPD	Corrective Action
MW-6 (10-12')	H8765	Benzene	X	X	1
		Toluene	X		1

1. The matrix-spike blank met criteria. No corrective action was taken.

Surrogate

All surrogate recoveries met method and/or project specific QC criteria.

Internal Standards

All internal standard areas met method and/or project specific QC criteria.

Calibrations

All calibrations and calibration verifications met method and/or project specific QC criteria.

Preparation Blanks

All preparation blanks met method and/or project specific QC criteria.

Semivolatile Organics

The GC/MS Semivolatile instruments used a J&W DB-5MS, 30 m X 0.25 mm ID capillary column.

Holding Times

All samples were prepared and analyzed within the method and/or QAPP specified holding time requirements.

Laboratory Control Sample

All spike recoveries met method and/or project specific QC requirements.

MS/MSD

The following compounds did not meet matrix spike/matrix spike duplicate RPD criteria:

Sample Description	Sample #	Compound	Corrective Action
MW-6 (10-12')	H8765	Acenaphthene	1

- 1 The MS and MSD percent recoveries met criteria. The matrix spike blank also met criteria. No corrective action was taken.

Surrogates

The following samples did not meet surrogate recovery criteria:

Sample Description	Sample #	Surrogate	Corrective Action
MW-6 (6-8')	H8764RE	Terphenyl-d14	1

1. Two (2) of the three (3) base/neutral and/or acid extractable surrogate recoveries passed laboratory criteria. In-house laboratory policy requires no further corrective action.

Internal Standard Areas

The internal standard area for the following samples did not meet abundance criteria:

Sample Description	Sample #	Internal Standard	Corrective Action
MW-6 (6-8')	H8764	Perylene-d12	1
MW-6 (10-12')	H8765	Perylene-d12	2
MW-6 (10-12')	H8765MS	Perylene-d12	2
MW-6 (10-12')	H8765MSD	Perylene-d12	2

1. The internal standard area was confirmed by reanalysis. Both sets of data are included. No further corrective action was taken.

1. The sample, MS and MSD showed similar results. No corrective action was taken.

Calibrations

All calibrations and calibration verifications met method and/or project specific QC criteria.

Preparation Blanks

All preparation blanks met method and/or project specific QC criteria.

Wet Chemistry

There were no excursions to note. All QC results were within established control limits.

RAW DATA

The raw data is organized according to the NYS DEC Contract Laboratory Program Category B order of data requirements.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE IDENTIFICATION AND ANALYTICAL REQUIREMENT SUMMARY

Customer Sample Code	Laboratory Sample Code	Analytical Requirements					
		VOA GC/MS Method #	BNA GC/MS Method #	VOA GC Method #	Pest PCBs Method #	Metals	Other
MW-8	J1800	8260	8270				
MW-9	J1801	8260	8270				
MW-9D	J1802	8260	8270				
MW-3	J1803	8260	8270				
MW-6	J1804	8260	8270				
MW-10	J1805	8260	8270				
MW-4	J1806	8260	8270				
MW-7	J1807	8260	8270				
MW-7	J1807MS	8260	8270				
MW-7	J1807MSD	8260	8270				
MW-5	J1808	8260	8270				
Bailer Equipment Blank	J1809	8260	8270				
MW-2	J1810	8260	8270				
MW-1	J1811	8260	8270				
Blind Duplicate	J1812	8260	8270				
QC Trip Blank	J1813	8260					

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

**SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOLATILE (VOA)
ANALYSIS**

Laboratory Sample ID	Matrix	Date Collected	Date Rec'd at Lab	Date Extracted	Date Analyzed
J1800	WATER	7/16/98	7/17/98		7/23/98
J1801	WATER	7/16/98	7/17/98		7/23/98
J1802	WATER	7/16/98	7/17/98		7/23/98
J1803	WATER	7/16/98	7/17/98		7/23/98
J1804	WATER	7/16/98	7/17/98		7/24/98
J1805	WATER	7/16/98	7/17/98		7/23/98
J1806	WATER	7/16/98	7/17/98		7/23/98
J1807	WATER	7/16/98	7/17/98		7/23/98
J1807MS	WATER	7/16/98	7/17/98		7/24/98
J1807MSD	WATER	7/16/98	7/17/98		7/24/98
J1808	WATER	7/16/98	7/17/98		7/23/98
J1809	WATER	7/16/98	7/17/98		7/24/98
J1810	WATER	7/16/98	7/17/98		7/24/98
J1811	WATER	7/16/98	7/17/98		7/24/98
J1812	WATER	7/16/98	7/17/98		7/24/98
J1813	WATER		7/17/98		7/23/98

SAMPLE PREPARATION AND ANALYSIS SUMMARY

SEMIVOLATILE(BNA) ANALYSES

4

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE IDENTIFICATION AND ANALYTICAL REQUIREMENT SUMMARY

Customer Sample Code	Laboratory Sample Code	Analytical Requirements					
		VOA GC/MS Method #	BNA GC/MS Method #	VOA GC Method #	Pest PCBs Method #	Metals	Other
MW-8 (8-10')	H8529	8260	8270				2540-G
MW-9 (10-12')	H8530	8260	8270				2540-G
Blind Duplicate	H8531	8260	8270				2540-G
MW-10 (6-8')	H8532	8260	8270				2540-G
MW-10 (12-14')	H8533	8260	8270				2540-G
QC Trip Blank	H8534	8260					
MW-7 (4-6')	H8763	8260	8270				2540-G
MW-6 (6-8')	H8764	8260	8270				2540-G
MW-6 (10-12')	H8765	8260	8270				2540-G
MW-6 (10-12')	H8765MS	8260	8270				
MW-6 (10-12')	H8765MSD	8260	8270				
MW-6 (10-12')	H8765D						2540-G
MW-6 (16-18')	H8766	8260	8270				2540-G
MW-6 (24-24.7')	H8767	8260	8270				2540-G
MW-6 (32-34')	H8768	8260	8270				2540-G
MW-9D (18-20')	H8769	8260	8270				2540-G
MW-9D (26-26.9')	H8770	8260	8270				2540-G
Equipment Blank	H8771	8260	8270				
Potable Water	H8772	8260	8270				
QC Trip Blank	H8773	8260					
SS-7	H8905						335.2 2540-G
SS-7	H8905MS						335.2 2540-G

SAMPLE IDENTIFICATION AND ANALYTICAL REQUIREMENT SUMMARY

[illegible]

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOLATILE (VOA)
ANALYSIS

Laboratory Sample ID	Matrix	Date Collected	Date Rec'd at Lab	Date Extracted	Date Analyzed
H8529	SOIL	6/16/98	6/17/98		6/19/98
H8530	SOIL	6/16/98	6/17/98		6/19/98
H8531	SOIL		6/17/98		6/19/98
H8532	SOIL	6/17/98	6/17/98		6/19/98
H8533	SOIL	6/17/98	6/17/98		6/19/98
H8534	WATER		6/17/98		6/19/98
H8763	SOIL	6/17/98	6/19/98		6/24/98
H8764	SOIL	6/17/98	6/19/98		6/24/98
H8765	SOIL	6/17/98	6/19/98		6/24/98
H8765MS	SOIL	6/17/98	6/19/98		6/24/98
H8765MSD	SOIL	6/17/98	6/19/98		6/24/98
H8766	SOIL	6/17/98	6/19/98		6/25/98
H8767	SOIL	6/17/98	6/19/98		6/24/98
H8768	SOIL	6/18/98	6/19/98		6/25/98
H8769	SOIL	6/18/98	6/19/98		6/24/98
H8770	SOIL	6/18/98	6/19/98		6/25/98
H8771	WATER	6/18/98	6/19/98		6/25/98
H8772	WATER	6/18/98	6/19/98		6/24/98
H8773	WATER		6/19/98		6/24/98

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

**SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOLATILE (VOA)
ANALYSIS**

Laboratory Sample ID	Matrix	Date Collected	Date Rec'd at Lab	Low Level Med Level	Date Analyzed
H8529	SOIL	6/16/98	6/17/98	LOW	6/19/98
H8530	SOIL	6/16/98	6/17/98	LOW	6/19/98
H8531	SOIL		6/17/98	LOW	6/19/98
H8532	SOIL	6/17/98	6/17/98	LOW	6/19/98
H8533	SOIL	6/17/98	6/17/98	LOW	6/19/98
H8534	WATER		6/17/98	LOW	6/19/98
H8763	SOIL	6/17/98	6/19/98	LOW	6/24/98
H8764	SOIL	6/17/98	6/19/98	LOW	6/24/98
H8765	SOIL	6/17/98	6/19/98	LOW	6/24/98
H8765MS	SOIL	6/17/98	6/19/98	LOW	6/24/98
H8765MSD	SOIL	6/17/98	6/19/98	LOW	6/24/98
H8766	SOIL	6/17/98	6/19/98	LOW	6/25/98
H8767	SOIL	6/17/98	6/19/98	LOW	6/24/98
H8768	SOIL	6/18/98	6/19/98	LOW	6/25/98
H8769	SOIL	6/18/98	6/19/98	LOW	6/24/98
H8770	SOIL	6/18/98	6/19/98	LOW	6/25/98
H8771	WATER	6/18/98	6/19/98	LOW	6/25/98
H8772	WATER	6/18/98	6/19/98	LOW	6/24/98
H8773	WATER		6/19/98	LOW	6/24/98

[illegible]

Soil vapor laboratory report



Performance Analytical Inc.

Air Quality Laboratory

LABORATORY REPORT

Client:	O'BRIEN & GERE ENGINEERS, INC.	Date of Report:	07/10/98
Address:	5000 Brittonfield Parkway	Date Received:	06/23/98
	Syracuse, NY 13221	PAI Project No:	P9801041
Contact:	Mr. Tim Eddy	Purchase Order:	Verbal
Client Project ID:	Niagara Mohawk Power Corporation	New York ELAP ID:	#11221

Four (4) Tedlar Bag Samples labeled:

"SV-1" "SV-2" "SV-3" "Blind Duplicate"

Five (5) PUF/XAD-2 Samples labeled:

"SV-1" "SV-2" "SV-3" "Blind Duplicate" "Trip Blank"

The samples were received at the laboratory under chain of custody on June 23, 1998. The samples were received intact. The dates of analyses are indicated on the attached data sheets.

BTEX Analysis

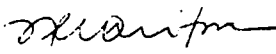
The Tedlar bags were analyzed for Benzene, Toluene, Ethylbenzene and total Xylenes according to modified CARB Method 410 using a gas chromatograph equipped with a photoionization detector.

Polynuclear Aromatic Hydrocarbons Analysis

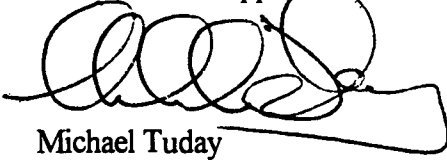
The PUF/XAD-2 cartridges were analyzed for polynuclear aromatic hydrocarbons (PAHs) using combined gas chromatography/mass spectrometry (GC/MS) according to the methodology outlined in EPA Method TO-13 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600/4-84-041, U.S. Environmental Protection Agency, Research Triangle Park, NC, April, 1984. The analyses were performed using a Hewlett-Packard Model 5890 Series II gas chromatograph/ Model 5971 mass selective detector equipped with a Model 7673A robot arm autoinjector. A 5% Phenyl/95% Dimethylpolysiloxane capillary column (RT_x-5, Restek Corporation, Bellefonte, PA) was used to achieve chromatographic separation.

The results of analyses are given on the attached data sheets.

Data Release Authorization:


Nelyn Quitoviera
Analytical Chemist

Reviewed and Approved:


Michael Tuday
Laboratory Director



Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : SV-1
PAI Sample ID : P9801041-001A

Test Code : Modified CARB Method 410
Analyst : J. Dan Taliaferro
Instrument : HP5890/PID #2
Matrix : Tedlar Bag

Date Sampled : 6/22/98
Date Received : 6/23/98
Date Analyzed : 6/23/98
Volume(s) Analyzed : 1.00 ml

D.F. = 1.00

CAS #	COMPOUND	RESULT	REPORTING	RESULT	REPORTING
		mg/m ³	LIMIT mg/m ³	ppm	LIMIT ppm
71-43-2	Benzene	ND	0.16	ND	0.050
108-88-3	Toluene	ND	0.19	ND	0.050
100-41-4	Ethylbenzene	ND	0.22	ND	0.050
1330-20-7	m- & p-Xylenes	ND	0.22	ND	0.050
95-47-6	o-Xylene	ND	0.22	ND	0.050

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : SV-2

PAI Sample ID : P9801041-002A

Test Code : Modified CARB Method 410

Analyst : J. Dan Taliaferro

Instrument : HP5890/PID #2

Matrix : Tedlar Bag

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Analyzed : 6/23/98

Volume(s) Analyzed : 1.00 ml

D.F. = 1.00

CAS #	COMPOUND	RESULT mg/m ³	REPORTING LIMIT mg/m ³	RESULT ppm	REPORTING LIMIT ppm
71-43-2	Benzene	ND	0.16	ND	0.050
108-88-3	Toluene	ND	0.19	ND	0.050
100-41-4	Ethylbenzene	ND	0.22	ND	0.050
1330-20-7	m- & p-Xylenes	ND	0.22	ND	0.050
95-47-6	o-Xylene	ND	0.22	ND	0.050

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RG

Date : 7/9/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : SV-3

PAI Sample ID : P9801041-003A

Test Code : Modified CARB Method 410

Analyst : J. Dan Taliaferro

Instrument : HP5890/PID #2

Matrix : Tedlar Bag

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Analyzed : 6/23/98

Volume(s) Analyzed : 1.00 ml

D.F. = 1.00

CAS #	COMPOUND	RESULT mg/m ³	REPORTING LIMIT mg/m ³	RESULT ppm	REPORTING LIMIT ppm
71-43-2	Benzene	ND	0.16	ND	0.050
108-88-3	Toluene	ND	0.19	ND	0.050
100-41-4	Ethylbenzene	ND	0.22	ND	0.050
1330-20-7	m- & p-Xylenes	ND	0.22	ND	0.050
95-47-6	o-Xylene	ND	0.22	ND	0.050

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : Blind Duplicate

PAI Sample ID : P9801041-004A

Test Code : Modified CARB Method 410

Analyst : J. Dan Taliaferro

Instrument : HP5890/PID #2

Matrix : Tedlar Bag

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Analyzed : 6/23/98

Volume(s) Analyzed : 1.00 ml

D.F. = 1.00

CAS #	COMPOUND	RESULT mg/m ³	REPORTING LIMIT mg/m ³	RESULT ppm	REPORTING LIMIT ppm
71-43-2	Benzene	ND	0.16	ND	0.050
108-88-3	Toluene	ND	0.19	ND	0.050
100-41-4	Ethylbenzene	ND	0.22	ND	0.050
1330-20-7	m- & p-Xylenes	ND	0.22	ND	0.050
95-47-6	o-Xylene	ND	0.22	ND	0.050

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RG

Date : 7/8/98



Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : Blind Duplicate

PAI Sample ID : P9801041-004A (Laboratory Duplicate)

Test Code : Modified CARB Method 410

Analyst : J. Dan Taliaferro

Instrument : HP5890/PID #2

Matrix : Tedlar Bag

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Analyzed : 6/23/98

Volume(s) Analyzed : 1.00 ml

D.F. = 1.00

CAS #	COMPOUND	RESULT mg/m ³	REPORTING LIMIT mg/m ³	RESULT ppm	REPORTING LIMIT ppm
71-43-2	Benzene	ND	0.16	ND	0.050
108-88-3	Toluene	ND	0.19	ND	0.050
100-41-4	Ethylbenzene	ND	0.22	ND	0.050
1330-20-7	m- & p-Xylenes	ND	0.22	ND	0.050
95-47-6	o-Xylene	ND	0.22	ND	0.050

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : N/A

PAI Sample ID : PAI Method Blank

Test Code : Modified CARB Method 410

Analyst : J. Dan Taliaferro

Instrument : HP5890/PID #2

Matrix : Tedlar Bag

Date Sampled : N/A

Date Received : N/A

Date Analyzed : 6/23/98

Volume(s) Analyzed : 1.00 ml

D.F. = 1.00

CAS #	COMPOUND	RESULT mg/m ³	REPORTING LIMIT mg/m ³	RESULT ppm	REPORTING LIMIT ppm
71-43-2	Benzene	ND	0.16	ND	0.050
108-88-3	Toluene	ND	0.19	ND	0.050
100-41-4	Ethylbenzene	ND	0.22	ND	0.050
1330-20-7	m- & p-Xylenes	ND	0.22	ND	0.050
95-47-6	o-Xylene	ND	0.22	ND	0.050

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : SV-1

PAI Sample ID : P9801041-001B

Test Code : Modified EPA TO-13

Analyst : Nelyn Quitoviera

Instrument : HP5890II/MSD

Matrix : PUF/XAD-2

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Extracted : 6/23/98

Date Analyzed : 6/24/98

D.F. = 1.00

CAS #	COMPOUND	RESULT µg/Sample	REPORTING LIMIT µg/Sample
91-20-3	Naphthalene	ND	0.25
208-96-8	Acenaphthalene	ND	0.25
83-32-9	Acenaphthene	ND	0.25
86-73-7	Fluorene	ND	0.25
85-01-8	Phenanthrene	ND	0.25
120-12-7	Anthracene	ND	0.25
206-44-0	Fluoranthene	ND	0.25
129-00-0	Pyrene	ND	0.25
56-55-3	Benzo(a)anthracene	ND	0.25
218-01-9	Chrysene	ND	0.25
205-99-2	Benzo(b)Fluoranthene	ND	0.25
207-08-9	Benzo(k)Fluoranthene	ND	0.25
50-32-8	Benzo(a)Pyrene	ND	0.25
193-39-5	Indeno(1,2,3-cd)pyrene	ND	0.25
53-70-3	Dibenzo(a,h)anthracene	ND	0.25
191-24-2	Benzo(g,h,i)perylene	ND	0.25

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : SV-2

PAI Sample ID : P9801041-002B

Test Code : Modified EPA TO-13

Analyst : Nelyn Quitoviera

Instrument : HP5890II/MSD

Matrix : PUF/XAD-2

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Extracted : 6/25/98

Date Analyzed : 6/26/98

D.F. = 1.00

CAS #	COMPOUND	RESULT µg/Sample	REPORTING LIMIT µg/Sample
91-20-3	Naphthalene	ND	0.25
208-96-8	Acenaphthalene	ND	0.25
83-32-9	Acenaphthene	ND	0.25
86-73-7	Fluorene	ND	0.25
85-01-8	Phenanthrene	ND	0.25
120-12-7	Anthracene	ND	0.25
206-44-0	Fluoranthene	ND	0.25
129-00-0	Pyrene	ND	0.25
56-55-3	Benzo(a)anthracene	ND	0.25
218-01-9	Chrysene	ND	0.25
205-99-2	Benzo(b)Fluoranthene	ND	0.25
207-08-9	Benzo(k)Fluoranthene	ND	0.25
50-32-8	Benzo(a)Pyrene	ND	0.25
193-39-5	Indeno(1,2,3-cd)pyrene	ND	0.25
53-70-3	Dibenzo(a,h)anthracene	ND	0.25
191-24-2	Benzo(g,h,i)perylene	ND	0.25

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/9/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : SV-3

PAI Sample ID : P9801041-003B

Test Code : Modified EPA TO-13

Analyst : Nelyn Quitoviera

Instrument : HP5890II/MSD

Matrix : PUF/XAD-2

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Extracted : 6/25/98

Date Analyzed : 6/26/98

D.F. = 1.00

CAS #	COMPOUND	RESULT µg/Sample	REPORTING LIMIT µg/Sample
91-20-3	Naphthalene	ND	0.25
208-96-8	Acenaphthalene	ND	0.25
83-32-9	Acenaphthene	ND	0.25
86-73-7	Fluorene	ND	0.25
85-01-8	Phenanthrene	ND	0.25
120-12-7	Anthracene	ND	0.25
206-44-0	Fluoranthene	ND	0.25
129-00-0	Pyrene	ND	0.25
56-55-3	Benzo(a)anthracene	ND	0.25
218-01-9	Chrysene	ND	0.25
205-99-2	Benzo(b)Fluoranthene	ND	0.25
207-08-9	Benzo(k)Fluoranthene	ND	0.25
50-32-8	Benzo(a)Pyrene	ND	0.25
193-39-5	Indeno(1,2,3-cd)pyrene	ND	0.25
53-70-3	Dibenzo(a,h)anthracene	ND	0.25
191-24-2	Benzo(g,h,i)perylene	ND	0.25

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : Blind Duplicate

PAI Sample ID : P9801041-004B

Test Code : Modified EPA TO-13

Analyst : Nelyn Quitoviera

Instrument : HP5890II/MSD

Matrix : PUF/XAD-2

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Extracted : 6/25/98

Date Analyzed : 6/26/98

D.F. = 1.00

CAS #	COMPOUND	RESULT µg/Sample	REPORTING LIMIT µg/Sample
91-20-3	Naphthalene	ND	0.25
208-96-8	Acenaphthalene	ND	0.25
83-32-9	Acenaphthene	ND	0.25
86-73-7	Fluorene	ND	0.25
85-01-8	Phenanthrene	ND	0.25
120-12-7	Anthracene	ND	0.25
206-44-0	Fluoranthene	ND	0.25
129-00-0	Pyrene	ND	0.25
56-55-3	Benzo(a)anthracene	ND	0.25
218-01-9	Chrysene	ND	0.25
205-99-2	Benzo(b)Fluoranthene	ND	0.25
207-08-9	Benzo(k)Fluoranthene	ND	0.25
50-32-8	Benzo(a)Pyrene	ND	0.25
193-39-5	Indeno(1,2,3-cd)pyrene	ND	0.25
53-70-3	Dibenzo(a,h)anthracene	ND	0.25
191-24-2	Benzo(g,h,i)perylene	ND	0.25

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RG

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : Trip Blank

PAI Sample ID : P9801041-005

Test Code : Modified EPA TO-13

Analyst : Nelyn Quitoviera

Instrument : HP5890II/MSD

Matrix : PUF/XAD-2

Date Sampled : 6/22/98

Date Received : 6/23/98

Date Extracted : 6/25/98

Date Analyzed : 6/26/98

D.F. = 1.00

CAS #	COMPOUND	RESULT µg/Sample	REPORTING LIMIT µg/Sample
91-20-3	Naphthalene	ND	0.25
208-96-8	Acenaphthalene	ND	0.25
83-32-9	Acenaphthene	ND	0.25
86-73-7	Fluorene	ND	0.25
85-01-8	Phenanthrene	ND	0.25
120-12-7	Anthracene	ND	0.25
206-44-0	Fluoranthene	ND	0.25
129-00-0	Pyrene	ND	0.25
56-55-3	Benzo(a)anthracene	ND	0.25
218-01-9	Chrysene	ND	0.25
205-99-2	Benzo(b)Fluoranthene	ND	0.25
207-08-9	Benzo(k)Fluoranthene	ND	0.25
50-32-8	Benzo(a)Pyrene	ND	0.25
193-39-5	Indeno(1,2,3-cd)pyrene	ND	0.25
53-70-3	Dibenzo(a,h)anthracene	ND	0.25
191-24-2	Benzo(g,h,i)perylene	ND	0.25

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/8/98



Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : N/A

PAI Sample ID : PAI Method Blank

Test Code : Modified EPA TO-13

Analyst : Nelyn Quitoviera

Instrument : HP5890II/MSD

Matrix : PUF/XAD-2

Date Sampled : N/A

Date Received : N/A

Date Extracted : 6/23/98

Date Analyzed : 6/24/98

D.F. = 1.00

CAS #	COMPOUND	RESULT µg/Sample	REPORTING LIMIT µg/Sample
91-20-3	Naphthalene	ND	0.25
208-96-8	Acenaphthalene	ND	0.25
83-32-9	Acenaphthene	ND	0.25
86-73-7	Fluorene	ND	0.25
85-01-8	Phenanthrene	ND	0.25
120-12-7	Anthracene	ND	0.25
206-44-0	Fluoranthene	ND	0.25
129-00-0	Pyrene	ND	0.25
56-55-3	Benzo(a)anthracene	ND	0.25
218-01-9	Chrysene	ND	0.25
205-99-2	Benzo(b)Fluoranthene	ND	0.25
207-08-9	Benzo(k)Fluoranthene	ND	0.25
50-32-8	Benzo(a)Pyrene	ND	0.25
193-39-5	Indeno(1,2,3-cd)pyrene	ND	0.25
53-70-3	Dibenzo(a,h)anthracene	ND	0.25
191-24-2	Benzo(g,h,i)perylene	ND	0.25

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RG

Date : 7/8/98



Performance Analytical Inc.

Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : O'Brien & Gere Engineers, Inc.

Client Sample ID : N/A

PAI Sample ID : PAI Method Blank

Test Code : Modified EPA TO-13

Analyst : Nelyn Quitoviera

Instrument : HP5890II/MSD

Matrix : PUF/XAD-2

Date Sampled : N/A

Date Received : N/A

Date Extracted : 6/25/98

Date Analyzed : 6/26/98

D.F. = 1.00

CAS #	COMPOUND	RESULT µg/Sample	REPORTING LIMIT µg/Sample
91-20-3	Naphthalene	ND	0.25
208-96-8	Acenaphthalene	ND	0.25
83-32-9	Acenaphthene	ND	0.25
86-73-7	Fluorene	ND	0.25
85-01-8	Phenanthrene	ND	0.25
120-12-7	Anthracene	ND	0.25
206-44-0	Fluoranthene	ND	0.25
129-00-0	Pyrene	ND	0.25
56-55-3	Benzo(a)anthracene	ND	0.25
218-01-9	Chrysene	ND	0.25
205-99-2	Benzo(b)Fluoranthene	ND	0.25
207-08-9	Benzo(k)Fluoranthene	ND	0.25
50-32-8	Benzo(a)Pyrene	ND	0.25
193-39-5	Indeno(1,2,3-cd)pyrene	ND	0.25
53-70-3	Dibenzo(a,h)anthracene	ND	0.25
191-24-2	Benzo(g,h,i)perylene	ND	0.25

TR = Detected Below Indicated Reporting Limit

ND = Not Detected

Verified by : RC

Date : 7/8/98



**20954 Osborne Street
Canoga Park, California 91304
Phone 818 709-1139
Fax 818 709-2915**

Chain of Custody Record Analytical Services Request

[illegible]

**Screening evaluation of potential
subsurface volatilization and
migration to ambient air**

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 1 - Residential Scenario

Table G-1a. Subsurface Soil

Site Specific Parameters		Units	Value	Notes	Building Specific Parameters		Units	Value
Theta (t)	Total Soil Porosity	cm ³ /cm ³	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4)	Ab	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm ²	2,430,000
Ev	Volumetric Water Content in Vadose Zone	cm ³ -H ₂ O/cm ³ volume	0.150	Default - USEPA Soil Screening Guidance (1996)	n (eta)	Fraction of Foundation Cracked	unitless	0.001
Theta (as)	Volumetric air Content in Vadose Zone	cm ³ -air/cm ³ volume	0.225	0.375 <- ws+as must=theta	Qb	Building Excavation Ventilation Rate	cfm/ft ²	0.065
	Vapor Soil Porosity	cm ³ /cm ³	3.0E-01			Building ventilation rate	cfm	117
	Soil Bulk Density	g/cm ³	2.1			Ventilation rate	cm ³ /s	55,224
hv	Thickness of vadose zone	cm			Lcrack	Length of Cracks in Foundation (slab thickness)	inch	8
Lt	Distance to source	ft	1.00			Length of Cracks	cm	20
	Distance to source	cm	30		Acrack	Area of Foundation Cracks	cm ²	1,620
R	Universal gas constant				ER	Building air exchange rate	(s)-1	0.000142
T	Temperature	Kelvin			Residential	Building air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1	0.5
Derivation of the Qsoil (Convective Flow Rate) Parameter:						Building air exchange rate- calculated (Qb / V)	(hr)-1	0.5
Qsoil	Volumetric flow rate	cm ³ /s	19	<- Calculated from J&E (1991) eq. 24	L	Building Length	ft	60
u (mu)	Vapor Viscosity	g/cm ²	0.00018	J&E (1991) Table I - representative default value		Length	cm	1,800
deltaP	Subsurface to building pressure differential	g/cm-s ²	10	J&E (1991) Table II - long-term average default	W	Building Width	ft	30
kv	Soil Permeability***	cm ²	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)		Width	cm	900
Xcrack	Total floor/wall seam perimeter distance	cm	5,400	Xcrack = 2 x (Building Length + Wdth)	H	Building Height	ft	6
Zcrack	Depth to source	cm	30	Equivalent to "Lt" parameter		Height	cm	240
r crack	Radius	cm	0.45	r crack = n (eta) x (Ab / Xcrack)	Aslab	Area of Building Slab	ft ²	1,800
						Area	cm ²	1,620,000
					D	Depth of Slab Below Grade	ft	5
						Depth	cm	150
					V	Volume of Building	ft ³	14,400
						Volume	cm ³	388,800,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm³/cm³ is the midrange of the values (25 to 50 cm³/cm³) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm² is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

Carter, M. and Bently, S.P. 1991. Correlations of Soil Properties. Pentech Press.

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM . 1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 1 - Residential Scenario

Table G-1a. Subsurface Soil

Chemical		SS							
Dair	Diffusion coefficient in air	cm ² /s	0.07956	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
					Csoil	Soil Concentration	mg/kg	0.0010	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	2.62E-04	
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>			
	0.001					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration*	ug/m ³	1.00E+02	
						Ambient Air Concentration Above RBC Screening level?		No	
Hsel	Selected Henry's Law Constant	unitless	7.7E-01	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	7.7E-01	calculated					
	H Henry's Law Constant	unitless	1.2E+00	calculated					
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	2.8E-02	EHRAV					
Koc	Partition Coefficient	unitless	152	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Chemical		SBS							
Dair	Diffusion coefficient in air	cm ² /s	0.06703	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
					Csoil	Soil Concentration	mg/kg	0.8100	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.0E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	5.22E-05	
Deff-s	Effective diffusion through soil	cm ² /s	9.0E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>			
	0.001				as pyrene	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.10E+01	
						Ambient Air Concentration Above RBC Screening level?		No	
Hsel	Selected Henry's Law Constant	unitless	1.9E-04	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.9E-04	calculated					
	H Henry's Law Constant	unitless	4.7E-03	calculated					
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	1.1E-04	EHRAV					
Koc	Partition Coefficient	unitless	2,500	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Chemical		SS							
Dair	Diffusion coefficient in air	cm ² /s	0.0932	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
					Csoil	Soil Concentration	mg/kg	0.0020	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.3E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	1.56E-04	
Deff-s	Effective diffusion through soil	cm ² /s	1.3E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	2.20E-01	
						Ambient Air Concentration Above RBC Screening level?		No	
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01	calculated					
	H Henry's Law Constant	unitless	2.3E-01	calculated					
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	5.5E-03	EHRAV					
Koc	Partition Coefficient	unitless	65	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 1 - Residential Scenario

Table G-1a. Subsurface Soil

Chemical Ethylbenzene									
Dair	Diffusion coefficient In air	cm2/s	0.06667	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	8.9E-03	calculated	Csoil	Soil Concentration	mg/kg	3.30	
Deff-s	Effective diffusion through soil	cm2/s	8.9E-03	calculated	Ci	Indoor Air Concentration	ug/m3	1.79E-01	
Indoor Air ConcentrationComparison with:									
USEPA Region III (4/1/98) Ambient Air Risk Based Concentration							ug/m3	1.10E+02	
Ambient Air Concentration Above RBC Screening level?								No	
* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)									
Hsel	Selected Henry's Law Constant	unitless	1.6E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-01	calculated					
H	Henry's Law Constant	unitless	3.5E-01	calculated					
H	Henry's Law Constant (EHRAV)	atm-m3/mol	8.4E-03	EHRAV					
Koc	Partition Coefficient	unitless	220	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					
Chemical Tetrachloroethene									
Dair	Diffusion coefficient In air	cm2/s	0.07404	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	9.9E-03	calculated	Csoil	Soil Concentration	mg/kg	0.003	
Deff-s	Effective diffusion through soil	cm2/s	9.9E-03	calculated	Ci	Indoor Air Concentration	ug/m3	2.69E-04	
Indoor Air ConcentrationComparison with:									
USEPA Region III (4/1/98) Ambient Air Risk Based Concentration							ug/m3	3.10E+00	
Ambient Air Concentration Above RBC Screening level?								No	
* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)									
Hsel	Selected Henry's Law Constant	unitless	2.6E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.6E-01	calculated					
H	Henry's Law Constant	unitless	9.6E-01	calculated					
H	Henry's Law Constant (EHRAV)	atm-m3/mol	2.3E-02	EHRAV					
Koc	Partition Coefficient	unitless	364	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					
Chemical Toluene									
detected in surface soil only									
Dair	Diffusion coefficient In air	cm2/s	0.07828	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.1E-02	calculated	Csoil	Soil Concentration	mg/kg	0.0010	
Deff-s	Effective diffusion through soil	cm2/s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m3	7.81E-05	
Indoor Air ConcentrationComparison with:									
USEPA Region III (4/1/98) Ambient Air Risk Based Concentration							ug/m3	4.20E+01	
Ambient Air Concentration Above RBC Screening level?								No	
* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)									
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated					
H	Henry's Law Constant	unitless	2.7E-01	calculated					
H	Henry's Law Constant (EHRAV)	atm-m3/mol	6.6E-03	EHRAV					
Koc	Partition Coefficient	unitless	120	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 1 - Residential Scenario

Table G-1a. Subsurface Soil

Chemical	Xylene (total)	detected in surface soil only							
Dair	Diffusion coefficient in air	cm ² /s	0.07164	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
					Csoil	Soil Concentration	mg/kg	0.0010	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.6E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	2.94E-05	
Deff-s	Effective diffusion through soil	cm ² /s	9.6E-03	calculated		Indoor Air Concentration Comparison with:			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	7.30E+02	
						Ambient Air Concentration Above RBC Screening level?			
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	8.6E-02	calculated					No
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	8.6E-02	calculated					
H	Henry's Law Constant	unitless	2.0E-01	calculated					
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	4.9E-03	EHRAV					(as o-Xylene)
Koc	Partition Coefficient	unitless	236	EHRAV					(as o-Xylene)
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2a. Subsurface Soil

Site Specific Parameters		Units	Value	Notes	Building Specific Parameters		Units	Value
Theta (t)	Total Soil Porosity	cm ³ /cm ³	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4)	Ab	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm ²	2,430,000
Ev	Volumetric Water Content in Vadose Zone	cm ³ -H ₂ O/cm ³ volume	0.150	Default - USEPA Soil Screening Guidance (1996)	n (eta)	Fraction of Foundation Cracked	unitless	0.001
Theta (as)	Volumetric air Content in Vadose Zone	cm ³ -air/cm ³ volume	0.225	0.375 <- ws+as must=theta	Qb	Building Excavation Ventilation Rate	cfm/ft ²	0.065
	Vapor Soil Porosity	cm ³ /cm ³	3.0E-01			Building ventilation rate	cfm	117
	Soil Bulk Density	g/cm ³	2.1			Ventilation rate	cm ³ /s	55,224
hv	Thickness of vadose zone	cm			Lcrack	Length of Cracks in Foundation (slab thickness)	inch	8
Lt	Distance to source	ft	1.00			Length of Cracks	cm	20
	Distance to source	cm	30		Acrack	Area of Foundation Cracks	cm ²	1,620
R	Universal gas constant				ER	Building air exchange rate	(s)-1	0.000142
T	Temperature	Kelvin			Residential	Building air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1	0.5
Derivation of the Qsoil (Convective Flow Rate) Parameter:						Building air exchange rate- calculated (Qb / V)	(hr)-1	0.5
Qsoil	Volumetric flow rate	cm ³ /s	19	<--- Calculated from J&E (1991) eq. 24	L	Building Length	ft	60
u (mu)	Vapor Viscosity	g/cm ²	0.00018	J&E (1991) Table I - representative default value		Length	cm	1,800
deltaP	Subsurface to building pressure differential	g/cm-s ²	10	J&E (1991) Table II - long-term average default	W	Building Width	ft	30
kv	Soil Permeability***	cm ²	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)		Width	cm	900
Xcrack	Total floor/wall seam perimeter distance	cm	5,400	Xcrack = 2 x (Building Length + Width)	H	Building Height	ft	8
Zcrack	Depth to source	cm	30	Equivalent to "Lt" parameter		Height	cm	240
r crack	Radius	cm	0.45	r crack = n (eta) x (Ab / Xcrack)	Aslab	Area of Building Slab	ft ²	1,800
						Area	cm ²	1,620,000
					D	Depth of Slab Below Grade	ft	5
						Depth	cm	150
					V	Volume of Building	ft ³	14,400
						Volume	cm ³	388,800,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm³/cm³ is the midrange of the values (25 to 50 cm³/cm³) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm² is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

Carter, M. and Bentley, S.P. 1991. Correlations of Soil Properties. Pentech Press.

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM. 1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2a. Subsurface Soil

Chemical 2-Butanone				SBS				2-Butanone	
Dair	Diffusion coefficient in air	cm2/s	0.08944	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.2E-02	calculated	Csoil	Soil Concentration	mg/kg	0.2719	
Deff-s	Effective diffusion through soil	cm2/s	1.2E-02	calculated	Ci	Indoor Air Concentration	ug/m3	1.99E-04	
							Indoor Air Concentration Comparison with:		
							USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
							Ambient Air Concentration Above RBC Screening level?		
							ug/m3 1.00E+02		
							No		
Hsel	Selected Henry's Law Constant	unitless	2.1E-03	calculated	* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)				
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	4.0E-02	calculated					
H	Henry's Law Constant	unitless	2.1E-03	calculated					
H	Henry's Law Constant (EHRAV)	atm-m3/mol	5.1E-05	EHRAV					
Koc	Partition Coefficient	unitless	5.41	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Chemical Acetone				SBS				Acetone	
Dair	Diffusion coefficient in air	cm2/s	0.11498	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.5E-02	calculated	Csoil	Soil Concentration	mg/kg	4.2000	
Deff-s	Effective diffusion through soil	cm2/s	1.5E-02	calculated	Ci	Indoor Air Concentration	ug/m3	2.20E-03	
							Indoor Air Concentration Comparison with:		
							USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	3.70E+01
							Ambient Air Concentration Above RBC Screening level?		No
							* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.5E-03	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	6.9E-02	calculated					
H	Henry's Law Constant	unitless	1.5E-03	calculated					
H	Henry's Law Constant (EHRAV)	atm-m3/mol	3.7E-05	EHRAV					
Koc	Partition Coefficient	unitless	2.20	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Chemical Benzene						Benzene		
Dair	Diffusion coefficient in air	cm2/s	0.0932	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04
					Csoil	Soil Concentration	mg/kg	0.4700
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.3E-02	calculated		Indoor Air Concentration	ug/m3	3.66E-02
Deff-s	Effective diffusion through soil	cm2/s	1.3E-02	calculated		Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	2.20E-01
						Ambient Air Concentration Above RBC Screening level?		
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated				No
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01	calculated				
H	Henry's Law Constant	unitless	2.3E-01	calculated				
H	Henry's Law Constant (EHRAV)	atm-m3/mol	5.5E-03	EHRAV				
Koc	Partition Coefficient	unitless	65	EHRAV				
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2a. Subsurface Soil

Chemical Ethylbenzene					Ethylbenzene		
Dair	Diffusion coefficient in air	cm ² /s	0.06667	EHRAV	Alpha	Attenuation Coefficient	unitless 3.4E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03	calculated	Csoil	Soil Concentration	mg/kg 7.1
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³ 3.85E-01
					<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.6E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-01	calculated			
H	Henry's Law Constant	unitless	3.5E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	8.4E-03	EHRAV			
Koc	Partition Coefficient	unitless	220	EHRAV			
foc	Fraction organic carbon	unitless	1.0E-02	default value			

Chemical Methylene Chloride					Methylene Chloride		
Dair	Diffusion coefficient in air	cm ² /s	0.0858	EHRAV	Alpha	Attenuation Coefficient	unitless 3.4E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02	calculated	Csoil	Soil Concentration	mg/kg 0.88
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02	calculated	Ci	Indoor Air Concentration	ug/m ³ 3.25E-02
					<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.1E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.2E+00	calculated			
H	Henry's Law Constant	unitless	1.1E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	2.6E-03	EHRAV			
Koc	Partition Coefficient	unitless	8.80	EHRAV			
foc	Fraction organic carbon	unitless	1.0E-02	default value			

Chemical Toluene					Toluene		
Dair	Diffusion coefficient in air	cm ² /s	0.07828	EHRAV	Alpha	Attenuation Coefficient	unitless 3.4E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Csoil	Soil Concentration	mg/kg 0.15
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³ 1.17E-02
					<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated			
H	Henry's Law Constant	unitless	2.7E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	6.6E-03	EHRAV			
Koc	Partition Coefficient	unitless	120	EHRAV			
foc	Fraction organic carbon	unitless	1.0E-02	default value			

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2a. Subsurface Soil

Chemical Xylene (total)				SBS				Xylene (total)
Dair	Diffusion coefficient in air	cm2/s	0.07164	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04
					Csoil	Soil Concentration	mg/kg	21
Deff-crack	Effective diffusion through foundation cracks	cm2/s	9.6E-03	calculated	Ci	Indoor Air Concentration	ug/m3	6.18E-01
Deff-s	Effective diffusion through soil	cm2/s	9.6E-03	calculated		Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	7.30E+02
						Ambient Air Concentration Above RBC Screening level?		No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	8.6E-02	calculated				
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	8.6E-02	calculated				
H	Henry's Law Constant	unitless	2.0E-01	calculated				
H	Henry's Law Constant (EHRAV)	atm-m3/mol	4.9E-03	EHRAV				(as o-Xylene)
Koc	Partition Coefficient	unitless	236	EHRAV				(as o-Xylene)
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Chemical Naphthalene								Naphthalene
Dair	Diffusion coefficient in air	cm2/s	0.08205	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04
					Csoil	Soil Concentration	mg/kg	0.1909
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m3	1.21E-04
Deff-s	Effective diffusion through soil	cm2/s	1.1E-02	calculated		Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	3.70E-02
						Ambient Air Concentration Above RBC Screening level?		No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.9E-03	calculated				
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.9E-03	calculated				
H	Henry's Law Constant	unitless	1.7E-02	calculated				
H	Henry's Law Constant (EHRAV)	atm-m3/mol	4.2E-04	EHRAV				
Koc	Partition Coefficient	unitless	940	EHRAV				
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Chemical Styrene								Styrene
Dair	Diffusion coefficient in air	cm2/s	0.07035	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04
					Csoil	Soil Concentration	mg/kg	0.0186
Deff-crack	Effective diffusion through foundation cracks	cm2/s	9.4E-03	calculated	Ci	Indoor Air Concentration	ug/m3	1.18E-04
Deff-s	Effective diffusion through soil	cm2/s	9.4E-03	calculated		Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	1.00E+02
						Ambient Air Concentration Above RBC Screening level?		No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.9E-02	calculated				
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.9E-02	calculated				
H	Henry's Law Constant	unitless	1.7E-01	calculated				
H	Henry's Law Constant (EHRAV)	atm-m3/mol	4.0E-03	EHRAV				
Koc	Partition Coefficient	unitless	891	EHRAV				
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2a. Subsurface Soil

Chemical: Tetrachloroethene					Tetrachloroethene			
Dair	Diffusion coefficient in air	cm ² /s	0.07404	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04
					Csoil	Soil Concentration	mg/kg	0.0637
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	5.71E-03
Deff-s	Effective diffusion through soil	cm ² /s	9.9E-03	calculated		Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
						Ambient Air Concentration Above RBC Screening level?		
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.6E-01	calculated				No
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.6E-01	calculated				
H	Henry's Law Constant	unitless	9.6E-01	calculated				
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	2.3E-02	EHRAV				
Koc	Partition Coefficient	unitless	364	EHRAV				
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2b. Ground Water

Site Specific Parameters		Units	Value	Notes	Building Specific Parameters		Units	Value
<i>Theta (t)</i>	Total Soil Porosity	cm3/cm3	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4)	<i>Ab</i>	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm2	2,430,000
<i>Ev</i>	Volumetric Water Content in Vadose Zone	cm3-H2O/cm3 volume	0.150	Default - USEPA Soil Screening Guidance (1996)	<i>n (eta)</i>	Fraction of Foundation Cracked	unitless	0.001
<i>Theta (as)</i>	Volumetric air Content in Vadose Zone	cm3-air/cm3 volume	0.225 0.375	<- ws+as must=theta	<i>Qb</i>	Building Excavation Ventilation Rate	cfm/ft2	0.065
	Vapor Soil Porosity	cm3/cm3	3.0E-01			Building ventilation rate	cfm	117
	Soil Bulk Density	g/cm3	2.1			Ventilation rate	cm3/s	55,224
<i>hv</i>	Thickness of vadose zone	cm			<i>Lcrack</i>	Length of Cracks in Foundation (slab thickness)	inch	8
<i>Lt</i>	Distance to source	ft	1			Length of Cracks	cm	20
	Distance to source	cm	30		<i>Acrack</i>	Area of Foundation Cracks	cm2	1,620
<i>R</i>	Universal gas constant				<i>ER</i>	Building air exchange rate	(s)-1	0.000142
<i>T</i>	Temperature	Kelvin			<i>Residential</i>	Building air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1	0.5
Derivation of the Qsoil (Convective Flow Rate) Parameter:						Building air exchange rate- calculated (Qb / V)	(hr)-1	0.5
<i>Qsoil</i>	Volumetric flow rate	cm3/s	19	<-- Calculated from J&E (1991) eq. 24	<i>L</i>	Building Length	ft	60
<i>u (mu)</i>	Vapor Viscosity	g/cm2	0.00018	J&E (1991) Table I - representative default value		Length	cm	1,800
<i>deltaP</i>	Subsurface to building pressure differential	g/cm-s2	10	J&E (1991) Table II - long-term average default	<i>W</i>	Building Width	ft	30
<i>kv</i>	Soil Permeability***	cm2	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)		Width	cm	900
<i>Xcrack</i>	Total floor/wall seam perimeter distance	cm	5,400	Xcrack = 2 x (Building Length + Width)	<i>H</i>	Building Height	ft	8
<i>Zcrack</i>	Depth to source	cm	30	Equivalent to "Lt" parameter		Height	cm	240
<i>r crack</i>	Radius	cm	0.45	r crack = n (eta) x (Ab / Xcrack)	<i>Aslab</i>	Area of Building Slab	ft2	1,800
						Area	cm2	1,620,000
					<i>D</i>	Depth of Slab Below Grade	ft	5
						Depth	cm	150
					<i>V</i>	Volume of Building	ft3	14,400
						Volume	cm3	388,800,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm3/cm3 is the midrange of the values (25 to 50 cm3/cm3) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm2 is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

Carter, M. and Bently, S.P. 1991. Correlations of Soil Properties. Pentech Press.

Epstein, C.M. 1994. 'The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J.'

ASTM . 1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2b. Ground Water

Chemical: Acenaphthylene				Acenaphthylene			
Dair	Diffusion coefficient in air	cm ² /s	0.06703	EHRAV	Alpha	Attenuation Coefficient	unitless 3.4E-04
					Cgw	Ground Water Concentration	mg/l 2.5E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.0E-03	calculated	CI	Indoor Air Concentration	ug/m ³ 4.03E-01
Deff-s	Effective diffusion through soil	cm ² /s	9.0E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>	
					as pyrene	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 1.10E+01
						Ambient Air Concentration Above RBC Screening level?	No
Hsel	Selected Henry's Law Constant	unitless	4.7E-03	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	4.7E-03	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	4.7E-03	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	1.1E-04	EHRAV			

Chemical: Benzene				Benzene			
Dair	Diffusion coefficient in air	cm ² /s	0.0932	EHRAV	Alpha	Attenuation Coefficient	unitless 3.4E-04
					Cgw	Ground Water Concentration	mg/l 9.8E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.3E-02	calculated	CI	Indoor Air Concentration	ug/m ³ 7.62E+01
Deff-s	Effective diffusion through soil	cm ² /s	1.3E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 2.20E-01
						Ambient Air Concentration Above RBC Screening level?	Yea
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	2.3E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	5.5E-03	EHRAV			

Chemical: Ethylbenzene				Ethylbenzene			
Dair	Diffusion coefficient in air	cm ² /s	0.06667	EHRAV	Alpha	Attenuation Coefficient	unitless 3.4E-04
					Cgw	Ground Water Concentration	mg/l 5.9E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03	calculated	CI	Indoor Air Concentration	ug/m ³ 7.03E+01
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 1.10E+02
						Ambient Air Concentration Above RBC Screening level?	No
Hsel	Selected Henry's Law Constant	unitless	3.5E-01	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	3.5E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	8.4E-03	EHRAV			

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2b. Ground Water

Chemical Methylene Chloride				Methylene Chloride			
Dair	Diffusion coefficient in air	cm ² /s	0.0858 EHRV	Alpha	Attenuation Coefficient	unitless	3.4E-04
				Cgw	Ground Water Concentration	mg/l	8.8E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02 calculated	Ci	Indoor Air Concentration	ug/m ³	3.25E-02
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	3.80E+00
Hsel	Selected Henry's Law Constant	unitless	1.1E-01 calculated		Ambient Air Concentration Above RBC Screening level?		
R	Universal gas constant		8.2E-05		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
T	Temperature	Kelvin	2.9E+02				No
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.1E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.1E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	2.6E-03 EHRV				

Chemical Naphthalene				Naphthalene			
Dair	Diffusion coefficient in air	cm ² /s	0.08205 EHRV	Alpha	Attenuation Coefficient	unitless	3.4E-04
				Cgw	Ground Water Concentration	mg/l	4.8E+00
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02 calculated	Ci	Indoor Air Concentration	ug/m ³	2.86E+01
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	3.70E-02
Hsel	Selected Henry's Law Constant	unitless	1.7E-02 calculated		Ambient Air Concentration Above RBC Screening level?		
R	Universal gas constant		8.2E-05		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
T	Temperature	Kelvin	2.9E+02				Yes
Hadj	Adjusted Henry's Law Constant (H/Koc x foc for soil)	unitless	1.7E-02 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.7E-02 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.2E-04 EHRV				

Chemical Phenol				Phenol			
Dair	Diffusion coefficient in air	cm ² /s	0.08924 EHRV	Alpha	Attenuation Coefficient	unitless	3.4E-04
				Cgw	Ground Water Concentration	mg/l	2.4E-02
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02 calculated	Ci	Indoor Air Concentration	ug/m ³	1.35E-04
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	2.20E+02
Hsel	Selected Henry's Law Constant	unitless	1.6E-05 calculated		Ambient Air Concentration Above RBC Screening level?		
R	Universal gas constant		8.2E-05		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
T	Temperature	Kelvin	2.9E+02				No
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-05 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.6E-05 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.0E-07 EHRV				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Residential Scenario

Table G-2b. Ground Water

Chemical: Styrene				Styrene			
Dair	Diffusion coefficient in air	cm ² /s	0.0735 EHRV	Alpha	Attenuation Coefficient	unitless	3.4E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.9E-03 calculated	Cgw	Ground Water Concentration	mg/l	7.3E-03
Deff-s	Effective diffusion through soil	cm ² /s	9.9E-03 calculated	Ci	Indoor Air Concentration	ug/m ³	4.14E-01
				<i>Indoor Air Concentration Comparison with:</i>			
				USEPA Region III (4/1/98) Ambient Air Risk Based Concentration			
				Ambient Air Concentration Above RBC Screening level?			
				* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	1.7E-01 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.7E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.7E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.0E-03 EHRV				

Chemical: Toluene				Toluene			
Dair	Diffusion coefficient in air	cm ² /s	0.07828 EHRV	Alpha	Attenuation Coefficient	unitless	3.4E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02 calculated	Cgw	Ground Water Concentration	mg/l	9.3E-02
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02 calculated	Ci	Indoor Air Concentration	ug/m ³	8.71E+00
				<i>Indoor Air Concentration Comparison with:</i>			
				USEPA Region III (4/1/98) Ambient Air Risk Based Concentration			
				Ambient Air Concentration Above RBC Screening level?			
				* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	2.7E-01 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.7E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	2.7E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	6.6E-03 EHRV				

Chemical: Xylene (total)				Xylene (total)			
Dair	Diffusion coefficient in air	cm ² /s	0.07164 EHRV	Alpha	Attenuation Coefficient	unitless	3.4E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.6E-03 calculated	Cgw	Ground Water Concentration	mg/l	8.0E-01
Deff-s	Effective diffusion through soil	cm ² /s	9.6E-03 calculated	Ci	Indoor Air Concentration	ug/m ³	5.55E+01
				<i>Indoor Air Concentration Comparison with:</i>			
				USEPA Region III (4/1/98) Ambient Air Risk Based Concentration			
				Ambient Air Concentration Above RBC Screening level?			
				* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	2.0E-01 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc for soil)	unitless	2.0E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	2.0E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.9E-03 EHRV (as o-xylene)				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 1 - Construction Scenario

Table G-3a. Subsurface Soil

Site Specific Parameters				Building Specific Parameters			
		Units	Value	Notes		Units	Value
Theta (t)	Total Soil Porosity	cm ³ /cm ³	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4)	Ab	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm ² 2,430,000
Ev	Volumetric Water Content in Vadose Zone	cm ³ -H ₂ O/cm ³ volume	0.150	Default - USEPA Soil Screening Guidance (1996)	n (eta)	Fraction of Foundation Cracked (no slab, n = ~1.0)	unitless 1.0E+00
Theta (as)	Volumetric air Content in Vadose Zone	cm ³ -air/cm ³ volume	0.225	0.375 <- ws+as must=theta	Qbe	Building Excavation Ventilation Rate	cfm/ft ²
	Vapor Soil Porosity	cm ³ /cm ³	3.0E-01			Building Excavation Ventilation Rate	cfm 6,392
	Soil Bulk Density	g/cm ³	2.1			Ventilation rate (wind speed x excavation cross sectional area)	cm ³ /s 3,017,250
hv	Thickness of vadose zone	cm			Lcrack	Length of Cracks in Foundation (slab thickness: no slab, Lcrack = ~0.0)	inch 1E-12
Lt	Distance to source	ft	1.00			Length of Cracks	cm 2.5E-12
	Distance to source	cm	30		Acrack	Area of Foundation Cracks	cm ² 1,620,000
R	Universal gas constant				ER	Building Excavation air exchange rate	(s)-1 0.012417
T	Temperature	Kelvin			Industrial:	Building Excavation air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1 44.70
Derivation of the Qsoil (Convective Flow Rate) Parameter:						Building Excavation air exchange rate- calculated (V / Qb)	(hr)-1 44.70
Qsoil	Volumetric flow rate	cm ³ /s	(47)	<--- Calculated from J&E (1991) eq. 24	Wind Speed	Conservative Estimate of Wind Speed	mph 0.50
u (mu)	Vapor Viscosity	g/cm ²	0.00018	J&E (1991) Table I - representative default value		Wind Speed	cm/s 22
deltaP	Subsurface to building pressure differential	g/cm-s ²	10	J&E (1991) Table II - long-term average default	L	Building Excavation Length	ft 60
kv	Soil Permeability***	cm ²	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)		Length	cm 1,800
Xcrack	Total floor/wall seam perimeter distance	cm	5,400	Xcrack = 2 x (Building Length + Width)	W	Building Excavation Width	ft 30
Zcrack	Depth to source	cm	30	Equivalent to "Lt" parameter		Width	cm 900
r crack	Radius	cm	450.00	r crack = n (eta) x (Ab / Xcrack)	H	Building Excavation Height (same as depth below grade)	ft 5
						Height	cm 150
					Aslab	Area of Building Slab Excavation	ft ² 1800
						Area	cm ² 1,620,000
					D	Depth of Slab Excavation Below Grade	ft 5
						Depth	cm 150
					V	Volume of Building Excavation	ft ³ 9,000
						Volume	cm ³ 243,000,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm³/cm³ is the midrange of the values (25 to 50 cm³/cm³) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm² is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

US Department of Commerce NOAA. 1994. Water Information Center, Inc. "Climates of the States".

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM .1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

**Niagara Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation**

Table G-3a. Subsurface Soil

Chemical		1,1,1-Trichloroethane		SS							
Dair	Diffusion coefficient in air	cm2/s	0.07965	EHRAV	Alpha	Attenuation Coefficient	unitless	2.9E-04			
					Csoil	Soil Concentration	mg/kg	0.0010			
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m3	2.20E-04			
Deff-s	Effective diffusion through soil	cm2/s	1.1E-02	calculated		Indoor Air ConcentrationComparison with:					
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	1.00E+02			
						Ambient Air Concentration Above RBC Screening level?	No				
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)					
Hsel	Selected Henry's Law Constant	unitless	7.7E-01	calculated							
R	Universal gas constant		8.2E-05								
T	Temperature	Kelvin	2.9E+02								
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	7.7E-01	calculated							
H	Henry's Law Constant	unitless	1.2E+00	calculated							
H	Henry's Law Constant (EHRAV)	atm-m3/mol	2.8E-02	EHRAV							
Koc	Partition Coefficient	unitless	152	EHRAV							
foc	Fraction organic carbon	unitless	1.0E-02	default value							

Chemical	Acenaphthalene	SBS							
Dair	Diffusion coefficient in air	cm2/s	0.06703	EHRAV	Alpha	Attenuation Coefficient	unitless	2.4E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	9.0E-03	calculated	Csoil	Soil Concentration	mg/kg	0.81	
Deff-s	Effective diffusion through soil	cm2/s	9.0E-03	calculated	Ci	Indoor Air Concentration	ug/m3	3.71E-05	
						Indoor Air Concentration Comparison with:			
					as pyrene	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	1.10E+01	
						Ambient Air Concentration Above RBC Screening level?			No
Hsel	Selected Henry's Law Constant	unitless	1.9E-04	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.9E-04	calculated					
H	Henry's Law Constant	unitless	4.7E-03	calculated					
H	Henry's Law Constant (EHRAV)	atm-m3/mol	1.1E-04	EHRAV					
Koc	Partition Coefficient	unitless	2,500	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Chemical	Benzene	SS	0.06703	0.0932	EHRAV	Alpha	Attenuation Coefficient	unitless	3.4E-04
Dair	Diffusion coefficient in air					Csoil	Soil Concentration	mg/kg	0.0020
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.3E-02	calculated		Ci	Indoor Air Concentration	ug/m3	1.53E-04
Deff-s	Effective diffusion through soil	cm2/s	1.3E-02	calculated			Indoor Air Concentration Comparison with:		
							USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	2.20E-01
							Ambient Air Concentration Above RBC Screening level?		No
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated			* - (Note: Constituents having an RBC based on noncancer effects have		
R	Universal gas constant		8.2E-05				an additional 0.1 safety factor applied to the RBC value)		
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01	calculated					
H	Henry's Law Constant	unitless	2.3E-01	calculated					
H	Henry's Law Constant (EHRAV)	atm-m3/mol	5.5E-03	EHRAV					
Koc	Partition Coefficient	unitless	65	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 1 - Construction Scenario

Table G-3a. Subsurface Soil

Chemical: Ethylbenzene		SBS							
Dair	Diffusion coefficient in air	cm ² /s	0.06667	EHRAV	Alpha	Attenuation Coefficient	unitless	2.4E-04	
					Csoil	Soil Concentration	mg/kg	3.30	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	1.26E-01	
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03	calculated		Indoor Air Concentration Comparison with:			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.10E+02	
						Ambient Air Concentration Above RBC Screening level?		No	
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	1.6E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-01	calculated					
	H Henry's Law Constant	unitless	3.5E-01	calculated					
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	8.4E-03	EHRAV					
Koc	Partition Coefficient	unitless	220	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					
Chemical: Tetrachloroethane									
Dair	Diffusion coefficient in air	cm ² /s	0.07404	EHRAV	Alpha	Attenuation Coefficient	unitless	2.7E-04	
					Csoil	Soil Concentration	mg/kg	0.0930	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	2.10E-04	
Deff-s	Effective diffusion through soil	cm ² /s	9.9E-03	calculated		Indoor Air Concentration Comparison with:			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	3.10E+00	
						Ambient Air Concentration Above RBC Screening level?		No	
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	2.6E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.6E-01	calculated					
	H Henry's Law Constant	unitless	9.6E-01	calculated					
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	2.3E-02	EHRAV					
Koc	Partition Coefficient	unitless	364	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					
Chemical: Toluene									
Dair	Diffusion coefficient in air	cm ² /s	0.07828	EHRAV	Alpha	Attenuation Coefficient	unitless	2.8E-04	
					Csoil	Soil Concentration	mg/kg	0.0010	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	6.46E-05	
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated		Indoor Air Concentration Comparison with:			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	4.20E+01	
						Ambient Air Concentration Above RBC Screening level?		No	
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated					
	H Henry's Law Constant	unitless	2.7E-01	calculated					
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	6.6E-03	EHRAV					
Koc	Partition Coefficient	unitless	120	EHRAV					
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 1 - Construction Scenario

Table G-3a. Subsurface Soil

Chemical	Xylene (total)								
Dair	Diffusion coefficient in air	cm ² /s	0.07164	EHRV	Alpha	Attenuation Coefficient	unitless	2.6E-04	
					Csoil	Soil Concentration	mg/kg	0.0010	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.6E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	2.23E-05	
Deff-s	Effective diffusion through soil	cm ² /s	9.6E-03	calculated		Indoor Air Concentration Comparison with: USEPA Region III (4/1/98) Ambient Air Risk Based Concentration Ambient Air Concentration Above RBC Screening level?			
							ug/m ³	7.30E+02	No
Hsel	Selected Henry's Law Constant	unitless	8.6E-02	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	8.6E-02	calculated					
	H Henry's Law Constant	unitless	2.0E-01	calculated					
	H Henry's Law Constant (EHRV)	atm-m ³ /mol	4.9E-03	EHRV					(as o-Xylene)
Koc	Partition Coefficient	unitless	236	EHRV					(as o-Xylene)
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Niagra Mohawk Power Company
South First Street Site - Fuiton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4a. Subsurface Soil

Site Specific Parameters				Building Specific Parameters			
		Units	Value	Notes		Units	Value
Theta (t)	Total Soil Porosity	cm ³ /cm ³	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4) Default: USEPA Soil Screening Guidance (1996)	Ab	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm ² 2,430,000
Ev	Volumetric Water Content in Vadose Zone	cm ³ -H ₂ O/cm ³ volume	0.150		n (eta)	Fraction of Foundation Cracked (no slab, n = ~1.0)	unitless 1.0E+00
Theta (as)	Volumetric air Content in Vadose Zone	cm ³ -air/cm ³ volume	0.225	0.375 <- ws+as must=theta	Qbe	Building Excavation Ventilation Rate	cfm/ft ² 6,392
	Vapor Soil Porosity	cm ³ /cm ³	3.0E-01			Building Excavation Ventilation Rate	cm ³ /s 3,017,250
	Soil Bulk Density	g/cm ³	2.1		Lcrack	Length of Cracks in Foundation (slab thickness: no slab, Lcrack = ~0.0)	inch 1E-12
hv	Thickness of vadose zone	cm				Length of Cracks	cm 2.5E-12
Lt	Distance to source	ft	1.00		Acrack	Area of Foundation Cracks	cm ² 1,620,000
	Distance to source	cm	30		ER	Building Excavation air exchange rate	(s)-1 0.012417
R	Universal gas constant				Industrial:	Building Excavation air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1 44.70
T	Temperature	Kelvin				Building Excavation air exchange rate- calculated (V / Qb)	(hr)-1 44.70
Derivation of the Qsoil (Convective Flow Rate) Parameter:				Wind Speed	Conservative Estimate of Wind Speed	mph 0.50	
Qsoil	Volumetric flow rate	cm ³ /s	(47)	<--- Calculated from J&E (1991) eq. 24		Wind Speed	cm/s 22
u (mu)	Vapor Viscosity	g/cm ²	0.00018	J&E (1991) Table I - representative default value	L	Building Excavation Length	ft 60
deltaP	Subsurface to building pressure differential	g/cm-s ²	10	J&E (1991) Table II - long-term average default		Length	cm 1,800
kv	Soil Permeability***	cm ²	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)	W	Building Excavation Width	ft 30
Xcrack	Total floor/wall seam perimeter distance	cm	5,400	Xcrack = 2 x (Building Length + Width)		Width	cm 900
Zcrack	Depth to source	cm	30	Equivalent to "Lt" parameter	H	Building Excavation Height (same as depth below grade)	ft 5
r:crack	Radius	cm	450.00	r crack = n (eta) x (Ab / Xcrack)		Height	cm 150
					Aslab	Area of Building Slab Excavation	ft ² 1800
						Area	cm ² 1,620,000
					D	Depth of Slab Excavation Below Grade	ft 5
						Depth	cm 150
					V	Volume of Building Excavation	ft ³ 9,000
						Volume	cm ³ 243,000,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm³/cm³ is the midrange of the values (25 to 50 cm³/cm³) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm² is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

US Department of Commerce NOAA. 1994. Water Information Center, Inc. "Climates of the States".

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM. 1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4a. Subsurface Soil

Chemical		2-Butanone		SBS		Alpha		Csoil		Ci		Indoor Air Concentration		Comparison with:	
Dair	Diffusion coefficient in air	cm2/s	0.08944	EHRV								Attenuation Coefficient	unitless	3.2E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.2E-02	calculated								Soil Concentration	mg/kg	0.2719	
Deff-s	Effective diffusion through soil	cm2/s	1.2E-02	calculated								Indoor Air Concentration	ug/m3	1.87E-04	
Hsel	Selected Henry's Law Constant	unitless	2.1E-03	calculated								Indoor Air Concentration Comparison with:			
R	Universal gas constant		8.2E-05									USEPA Region III (4/1/98) Ambient Air Risk Based Concentration			
T	Temperature	Kelvin	2.9E+02									Ambient Air Concentration Above RBC Screening level?			
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	4.0E-02	calculated								* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
H	Henry's Law Constant	unitless	2.1E-03	calculated											
H	Henry's Law Constant (EHRV)	atm-m3/mol	5.1E-05	EHRV											
Koc	Partition Coefficient	unitless	5.41	EHRV											
foc	Fraction organic carbon	unitless	1.0E-02	default value											

Chemical		Acetone		SBS		Alpha		Csoil		Ci		Indoor Air Concentration		Comparison with:	
Dair	Diffusion coefficient in air	cm2/s	0.11498	EHRV								Attenuation Coefficient	unitless	4.1E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.5E-02	calculated								Soil Concentration	mg/kg	4.20	
Deff-s	Effective diffusion through soil	cm2/s	1.5E-02	calculated								Indoor Air Concentration	ug/m3	2.66E-03	
Hsel	Selected Henry's Law Constant	unitless	1.5E-03	calculated								Indoor Air Concentration Comparison with:			
R	Universal gas constant		8.2E-05									USEPA Region III (4/1/98) Ambient Air Risk Based Concentration			
T	Temperature	Kelvin	2.9E+02									Ambient Air Concentration Above RBC Screening level?			
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	6.9E-02	calculated								* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
H	Henry's Law Constant	unitless	1.5E-03	calculated											
H	Henry's Law Constant (EHRV)	atm-m3/mol	3.7E-05	EHRV											
Koc	Partition Coefficient	unitless	2.20	EHRV											
foc	Fraction organic carbon	unitless	1.0E-02	default value											

Chemical		Benzene		SBS		Alpha		Csoil		Ci		Indoor Air Concentration		Comparison with:	
Dair	Diffusion coefficient in air	cm2/s	0.0932	EHRV								Attenuation Coefficient	unitless	3.4E-04	
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.3E-02	calculated								Soil Concentration	mg/kg	0.1909	
Deff-s	Effective diffusion through soil	cm2/s	1.3E-02	calculated								Indoor Air Concentration	ug/m3	1.46E-02	
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated								Indoor Air Concentration Comparison with:			
R	Universal gas constant		8.2E-05									USEPA Region III (4/1/98) Ambient Air Risk Based Concentration			
T	Temperature	Kelvin	2.9E+02									Ambient Air Concentration Above RBC Screening level?			
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01	calculated								* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
H	Henry's Law Constant	unitless	2.3E-01	calculated											
H	Henry's Law Constant (EHRV)	atm-m3/mol	5.5E-03	EHRV											
Koc	Partition Coefficient	unitless	65	EHRV											
foc	Fraction organic carbon	unitless	1.0E-02	default value											

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4a. Subsurface Soil

Chemical	Ethylbenzene	SBS						
Dair	Diffusion coefficient in air	cm ² /s	0.06667	EHRAV	Alpha	Attenuation Coefficient	unitless	2.4E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03	calculated	Csoil	Soil Concentration	mg/kg	0.0049
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	1.88E-04
						Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.10E+02
						Ambient Air Concentration Above RBC Screening level?		No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.6E-01	calculated				
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-01	calculated				
	H Henry's Law Constant	unitless	3.5E-01	calculated				
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	8.4E-03	EHRAV				
Koc	Partition Coefficient	unitless	220	EHRAV				
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Chemical	Methylene Chloride	SBS						
Dair	Diffusion coefficient in air	cm ² /s	0.0858	EHRAV	Alpha	Attenuation Coefficient	unitless	3.1E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02	calculated	Csoil	Soil Concentration	mg/kg	0.88
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	2.94E-02
						Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	3.80E+00
						Ambient Air Concentration Above RBC Screening level?		No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.1E-01	calculated				
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.2E+00	calculated				
	H Henry's Law Constant	unitless	1.1E-01	calculated				
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	2.6E-03	EHRAV				
Koc	Partition Coefficient	unitless	8.80	EHRAV				
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Chemical	Toluene	SBS						
Dair	Diffusion coefficient in air	cm ² /s	0.07828	EHRAV	Alpha	Attenuation Coefficient	unitless	2.8E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Csoil	Soil Concentration	mg/kg	0.0139
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	8.97E-04
						Indoor Air Concentration Comparison with:		
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	4.20E+01
						Ambient Air Concentration Above RBC Screening level?		No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated				
R	Universal gas constant		8.2E-05					
T	Temperature	Kelvin	2.9E+02					
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated				
	H Henry's Law Constant	unitless	2.7E-01	calculated				
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	6.6E-03	EHRAV				
Koc	Partition Coefficient	unitless	120	EHRAV				
foc	Fraction organic carbon	unitless	1.0E-02	default value				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4a. Subsurface Soil

Chemical	Xylene (total)	SBS							
Dair	Diffusion coefficient in air	cm ² /s	0.07164	EHRAV	Alpha	Attenuation Coefficient	unitless	2.6E-04	
					Csoil	Soil Concentration	mg/kg	0.0186	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.6E-03	calculated	CI	Indoor Air Concentration	ug/m ³	4.15E-04	
Deff-s	Effective diffusion through soil	cm ² /s	9.6E-03	calculated		Indoor Air Concentration Comparison with:			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	7.30E+02	
						Ambient Air Concentration Above RBC Screening level?		No	
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	8.6E-02	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
	Hadj Adjusted Henry's Law Constant (H/Koc x foc)	unitless	8.6E-02	calculated					
	H Henry's Law Constant	unitless	2.0E-01	calculated					
	H Henry's Law Constant (EHRAV)	atm-m ³ /mol	4.9E-03	EHRAV					(as o-Xylene)
Koc	Partition Coefficient	unitless	236	EHRAV					(as o-Xylene)
foc	Fraction organic carbon	unitless	1.0E-02	default value					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4b. Ground Water

Site Specific Parameters				Units	Value	Notes	Building Specific Parameters				Units	Value
<i>Theta (l)</i>	Total Soil Porosity	cm ³ /cm ³	0.375			<--- sand* midrange (Freeze & Cherry 1979 -Table 2.4)	<i>Ab</i>	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm ²			1,620,000
<i>Ev</i>	Volumetric Water Content in Vadose Zone	cm ³ -H ₂ O/cm ³ volume	0.150			Default - USEPA Soil Screening Guidance (1996)	<i>n (eta)</i>	Fraction of Foundation Cracked (no slab, n = ~1.0)	unitless			1.0E+00
<i>Theta (as)</i>	Volumetric air Content in Vadose Zone	cm ³ -air/cm ³ volume	0.225	0.375		<- ws+as must=theta	<i>Qbe</i>	Building Excavation Ventilation Rate	cfm/ft ²			
	Vapor Soil Porosity	cm ³ /cm ³	3.0E-01					Building Excavation Ventilation Rate	cfm			6,392
								Ventilation rate (wind speed x excavation cross sectional area)	cm ³ /s			3,017,250
	Soil Bulk Density	g/cm ³	2.1				<i>Lcrack</i>	Length of Cracks in Foundation (slab thickness: no slab, Lcrack = ~0.0)	inch			1E-12
<i>hv</i>	Thickness of vadose zone	cm						Length of Cracks	cm			2.5E-12
<i>Lt</i>	Distance to source	ft	1				<i>Acrack</i>	Area of Foundation Cracks	cm ²			1,620,000
	Distance to source	cm	30				<i>ER</i>	Building Excavation air exchange rate	(s)-1			0.012417
<i>R</i>	Universal gas constant						<i>Industrial:</i>	Building Excavation air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1			44.70
<i>T</i>	Temperature	Kelvin						Building Excavation air exchange rate- calculated (V / Qb)	(hr)-1			44.70
Derivation of the Qsoil (Convective Flow Rate) Parameter:							<i>Wind Speed</i>	Conservative Estimate of Wind Speed	mph			0.50
<i>Qsoil</i>	Volumetric flow rate	cm ³ /s	(59)			<--- Calculated from J&E (1991) eq. 24		Wind Speed	cm/s			22
<i>u (mu)</i>	Vapor Viscosity	g/cm ²	0.00018			J&E (1991) Table I - representative default value	<i>L</i>	Building Excavation Length	ft			60
<i>deltaP</i>	Subsurface to building pressure differential	g/cm-s ²	10			J&E (1991) Table II - long-term average default		Length	cm			1,800
<i>kv</i>	Soil Permeability***	cm ²	5E-08			sand midrange (Freeze & Cherry 1979 -Table 2.2)	<i>W</i>	Building Excavation Width	ft			30
<i>Xcrack</i>	Total floor/wall seam perimeter distance	cm	5,400			Xcrack = 2 x (Building Length + Width)		Width	cm			900
<i>Zcrack</i>	Depth to source	cm	30			Equivalent to "Lt" parameter	<i>H</i>	Building Excavation Height (same as depth below grade)	ft			5
<i>r crack</i>	Radius	cm	300.00			r crack = n (eta) x (Ab / Xcrack)		Height	cm			150
							<i>Aslab</i>	Area of Building Slab Excavation	ft ²			1,800
								Area	cm ²			1,620,000
							<i>D</i>	Depth of Slab Excavation Below Grade	ft			0
								Depth	cm			0
								Volume of Building Excavation	ft ³			9,000
							<i>V</i>	Volume	cm ³			243,000,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm³/cm³ is the midrange of the values (25 to 50 cm³/cm³) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm² is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

US Department of Commerce NOAA. 1994. Water Information Center, Inc. "Climates of the States".

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM .1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4b. Ground Water

Chemical Acenaphthylene									
Dair	Diffusion coefficient in air	cm ² /s	0.06703	EHRV	Alpha	Attenuation Coefficient	unitless	1.6E-04	
					Cgw	Ground Water Concentration	mg/l	2.5E-01	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.0E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	1.91E-01	
Deff-s	Effective diffusion through soil	cm ² /s	9.0E-03	calculated					
					as pyrene	<i>Indoor Air Concentration Comparison with:</i>			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.10E+01	
						Ambient Air Concentration Above RBC Screening level?			No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	4.7E-03	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	4.7E-03	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	4.7E-03	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	1.1E-04	EHRV					

Chemical Benzene									
Dair	Diffusion coefficient in air	cm ² /s	0.0932	EHRV	Alpha	Attenuation Coefficient	unitless	2.2E-04	
					Cgw	Ground Water Concentration	mg/l	9.8E-01	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.3E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	4.99E+01	
Deff-s	Effective diffusion through soil	cm ² /s	1.3E-02	calculated					
						<i>Indoor Air Concentration Comparison with:</i>			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	2.20E-01	
						Ambient Air Concentration Above RBC Screening level?			Yes
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	2.3E-01	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	5.5E-03	EHRV					

Chemical Ethylbenzene									
Dair	Diffusion coefficient in air	cm ² /s	0.06667	EHRV	Alpha	Attenuation Coefficient	unitless	1.6E-04	
					Cgw	Ground Water Concentration	mg/l	5.9E-01	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	3.32E+01	
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03	calculated					
						<i>Indoor Air Concentration Comparison with:</i>			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.10E+02	
						Ambient Air Concentration Above RBC Screening level?			No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	3.5E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	3.5E-01	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	8.4E-03	EHRV					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4b. Ground Water

Chemical: Methylene Chloride									
Dair	Diffusion coefficient in air	cm ² /s	0.0858	EHRV	Alpha	Attenuation Coefficient	unitless	2.1E-04	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02	calculated	Cgw	Ground Water Concentration	mg/l	8.8E-04	
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	1.96E-02	
<i>Indoor Air Concentration Comparison with:</i>									
USEPA Region III (4/1/98) Ambient Air Risk Based Concentration							ug/m ³	3.80E+00	No
Ambient Air Concentration Above RBC Screening level?									
* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)									
Hsel	Selected Henry's Law Constant	unitless	1.1E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.1E-01	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	1.1E-01	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	2.6E-03	EHRV					

Chemical: Naphthalene									
Dair	Diffusion coefficient in air	cm ² /s	0.08205	EHRV	Alpha	Attenuation Coefficient	unitless	2.0E-04	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Cgw	Ground Water Concentration	mg/l	4.8E+00	
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	1.65E+01	
<i>Indoor Air Concentration Comparison with:</i>									
USEPA Region III (4/1/98) Ambient Air Risk Based Concentration							ug/m ³	3.70E-02	Yes
Ambient Air Concentration Above RBC Screening level?									
* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)									
Hsel	Selected Henry's Law Constant	unitless	1.7E-02	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.7E-02	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	1.7E-02	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.2E-04	EHRV					

Chemical: Phenol									
Dair	Diffusion coefficient in air	cm ² /s	0.08924	EHRV	Alpha	Attenuation Coefficient	unitless	2.1E-04	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02	calculated	Cgw	Ground Water Concentration	mg/l	2.4E-02	
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	8.46E-05	
<i>Indoor Air Concentration Comparison with:</i>									
USEPA Region III (4/1/98) Ambient Air Risk Based Concentration							ug/m ³	2.20E+02	No
Ambient Air Concentration Above RBC Screening level?									
* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)									
Hsel	Selected Henry's Law Constant	unitless	1.8E-05	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.8E-05	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	1.8E-05	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.0E-07	EHRV					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Construction Scenario

Table G-4b. Ground Water

Chemical Styrene									
Dair	Diffusion coefficient in air	cm ² /s	0.0735	EHRV	Alpha	Attenuation Coefficient	unitless	1.8E-04	
					Cgw	Ground Water Concentration	mg/l	7.3E-03	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	2.15E-01	
Deff-s	Effective diffusion through soil	cm ² /s	9.9E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.00E+02	
						Ambient Air Concentration Above RBC Screening level?		No	
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	1.7E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.7E-01	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	1.7E-01	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.0E-03	EHRV					

Chemical Toluene									
Dair	Diffusion coefficient in air	cm ² /s	0.07828	EHRV	Alpha	Attenuation Coefficient	unitless	1.9E-04	
					Cgw	Ground Water Concentration	mg/l	9.3E-02	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³	4.80E+00	
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	4.20E+01	
						Ambient Air Concentration Above RBC Screening level?		No	
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	2.7E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.7E-01	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	2.7E-01	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	6.6E-03	EHRV					

Chemical Xylene (total)									
Dair	Diffusion coefficient in air	cm ² /s	0.07164	EHRV	Alpha	Attenuation Coefficient	unitless	1.7E-04	
					Cgw	Ground Water Concentration	mg/l	8.0E-01	
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.6E-03	calculated	Ci	Indoor Air Concentration	ug/m ³	2.81E+01	
Deff-s	Effective diffusion through soil	cm ² /s	9.6E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>			
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	7.30E+02	
						Ambient Air Concentration Above RBC Screening level?		No	
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)			
Hsel	Selected Henry's Law Constant	unitless	2.0E-01	calculated					
R	Universal gas constant		8.2E-05						
T	Temperature	Kelvin	2.9E+02						
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.0E-01	calculated (not soil adjusted for ground water media)					
H	Henry's Law Constant	unitless	2.0E-01	calculated					
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.9E-03	EHRV					

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5a. Subsurface Soil

Site Specific Parameters				Building Specific Parameters			
		Units	Value	Notes		Units	Value
Theta (t)	Total Soil Porosity	cm ³ /cm ³	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4)	Ab	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm ² 4,320,000
Ev	Volumetric Water Content in Vadose Zone	cm ³ -H ₂ O/cm ³ volume	0.150	Default - USEPA Soil Screening Guidance (1996)	n (eta)	Fraction of Foundation Cracked	unitless 0.001
Theta (as)	Volumetric air Content in Vadose Zone	cm ³ -air/cm ³ volume	0.225	0.375 <- ws+as must=theta	Qb	Building ventilation rate - commercial building estimate (~ 0.75/hr)	cfm/ft ² 0.095
	Vapor Soil Porosity	cm ³ /cm ³	3.0E-01			Building ventilation rate (estimate: 0.065 cfm/ft ²)	cfm 456
	Soil Bulk Density	g/cm ³	2.1			Ventilation rate	cm ³ /s 215,232
hv	Thickness of vadose zone	cm			Lcrack	Length of Cracks in Foundation (slab thickness)	inch 8
Li	Distance to source	ft	5.00			Length of Cracks	cm 20
	Distance to source	cm	150		Acrack	Area of Foundation Cracks	cm ² 4,320
R	Universal gas constant				ER	Building air exchange rate	(s)-1 0.000208
T	Temperature	Kelvin				Building air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1 0.75
						Building air exchange rate- calculated (Qb / V)	(hr)-1 0.75
Derivation of the Qsoil (Convective Flow Rate) Parameter:							
Qsoil	Volumetric flow rate	cm ³ /s	23	<-- Calculated from J&E (1991) eq. 24	L	Building Length	ft 80
u (mu)	Vapor Viscosity	g/cm ²	0.00018	J&E (1991) Table I - representative default value		Length	cm 2,400
deltaP	Subsurface to building pressure differential	g/cm-s ²	10	J&E (1991) Table II - long-term average default	W	Building Width	ft 60
kv	Soil Permeability***	cm ²	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)		Width	cm 1,800
Xcrack	Total floor/wall seam perimeter distance	cm	8,400	Xcrack = 2 x (Building Length + Width)	H	Building Height	ft 8
Zcrack	Depth to source	cm	150	Equivalent to "Lt" parameter		Height	cm 240
r.crack	Radius	cm	0.51	r crack = n (eta) x (Ab / Xcrack)	Aslab	Area of Building Slab	ft ² 4,800
						Area	cm ² 4,320,000
					D	Depth of Slab Below Grade	ft 0
						Depth	cm 0
					V	Volume of Building	ft ³ 38,400
						Volume	cm ³ 1,036,800,000
					Source	Area of source available for migration to building (50% based on Figure 4-	ft ² 2,400
						Source Area	cm ² 2,229,600

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm³/cm³ is the midrange of the values (25 to 50 cm³/cm³) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm² is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

Carter, M. and Bentley, S.P. 1991. Correlations of Soil Properties. Pentech Press.

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM .1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Wesrthollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5a. Subsurface Soil

Chemical 2-Butanone				2-Butanone			
Dair	Diffusion coefficient in air	cm2/s	0.08944 EHRV	Alpha	Attenuation Coefficient	unitless	1.0E-04
				Csoil	Soil Concentration	mg/kg	0.2719
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.2E-02 calculated	Ci	Indoor Air Concentration	ug/m3	5.83E-05
Deff-s	Effective diffusion through soil	cm2/s	1.2E-02 calculated		Indoor Air Concentration Comparison with:		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	1.00E+02
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.1E-03 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	4.0E-02 calculated				
H	Henry's Law Constant	unitless	2.1E-03 calculated				
H	Henry's Law Constant (EHRV)	atm-m3/mol	5.1E-05 EHRV				
Koc	Partition Coefficient	unitless	5.41 EHRV				
foc	Fraction organic carbon	unitless	1.0E-02 default value				

Chemical Acetone				Acetone			
Dair	Diffusion coefficient in air	cm2/s	0.11498 EHRV	Alpha	Attenuation Coefficient	unitless	1.0E-04
				Csoil	Soil Concentration	mg/kg	4.2000
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.5E-02 calculated	Ci	Indoor Air Concentration	ug/m3	6.53E-04
Deff-s	Effective diffusion through soil	cm2/s	1.5E-02 calculated		Indoor Air Concentration Comparison with:		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	3.70E+01
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.5E-03 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	6.9E-02 calculated				
H	Henry's Law Constant	unitless	1.5E-03 calculated				
H	Henry's Law Constant (EHRV)	atm-m3/mol	3.7E-05 EHRV				
Koc	Partition Coefficient	unitless	2.20 EHRV				
foc	Fraction organic carbon	unitless	1.0E-02 default value				

Chemical Benzene				Benzene			
Dair	Diffusion coefficient in air	cm2/s	0.0932 EHRV	Alpha	Attenuation Coefficient	unitless	1.0E-04
				Csoil	Soil Concentration	mg/kg	0.4700
Deff-crack	Effective diffusion through foundation cracks	cm2/s	1.3E-02 calculated	Ci	Indoor Air Concentration	ug/m3	1.07E-02
Deff-s	Effective diffusion through soil	cm2/s	1.3E-02 calculated		Indoor Air Concentration Comparison with:		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3	2.20E+01
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.3E-01 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01 calculated				
H	Henry's Law Constant	unitless	2.3E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m3/mol	5.5E-03 EHRV				
Koc	Partition Coefficient	unitless	65 EHRV				
foc	Fraction organic carbon	unitless	1.0E-02 default value				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5a. Subsurface Soil

Chemical Ethylbenzene				Ethylbenzene			
Dair	Diffusion coefficient in air	cm ² /s	0.06667	EHRAV	Alpha	Attenuation Coefficient	unitless 9.8E-05
					Csoil	Soil Concentration	mg/kg 7.1
					Ci	Indoor Air Concentration	ug/m ³ 1.11E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03	calculated	Indoor Air Concentration Comparison with:		
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03	calculated	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.6E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-01	calculated			
H	Henry's Law Constant	unitless	3.5E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	8.4E-03	EHRAV			
Koc	Partition Coefficient	unitless	220	EHRAV			
foc	Fraction organic carbon	unitless	1.0E-02	default value			

Chemical Methylene Chloride				Methylene Chloride			
Dair	Diffusion coefficient in air	cm ² /s	0.0858	EHRAV	Alpha	Attenuation Coefficient	unitless 1.0E-04
					Csoil	Soil Concentration	mg/kg 0.88
					Ci	Indoor Air Concentration	ug/m ³ 9.53E-03
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02	calculated	Indoor Air Concentration Comparison with:		
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02	calculated	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.1E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.2E+00	calculated			
H	Henry's Law Constant	unitless	1.1E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	2.6E-03	EHRAV			
Koc	Partition Coefficient	unitless	8.80	EHRAV			
foc	Fraction organic carbon	unitless	1.0E-02	default value			

Chemical Toluene				Toluene			
Dair	Diffusion coefficient in air	cm ² /s	0.07828	EHRAV	Alpha	Attenuation Coefficient	unitless 9.9E-05
					Csoil	Soil Concentration	mg/kg 0.15
					Ci	Indoor Air Concentration	ug/m ³ 3.41E-03
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Indoor Air Concentration Comparison with:		
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated			
H	Henry's Law Constant	unitless	2.7E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	6.6E-03	EHRAV			
Koc	Partition Coefficient	unitless	120	EHRAV			
foc	Fraction organic carbon	unitless	1.0E-02	default value			

Niagra Mohawk Power Company
 South First Street Site - Fulton, NY
 Human Health Risk Evaluation
 Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5a. Subsurface Soil

Chemical Xylene (total)		SBS					Xylene (total)
Dair	Diffusion coefficient in air	cm2/s	0.07164	EHRAV	Alpha	Attenuation Coefficient	unitless 9.9E-05
					Csoil	Soil Concentration	mg/kg 21
Deff-crack	Effective diffusion through foundation cracks	cm2/s	9.6E-03	calculated	CI	Indoor Air Concentration	ug/m3 1.79E-01
Deff-s	Effective diffusion through soil	cm2/s	9.6E-03	calculated		Indoor Air Concentration Comparison with:	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m3 7.30E+02
						Ambient Air Concentration Above RBC Screening level?	No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	8.6E-02	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	8.6E-02	calculated			
H	Henry's Law Constant	unitless	2.0E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m3/mol	4.9E-03	EHRAV		(as o-Xylene)	
Koc	Partition Coefficient	unitless	236	EHRAV		(as o-Xylene)	
foc	Fraction organic carbon	unitless	1.0E-02	default value			

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5b. Ground Water

Site Specific Parameters				Building Specific Parameters			
		Units	Value	Notes		Units	Value
Theta (t)	Total Soil Porosity	cm3/cm3	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4)	Ab	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm2 4,320,000
Ev	Volumetric Water Content in Vadose Zone	cm3-H2O/cm3 volume	0.150	Default - USEPA Soil Screening Guidance (1996)	n (eta)	Fraction of Foundation Cracked	unitless 0.001
Theta (as)	Volumetric air Content in Vadose Zone	cm3-air/cm3 volume	0.225	0.375 <- ws+as must=theta	Qb	Building ventilation rate - commercial building estimate (~ 0.75/hr)	cfm/ft2 0.095
	Vapor Soil Porosity	cm3/cm3	3.0E-01			Building ventilation rate	cfm 456
						Ventilation rate	cm3/s 215,232
	Soil Bulk Density	g/cm3	2.1		Lcrack	Length of Cracks in Foundation (slab thickness)	Inch 8
hv	Thickness of vadose zone	cm				Length of Cracks	cm 20
Lt	Distance to source	ft	5.00		Acrack	Area of Foundation Cracks	cm2 4,320
	Distance to source	cm	150		ER	Building air exchange rate	(s)-1 0.000208
R	Universal gas constant					Building air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1 0.75
T	Temperature	Kelvin				Building air exchange rate - commercial estimate - calculated (Qb / V)	(hr)-1 0.75
Derivation of the Qsoil (Convective Flow Rate) Parameter:							
Qsoil	Volumetric flow rate	cm3/s	23	<-- Calculated from J&E (1991) eq. 24	L	Building Length	ft 80
u (mu)	Vapor Viscosity	g/cm2	0.00018	J&E (1991) Table I - representative default value		Length	cm 2,400
deltaP	Subsurface to building pressure differential	g/cm-s2	10	J&E (1991) Table II - long-term average default	W	Building Width	ft 60
kv	Soil Permeability***	cm2	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)		Width	cm 1,800
Xcrack	Total floor/wall seam perimeter distance	cm	8,400	Xcrack = 2 x (Building Length + Width)	H	Building Height	ft 8
Zcrack	Depth to source	cm	150	Equivalent to "Lt" parameter		Height	cm 240
r crack	Radius	cm	0.51	r crack = n (eta) x (Ab / Xcrack)	Aslab	Area of Building Slab	ft2 4,800
						Area	cm2 4,320,000
					D	Depth of Slab Below Grade	ft 0
						Depth	cm 0
					V	Volume of Building	ft3 38,400
						Volume	cm3 1,036,800,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm3/cm3 is the midrange of the values (25 to 50 cm3/cm3) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm2 is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

Carter, M. and Bently, S.P. 1991. Correlations of Soil Properties. Pentech Press.

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM .1995 "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5b. Ground Water

Chemical Acenaphthylene				Acenaphthylene			
Dair	Diffusion coefficient in air	cm ² /s	0.06703 EHRV	Alpha	Attenuation Coefficient	unitless	9.8E-05
				Cgw	Ground Water Concentration	mg/l	2.5E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.0E-03 calculated	Ci	Indoor Air Concentration	ug/m ³	1.17E-01
Deff-s	Effective diffusion through soil	cm ² /s	9.0E-03 calculated		<i>Indoor Air Concentration Comparison with:</i>		
				as pyrene	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.10E+01
					Ambient Air Concentration Above RBC Screening level?		No
Hsel	Selected Henry's Law Constant	unitless	4.7E-03 calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	4.7E-03 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	4.7E-03 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	1.1E-04 EHRV				

Chemical Benzene				Benzene			
Dair	Diffusion coefficient in air	cm ² /s	0.0932 EHRV	Alpha	Attenuation Coefficient	unitless	1.0E-04
				Cgw	Ground Water Concentration Note (1)	mg/l	5.5E-02
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.3E-02 calculated	Ci	Indoor Air Concentration	ug/m ³	1.26E+00
Deff-s	Effective diffusion through soil	cm ² /s	1.3E-02 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	2.20E-01
					Ambient Air Concentration Above RBC Screening level?		Yes
Hsel	Selected Henry's Law Constant	unitless	2.3E-01 calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	2.3E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	5.5E-03 EHRV				

Note 1: Analytical data is not available for the subsurface beneath the Area 2 church. Interpolation of benzene data (see Figure 4-3), however, yields an area weighted concentration (50% at 0.100mg/L and 50% at 0.010 mg/l) of approximately 0.055 mg/L.

Chemical Ethylbenzene				Ethylbenzene			
Dair	Diffusion coefficient in air	cm ² /s	0.06667 EHRV	Alpha	Attenuation Coefficient	unitless	9.8E-05
				Cgw	Ground Water Concentration	mg/l	5.9E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03 calculated	Ci	Indoor Air Concentration	ug/m ³	2.03E+01
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	1.10E+02
					Ambient Air Concentration Above RBC Screening level?		No
Hsel	Selected Henry's Law Constant	unitless	3.5E-01 calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	3.5E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	8.4E-03 EHRV				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5b. Ground Water

Chemical: Methylene Chloride				Methylene Chloride			
Dair	Diffusion coefficient in air	cm ² /s	0.0858	EHRAV	Alpha	Attenuation Coefficient	unitless 1.0E-04
					Cgw	Ground Water Concentration	mg/l 8.8E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02	calculated	Ci	Indoor Air Concentration	ug/m ³ 9.53E-03
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 3.80E+00
						Ambient Air Concentration Above RBC Screening level?	No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	1.1E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.1E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	1.1E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	2.6E-03	EHRAV			

Chemical: Naphthalene				Naphthalene			
Dair	Diffusion coefficient in air	cm ² /s	0.08205	EHRAV	Alpha	Attenuation Coefficient	unitless 1.0E-04
					Cgw	Ground Water Concentration	mg/l 4.8E+00
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³ 8.37E+00
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 3.70E-02
						Ambient Air Concentration Above RBC Screening level?	Yes
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	1.7E-02	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc for soil)	unitless	1.7E-02	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	1.7E-02	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	4.2E-04	EHRAV			

Chemical: Phenol				Phenol			
Dair	Diffusion coefficient in air	cm ² /s	0.08924	EHRAV	Alpha	Attenuation Coefficient	unitless 1.0E-04
					Cgw	Ground Water Concentration	mg/l 2.4E-02
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02	calculated	Ci	Indoor Air Concentration	ug/m ³ 3.96E-05
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 2.20E+02
						Ambient Air Concentration Above RBC Screening level?	No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	1.6E-05	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-05	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	1.6E-05	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	4.0E-07	EHRAV			

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5b. Ground Water

Chemical: Styrene				Styrene			
Dair	Diffusion coefficient in air	cm ² /s	0.0735	EHRAV	Alpha	Attenuation Coefficient	unitless 9.9E-05
					Cgw	Ground Water Concentration	mg/l 7.3E-03
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.9E-03	calculated	Ci	Indoor Air Concentration	ug/m ³ 1.20E-01
Deff-s	Effective diffusion through soil	cm ² /s	9.9E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 1.00E+02
						Ambient Air Concentration Above RBC Screening level?	No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	1.7E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.7E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	1.7E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	4.0E-03	EHRAV			

Chemical: Toluene				Toluene			
Dair	Diffusion coefficient in air	cm ² /s	0.07828	EHRAV	Alpha	Attenuation Coefficient	unitless 9.9E-05
					Cgw	Ground Water Concentration	mg/l 9.3E-02
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02	calculated	Ci	Indoor Air Concentration	ug/m ³ 2.54E+00
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 4.20E+01
						Ambient Air Concentration Above RBC Screening level?	No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	2.7E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.7E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	2.7E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	6.6E-03	EHRAV			

Chemical: Xylene (total)				Xylene (total)			
Dair	Diffusion coefficient in air	cm ² /s	0.07164	EHRAV	Alpha	Attenuation Coefficient	unitless 9.9E-05
					Cgw	Ground Water Concentration	mg/l 8.0E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.6E-03	calculated	Ci	Indoor Air Concentration	ug/m ³ 1.61E+01
Deff-s	Effective diffusion through soil	cm ² /s	9.6E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 7.30E+02
						Ambient Air Concentration Above RBC Screening level?	No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	2.0E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc for soil)	unitless	2.0E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	2.0E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	4.9E-03	EHRAV (as o-xylene)			

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5b. Ground Water

Site Specific Parameters				Building Specific Parameters			
		Units	Value	Notes		Units	Value
<i>Theta (t)</i>	Total Soil Porosity	cm3/cm3	0.375	sand* midrange (Freeze & Cherry 1979 -Table 2.4)	<i>Ab</i>	Foundation Surface Area for Diffusion (influenced by vapor migration)	cm2 4,320,000
<i>Ev</i>	Volumetric Water Content in Vadose Zone	cm3-H2O/cm3 volume	0.150	Default - USEPA Soil Screening Guidance (1996)	<i>n (eta)</i>	Fraction of Foundation Cracked	unitless 0.001
<i>Theta (as)</i>	Volumetric air Content in Vadose Zone	cm3-air/cm3 volume	0.225	0.375 <- ws+as must=theta	<i>Qb</i>	Building ventilation rate - commercial building estimate (~ 0.75/hr)	cfm/ft2 0.095
	Vapor Soil Porosity	cm3/cm3	3.0E-01			Building ventilation rate	cfm 456
						Ventilation rate	cm3/s 215,232
	Soil Bulk Density	g/cm3	2.1		<i>Lcrack</i>	Length of Cracks in Foundation (slab thickness)	inch 8
<i>hv</i>	Thickness of vadose zone	cm				Length of Cracks	cm 20
<i>Lt</i>	Distance to source	ft	5.00		<i>Acrack</i>	Area of Foundation Cracks	cm2 4,320
	Distance to source	cm	150		<i>ER</i>	Building air exchange rate	(s)-1 0.000208
<i>R</i>	Universal gas constant					Building air exchange rate (Defaults: Residential ~ 0.5, Industrial ~ 1.0)	(hr)-1 0.75
<i>T</i>	Temperature	Kelvin				Building air exchange rate - commercial estimate - calculated (Qb / V)	(hr)-1 0.75
<i>Derivation of the Qsoil (Convective Flow Rate) Parameter:</i>							
<i>Qsoil</i>	Volumetric flow rate	cm3/s	23	<-- Calculated from J&E (1991) eq. 24	<i>L</i>	Building Length	ft 80
<i>u (mu)</i>	Vapor Viscosity	g/cm2	0.00018	J&E (1991) Table I - representative default value		Length	cm 2,400
<i>deltaP</i>	Subsurface to building pressure differential	g/cm-s2	10	J&E (1991) Table II - long-term average default	<i>W</i>	Building Width	ft 60
<i>kv</i>	Soil Permeability***	cm2	5E-08	sand midrange (Freeze & Cherry 1979 -Table 2.2)		Width	cm 1,800
<i>Xcrack</i>	Total floor/wall seam perimeter distance	cm	8,400	Xcrack = 2 x (Building Length + Width)	<i>H</i>	Building Height	ft 8
<i>Zcrack</i>	Depth to source	cm	150	Equivalent to "Lt" parameter		Height	cm 240
<i>r crack</i>	Radius	cm	0.51	r crack = n (eta) x (Ab / Xcrack)	<i>Aslab</i>	Area of Building Slab	ft2 4,800
						Area	cm2 4,320,000
					<i>D</i>	Depth of Slab Below Grade	ft 0
						Depth	cm 0
					<i>V</i>	Volume of Building	ft3 38,400
						Volume	cm3 1,036,800,000

Notes:

Soil is described as fill, sand, and gravel. O'Brien & Gere (1997)

* - The porosity value of 0.375 cm3/cm3 is the midrange of the values (25 to 50 cm3/cm3) reported for sand in Freeze & Cherry (1979 -Table 2.4)

*** - The permeability value of 5 E-08 cm2 is the approximate midrange of the values shown for silty to clean sand (Freeze & Cherry 1979 -Table 2.2)

References:

Carter, M. and Bentley, S.P. 1991. Correlations of Soil Properties. Pentech Press.

Epstein, C.M. 1994. "The Hydrology of New Jersey Wetlands. Stockton State/Cook Colleges, N.J."

ASTM. 1995. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". E 1739-95e1

Johnson, P.C. and R.A. Ettinger. 1991. Shell Development, Westhollow Research Center. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings". Environ. Sci. Technol., 25, 1445-1452.

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5b. Ground Water

Chemical Acenaphthylene				Acenaphthylene			
Dair	Diffusion coefficient in air	cm ² /s	0.06703	EHRAV	Alpha	Attenuation Coefficient	unitless 9.8E-05
					Cgw	Ground Water Concentration	mg/l 2.5E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.0E-03	calculated	CI	Indoor Air Concentration	ug/m ³ 1.17E-01
Deff-s	Effective diffusion through soil	cm ² /s	9.0E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>	
					as pyrene	USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 1.10E+01
						Ambient Air Concentration Above RBC Screening level?	No
Hsel	Selected Henry's Law Constant	unitless	4.7E-03	calculated		* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	4.7E-03	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	4.7E-03	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	1.1E-04	EHRAV			

Chemical Benzene				Benzene			
Dair	Diffusion coefficient in air	cm ² /s	0.0932	EHRAV	Alpha	Attenuation Coefficient	unitless 1.0E-04
					Cgw	Ground Water Concentration Note (1)	mg/l 5.5E-02
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.3E-02	calculated	CI	Indoor Air Concentration	ug/m ³ 1.26E+00
Deff-s	Effective diffusion through soil	cm ² /s	1.3E-02	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 2.20E-01
						Ambient Air Concentration Above RBC Screening level?	Yes
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	2.3E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.3E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	2.3E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	5.5E-03	EHRAV			

Note 1: Analytical data is not available for the subsurface beneath the Area 2 church. Interpolation of benzene data (see Figure 4-3), however, yields an area weighted concentration (50% at 0.100mg/L and 50% at 0.010 mg/l) of approximately 0.055 mg/L.

Chemical Ethylbenzene				Ethylbenzene			
Dair	Diffusion coefficient in air	cm ² /s	0.06667	EHRAV	Alpha	Attenuation Coefficient	unitless 9.8E-05
					Cgw	Ground Water Concentration	mg/l 5.9E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	8.9E-03	calculated	CI	Indoor Air Concentration	ug/m ³ 2.03E+01
Deff-s	Effective diffusion through soil	cm ² /s	8.9E-03	calculated		<i>Indoor Air Concentration Comparison with:</i>	
						USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³ 1.10E+02
						Ambient Air Concentration Above RBC Screening level?	No
						* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)	
Hsel	Selected Henry's Law Constant	unitless	3.5E-01	calculated			
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	3.5E-01	calculated (not soil adjusted for ground water media)			
H	Henry's Law Constant	unitless	3.5E-01	calculated			
H	Henry's Law Constant (EHRAV)	atm-m ³ /mol	8.4E-03	EHRAV			

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

Table G-5b. Ground Water

Chemical Methylene Chloride				Methylene Chloride			
Dair	Diffusion coefficient in air	cm ² /s	0.0858 EHRV	Alpha	Attenuation Coefficient	unitless	1.0E-04
				Cgw	Ground Water Concentration	mg/l	8.8E-04
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02 calculated	CI	Indoor Air Concentration	ug/m ³	9.53E-03
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02 calculated		Indoor Air Concentration Comparison with:		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	3.80E+00
					Ambient Air Concentration Above RBC Screening level?		No
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.1E-01 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.1E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.1E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	2.6E-03 EHRV				

Chemical Naphthalene				Naphthalene			
Dair	Diffusion coefficient in air	cm ² /s	0.08205 EHRV	Alpha	Attenuation Coefficient	unitless	1.0E-04
				Cgw	Ground Water Concentration	mg/l	4.8E+00
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02 calculated	CI	Indoor Air Concentration	ug/m ³	8.37E+00
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02 calculated		Indoor Air Concentration Comparison with:		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	3.70E-02
					Ambient Air Concentration Above RBC Screening level?		Yes
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.7E-02 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc for soil)	unitless	1.7E-02 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.7E-02 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.2E-04 EHRV				

Chemical Phenol				Phenol			
Dair	Diffusion coefficient in air	cm ² /s	0.08924 EHRV	Alpha	Attenuation Coefficient	unitless	1.0E-04
				Cgw	Ground Water Concentration	mg/l	2.4E-02
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.2E-02 calculated	CI	Indoor Air Concentration	ug/m ³	3.96E-05
Deff-s	Effective diffusion through soil	cm ² /s	1.2E-02 calculated		Indoor Air Concentration Comparison with:		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration	ug/m ³	2.20E+02
					Ambient Air Concentration Above RBC Screening level?		No
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.6E-05 calculated				
R	Universal gas constant		8.2E-05				
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.6E-05 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.6E-05 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.0E-07 EHRV				

Niagra Mohawk Power Company
South First Street Site - Fulton, NY
Human Health Risk Evaluation
Volatilization / Migration to Ambient-Air Estimated Concentration Screening
Area 2 - Church Scenario

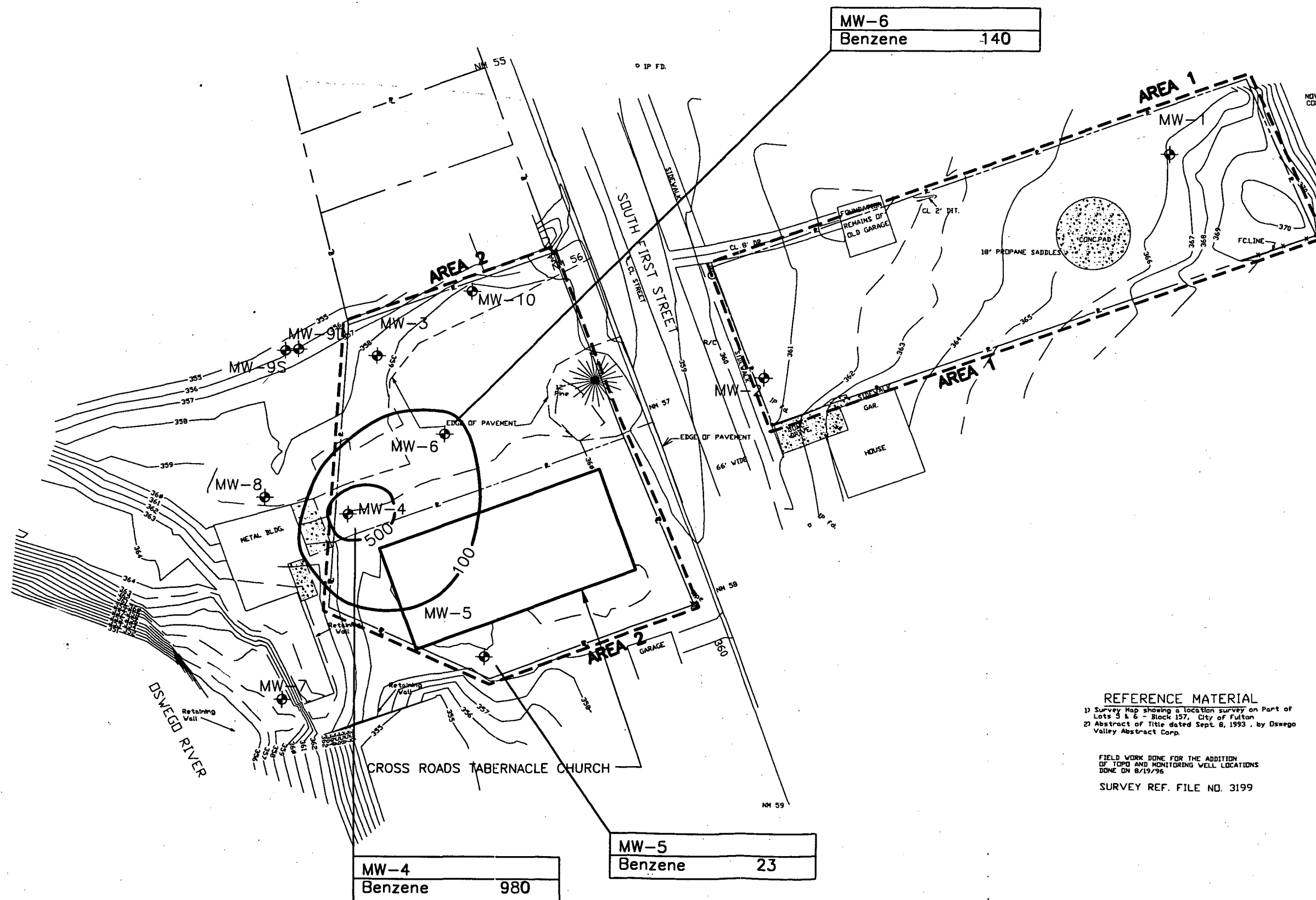
Table G-5b. Ground Water

Chemical Styrene				Styrene			
Dair	Diffusion coefficient in air	cm ² /s	0.0735 EHRV	Alpha	Attenuation Coefficient	unitless	9.9E-05
				Cgw	Ground Water Concentration	mg/l	7.3E-03
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.9E-03 calculated	Ci	Indoor Air Concentration	ug/m ³	1.20E-01
Deff-s	Effective diffusion through soil	cm ² /s	9.9E-03 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	1.7E-01 calculated			ug/m ³	1.00E+02
R	Universal gas constant		8.2E-05				No
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	1.7E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	1.7E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.0E-03 EHRV				

Chemical Toluene				Toluene			
Dair	Diffusion coefficient in air	cm ² /s	0.07828 EHRV	Alpha	Attenuation Coefficient	unitless	9.9E-05
				Cgw	Ground Water Concentration	mg/l	9.3E-02
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	1.1E-02 calculated	Ci	Indoor Air Concentration	ug/m ³	2.54E+00
Deff-s	Effective diffusion through soil	cm ² /s	1.1E-02 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.7E-01 calculated			ug/m ³	4.20E+01
R	Universal gas constant		8.2E-05				No
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc)	unitless	2.7E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	2.7E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	8.8E-03 EHRV				

Chemical Xylene (total)				Xylene (total)			
Dair	Diffusion coefficient in air	cm ² /s	0.07164 EHRV	Alpha	Attenuation Coefficient	unitless	9.9E-05
				Cgw	Ground Water Concentration	mg/l	8.0E-01
Deff-crack	Effective diffusion through foundation cracks	cm ² /s	9.6E-03 calculated	Ci	Indoor Air Concentration	ug/m ³	1.61E+01
Deff-s	Effective diffusion through soil	cm ² /s	9.6E-03 calculated		<i>Indoor Air Concentration Comparison with:</i>		
					USEPA Region III (4/1/98) Ambient Air Risk Based Concentration		
					Ambient Air Concentration Above RBC Screening level?		
					* - (Note: Constituents having an RBC based on noncancer effects have an additional 0.1 safety factor applied to the RBC value)		
Hsel	Selected Henry's Law Constant	unitless	2.0E-01 calculated			ug/m ³	7.30E+02
R	Universal gas constant		8.2E-05				No
T	Temperature	Kelvin	2.9E+02				
Hadj	Adjusted Henry's Law Constant (H/Koc x foc for soil)	unitless	2.0E-01 calculated (not soil adjusted for ground water media)				
H	Henry's Law Constant	unitless	2.0E-01 calculated				
H	Henry's Law Constant (EHRV)	atm-m ³ /mol	4.9E-03 EHRV (as o-xylene)				

FIGURE G-1



NIAGARA MOHAWK
SOUTH FIRST STREET SITE
FULTON, NEW YORK

BENZENE CONCENTRATION MAP

1118.081-016

**Chronic daily intake
cancer risk and hazard
quotient calculations**

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		100	1	350	30	70	25550			
2,4-DIMETHYLPHENOL		100	1	350	30	70	25550			
4-METHYLPHENOL		100	1	350	30	70	25550			
TOLUENE		100	1	350	30	70	25550			
AROCLO-1260		100	1	350	30	70	25550		2.0000	
PYRENE		100	1	350	30	70	25550			
INDENO[1,2,3-C,D]PYRENE	4.400	100	1	350	30	70	25550	0.000003	0.7300	1.9E-06
BENZO[B]FLUORANTHENE	50.000	100	1	350	30	70	25550	0.000029	0.7300	2.1E-05
FLUORANTHENE		100	1	350	30	70	25550			
BENZO[K]FLUORANTHENE		100	1	350	30	70	25550		0.0730	
CHRYSENE		100	1	350	30	70	25550		0.0073	
BENZO[A]PYRENE	4.000	100	1	350	30	70	25550	0.000002	7.3000	1.7E-05
DIBENZ[A,H]ANTHRACENE		100	1	350	30	70	25550		7.3000	
BENZ[A]ANTHRACENE	3.000	100	1	350	30	70	25550	0.000002	0.7300	1.3E-06
CYANIDE (FREE)	810.000	100	1	350	30	70	25550	0.000476		
BENZENE		100	1	350	30	70	25550		0.0290	
ALUMINUM	9600.000	100	1	350	30	70	25550	0.005636		
Mercury (inorganic)		100	1	350	30	70	25550			
IRON	24000.000	100	1	350	30	70	25550	0.014090		
MANGANESE-NONFOOD	510.000	100	1	350	30	70	25550	0.000299		
Mercury (inorganic)		100	1	350	30	70	25550			
NICKEL		100	1	350	30	70	25550			
ARSENIC	9.000	100	1	350	30	70	25550	0.000005	1.5000	7.9E-06
BARIUM		100	1	350	30	70	25550			
BERYLLIUM		100	1	350	30	70	25550			
CADMIUM-WATER		100	1	350	30	70	25550			
COPPER		100	1	350	30	70	25550			
VANADIUM		100	1	350	30	70	25550			
ZINC		100	1	350	30	70	25550			
TRICHLOROETHENE		100	1	350	30	70	25550		0.0110	
ACENAPHTHENE		100	1	350	30	70	25550			
FLUORENE		100	1	350	30	70	25550			
NAPHTHALENE		100	1	350	30	70	25550			
2-METHYLNAPHTHALENE		100	1	350	30	70	25550			
ACENAPHTHYLENE		100	1	350	30	70	25550			
PHENANTHRENE		100	1	350	30	70	25550			

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-1

Appendix H

NiMO MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral Rfd (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		100	1	350	30	70	10950		0.1000	
2,4-DIMETHYLPHENOL		100	1	350	30	70	10950		0.0200	
4-METHYLPHENOL		100	1	350	30	70	10950		0.0050	
TOLUENE		100	1	350	30	70	10950		0.2000	
AROCLOP-1260		100	1	350	30	70	10950			
PYRENE		100	1	350	30	70	10950		0.0300	
INDENO[1,2,3-C,D]PYRENE	4.400	100	1	350	30	70	10950	0.000006		
BENZO[B]FLUORANTHENE	50.000	100	1	350	30	70	10950	0.000068		
FLUORANTHENE		100	1	350	30	70	10950		0.0400	
BENZO[K]FLUORANTHENE		100	1	350	30	70	10950			
CHRYSENE		100	1	350	30	70	10950			
BENZO[A]PYRENE	4.000	100	1	350	30	70	10950	0.000005		
DIBENZ[A,H]ANTHRACENE		100	1	350	30	70	10950			
BENZ[A]ANTHRACENE	3.000	100	1	350	30	70	10950	0.000004		
CYANIDE (FREE)	810.000	100	1	350	30	70	10950	0.001110	0.0200	5.5E-02
BENZENE		100	1	350	30	70	10950		0.0030	
ALUMINUM	9600.000	100	1	350	30	70	10950	0.013151	1.0000	1.3E-02
Mercury (inorganic)		100	1	350	30	70	10950		0.0003	
IRON	24000.000	100	1	350	30	70	10950	0.032877	0.3000	1.1E-01
MANGANESE-NONFOOD	510.000	100	1	350	30	70	10950	0.000699	0.0200	3.5E-02
Mercury (inorganic)		100	1	350	30	70	10950			
NICKEL		100	1	350	30	70	10950		0.0200	
ARSENIC	9.000	100	1	350	30	70	10950	0.000012	0.0003	4.1E-02
BARIUM		100	1	350	30	70	10950		0.0700	
BERYLLIUM		100	1	350	30	70	10950		0.0020	
CADMIUM-WATER		100	1	350	30	70	10950		0.0005	
COPPER		100	1	350	30	70	10950		0.0400	
VANADIUM		100	1	350	30	70	10950		0.0070	
ZINC		100	1	350	30	70	10950		0.3000	
TRICHLOROETHENE		100	1	350	30	70	10950		0.0060	
ACENAPHTHENE		100	1	350	30	70	10950		0.0600	
FLUORENE		100	1	350	30	70	10950		0.0400	
NAPHTHALENE		100	1	350	30	70	10950		0.0400	
2-METHYLNAPHTHALENE		100	1	350	30	70	10950		0.0400	
ACENAPHTHYLENE		100	1	350	30	70	10950		0.0300	
PHENANTHRENE		100	1	350	30	70	10950		0.0300	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT.N\TM\REPORT\APPH_SAS.WPD

Page H-2

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		5800	0.443	0.0300	350	30	70
2,4-DIMETHYLPHENOL		5800	0.443	0.1000	350	30	70
4-METHYLPHENOL		5800	0.443	0.2500	350	30	70
TOLUENE		5800	0.443	0.0300	350	30	70
AROCLO-1260		5800	0.443	0.0600	350	30	70
PYRENE		5800	0.443	0.0300	350	30	70
INDENO [1, 2, 3-C, D] PYRENE	4.400	5800	0.443	0.0300	350	30	70
BENZO [B] FLUORANTHENE	50.000	5800	0.443	0.0300	350	30	70
FLUORANTHENE		5800	0.443	0.0300	350	30	70
BENZO [K] FLUORANTHENE		5800	0.443	0.0300	350	30	70
CHRYSENE		5800	0.443	0.0300	350	30	70
BENZO [A] PYRENE	4.000	5800	0.443	0.0300	350	30	70
DIBENZ [A, H] ANTHRACENE		5800	0.443	0.0300	350	30	70
BENZ [A] ANTHRACENE	3.000	5800	0.443	0.0300	350	30	70
CYANIDE (FREE)	810.000	5800	0.443	0.0010	350	30	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE	25550			0.900		
2,4-DIMETHYLPHENOL	25550			0.500		
4-METHYLPHENOL	25550			1.000		
TOLUENE	25550			1.000		
AROCLO-1260	25550		2.0000	0.950	2.1053	
PYRENE	25550			0.600		
INDENO [1, 2, 3-C, D] PYRENE	25550	.0000020	0.7300	0.500	1.4600	2.9E-06
BENZO [B] FLUORANTHENE	25550	.0000226	0.7300	0.500	1.4600	3.3E-05
FLUORANTHENE	25550			0.500		
BENZO [K] FLUORANTHENE	25550		0.0730	0.500	0.1460	
CHRYSENE	25550		0.0073	0.500	0.0146	
BENZO [A] PYRENE	25550	.0000018	7.3000	0.500	14.6000	2.6E-05
DIBENZ [A, H] ANTHRACENE	25550		7.3000	0.500	14.6000	
BENZ [A] ANTHRACENE	25550	.0000014	0.7300	0.500	1.4600	2.0E-06
CYANIDE (FREE)	25550	.0000122		0.720		

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		5800	0.443	0.0005	350	30	70
ALUMINUM	9600.000	5800	0.443	0.0100	350	30	70
Mercury (inorganic)		5800	0.443	0.0010	350	30	70
IRON	24000.000	5800	0.443	0.0100	350	30	70
MANGANESE-NONFOOD	510.000	5800	0.443	0.0100	350	30	70
Mercury (inorganic)		5800	0.443		350	30	70
NICKEL		5800	0.443	0.0005	350	30	70
ARSENIC	9.000	5800	0.443	0.0010	350	30	70
BARIUM		5800	0.443	0.0010	350	30	70
BERYLLIUM		5800	0.443	0.0010	350	30	70
CADMIUM-WATER		5800	0.443	0.0010	350	30	70
COPPER		5800	0.443	0.0010	350	30	70
VANADIUM		5800	0.443	0.0010	350	30	70
ZINC		5800	0.443	0.0010	350	30	70
TRICHLOROETHENE		5800	0.443	0.0005	350	30	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
BENZENE	25550		0.0290	1.000	0.0290	
ALUMINUM	25550	.0014481		0.050		
Mercury (inorganic)	25550			0.150		
IRON	25550	.0036203		0.100		
MANGANESE-NONFOOD	25550	.0000769		0.030		
Mercury (inorganic)	25550					
NICKEL	25550			0.100		
ARSENIC	25550	.0000001	1.5000	0.950	1.5789	2.1E-07
BARIUM	25550			0.050		
BERYLLIUM	25550			0.010		
CADMIUM-WATER	25550			0.025		
COPPER	25550			0.600		
VANADIUM	25550			0.010		
ZINC	25550			0.300		
TRICHLOROETHENE	25550		0.0110	1.000	0.0110	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-4

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		5800	0.443	0.0300	350	30	70
FLUORENE		5800	0.443	0.0300	350	30	70
NAPHTHALENE		5800	0.443	0.2500	350	30	70
2-METHYLNAPHTHALENE		5800	0.443	0.1000	350	30	70
ACENAPHTHYLENE		5800	0.443	0.0300	350	30	70
PHENANTHRENE		5800	0.443	0.0300	350	30	70

CHEMICAL	Averaging time (cancer 1 (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ACENAPHTHENE	25550			1.000		
FLUORENE	25550			1.000		
NAPHTHALENE	25550			1.000		
2-METHYLNAPHTHALENE	25550			0.500		
ACENAPHTHYLENE	25550			0.600		
PHENANTHRENE	25550			0.600		

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-5

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		5800	0.443	0.0300	350	30	70
2,4-DIMETHYLPHENOL		5800	0.443	0.1000	350	30	70
4-METHYLPHENOL		5800	0.443	0.2500	350	30	70
TOLUENE		5800	0.443	0.0300	350	30	70
AROCLOL-1260		5800	0.443	0.0600	350	30	70
PYRENE		5800	0.443	0.0300	350	30	70
INDENO[1,2,3-C,D]PYRENE	4.400	5800	0.443	0.0300	350	30	70
BENZO[B]FLUORANTHENE	50.000	5800	0.443	0.0300	350	30	70
FLUORANTHENE		5800	0.443	0.0300	350	30	70
BENZO[K]FLUORANTHENE		5800	0.443	0.0300	350	30	70
CHRYSENE		5800	0.443	0.0300	350	30	70
BENZO[A]PYRENE	4.000	5800	0.443	0.0300	350	30	70
DIBENZ[A,H]ANTHRACENE		5800	0.443	0.0300	350	30	70
BENZ[A]ANTHRACENE	3.000	5800	0.443	0.0300	350	30	70
CYANIDE (FREE)	810.000	5800	0.443	0.0010	350	30	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE	10950		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL	10950		0.0200	0.500	0.01000	
4-METHYLPHENOL	10950		0.0050	1.000	0.00500	
TOLUENE	10950		0.2000	1.000	0.20000	
AROCLOL-1260	10950			0.950		
PYRENE	10950		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	10950	.0000046		0.500		
BENZO[B]FLUORANTHENE	10950	.0000528		0.500		
FLUORANTHENE	10950		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE	10950			0.500		
CHRYSENE	10950			0.500		
BENZO[A]PYRENE	10950	.0000042		0.500		
DIBENZ[A,H]ANTHRACENE	10950			0.500		
BENZ[A]ANTHRACENE	10950	.0000032		0.500		
CYANIDE (FREE)	10950	.0000285	0.0200	0.720	0.01440	2.0E-03

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-6

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		5800	0.443	0.0005	350	30	70
ALUMINUM	9600.000	5800	0.443	0.0100	350	30	70
Mercury (inorganic)		5800	0.443	0.0010	350	30	70
IRON	24000.000	5800	0.443	0.0100	350	30	70
MANGANESE-NONFOOD	510.000	5800	0.443	0.0100	350	30	70
Mercury (inorganic)		5800	0.443		350	30	70
NICKEL		5800	0.443	0.0005	350	30	70
ARSENIC	9.000	5800	0.443	0.0010	350	30	70
BARIUM		5800	0.443	0.0010	350	30	70
BERYLLIUM		5800	0.443	0.0010	350	30	70
CADMIUM-WATER		5800	0.443	0.0010	350	30	70
COPPER		5800	0.443	0.0010	350	30	70
VANADIUM		5800	0.443	0.0010	350	30	70
ZINC		5800	0.443	0.0010	350	30	70
TRICHLOROETHENE		5800	0.443	0.0005	350	30	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
BENZENE	10950		0.0030	1.000	0.00300	
ALUMINUM	10950	.0033789	1.0000	0.050	0.05000	6.8E-02
Mercury (inorganic)	10950		0.0003	0.150	0.00005	
IRON	10950	.0084473	0.3000	0.100	0.03000	2.8E-01
MANGANESE-NONFOOD	10950	.0001795	0.0200	0.030	0.00060	3.0E-01
Mercury (inorganic)	10950					
NICKEL	10950		0.0200	0.100	0.00200	
ARSENIC	10950	.0000003	0.0003	0.950	0.00029	1.1E-03
BARIUM	10950		0.0700	0.050	0.00350	
BERYLLIUM	10950		0.0020	0.010	0.00002	
CADMIUM-WATER	10950		0.0005	0.025	0.00001	
COPPER	10950		0.0400	0.600	0.02400	
VANADIUM	10950		0.0070	0.010	0.00007	
ZINC	10950		0.3000	0.300	0.09000	
TRICHLOROETHENE	10950		0.0060	1.000	0.00600	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		5800	0.443	0.0300	350	30	70
FLUORENE		5800	0.443	0.0300	350	30	70
NAPHTHALENE		5800	0.443	0.2500	350	30	70
2-METHYLNAPHTHALENE		5800	0.443	0.1000	350	30	70
ACENAPHTHYLENE		5800	0.443	0.0300	350	30	70
PHENANTHRENE		5800	0.443	0.0300	350	30	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ACENAPHTHENE	10950		0.0600	1.000	0.06000	
FLUORENE	10950		0.0400	1.000	0.04000	
NAPHTHALENE	10950		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE	10950		0.0400	0.500	0.02000	
ACENAPHTHYLENE	10950		0.0300	0.600	0.01800	
PHENANTHRENE	10950		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Adult Resident

ADULT RESIDENT (RME)
Cancer Risk and Hazard Index Summary Table

PATHWAY	TOTCR	TOTHI
Incidental ingestion of surface soil.	5.0E-05	2.5E-01
Dermal contact with surface soil.	6.5E-05	6.5E-01
Total	1.1E-04	9.1E-01

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-9

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		200	1	350	6	16	25550			
2,4-DIMETHYLPHENOL		200	1	350	6	16	25550			
4-METHYLPHENOL		200	1	350	6	16	25550			
TOLUENE		200	1	350	6	16	25550			
AROCLOR-1260		200	1	350	6	16	25550		2.0000	
PYRENE		200	1	350	6	16	25550			
INDENO[1,2,3-C,D]PYRENE	4.400	200	1	350	6	16	25550	0.000005	0.7300	3.3E-06
BENZO[B]FLUORANTHENE	50.000	200	1	350	6	16	25550	0.000051	0.7300	3.8E-05
FLUORANTHENE		200	1	350	6	16	25550			
BENZO[K]FLUORANTHENE		200	1	350	6	16	25550		0.0730	
CHRYSENE		200	1	350	6	16	25550		0.0073	
BENZO[A]PYRENE	4.000	200	1	350	6	16	25550	0.000004	7.3000	3.0E-05
DIBENZ[A,H]ANTHRACENE		200	1	350	6	16	25550		7.3000	
BENZ[A]ANTHRACENE	3.000	200	1	350	6	16	25550	0.000003	0.7300	2.3E-06
CYANIDE (FREE)	810.000	200	1	350	6	16	25550	0.000832		
BENZENE		200	1	350	6	16	25550		0.0290	
ALUMINUM	9600.000	200	1	350	6	16	25550	0.009863		
Mercury (inorganic)		200	1	350	6	16	25550			
IRON	24000.000	200	1	350	6	16	25550	0.024658		
MANGANESE-NONFOOD	510.000	200	1	350	6	16	25550	0.000524		
Mercury (inorganic)		200	1	350	6	16	25550			
NICKEL		200	1	350	6	16	25550			
ARSENIC	9.000	200	1	350	6	16	25550	0.000009	1.5000	1.4E-05
BARIUM		200	1	350	6	16	25550			
BERYLLIUM		200	1	350	6	16	25550			
CADMIUM-WATER		200	1	350	6	16	25550			
COPPER		200	1	350	6	16	25550			
VANADIUM		200	1	350	6	16	25550			
ZINC		200	1	350	6	16	25550			
TRICHLOROETHENE		200	1	350	6	16	25550		0.0110	
ACENAPHTHENE		200	1	350	6	16	25550			
FLUORENE		200	1	350	6	16	25550			
NAPHTHALENE		200	1	350	6	16	25550			
2-METHYLNAPHTHALENE		200	1	350	6	16	25550			
ACENAPHTHYLENE		200	1	350	6	16	25550			
PHENANTHRENE		200	1	350	6	16	25550			

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-10

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		200	1	350	6	16	2190		0.1000	
2,4-DIMETHYLPHENOL		200	1	350	6	16	2190		0.0200	
4-METHYLPHENOL		200	1	350	6	16	2190		0.0050	
TOLUENE		200	1	350	6	16	2190		0.2000	
AROCLOR-1260		200	1	350	6	16	2190			
PYRENE		200	1	350	6	16	2190		0.0300	
INDENO[1,2,3-C,D]PYRENE	4.400	200	1	350	6	16	2190	0.00005		
BENZO[B]FLUORANTHENE	50.000	200	1	350	6	16	2190	0.00060		
FLUORANTHENE		200	1	350	6	16	2190		0.0400	
BENZO[K]FLUORANTHENE		200	1	350	6	16	2190			
CHRYSENE		200	1	350	6	16	2190			
BENZO[A]PYRENE	4.000	200	1	350	6	16	2190	0.00005		
DIBENZ[A,H]ANTHRACENE		200	1	350	6	16	2190			
BENZ[A]ANTHRACENE	3.000	200	1	350	6	16	2190	0.00004		
CYANIDE (FREE)	810.000	200	1	350	6	16	2190	0.00971	0.0200	4.9E-01
BENZENE		200	1	350	6	16	2190		0.0030	
ALUMINUM	9600.000	200	1	350	6	16	2190	0.11507	1.0000	1.2E-01
Mercury (inorganic)		200	1	350	6	16	2190		0.0003	
IRON	24000.000	200	1	350	6	16	2190	0.28767	0.3000	9.6E-01
MANGANESE-NONFOOD	510.000	200	1	350	6	16	2190	0.00611	0.0200	3.1E-01
Mercury (inorganic)		200	1	350	6	16	2190			
NICKEL		200	1	350	6	16	2190		0.0200	
ARSENIC	9.000	200	1	350	6	16	2190	0.00011	0.0003	3.6E-01
BARIUM		200	1	350	6	16	2190		0.0700	
BERYLLIUM		200	1	350	6	16	2190		0.0020	
CADMIUM-WATER		200	1	350	6	16	2190		0.0005	
COPPER		200	1	350	6	16	2190		0.0400	
VANADIUM		200	1	350	6	16	2190		0.0070	
ZINC		200	1	350	6	16	2190		0.3000	
TRICHLOROETHENE		200	1	350	6	16	2190		0.0060	
ACENAPHTHENE		200	1	350	6	16	2190		0.0600	
FLUORENE		200	1	350	6	16	2190		0.0400	
NAPHTHALENE		200	1	350	6	16	2190		0.0400	
2-METHYLNAPHTHALENE		200	1	350	6	16	2190		0.0400	
ACENAPHTHYLENE		200	1	350	6	16	2190		0.0300	
PHENANTHRENE		200	1	350	6	16	2190		0.0300	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-11

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		2300	0.433	0.0300	350	6	16
2,4-DIMETHYLPHENOL		2300	0.433	0.1000	350	6	16
4-METHYLPHENOL		2300	0.433	0.2500	350	6	16
TOLUENE		2300	0.433	0.0300	350	6	16
AROCLOL-1260		2300	0.433	0.0600	350	6	16
PYRENE		2300	0.433	0.0300	350	6	16
INDENO[1,2,3-C,D]PYRENE	4.400	2300	0.433	0.0300	350	6	16
BENZO[B]FLUORANTHENE	50.000	2300	0.433	0.0300	350	6	16
FLUORANTHENE		2300	0.433	0.0300	350	6	16
BENZO[K]FLUORANTHENE		2300	0.433	0.0300	350	6	16
CHRYSENE		2300	0.433	0.0300	350	6	16
BENZO[A]PYRENE	4.000	2300	0.433	0.0300	350	6	16
DIBENZ[A,H]ANTHRACENE		2300	0.433	0.0300	350	6	16
BENZ[A]ANTHRACENE	3.000	2300	0.433	0.0300	350	6	16
CYANIDE (FREE)	810.000	2300	0.433	0.0010	350	6	16

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE	25550			0.900		
2,4-DIMETHYLPHENOL	25550			0.500		
4-METHYLPHENOL	25550			1.000		
TOLUENE	25550			1.000		
AROCLOL-1260	25550		2.0000	0.950	2.1053	
PYRENE	25550			0.600		
INDENO[1,2,3-C,D]PYRENE	25550	.0000007	0.7300	0.500	1.4600	9.9E-07
BENZO[B]FLUORANTHENE	25550	.0000077	0.7300	0.500	1.4600	1.1E-05
FLUORANTHENE	25550			0.500		
BENZO[K]FLUORANTHENE	25550		0.0730	0.500	0.1460	
CHRYSENE	25550		0.0073	0.500	0.0146	
BENZO[A]PYRENE	25550	.0000006	7.3000	0.500	14.6000	9.0E-06
DIBENZ[A,H]ANTHRACENE	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	25550	.0000005	0.7300	0.500	1.4600	6.7E-07
CYANIDE (FREE)	25550	.0000041		0.720		

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Carcinogenic GDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		2300	0.433	0.0005	350	6	16
ALUMINUM	9600.000	2300	0.433	0.0100	350	6	16
Mercury (inorganic)		2300	0.433	0.0010	350	6	16
IRON	24000.000	2300	0.433	0.0100	350	6	16
MANGANESE-NONFOOD	510.000	2300	0.433	0.0100	350	6	16
Mercury (inorganic)		2300	0.433		350	6	16
NICKEL		2300	0.433	0.0005	350	6	16
ARSENIC	9.000	2300	0.433	0.0010	350	6	16
BARIUM		2300	0.433	0.0010	350	6	16
BERYLLIUM		2300	0.433	0.0010	350	6	16
CADMIUM-WATER		2300	0.433	0.0010	350	6	16
COPPER		2300	0.433	0.0010	350	6	16
VANADIUM		2300	0.433	0.0010	350	6	16
ZINC		2300	0.433	0.0010	350	6	16
TRICHLOROETHENE		2300	0.433	0.0005	350	6	16

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
BENZENE	25550		0.0290	1.000	0.0290	
ALUMINUM	25550	.0004911		0.050		
Mercury (inorganic)	25550			0.150		
IRON	25550	.0012278		0.100		
MANGANESE-NONFOOD	25550	.0000261		0.030		
Mercury (inorganic)	25550					
NICKEL	25550			0.100		
ARSENIC	25550	.0000000	1.5000	0.950	1.5789	7.3E-08
BARIUM	25550			0.050		
BERYLLIUM	25550			0.010		
CADMIUM-WATER	25550			0.025		
COPPER	25550			0.600		
VANADIUM	25550			0.010		
ZINC	25550			0.300		
TRICHLOROETHENE	25550		0.0110	1.000	0.0110	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-13

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		2300	0.433	0.0300	350	6	16
FLUORENE		2300	0.433	0.0300	350	6	16
NAPHTHALENE		2300	0.433	0.2500	350	6	16
2-METHYLNAPHTHALENE		2300	0.433	0.1000	350	6	16
ACENAPHTHYLENE		2300	0.433	0.0300	350	6	16
PHENANTHRENE		2300	0.433	0.0300	350	6	16

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ACENAPHTHENE	25550			1.000		
FLUORENE	25550			1.000		
NAPHTHALENE	25550			1.000		
2-METHYLNAPHTHALENE	25550			0.500		
ACENAPHTHYLENE	25550			0.600		
PHENANTHRENE	25550			0.600		

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-14

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		2300	0.433	0.0300	350	6	16
2,4-DIMETHYLPHENOL		2300	0.433	0.1000	350	6	16
4-METHYLPHENOL		2300	0.433	0.2500	350	6	16
TOLUENE		2300	0.433	0.0300	350	6	16
AROCLO-1260		2300	0.433	0.0600	350	6	16
PYRENE		2300	0.433	0.0300	350	6	16
INDENO[1,2,3-C,D]PYRENE	4.400	2300	0.433	0.0300	350	6	16
BENZO[B]FLUORANTHENE	50.000	2300	0.433	0.0300	350	6	16
FLUORANTHENE		2300	0.433	0.0300	350	6	16
BENZO[K]FLUORANTHENE		2300	0.433	0.0300	350	6	16
CHRYSENE		2300	0.433	0.0300	350	6	16
BENZO[A]PYRENE	4.000	2300	0.433	0.0300	350	6	16
DIBENZ[A,H]ANTHRACENE		2300	0.433	0.0300	350	6	16
BENZ[A]ANTHRACENE	3.000	2300	0.433	0.0300	350	6	16
CYANIDE (FREE)	810.000	2300	0.433	0.0010	350	6	16

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral Rfd (mg/kg-day)	GI absorption factor	Adjusted C Rfd	Hazard Quotient
ETHYLBENZENE	2190		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL	2190		0.0200	0.500	0.01000	
4-METHYLPHENOL	2190		0.0050	1.000	0.00500	
TOLUENE	2190		0.2000	1.000	0.20000	
AROCLO-1260	2190			0.950		
PYRENE	2190		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	2190	0.000008		0.500		
BENZO[B]FLUORANTHENE	2190	0.000090		0.500		
FLUORANTHENE	2190		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE	2190			0.500		
CHRYSENE	2190			0.500		
BENZO[A]PYRENE	2190	0.000007		0.500		
DIBENZ[A,H]ANTHRACENE	2190			0.500		
BENZ[A]ANTHRACENE	2190	0.000005		0.500		
CYANIDE (FREE)	2190	0.000048	0.0200	0.720	0.01440	3.4E-03

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		2300	0.433	0.0005	350	6	16
ALUMINUM	9600.000	2300	0.433	0.0100	350	6	16
Mercury (inorganic)		2300	0.433	0.0010	350	6	16
IRON	24000.000	2300	0.433	0.0100	350	6	16
MANGANESE-NONFOOD	510.000	2300	0.433	0.0100	350	6	16
Mercury (inorganic)		2300	0.433		350	6	16
NICKEL		2300	0.433	0.0005	350	6	16
ARSENIC	9.000	2300	0.433	0.0010	350	6	16
BARIUM		2300	0.433	0.0010	350	6	16
BERYLLIUM		2300	0.433	0.0010	350	6	16
CADMIUM-WATER		2300	0.433	0.0010	350	6	16
COPPER		2300	0.433	0.0010	350	6	16
VANADIUM		2300	0.433	0.0010	350	6	16
ZINC		2300	0.433	0.0010	350	6	16
TRICHLOROETHENE		2300	0.433	0.0005	350	6	16

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
BENZENE	2190		0.0030	1.000	0.00300	
ALUMINUM	2190	0.005730	1.0000	0.050	0.05000	1.1E-01
Mercury (inorganic)	2190		0.0003	0.150	0.00005	
IRON	2190	0.014325	0.3000	0.100	0.03000	4.8E-01
MANGANESE-NONFOOD	2190	0.000304	0.0200	0.030	0.00060	5.1E-01
Mercury (inorganic)	2190					
NICKEL	2190		0.0200	0.100	0.00200	
ARSENIC	2190	0.000001	0.0003	0.950	0.00029	1.9E-03
BARIUM	2190		0.0700	0.050	0.00350	
BERYLLIUM	2190		0.0020	0.010	0.00002	
CADMIUM-WATER	2190		0.0005	0.025	0.00001	
COPPER	2190		0.0400	0.600	0.02400	
VANADIUM	2190		0.0070	0.010	0.00007	
ZINC	2190		0.3000	0.300	0.09000	
TRICHLOROETHENE	2190		0.0060	1.000	0.00600	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-16

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		2300	0.433	0.0300	350	6	16
FLUORENE		2300	0.433	0.0300	350	6	16
NAPHTHALENE		2300	0.433	0.2500	350	6	16
2-METHYLNAPHTHALENE		2300	0.433	0.1000	350	6	16
ACENAPHTHYLENE		2300	0.433	0.0300	350	6	16
PHENANTHRENE		2300	0.433	0.0300	350	6	16

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ACENAPHTHENE	2190		0.0600	1.000	0.06000	
FLUORENE	2190		0.0400	1.000	0.04000	
NAPHTHALENE	2190		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE	2190		0.0400	0.500	0.02000	
ACENAPHTHYLENE	2190		0.0300	0.600	0.01800	
PHENANTHRENE	2190		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Child Resident

CHILD RESIDENT (RME)
Cancer Risk and Hazard Index Summary Table

PATHWAY	TOTCR	TOTHI
Incidental ingestion of surface soil.	8.7E-05	2.2E+00
Dermal contact with surface soil.	2.2E-05	1.1E+00
Total	1.1E-04	3.3E+00

O'Brien & Gere Engineers, Inc. - 20NOV98 - RAPROG7.SAS

January 7, 1999

F:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-18

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/ (mg/kg-day)	Cancer risk
ETHYLBENZENE		480	1	60	1	70	25550			
2,4-DIMETHYLPHENOL		480	1	60	1	70	25550			
4-METHYLPHENOL		480	1	60	1	70	25550			
TOLUENE		480	1	60	1	70	25550			
AROCLOR-1260		480	1	60	1	70	25550		2.0000	
PYRENE		480	1	60	1	70	25550			
INDENO[1,2,3-C,D]PYRENE	4.400	480	1	60	1	70	25550	.00000007	0.7300	5.2E-08
BENZO[B]FLUORANTHENE	50.000	480	1	60	1	70	25550	.00000081	0.7300	5.9E-07
FLUORANTHENE		480	1	60	1	70	25550			
BENZO[K]FLUORANTHENE		480	1	60	1	70	25550		0.0730	
CHRYSENE		480	1	60	1	70	25550		0.0073	
BENZO[A]PYRENE	4.000	480	1	60	1	70	25550	.00000006	7.3000	4.7E-07
DIBENZ[A,H]ANTHRACENE		480	1	60	1	70	25550		7.3000	
BENZ[A]ANTHRACENE	3.000	480	1	60	1	70	25550	.00000005	0.7300	3.5E-08
CYANIDE (FREE)	810.000	480	1	60	1	70	25550	.00001304		
BENZENE		480	1	60	1	70	25550		0.0290	
ALUMINUM	9600.000	480	1	60	1	70	25550	.00015459		
Mercury (inorganic)		480	1	60	1	70	25550			
IRON	24000.000	480	1	60	1	70	25550	.00038647		
MANGANESE-NONFOOD	510.000	480	1	60	1	70	25550	.00000821		
Mercury (inorganic)		480	1	60	1	70	25550			
NICKEL		480	1	60	1	70	25550			
ARSENIC	9.000	480	1	60	1	70	25550	.00000014	1.5000	2.2E-07
BARIUM		480	1	60	1	70	25550			
BERYLLIUM		480	1	60	1	70	25550			
CADMIUM-WATER		480	1	60	1	70	25550			
COPPER		480	1	60	1	70	25550			
VANADIUM		480	1	60	1	70	25550			
ZINC		480	1	60	1	70	25550			
TRICHLOROETHENE		480	1	60	1	70	25550		0.0110	
ACENAPHTHENE		480	1	60	1	70	25550			
FLUORENE		480	1	60	1	70	25550			
NAPHTHALENE		480	1	60	1	70	25550			
2-METHYLNAPHTHALENE		480	1	60	1	70	25550			
ACENAPHTHYLENE		480	1	60	1	70	25550			
PHENANTHRENE		480	1	60	1	70	25550			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-19

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		480	1	60	1	70	365		0.1000	
2,4-DIMETHYLPHENOL		480	1	60	1	70	365		0.0200	
4-METHYLPHENOL		480	1	60	1	70	365		0.0050	
TOLUENE		480	1	60	1	70	365		0.2000	
AROCLOR-1260		480	1	60	1	70	365			
PYRENE		480	1	60	1	70	365		0.0300	
INDENO[1,2,3-C,D]PYRENE	4.400	480	1	60	1	70	365	0.000005		
BENZO[B]FLUORANTHENE	50.000	480	1	60	1	70	365	0.000056		
FLUORANTHENE		480	1	60	1	70	365		0.0400	
BENZO[K]FLUORANTHENE		480	1	60	1	70	365			
CHRYSENE		480	1	60	1	70	365			
BENZO[A]PYRENE	4.000	480	1	60	1	70	365	0.000005		
DIBENZ[A,H]ANTHRACENE		480	1	60	1	70	365			
BENZ[A]ANTHRACENE	3.000	480	1	60	1	70	365	0.000003		
CYANIDE (FREE)	810.000	480	1	60	1	70	365	0.000913	0.0200	4.6E-02
BENZENE		480	1	60	1	70	365		0.0030	
ALUMINUM	9600.000	480	1	60	1	70	365	0.010821	1.0000	1.1E-02
Mercury (inorganic)		480	1	60	1	70	365		0.0003	
IRON	24000.000	480	1	60	1	70	365	0.027053	0.3000	9.0E-02
MANGANESE-NONFOOD	510.000	480	1	60	1	70	365	0.000575	0.0200	2.9E-02
Mercury (inorganic)		480	1	60	1	70	365			
NICKEL		480	1	60	1	70	365		0.0200	
ARSENIC	9.000	480	1	60	1	70	365	0.000010	0.0003	3.4E-02
BARIIUM		480	1	60	1	70	365		0.0700	
BERYLLIUM		480	1	60	1	70	365		0.0020	
CADMIUM-WATER		480	1	60	1	70	365		0.0005	
COPPER		480	1	60	1	70	365		0.0400	
VANADIUM		480	1	60	1	70	365		0.0070	
ZINC		480	1	60	1	70	365		0.3000	
TRICHLOROETHENE		480	1	60	1	70	365		0.0060	
ACENAPHTHENE		480	1	60	1	70	365		0.0600	
FLUORENE		480	1	60	1	70	365		0.0400	
NAPHTHALENE		480	1	60	1	70	365		0.0400	
2-METHYLNAPHTHALENE		480	1	60	1	70	365		0.0400	
ACENAPHTHYLENE		480	1	60	1	70	365		0.0300	
PHENANTHRENE		480	1	60	1	70	365		0.0300	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-20

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		5800	0.433	0.0300	60	1	70
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70
TOLUENE		5800	0.433	0.0300	60	1	70
AROCLOL-1260		5800	0.433	0.0600	60	1	70
PYRENE		5800	0.433	0.0300	60	1	70
INDENO[1,2,3-C,D]PYRENE	4.400	5800	0.433	0.0300	60	1	70
BENZO[B]FLUORANTHENE	50.000	5800	0.433	0.0300	60	1	70
FLUORANTHENE		5800	0.433	0.0300	60	1	70
BENZO[K]FLUORANTHENE		5800	0.433	0.0300	60	1	70
CHRYSENE		5800	0.433	0.0300	60	1	70
BENZO[A]PYRENE	4.000	5800	0.433	0.0300	60	1	70
DIBENZ[A,H]ANTHRACENE		5800	0.433	0.0300	60	1	70
BENZ[A]ANTHRACENE	3.000	5800	0.433	0.0300	60	1	70
CYANIDE (FREE)	810.000	5800	0.433	0.0010	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE	25550			0.900		
2,4-DIMETHYLPHENOL	25550			0.500		
4-METHYLPHENOL	25550			1.000		
TOLUENE	25550			1.000		
AROCLOL-1260	25550		2.0000	0.950	2.1053	
PYRENE	25550			0.600		
INDENO[1,2,3-C,D]PYRENE	25550	.000000011	0.7300	0.500	1.4600	1.6E-08
BENZO[B]FLUORANTHENE	25550	.000000126	0.7300	0.500	1.4600	1.8E-07
FLUORANTHENE	25550			0.500		
BENZO[K]FLUORANTHENE	25550		0.0730	0.500	0.1460	
CHRYSENE	25550		0.0073	0.500	0.0146	
BENZO[A]PYRENE	25550	.000000010	7.3000	0.500	14.6000	1.5E-07
DIBENZ[A,H]ANTHRACENE	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	25550	.000000008	0.7300	0.500	1.4600	1.1E-08
CYANIDE (FREE)	25550	.000000068		0.720		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		5800	0.433	0.0005	60	1	70
ALUMINUM	9600.000	5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433	0.0010	60	1	70
IRON	24000.000	5800	0.433	0.0100	60	1	70
MANGANESE-NONFOOD	510.000	5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433	0.0010	60	1	70
NICKEL		5800	0.433	0.0005	60	1	70
ARSENIC	9.000	5800	0.433	0.0010	60	1	70
BARIUM		5800	0.433	0.0010	60	1	70
BERYLLIUM		5800	0.433	0.0010	60	1	70
CADMIUM-WATER		5800	0.433	0.0010	60	1	70
COPPER		5800	0.433	0.0010	60	1	70
VANADIUM		5800	0.433	0.0010	60	1	70
ZINC		5800	0.433	0.0010	60	1	70
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
BENZENE	25550		0.0290	1.000	0.0290	
ALUMINUM	25550	.000008088		0.050		
Mercury (inorganic)	25550			0.150		
IRON	25550	.000020220		0.100		
MANGANESE-NONFOOD	25550	.000000430		0.030		
Mercury (inorganic)	25550					
NICKEL	25550			0.100		
ARSENIC	25550	.000000001	1.5000	0.950	1.5789	1.2E-09
BARIUM	25550			0.050		
BERYLLIUM	25550			0.010		
CADMIUM-WATER	25550			0.025		
COPPER	25550			0.600		
VANADIUM	25550			0.010		
ZINC	25550			0.300		
TRICHLOROETHENE	25550		0.0110	1.000	0.0110	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		5800	0.433	0.0300	60	1	70
FLUORENE		5800	0.433	0.0300	60	1	70
NAPHTHALENE		5800	0.433	0.2500	60	1	70
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70
PHENANTHRENE		5800	0.433	0.0300	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ACENAPHTHENE	25550			1.000		
FLUORENE	25550			1.000		
NAPHTHALENE	25550			1.000		
2-METHYLNAPHTHALENE	25550			0.500		
ACENAPHTHYLENE	25550			0.600		
PHENANTHRENE	25550			0.600		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT\TMP\REPORT\APPH_SAS.WPD

Page H-23

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		5800	0.433	0.0300	60	1	70
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70
TOLUENE		5800	0.433	0.0300	60	1	70
AROCLOR-1260		5800	0.433	0.0600	60	1	70
PYRENE		5800	0.433	0.0300	60	1	70
INDENO[1,2,3-C,D]PYRENE	4.400	5800	0.433	0.0300	60	1	70
BENZO[B]FLUORANTHENE	50.000	5800	0.433	0.0300	60	1	70
FLUORANTHENE		5800	0.433	0.0300	60	1	70
BENZO[K]FLUORANTHENE		5800	0.433	0.0300	60	1	70
CHRYSENE		5800	0.433	0.0300	60	1	70
BENZO[A]PYRENE	4.000	5800	0.433	0.0300	60	1	70
DIBENZ[A,H]ANTHRACENE		5800	0.433	0.0300	60	1	70
BENZ[A]ANTHRACENE	3.000	5800	0.433	0.0300	60	1	70
CYANIDE (FREE)	810.000	5800	0.433	0.0010	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE	365		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL	365		0.0200	0.500	0.01000	
4-METHYLPHENOL	365		0.0050	1.000	0.00500	
TOLUENE	365		0.2000	1.000	0.20000	
AROCLOR-1260	365			0.950		
PYRENE	365		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	365	.0000008		0.500		
BENZO[B]FLUORANTHENE	365	.0000088		0.500		
FLUORANTHENE	365		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE	365			0.500		
CHRYSENE	365			0.500		
BENZO[A]PYRENE	365	.0000007		0.500		
DIBENZ[A,H]ANTHRACENE	365			0.500		
BENZ[A]ANTHRACENE	365	.0000005		0.500		
CYANIDE (FREE)	365	.0000048	0.0200	0.720	0.01440	3.3E-04

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-24

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		5800	0.433	0.0005	60	1	70
ALUMINUM	9600.000	5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433	0.0010	60	1	70
IRON	24000.000	5800	0.433	0.0100	60	1	70
MANGANESE-NONFOOD	510.000	5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433		60	1	70
NICKEL		5800	0.433	0.0005	60	1	70
ARSENIC	9.000	5800	0.433	0.0010	60	1	70
BARIUM		5800	0.433	0.0010	60	1	70
BERYLLIUM		5800	0.433	0.0010	60	1	70
CADMIUM-WATER		5800	0.433	0.0010	60	1	70
COPPER		5800	0.433	0.0010	60	1	70
VANADIUM		5800	0.433	0.0010	60	1	70
ZINC		5800	0.433	0.0010	60	1	70
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
BENZENE	365		0.0030	1.000	0.00300	
ALUMINUM	365	.0005662	1.0000	0.050	0.05000	1.1E-02
Mercury (inorganic)	365		0.0003	0.150	0.00005	
IRON	365	.0014154	0.3000	0.100	0.03000	4.7E-02
MANGANESE-NONFOOD	365	.0000301	0.0200	0.030	0.00060	5.0E-02
Mercury (inorganic)	365					
NICKEL	365		0.0200	0.100	0.00200	
ARSENIC	365	.0000001	0.0003	0.950	0.00029	1.9E-04
BARIUM	365		0.0700	0.050	0.00350	
BERYLLIUM	365		0.0020	0.010	0.00002	
CADMIUM-WATER	365		0.0005	0.025	0.00001	
COPPER	365		0.0400	0.600	0.02400	
VANADIUM	365		0.0070	0.010	0.00007	
ZINC	365		0.3000	0.300	0.09000	
TRICHLOROETHENE	365		0.0060	1.000	0.00600	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-25

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm ² /d)	SS to skin adherence factor (mg/cm ²)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		5800	0.433	0.0300	60	1	70
FLUORENE		5800	0.433	0.0300	60	1	70
NAPHTHALENE		5800	0.433	0.2500	60	1	70
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70
PHENANTHRENE		5800	0.433	0.0300	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral Rfd (mg/kg-day)	GI absorption factor	Adjusted C Rfd	Hazard Quotient
ACENAPHTHENE	365		0.0600	1.000	0.06000	
FLUORENE	365		0.0400	1.000	0.04000	
NAPHTHALENE	365		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE	365		0.0400	0.500	0.02000	
ACENAPHTHYLENE	365		0.0300	0.600	0.01800	
PHENANTHRENE	365		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-26

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of subsurface soil.

CHEMICAL	SB CONC	SB ingestion rate (mg/d)	Fraction SB ingested from source	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/ (mg/kg-day)	Cancer risk
ETHYLBENZENE		480	1	60	1	70	25550			
2,4-DIMETHYLPHENOL		480	1	60	1	70	25550			
4-METHYLPHENOL		480	1	60	1	70	25550			
TOLUENE		480	1	60	1	70	25550			
AROCLOR-1260		480	1	60	1	70	25550		2.0000	
PYRENE		480	1	60	1	70	25550			
INDENO[1,2,3-C,D]PYRENE	3.400	480	1	60	1	70	25550	.00000005	0.7300	4.0E-08
BENZO[B]FLUORANTHENE	62.000	480	1	60	1	70	25550	.00000100	0.7300	7.3E-07
FLUORANTHENE		480	1	60	1	70	25550			
BENZO[K]FLUORANTHENE		480	1	60	1	70	25550		0.0730	
CHRYSENE		480	1	60	1	70	25550		0.0073	
BENZO[A]PYRENE	3.800	480	1	60	1	70	25550	.00000006	7.3000	4.5E-07
DIBENZ[A,H]ANTHRACENE		480	1	60	1	70	25550		7.3000	
BENZ[A]ANTHRACENE	3.600	480	1	60	1	70	25550	.00000006	0.7300	4.2E-08
CYANIDE (FREE)		480	1	60	1	70	25550			
BENZENE		480	1	60	1	70	25550		0.0290	
ALUMINUM		480	1	60	1	70	25550			
Mercury (inorganic)		480	1	60	1	70	25550			
IRON	17000.000	480	1	60	1	70	25550	.00027375		
MANGANESE-NONFOOD	500.000	480	1	60	1	70	25550	.00000805		
Mercury (inorganic)		480	1	60	1	70	25550			
NICKEL		480	1	60	1	70	25550			
ARSENIC	4.000	480	1	60	1	70	25550	.00000006	1.5000	9.7E-08
BARIUM		480	1	60	1	70	25550			
BERYLLIUM		480	1	60	1	70	25550			
CADMIUM-WATER		480	1	60	1	70	25550			
COPPER		480	1	60	1	70	25550			
VANADIUM		480	1	60	1	70	25550			
ZINC	29.000	480	1	60	1	70	25550	.00000047		
TRICHLOROETHENE		480	1	60	1	70	25550		0.0110	
ACENAPHTHENE		480	1	60	1	70	25550			
FLUORENE		480	1	60	1	70	25550			
NAPHTHALENE		480	1	60	1	70	25550			
2-METHYLNAPHTHALENE		480	1	60	1	70	25550			
ACENAPHTHYLENE		480	1	60	1	70	25550			
PHENANTHRENE		480	1	60	1	70	25550			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

F:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of subsurface soil.

CHEMICAL	SBCONC	SB ingestion rate (mg/d)	Fraction SB ingested from source	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		480	1	60	1	70	365		0.1000	
2,4-DIMETHYLPHENOL		480	1	60	1	70	365		0.0200	
4-METHYLPHENOL		480	1	60	1	70	365		0.0050	
TOLUENE		480	1	60	1	70	365		0.2000	
AROCLOR-1260		480	1	60	1	70	365			
PYRENE		480	1	60	1	70	365		0.0300	
INDENO[1,2,3-C,D]PYRENE	3.400	480	1	60	1	70	365	0.000004		
BENZO[B]FLUORANTHENE	62.000	480	1	60	1	70	365	0.000070		
FLUORANTHENE		480	1	60	1	70	365		0.0400	
BENZO[K]FLUORANTHENE		480	1	60	1	70	365			
CHRYSENE		480	1	60	1	70	365			
BENZO[A]PYRENE	3.800	480	1	60	1	70	365	0.000004		
DIBENZ[A,H]ANTHRACENE		480	1	60	1	70	365			
BENZ[A]ANTHRACENE	3.600	480	1	60	1	70	365	0.000004		
CYANIDE (FREE)		480	1	60	1	70	365		0.0200	
BENZENE		480	1	60	1	70	365		0.0030	
ALUMINUM		480	1	60	1	70	365		1.0000	
Mercury (inorganic)		480	1	60	1	70	365		0.0003	
IRON	17000.000	480	1	60	1	70	365	0.019162	0.3000	6.4E-02
MANGANESE-NONFOOD	500.000	480	1	60	1	70	365	0.000564	0.0200	2.8E-02
Mercury (inorganic)		480	1	60	1	70	365			
NICKEL		480	1	60	1	70	365		0.0200	
ARSENIC	4.000	480	1	60	1	70	365	0.000005	0.0003	1.5E-02
BARIUM		480	1	60	1	70	365		0.0700	
BERYLLIUM		480	1	60	1	70	365		0.0020	
CADMIUM-WATER		480	1	60	1	70	365		0.0005	
COPPER		480	1	60	1	70	365		0.0400	
VANADIUM		480	1	60	1	70	365		0.0070	
ZINC	29.000	480	1	60	1	70	365	0.000033	0.3000	1.1E-04
TRICHLOROETHENE		480	1	60	1	70	365		0.0060	
ACENAPHTHENE		480	1	60	1	70	365		0.0600	
FLUORENE		480	1	60	1	70	365		0.0400	
NAPHTHALENE		480	1	60	1	70	365		0.0400	
2-METHYLNAPHTHALENE		480	1	60	1	70	365		0.0400	
ACENAPHTHYLENE		480	1	60	1	70	365		0.0300	
PHENANTHRENE		480	1	60	1	70	365		0.0300	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-28

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with subsurface soil.

CHEMICAL	SBCONC	Exposed skin surface area to SB (cm2/d)	SB to skin adherence factor (mg/cm2)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		5800	0.433	0.0300	60	1	70
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70
TOLUENE		5800	0.433	0.0300	60	1	70
AROCLO-1260		5800	0.433	0.0600	60	1	70
PYRENE		5800	0.433	0.0300	60	1	70
INDENO[1,2,3-C,D]PYRENE	3.400	5800	0.433	0.0300	60	1	70
BENZO[B]FLUORANTHENE	62.000	5800	0.433	0.0300	60	1	70
FLUORANTHENE		5800	0.433	0.0300	60	1	70
BENZO[K]FLUORANTHENE		5800	0.433	0.0300	60	1	70
CHRYSENE		5800	0.433	0.0300	60	1	70
BENZO[A]PYRENE	3.800	5800	0.433	0.0300	60	1	70
DIBENZ[A,H]ANTHRACENE		5800	0.433	0.0300	60	1	70
BENZ[A]ANTHRACENE	3.600	5800	0.433	0.0300	60	1	70
CYANIDE (FREE)		5800	0.433	0.0010	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted slope factor	Cancer risk
ETHYLBENZENE	25550			0.900		
2,4-DIMETHYLPHENOL	25550			0.500		
4-METHYLPHENOL	25550			1.000		
TOLUENE	25550			1.000		
AROCLO-1260	25550		2.0000	0.950	2.1053	
PYRENE	25550			0.600		
INDENO[1,2,3-C,D]PYRENE	25550	.000000009	0.7300	0.500	1.4600	1.3E-08
BENZO[B]FLUORANTHENE	25550	.000000157	0.7300	0.500	1.4600	2.3E-07
FLUORANTHENE	25550			0.500		
BENZO[K]FLUORANTHENE	25550		0.0730	0.500	0.1460	
CHRYSENE	25550		0.0073	0.500	0.0146	
BENZO[A]PYRENE	25550	.000000010	7.3000	0.500	14.6000	1.4E-07
DIBENZ[A,H]ANTHRACENE	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	25550	.000000009	0.7300	0.500	1.4600	1.3E-08
CYANIDE (FREE)	25550			0.720		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-29

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with subsurface soil.

CHEMICAL	SBCONC	Exposed skin surface area to SB (cm2/d)	SB to skin adherence factor (mg/cm2)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		5800	0.433	0.0005	60	1	70
ALUMINUM		5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433	0.0010	60	1	70
IRON	17000.000	5800	0.433	0.0100	60	1	70
MANGANESE-NONFOOD	500.000	5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433		60	1	70
NICKEL		5800	0.433	0.0005	60	1	70
ARSENIC	4.000	5800	0.433	0.0010	60	1	70
BARIUM		5800	0.433	0.0010	60	1	70
BERYLLIUM		5800	0.433	0.0010	60	1	70
CADMIUM-WATER		5800	0.433	0.0010	60	1	70
COPPER		5800	0.433	0.0010	60	1	70
VANADIUM		5800	0.433	0.0010	60	1	70
ZINC	29.000	5800	0.433	0.0010	60	1	70
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted slope factor	Cancer risk
BENZENE	25550		0.0290	1.000	0.0290	
ALUMINUM	25550			0.050		
Mercury (inorganic)	25550			0.150		
IRON	25550	.000014323		0.100		
MANGANESE-NONFOOD	25550	.000000421		0.030		
Mercury (inorganic)	25550					
NICKEL	25550			0.100		
ARSENIC	25550	.000000000	1.5000	0.950	1.5789	5.3E-10
BARIUM	25550			0.050		
BERYLLIUM	25550			0.010		
CADMIUM-WATER	25550			0.025		
COPPER	25550			0.600		
VANADIUM	25550			0.010		
ZINC	25550	.000000002		0.300		
TRICHLOROETHENE	25550		0.0110	1.000	0.0110	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with subsurface soil.

CHEMICAL	SBCONC	Exposed skin surface area to SB (cm2/d)	SB to skin adherence factor (mg/cm2)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		5800	0.433	0.0300	60	1	70
FLUORENE		5800	0.433	0.0300	60	1	70
NAPHTHALENE		5800	0.433	0.2500	60	1	70
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70
PHENANTHRENE		5800	0.433	0.0300	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted slope factor	Cancer risk
ACENAPHTHENE	25550			1.000		
FLUORENE	25550			1.000		
NAPHTHALENE	25550			1.000		
2-METHYLNAPHTHALENE	25550			0.500		
ACENAPHTHYLENE	25550			0.600		
PHENANTHRENE	25550			0.600		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-31

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with subsurface soil.

CHEMICAL	SB CONC	Exposed skin surface area to SB (cm2/d)	SB to skin adherence factor (mg/cm2)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE		5800	0.433	0.0300	60	1	70
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70
TOLUENE		5800	0.433	0.0300	60	1	70
AROCLOR-1260		5800	0.433	0.0600	60	1	70
PYRENE		5800	0.433	0.0300	60	1	70
INDENO[1,2,3-C,D]PYRENE	3.400	5800	0.433	0.0300	60	1	70
BENZO[B]FLUORANTHENE	62.000	5800	0.433	0.0300	60	1	70
FLUORANTHENE		5800	0.433	0.0300	60	1	70
BENZO[K]FLUORANTHENE		5800	0.433	0.0300	60	1	70
CHRYSENE		5800	0.433	0.0300	60	1	70
BENZO[A]PYRENE	3.800	5800	0.433	0.0300	60	1	70
DIBENZ[A,H]ANTHRACENE		5800	0.433	0.0300	60	1	70
BENZ[A]ANTHRACENE	3.600	5800	0.433	0.0300	60	1	70
CYANIDE (FREE)		5800	0.433	0.0010	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE	365		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL	365		0.0200	0.500	0.01000	
4-METHYLPHENOL	365		0.0050	1.000	0.00500	
TOLUENE	365		0.2000	1.000	0.20000	
AROCLOR-1260	365			0.950		
PYRENE	365		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	365	.0000006		0.500		
BENZO[B]FLUORANTHENE	365	.0000110		0.500		
FLUORANTHENE	365		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE	365			0.500		
CHRYSENE	365			0.500		
BENZO[A]PYRENE	365	.0000007		0.500		
DIBENZ[A,H]ANTHRACENE	365			0.500		
BENZ[A]ANTHRACENE	365	.0000006		0.500		
CYANIDE (FREE)	365		0.0200	0.720	0.01440	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with subsurface soil.

CHEMICAL	SBCONC	Exposed skin surface area to SB (cm2/d)	SB to skin adherence factor (mg/cm2)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE		5800	0.433	0.0005	60	1	70
ALUMINUM		5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433	0.0010	60	1	70
IRON	17000.000	5800	0.433	0.0100	60	1	70
MANGANESE-NONFOOD	500.000	5800	0.433	0.0100	60	1	70
Mercury (inorganic)		5800	0.433		60	1	70
NICKEL		5800	0.433	0.0005	60	1	70
ARSENIC	4.000	5800	0.433	0.0010	60	1	70
BARIUM		5800	0.433	0.0010	60	1	70
BERYLLIUM		5800	0.433	0.0010	60	1	70
CADMIUM-WATER		5800	0.433	0.0010	60	1	70
COPPER		5800	0.433	0.0010	60	1	70
VANADIUM		5800	0.433	0.0010	60	1	70
ZINC	29.000	5800	0.433	0.0010	60	1	70
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
BENZENE	365		0.0030	1.000	0.00300	
ALUMINUM	365		1.0000	0.050	0.05000	
Mercury (inorganic)	365		0.0003	0.150	0.00005	
IRON	365	.0010026	0.3000	0.100	0.03000	3.3E-02
MANGANESE-NONFOOD	365	.0000295	0.0200	0.030	0.00060	4.9E-02
Mercury (inorganic)	365					
NICKEL	365		0.0200	0.100	0.00200	
ARSENIC	365	.0000000	0.0003	0.950	0.00029	8.3E-05
BARIUM	365		0.0700	0.050	0.00350	
BERYLLIUM	365		0.0020	0.010	0.00002	
CADMIUM-WATER	365		0.0005	0.025	0.00001	
COPPER	365		0.0400	0.600	0.02400	
VANADIUM	365		0.0070	0.010	0.00007	
ZINC	365	.0000002	0.3000	0.300	0.09000	1.9E-06
TRICHLOROETHENE	365		0.0060	1.000	0.00600	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with subsurface soil.

CHEMICAL	SB CONC	Exposed skin surface area to SB (cm2/d)	SB to skin adherence factor (mg/cm2)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)
ACENAPHTHENE		5800	0.433	0.0300	60	1	70
FLUORENE		5800	0.433	0.0300	60	1	70
NAPHTHALENE		5800	0.433	0.2500	60	1	70
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70
PHENANTHRENE		5800	0.433	0.0300	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ACENAPHTHENE	365		0.0600	1.000	0.06000	
FLUORENE	365		0.0400	1.000	0.04000	
NAPHTHALENE	365		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE	365		0.0400	0.500	0.02000	
ACENAPHTHYLENE	365		0.0300	0.600	0.01800	
PHENANTHRENE	365		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of ground water.

CHEMICAL	GWCONC	GW ingestion rate (l/hour)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		0.01	1	60	1	70	25550			
2,4-DIMETHYLPHENOL		0.01	1	60	1	70	25550			
4-METHYLPHENOL		0.01	1	60	1	70	25550			
TOLUENE		0.01	1	60	1	70	25550			
AROCLO-1260	1.400	0.01	1	60	1	70	25550	.00000000	2.0000	9.4E-10
PYRENE		0.01	1	60	1	70	25550			
INDENO[1,2,3-C,D]PYRENE		0.01	1	60	1	70	25550		0.7300	
BENZO[B]FLUORANTHENE		0.01	1	60	1	70	25550		0.7300	
FLUORANTHENE		0.01	1	60	1	70	25550			
BENZO[K]FLUORANTHENE		0.01	1	60	1	70	25550		0.0730	
CHRYSENE		0.01	1	60	1	70	25550		0.0073	
BENZO[A]PYRENE		0.01	1	60	1	70	25550		7.3000	
DIBENZ[A,H]ANTHRACENE		0.01	1	60	1	70	25550		7.3000	
BENZ[A]ANTHRACENE		0.01	1	60	1	70	25550		0.7300	
CYANIDE (FREE)	601.000	0.01	1	60	1	70	25550	.00000020		
BENZENE		0.01	1	60	1	70	25550		0.0290	
ALUMINUM	170000.000	0.01	1	60	1	70	25550	.00005703		
Mercury (inorganic)		0.01	1	60	1	70	25550			
IRON	320000.000	0.01	1	60	1	70	25550	.00010735		
MANGANESE-NONFOOD	260.000	0.01	1	60	1	70	25550	.00000009		
Mercury (inorganic)	2.100	0.01	1	60	1	70	25550	.00000000		
NICKEL	270.000	0.01	1	60	1	70	25550	.00000009		
ARSENIC	100.000	0.01	1	60	1	70	25550	.00000003	1.5000	5.0E-08
BARIUM	4900.000	0.01	1	60	1	70	25550	.00000164		
BERYLLIUM	8.000	0.01	1	60	1	70	25550	.00000000		
CADMIUM-WATER	31.000	0.01	1	60	1	70	25550	.00000001		
COPPER	650.000	0.01	1	60	1	70	25550	.00000022		
VANADIUM	270.000	0.01	1	60	1	70	25550	.00000009		
ZINC		0.01	1	60	1	70	25550			
TRICHLOROETHENE		0.01	1	60	1	70	25550		0.0110	
ACENAPHTHENE		0.01	1	60	1	70	25550			
FLUORENE		0.01	1	60	1	70	25550			
NAPHTHALENE		0.01	1	60	1	70	25550			
2-METHYLNAPHTHALENE		0.01	1	60	1	70	25550			
ACENAPHTHYLENE		0.01	1	60	1	70	25550			
PHENANTHRENE		0.01	1	60	1	70	25550			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-35

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of ground water.

CHEMICAL	GWCONC	GW ingestion rate (l/hour)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		0.01	1	60	1	70	365		0.1000	
2,4-DIMETHYLPHENOL		0.01	1	60	1	70	365		0.0200	
4-METHYLPHENOL		0.01	1	60	1	70	365		0.0050	
TOLUENE		0.01	1	60	1	70	365		0.2000	
AROCLOR-1260	1.400	0.01	1	60	1	70	365	.0000000	0.0300	
PYRENE		0.01	1	60	1	70	365			
INDENO[1,2,3-C,D]PYRENE		0.01	1	60	1	70	365			
BENZO[B]FLUORANTHENE		0.01	1	60	1	70	365		0.0400	
FLUORANTHENE		0.01	1	60	1	70	365			
BENZO[K]FLUORANTHENE		0.01	1	60	1	70	365			
CHRYSENE		0.01	1	60	1	70	365			
BENZO[A]PYRENE		0.01	1	60	1	70	365			
DIBENZ[A,H]ANTHRACENE		0.01	1	60	1	70	365			
BENZ[A]ANTHRACENE		0.01	1	60	1	70	365			
CYANIDE (FREE)	601.000	0.01	1	60	1	70	365	.0000141	0.0200	7.1E-04
BENZENE		0.01	1	60	1	70	365		0.0030	
ALUMINUM	170000.000	0.01	1	60	1	70	365	.0039922	1.0000	4.0E-03
Mercury (inorganic)		0.01	1	60	1	70	365		0.0003	
IRON	320000.000	0.01	1	60	1	70	365	.0075147	0.3000	2.5E-02
MANGANESE-NONFOOD	260.000	0.01	1	60	1	70	365	.0000061	0.0200	3.1E-04
Mercury (inorganic)	2.100	0.01	1	60	1	70	365	.0000000		
NICKEL	270.000	0.01	1	60	1	70	365	.0000063	0.0200	3.2E-04
ARSENIC	100.000	0.01	1	60	1	70	365	.0000023	0.0003	7.8E-03
BARIUM	4900.000	0.01	1	60	1	70	365	.0001151	0.0700	1.6E-03
BERYLLIUM	8.000	0.01	1	60	1	70	365	.0000002	0.0020	9.4E-05
CADMIUM-WATER	31.000	0.01	1	60	1	70	365	.0000007	0.0005	1.5E-03
COPPER	650.000	0.01	1	60	1	70	365	.0000153	0.0400	3.8E-04
VANADIUM	270.000	0.01	1	60	1	70	365	.0000063	0.0070	9.1E-04
ZINC		0.01	1	60	1	70	365		0.3000	
TRICHLOROETHENE		0.01	1	60	1	70	365		0.0060	
ACENAPHTHENE		0.01	1	60	1	70	365		0.0600	
FLUORENE		0.01	1	60	1	70	365		0.0400	
NAPHTHALENE		0.01	1	60	1	70	365		0.0400	
2-METHYLNAPHTHALENE		0.01	1	60	1	70	365		0.0400	
ACENAPHTHYLENE		0.01	1	60	1	70	365		0.0300	
PHENANTHRENE		0.01	1	60	1	70	365		0.0300	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)
ETHYLBENZENE		5800	1.000	1	60	1
2,4-DIMETHYLPHENOL		5800	0.110	1	60	1
4-METHYLPHENOL		5800	0.110	1	60	1
TOLUENE		5800	1.000	1	60	1
AROCOLOR-1260	1.400	5800	1.600	1	60	1
PYRENE		5800	0.530	1	60	1
INDENO[1,2,3-C,D]PYRENE		5800	1.900	1	60	1
BENZO[B]FLUORANTHENE		5800	1.200	1	60	1
FLUORANTHENE		5800	0.360	1	60	1
BENZO[K]FLUORANTHENE		5800	1.100	1	60	1
CHRYSENE		5800	0.810	1	60	1
BENZO[A]PYRENE		5800	1.200	1	60	1
DIBENZ[A,H]ANTHRACENE		5800	2.700	1	60	1
BENZ[A]ANTHRACENE		5800	0.810	1	60	1
CYANIDE (FREE)	601.000	5800	0.001	1	60	1

CHEMICAL	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE	70	25550			0.900		
2,4-DIMETHYLPHENOL	70	25550			0.500		
4-METHYLPHENOL	70	25550			1.000		
TOLUENE	70	25550			1.000		
AROCOLOR-1260	70	25550	.000000436	2.0000	0.950	2.1053	9.2E-07
PYRENE	70	25550			0.600		
INDENO[1,2,3-C,D]PYRENE	70	25550		0.7300	0.500	1.4600	
BENZO[B]FLUORANTHENE	70	25550		0.7300	0.500	1.4600	
FLUORANTHENE	70	25550			0.500		
BENZO[K]FLUORANTHENE	70	25550		0.0730	0.500	0.1460	
CHRYSENE	70	25550		0.0073	0.500	0.0146	
BENZO[A]PYRENE	70	25550		7.3000	0.500	14.6000	
DIBENZ[A,H]ANTHRACENE	70	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	70	25550		0.7300	0.500	1.4600	
CYANIDE (FREE)	70	25550	.000000117		0.720		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-37

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)
BENZENE		5800	0.110	1	60	1
ALUMINUM	170000.000	5800	0.001	1	60	1
Mercury (inorganic)		5800	0.001	1	60	1
IRON	320000.000	5800	0.001	1	60	1
MANGANESE-NONFOOD	260.000	5800	0.001	1	60	1
Mercury (inorganic)	2.100	5800		1	60	1
NICKEL	270.000	5800	0.001	1	60	1
ARSENIC	100.000	5800	0.001	1	60	1
BARIUM	4900.000	5800	0.001	1	60	1
BERYLLIUM	8.000	5800	0.001	1	60	1
CADMIUM-WATER	31.000	5800	0.001	1	60	1
COPPER	650.000	5800	0.001	1	60	1
VANADIUM	270.000	5800	0.001	1	60	1
ZINC		5800	0.001	1	60	1
TRICHLOROETHENE		5800	0.230	1	60	1

CHEMICAL	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
BENZENE	70	25550		0.0290	1.000	0.0290	
ALUMINUM	70	25550	.000033078		0.050		
Mercury (inorganic)	70	25550			0.150		
IRON	70	25550	.000062264		0.100		
MANGANESE-NONFOOD	70	25550	.000000051		0.030		
Mercury (inorganic)	70	25550					
NICKEL	70	25550	.000000053		0.100		
ARSENIC	70	25550	.000000019	1.5000	0.950	1.5789	3.1E-08
BARIUM	70	25550	.000000953		0.050		
BERYLLIUM	70	25550	.000000002		0.010		
CADMIUM-WATER	70	25550	.000000006		0.025		
COPPER	70	25550	.000000126		0.600		
VANADIUM	70	25550	.000000053		0.010		
ZINC	70	25550			0.300		
TRICHLOROETHENE	70	25550		0.0110	1.000	0.0110	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)
ACENAPHTHENE		5800	0.130	1	60	1
FLUORENE		5800	0.170	1	60	1
NAPHTHALENE		5800	0.070	1	60	1
2-METHYLNAPHTHALENE		5800	0.069	1	60	1
ACENAPHTHYLENE		5800	0.530	1	60	1
PHENANTHRENE		5800	0.530	1	60	1

CHEMICAL	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ACENAPHTHENE	70	25550			1.000		
FLUORENE	70	25550			1.000		
NAPHTHALENE	70	25550			1.000		
2-METHYLNAPHTHALENE	70	25550			0.500		
ACENAPHTHYLENE	70	25550			0.600		
PHENANTHRENE	70	25550			0.600		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT\TMP\REPORT\APPH_SAS.WPD

Page H-39

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm ²)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)
ETHYLBENZENE		5800	1.000	1	60	1
2,4-DIMETHYLPHENOL		5800	0.110	1	60	1
4-METHYLPHENOL		5800	0.110	1	60	1
TOLUENE		5800	1.000	1	60	1
AROCLOR-1260	1.400	5800	1.600	1	60	1
PYRENE		5800	0.530	1	60	1
INDENO[1,2,3-C,D]PYRENE		5800	1.900	1	60	1
BENZO[B]FLUORANTHENE		5800	1.200	1	60	1
FLUORANTHENE		5800	0.360	1	60	1
BENZO[K]FLUORANTHENE		5800	1.100	1	60	1
CHRYSENE		5800	0.810	1	60	1
BENZO[A]PYRENE		5800	1.200	1	60	1
DIBENZ[A,H]ANTHRACENE		5800	2.700	1	60	1
BENZ[A]ANTHRACENE		5800	0.810	1	60	1
CYANIDE (FREE)	601.000	5800	0.001	1	60	1

CHEMICAL	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE	70	365		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL	70	365		0.0200	0.500	0.01000	
4-METHYLPHENOL	70	365		0.0050	1.000	0.00500	
TOLUENE	70	365		0.2000	1.000	0.20000	
AROCLOR-1260	70	365	.0000305		0.950		
PYRENE	70	365		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	70	365			0.500		
BENZO[B]FLUORANTHENE	70	365			0.500		
FLUORANTHENE	70	365		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE	70	365			0.500		
CHRYSENE	70	365			0.500		
BENZO[A]PYRENE	70	365			0.500		
DIBENZ[A,H]ANTHRACENE	70	365			0.500		
BENZ[A]ANTHRACENE	70	365			0.500		
CYANIDE (FREE)	70	365	.0000082	0.0200	0.720	0.01440	5.7E-04

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-40

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm ²)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)
BENZENE		5800	0.110	1	60	1
ALUMINUM	170000.000	5800	0.001	1	60	1
Mercury (inorganic)		5800	0.001	1	60	1
IRON	320000.000	5800	0.001	1	60	1
MANGANESE-NONFOOD	260.000	5800	0.001	1	60	1
Mercury (inorganic)	2.100	5800		1	60	1
NICKEL	270.000	5800	0.001	1	60	1
ARSENIC	100.000	5800	0.001	1	60	1
BARIIUM	4900.000	5800	0.001	1	60	1
BERYLLIUM	8.000	5800	0.001	1	60	1
CADMIUM-WATER	31.000	5800	0.001	1	60	1
COPPER	650.000	5800	0.001	1	60	1
VANADIUM	270.000	5800	0.001	1	60	1
ZINC		5800	0.001	1	60	1
TRICHLOROETHENE		5800	0.230	1	60	1

CHEMICAL	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
BENZENE	70	365		0.0030	1.000	0.00300	
ALUMINUM	70	365	.0023155	1.0000	0.050	0.05000	4.6E-02
Mercury (inorganic)	70	365		0.0003	0.150	0.00005	
IRON	70	365	.0043585	0.3000	0.100	0.03000	1.5E-01
MANGANESE-NONFOOD	70	365	.0000035	0.0200	0.030	0.00060	5.9E-03
Mercury (inorganic)	70	365					
NICKEL	70	365	.0000037	0.0200	0.100	0.00200	1.8E-03
ARSENIC	70	365	.0000014	0.0003	0.950	0.00029	4.8E-03
BARIIUM	70	365	.0000667	0.0700	0.050	0.00350	1.9E-02
BERYLLIUM	70	365	.0000001	0.0020	0.010	0.00002	5.4E-03
CADMIUM-WATER	70	365	.0000004	0.0005	0.025	0.00001	3.4E-02
COPPER	70	365	.0000089	0.0400	0.600	0.02400	3.7E-04
VANADIUM	70	365	.0000037	0.0070	0.010	0.00007	5.3E-02
ZINC	70	365		0.3000	0.300	0.09000	
TRICHLOROETHENE	70	365		0.0060	1.000	0.00600	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-41

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm ²)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)
ACENAPHTHENE		5800	0.130	1	60	1
FLUORENE		5800	0.170	1	60	1
NAPHTHALENE		5800	0.070	1	60	1
2-METHYLNAPHTHALENE		5800	0.069	1	60	1
ACENAPHTHYLENE		5800	0.530	1	60	1
PHENANTHRENE		5800	0.530	1	60	1

CHEMICAL	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ACENAPHTHENE	70	365		0.0600	1.000	0.06000	
FLUORENE	70	365		0.0400	1.000	0.04000	
NAPHTHALENE	70	365		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE	70	365		0.0400	0.500	0.02000	
ACENAPHTHYLENE	70	365		0.0300	0.600	0.01800	
PHENANTHRENE	70	365		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-42

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Inhalation of ambient air.

CHEMICAL	AACONC	AA inhalation rate (m3/hr)	AA exposure time (hr/d)	AA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Inhalation slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		1.68	8	60	1	70	25550			
2,4-DIMETHYLPHENOL		1.68	8	60	1	70	25550			
4-METHYLPHENOL		1.68	8	60	1	70	25550			
TOLUENE		1.68	8	60	1	70	25550			
AROCLOR-1260		1.68	8	60	1	70	25550		2.000	
PYRENE		1.68	8	60	1	70	25550			
INDENO[1,2,3-C,D]PYRENE		1.68	8	60	1	70	25550			
BENZO[B]FLUORANTHENE		1.68	8	60	1	70	25550			
FLUORANTHENE		1.68	8	60	1	70	25550			
BENZO[K]FLUORANTHENE		1.68	8	60	1	70	25550			
CHRYSENE		1.68	8	60	1	70	25550			
BENZO[A]PYRENE		1.68	8	60	1	70	25550		3.100	
DIBENZ[A,H]ANTHRACENE		1.68	8	60	1	70	25550			
BENZ[A]ANTHRACENE		1.68	8	60	1	70	25550			
CYANIDE (FREE)		1.68	8	60	1	70	25550			
BENZENE		1.68	8	60	1	70	25550		0.029	
ALUMINUM		1.68	8	60	1	70	25550			
Mercury (inorganic)		1.68	8	60	1	70	25550			
IRON		1.68	8	60	1	70	25550			
MANGANESE-NONFOOD		1.68	8	60	1	70	25550			
Mercury (inorganic)		1.68	8	60	1	70	25550			
NICKEL		1.68	8	60	1	70	25550			
ARSENIC		1.68	8	60	1	70	25550		15.100	
BARIUM		1.68	8	60	1	70	25550			
BERYLLIUM		1.68	8	60	1	70	25550		8.400	
CADMIUM-WATER		1.68	8	60	1	70	25550		6.300	
COPPER		1.68	8	60	1	70	25550			
VANADIUM		1.68	8	60	1	70	25550			
ZINC		1.68	8	60	1	70	25550			
TRICHLOROETHENE		1.68	8	60	1	70	25550		0.006	
ACENAPHTHENE		1.68	8	60	1	70	25550			
FLUORENE		1.68	8	60	1	70	25550			
NAPHTHALENE		1.68	8	60	1	70	25550			
2-METHYLNAPHTHALENE		1.68	8	60	1	70	25550			
ACENAPHTHYLENE		1.68	8	60	1	70	25550			
PHENANTHRENE		1.68	8	60	1	70	25550			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-43

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Inhalation of ambient air.

CHEMICAL	AACONC	AA inhalation rate (m3/hr)	AA exposure time (hr/d)	AA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Inhal RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		1.68	8	60	1	70	365		0.29000	
2,4-DIMETHYLPHENOL		1.68	8	60	1	70	365			
4-METHYLPHENOL		1.68	8	60	1	70	365			
TOLUENE		1.68	8	60	1	70	365		0.11400	
AROCLOR-1260		1.68	8	60	1	70	365			
PYRENE		1.68	8	60	1	70	365			
INDENO[1,2,3-C,D]PYRENE		1.68	8	60	1	70	365			
BENZO[B]FLUORANTHENE		1.68	8	60	1	70	365			
FLUORANTHENE		1.68	8	60	1	70	365			
BENZO[K]FLUORANTHENE		1.68	8	60	1	70	365			
CHRYSENE		1.68	8	60	1	70	365			
BENZO[A]PYRENE		1.68	8	60	1	70	365			
DIBENZ[A,H]ANTHRACENE		1.68	8	60	1	70	365			
BENZ[A]ANTHRACENE		1.68	8	60	1	70	365			
CYANIDE (FREE)		1.68	8	60	1	70	365			
BENZENE		1.68	8	60	1	70	365		0.00170	
ALUMINUM		1.68	8	60	1	70	365		0.00100	
Mercury (inorganic)		1.68	8	60	1	70	365		0.00009	
IRON		1.68	8	60	1	70	365			
MANGANESE-NONFOOD		1.68	8	60	1	70	365		0.00001	
Mercury (inorganic)		1.68	8	60	1	70	365			
NICKEL		1.68	8	60	1	70	365			
ARSENIC		1.68	8	60	1	70	365			
BARIUM		1.68	8	60	1	70	365		0.00014	
BERYLLIUM		1.68	8	60	1	70	365		0.00001	
CADMIUM-WATER		1.68	8	60	1	70	365			
COPPER		1.68	8	60	1	70	365			
VANADIUM		1.68	8	60	1	70	365			
ZINC		1.68	8	60	1	70	365			
TRICHLOROETHENE		1.68	8	60	1	70	365			
ACENAPHTHENE		1.68	8	60	1	70	365			
FLUORENE		1.68	8	60	1	70	365			
NAPHTHALENE		1.68	8	60	1	70	365		0.00086	
2-METHYLNAPHTHALENE		1.68	8	60	1	70	365			
ACENAPHTHYLENE		1.68	8	60	1	70	365			
PHENANTHRENE		1.68	8	60	1	70	365			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-44

Appendix H

NiMo MGP Site Fulton, NY - Area 1 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Cancer Risk and Hazard Index Summary Table

PATHWAY	TOTCR	TOTHI
Incidental ingestion of surface soil.	1.4E-06	2.1E-01
Dermal contact with surface soil.	3.6E-07	1.1E-01
Incidental ingestion of subsurface soil.	1.4E-06	1.1E-01
Dermal contact with subsurface soil.	4.0E-07	8.3E-02
Incidental ingestion of ground water.	5.1E-08	4.3E-02
Dermal contact with ground water.	9.5E-07	3.2E-01
Inhalation of ambient air.		
Total	4.5E-06	8.7E-01

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Adult Resident

ADULT RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/ (mg/kg-day)	Cancer risk
ETHYLBENZENE		100	1	350	30	70	25550			
2,4-DIMETHYLPHENOL		100	1	350	30	70	25550			
4-METHYLPHENOL		100	1	350	30	70	25550			
TOLUENE		100	1	350	30	70	25550			
AROCLO-1260		100	1	350	30	70	25550		2.0000	
PYRENE		100	1	350	30	70	25550			
INDENO[1,2,3-C,D]PYRENE	11	100	1	350	30	70	25550	.0000065	0.7300	4.7E-06
BENZO[B]FLUORANTHENE	22	100	1	350	30	70	25550	.0000129	0.7300	9.4E-06
FLUORANTHENE		100	1	350	30	70	25550			
BENZO[K]FLUORANTHENE		100	1	350	30	70	25550		0.0730	
CHRYSENE		100	1	350	30	70	25550		0.0073	
BENZO[A]PYRENE	19	100	1	350	30	70	25550	.0000112	7.3000	8.1E-05
DIBENZ[A,H]ANTHRACENE		100	1	350	30	70	25550		7.3000	
BENZ[A]ANTHRACENE	14	100	1	350	30	70	25550	.0000082	0.7300	6.0E-06
CYANIDE (FREE)		100	1	350	30	70	25550			
BENZENE		100	1	350	30	70	25550		0.0290	
ALUMINUM		100	1	350	30	70	25550			
Mercury (inorganic)		100	1	350	30	70	25550			
IRON	14000	100	1	350	30	70	25550	.0082192		
MANGANESE-NONFOOD	440	100	1	350	30	70	25550	.0002583		
NICKEL		100	1	350	30	70	25550			
ARSENIC	6	100	1	350	30	70	25550	.0000035	1.5000	5.3E-06
BARIUM		100	1	350	30	70	25550			
BERYLLIUM		100	1	350	30	70	25550			
CADMIUM-WATER		100	1	350	30	70	25550			
COPPER		100	1	350	30	70	25550			
VANADIUM		100	1	350	30	70	25550			
ZINC		100	1	350	30	70	25550			
TRICHLOROETHENE		100	1	350	30	70	25550		0.0110	
ACENAPHTHENE		100	1	350	30	70	25550			
FLUORENE		100	1	350	30	70	25550			
NAPHTHALENE		100	1	350	30	70	25550			
2-METHYLNAPHTHALENE		100	1	350	30	70	25550			
ACENAPHTHYLENE		100	1	350	30	70	25550			
PHENANTHRENE		100	1	350	30	70	25550			

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-46

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Adult Resident

ADULT RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral Rfd (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		100	1	350	30	70	10950		0.1000	
2,4-DIMETHYLPHENOL		100	1	350	30	70	10950		0.0200	
4-METHYLPHENOL		100	1	350	30	70	10950		0.0050	
TOLUENE		100	1	350	30	70	10950		0.2000	
AROCLOL-1260		100	1	350	30	70	10950			
PYRENE		100	1	350	30	70	10950		0.0300	
INDENO[1,2,3-C,D]PYRENE	11	100	1	350	30	70	10950	0.000015		
BENZO[B]FLUORANTHENE	22	100	1	350	30	70	10950	0.000030		
FLUORANTHENE		100	1	350	30	70	10950		0.0400	
BENZO[K]FLUORANTHENE		100	1	350	30	70	10950			
CHRYSENE		100	1	350	30	70	10950			
BENZO[A]PYRENE	19	100	1	350	30	70	10950	0.000026		
DIBENZ[A,H]ANTHRACENE		100	1	350	30	70	10950			
BENZ[A]ANTHRACENE	14	100	1	350	30	70	10950	0.000019		
CYANIDE (FREE)		100	1	350	30	70	10950		0.0200	
BENZENE		100	1	350	30	70	10950		0.0030	
ALUMINUM		100	1	350	30	70	10950		1.0000	
Mercury (inorganic)		100	1	350	30	70	10950		0.0003	
IRON	14000	100	1	350	30	70	10950	0.019178	0.3000	6.4E-02
MANGANESE-NONFOOD	440	100	1	350	30	70	10950	0.000603	0.0200	3.0E-02
NICKEL		100	1	350	30	70	10950		0.0200	
ARSENIC	6	100	1	350	30	70	10950	0.000008	0.0003	2.7E-02
BARIUM		100	1	350	30	70	10950		0.0700	
BERYLLIUM		100	1	350	30	70	10950		0.0020	
CADMIUM-WATER		100	1	350	30	70	10950		0.0005	
COPPER		100	1	350	30	70	10950		0.0400	
VANADIUM		100	1	350	30	70	10950		0.0070	
ZINC		100	1	350	30	70	10950		0.3000	
TRICHLOROETHENE		100	1	350	30	70	10950		0.0060	
ACENAPHTHENE		100	1	350	30	70	10950		0.0600	
FLUORENE		100	1	350	30	70	10950		0.0400	
NAPHTHALENE		100	1	350	30	70	10950		0.0400	
2-METHYLNAPHTHALENE		100	1	350	30	70	10950		0.0400	
ACENAPHTHYLENE		100	1	350	30	70	10950		0.0300	
PHENANTHRENE		100	1	350	30	70	10950		0.0300	

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-47

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Adult Resident

ADULT RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE		5800	0.443	0.0300	350	30	70	25550			0.900		
2,4-DIMETHYLPHENOL		5800	0.443	0.1000	350	30	70	25550			0.500		
4-METHYLPHENOL		5800	0.443	0.2500	350	30	70	25550			1.000		
TOLUENE		5800	0.443	0.0300	350	30	70	25550			1.000		
AROCOLOR-1260		5800	0.443	0.0600	350	30	70	25550		2.0000	0.950	2.1053	
PYRENE		5800	0.443	0.0300	350	30	70	25550			0.600		
INDENO[1,2,3-C,D]PYRENE	11	5800	0.443	0.0300	350	30	70	25550	.0000050	0.7300	0.500	1.4600	7.3E-06
BENZO[B]FLUORANTHENE	22	5800	0.443	0.0300	350	30	70	25550	.0000100	0.7300	0.500	1.4600	1.5E-05
FLUORANTHENE		5800	0.443	0.0300	350	30	70	25550			0.500		
BENZO[K]FLUORANTHENE		5800	0.443	0.0300	350	30	70	25550		0.0730	0.500	0.1460	
CHRYSENE		5800	0.443	0.0300	350	30	70	25550		0.0073	0.500	0.0146	
BENZO[A]PYRENE	19	5800	0.443	0.0300	350	30	70	25550	.0000086	7.3000	0.500	14.6000	1.3E-04
DIBENZ[A,H]ANTHRACENE		5800	0.443	0.0300	350	30	70	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	14	5800	0.443	0.0300	350	30	70	25550	.0000063	0.7300	0.500	1.4600	9.2E-06
CYANIDE (FREE)		5800	0.443	0.0010	350	30	70	25550			0.720		
BENZENE		5800	0.443	0.0005	350	30	70	25550		0.0290	1.000	0.0290	
ALUMINUM		5800	0.443	0.0100	350	30	70	25550			0.050		
Mercury (inorganic)		5800	0.443	0.0010	350	30	70	25550			0.150		
IRON	14000	5800	0.443	0.0100	350	30	70	25550	.0021118		0.100		
MANGANESE-NONFOOD	440	5800	0.443	0.0100	350	30	70	25550	.0000664		0.030		
NICKEL		5800	0.443	0.0005	350	30	70	25550			0.100		
ARSENIC	6	5800	0.443	0.0010	350	30	70	25550	.0000001	1.5000	0.950	1.5789	1.4E-07
BARIUM		5800	0.443	0.0010	350	30	70	25550			0.050		
BERYLLIUM		5800	0.443	0.0010	350	30	70	25550			0.010		
CADMIUM-WATER		5800	0.443	0.0010	350	30	70	25550			0.025		
COPPER		5800	0.443	0.0010	350	30	70	25550			0.600		
VANADIUM		5800	0.443	0.0010	350	30	70	25550			0.010		
ZINC		5800	0.443	0.0010	350	30	70	25550			0.300		
TRICHLOROETHENE		5800	0.443	0.0005	350	30	70	25550		0.0110	1.000	0.0110	
ACENAPHTHENE		5800	0.443	0.0300	350	30	70	25550			1.000		
FLUORENE		5800	0.443	0.0300	350	30	70	25550			1.000		
NAPHTHALENE		5800	0.443	0.2500	350	30	70	25550			1.000		
2-METHYLNAPHTHALENE		5800	0.443	0.1000	350	30	70	25550			0.500		
ACENAPHTHYLENE		5800	0.443	0.0300	350	30	70	25550			0.600		
PHENANTHRENE		5800	0.443	0.0300	350	30	70	25550			0.600		

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-48

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Adult Resident

ADULT RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE		5800	0.443	0.0300	350	30	70	10950		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL		5800	0.443	0.1000	350	30	70	10950		0.0200	0.500	0.01000	
4-METHYLPHENOL		5800	0.443	0.2500	350	30	70	10950		0.0050	1.000	0.00500	
TOLUENE		5800	0.443	0.0300	350	30	70	10950		0.2000	1.000	0.20000	
AROCLOL-1260		5800	0.443	0.0600	350	30	70	10950			0.950		
PYRENE		5800	0.443	0.0300	350	30	70	10950		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	11	5800	0.443	0.0300	350	30	70	10950	.0000116		0.500		
BENZO[B]FLUORANTHENE	22	5800	0.443	0.0300	350	30	70	10950	.0000232		0.500		
FLUORANTHENE		5800	0.443	0.0300	350	30	70	10950		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE		5800	0.443	0.0300	350	30	70	10950			0.500		
CHRYSENE		5800	0.443	0.0300	350	30	70	10950			0.500		
BENZO[A]PYRENE	19	5800	0.443	0.0300	350	30	70	10950	.0000201		0.500		
DIBENZ[A,H]ANTHRACENE		5800	0.443	0.0300	350	30	70	10950			0.500		
BENZ[A]ANTHRACENE	14	5800	0.443	0.0300	350	30	70	10950	.0000148		0.500		
CYANIDE (FREE)		5800	0.443	0.0010	350	30	70	10950		0.0200	0.720	0.01440	
BENZENE		5800	0.443	0.0005	350	30	70	10950		0.0030	1.000	0.00300	
ALUMINUM		5800	0.443	0.0100	350	30	70	10950		1.0000	0.050	0.05000	
Mercury (inorganic)		5800	0.443	0.0010	350	30	70	10950		0.0003	0.150	0.00005	
IRON	14000	5800	0.443	0.0100	350	30	70	10950	.0049276	0.3000	0.100	0.03000	1.6E-01
MANGANESE-NONFOOD	440	5800	0.443	0.0100	350	30	70	10950	.0001549	0.0200	0.030	0.00060	2.6E-01
NICKEL		5800	0.443	0.0005	350	30	70	10950		0.0200	0.100	0.00200	
ARSENIC	6	5800	0.443	0.0010	350	30	70	10950	.0000002	0.0003	0.950	0.00029	7.4E-04
BARIUM		5800	0.443	0.0010	350	30	70	10950		0.0700	0.050	0.00350	
BERYLLIUM		5800	0.443	0.0010	350	30	70	10950		0.0020	0.010	0.00002	
CADMIUM-WATER		5800	0.443	0.0010	350	30	70	10950		0.0005	0.025	0.00001	
COPPER		5800	0.443	0.0010	350	30	70	10950		0.0400	0.600	0.02400	
VANADIUM		5800	0.443	0.0010	350	30	70	10950		0.0070	0.010	0.00007	
ZINC		5800	0.443	0.0010	350	30	70	10950		0.3000	0.300	0.09000	
TRICHLOROETHENE		5800	0.443	0.0005	350	30	70	10950		0.0060	1.000	0.00600	
ACENAPHTHENE		5800	0.443	0.0300	350	30	70	10950		0.0600	1.000	0.06000	
FLUORENE		5800	0.443	0.0300	350	30	70	10950		0.0400	1.000	0.04000	
NAPHTHALENE		5800	0.443	0.2500	350	30	70	10950		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE		5800	0.443	0.1000	350	30	70	10950		0.0400	0.500	0.02000	
ACENAPHTHYLENE		5800	0.443	0.0300	350	30	70	10950		0.0300	0.600	0.01800	
PHENANTHRENE		5800	0.443	0.0300	350	30	70	10950		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-49

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Adult Resident

ADULT RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Inhalation of indoor air.

CHEMICAL	IA inhalation rate (m3/hr)	IA exposure time (hr/d)	IA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Inhalation slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE	1.02	16	350	30	70	25550			
2,4-DIMETHYLPHENOL	1.02	16	350	30	70	25550			
4-METHYLPHENOL	1.02	16	350	30	70	25550			
TOLUENE	1.02	16	350	30	70	25550			
AROCLOR-1260	1.02	16	350	30	70	25550		2.000	
PYRENE	1.02	16	350	30	70	25550			
INDENO[1,2,3-C,D]PYRENE	1.02	16	350	30	70	25550			
BENZO[B]FLUORANTHENE	1.02	16	350	30	70	25550			
FLUORANTHENE	1.02	16	350	30	70	25550			
BENZO[K]FLUORANTHENE	1.02	16	350	30	70	25550			
CHRYSENE	1.02	16	350	30	70	25550			
BENZO[A]PYRENE	1.02	16	350	30	70	25550		3.100	
DIBENZ[A,H]ANTHRACENE	1.02	16	350	30	70	25550			
BENZ[A]ANTHRACENE	1.02	16	350	30	70	25550			
CYANIDE (FREE)	1.02	16	350	30	70	25550			
BENZENE	.0070	1.02	16	350	30	70	.00067068	0.029	1.9E-05
ALUMINUM	1.02	16	350	30	70	25550			
Mercury (inorganic)	1.02	16	350	30	70	25550			
IRON	1.02	16	350	30	70	25550			
MANGANESE-NONFOOD	1.02	16	350	30	70	25550			
NICKEL	1.02	16	350	30	70	25550		15.100	
ARSENIC	1.02	16	350	30	70	25550			
BARIUM	1.02	16	350	30	70	25550		8.400	
BERYLLIUM	1.02	16	350	30	70	25550		6.300	
CADMIUM-WATER	1.02	16	350	30	70	25550			
COPPER	1.02	16	350	30	70	25550			
VANADIUM	1.02	16	350	30	70	25550			
ZINC	1.02	16	350	30	70	25550		0.006	
TRICHLOROETHENE	1.02	16	350	30	70	25550			
ACENAPHTHENE	1.02	16	350	30	70	25550			
FLUORENE	1.02	16	350	30	70	25550			
NAPHTHALENE	.0026	1.02	16	350	30	70	.00024911		
2-METHYLNAPHTHALENE	1.02	16	350	30	70	25550			
ACENAPHTHYLENE	1.02	16	350	30	70	25550			
PHENANTHRENE	1.02	16	350	30	70	25550			

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-50

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Adult Resident

ADULT RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Inhalation of indoor air.

CHEMICAL	IACONC	IA inhalation rate (m3/hr)	IA exposure time (hr/d)	IA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Inhal RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		1.02	16	350	30	70	10950		0.29000	
2,4-DIMETHYLPHENOL		1.02	16	350	30	70	10950			
4-METHYLPHENOL		1.02	16	350	30	70	10950			
TOLUENE		1.02	16	350	30	70	10950		0.11400	
AROCLOL-1260		1.02	16	350	30	70	10950			
PYRENE		1.02	16	350	30	70	10950			
INDENO[1,2;3-C,D]PYRENE		1.02	16	350	30	70	10950			
BENZO[B]FLUORANTHENE		1.02	16	350	30	70	10950			
FLUORANTHENE		1.02	16	350	30	70	10950			
BENZO[K]FLUORANTHENE		1.02	16	350	30	70	10950			
CHRYSENE		1.02	16	350	30	70	10950			
BENZO[A]PYRENE		1.02	16	350	30	70	10950			
DIBENZ[A,H]ANTHRACENE		1.02	16	350	30	70	10950			
BENZ[A]ANTHRACENE		1.02	16	350	30	70	10950			
CYANIDE (FREE)		1.02	16	350	30	70	10950			
BENZENE	.0070	1.02	16	350	30	70	10950	.0015649	0.00170	9.2E-01
ALUMINUM		1.02	16	350	30	70	10950		0.00100	
Mercury (inorganic)		1.02	16	350	30	70	10950		0.00009	
IRON		1.02	16	350	30	70	10950			
MANGANESE-NONFOOD		1.02	16	350	30	70	10950		0.00001	
NICKEL		1.02	16	350	30	70	10950			
ARSENIC		1.02	16	350	30	70	10950			
BARIUM		1.02	16	350	30	70	10950		0.00014	
BERYLLIUM		1.02	16	350	30	70	10950		0.00001	
CADMIUM-WATER		1.02	16	350	30	70	10950			
COPPER		1.02	16	350	30	70	10950			
VANADIUM		1.02	16	350	30	70	10950			
ZINC		1.02	16	350	30	70	10950			
TRICHLOROETHENE		1.02	16	350	30	70	10950			
ACENAPHTHENE		1.02	16	350	30	70	10950			
FLUORENE		1.02	16	350	30	70	10950			
NAPHTHALENE	.0026	1.02	16	350	30	70	10950	.0005813	0.00086	6.8E-01
2-METHYLNAPHTHALENE		1.02	16	350	30	70	10950			
ACENAPHTHYLENE		1.02	16	350	30	70	10950			
PHENANTHRENE		1.02	16	350	30	70	10950			

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-51

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Adult Resident

ADULT RESIDENT (RME)
Cancer Risk and Hazard Index Summary Table

PATHWAY	TOTCR	TOTHI
Incidental ingestion of surface soil.	1.1E-04	1.2E-01
Dermal contact with surface soil.	1.6E-04	4.2E-01
Inhalation of indoor air.	1.9E-05	1.6E+00
Total	2.8E-04	2.1E+00

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-52

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Child Resident

CHILD RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		200	1	350	6	16	25550			
2,4-DIMETHYLPHENOL		200	1	350	6	16	25550			
4-METHYLPHENOL		200	1	350	6	16	25550			
TOLUENE		200	1	350	6	16	25550			
AROCLOR-1260		200	1	350	6	16	25550		2.0000	
PYRENE		200	1	350	6	16	25550			
INDENO[1,2,3-C,D]PYRENE	11	200	1	350	6	16	25550	0.000011	0.7300	8.3E-06
BENZO[B]FLUORANTHENE	22	200	1	350	6	16	25550	0.000023	0.7300	1.7E-05
FLUORANTHENE		200	1	350	6	16	25550			
BENZO[K]FLUORANTHENE		200	1	350	6	16	25550		0.0730	
CHRYSENE		200	1	350	6	16	25550		0.0073	
BENZO[A]PYRENE	19	200	1	350	6	16	25550	0.000020	7.3000	1.4E-04
DIBENZ[A,H]ANTHRACENE		200	1	350	6	16	25550		7.3000	
BENZ[A]ANTHRACENE	14	200	1	350	6	16	25550	0.000014	0.7300	1.1E-05
CYANIDE (FREE)		200	1	350	6	16	25550			
BENZENE		200	1	350	6	16	25550		0.0290	
ALUMINUM		200	1	350	6	16	25550			
Mercury (inorganic)		200	1	350	6	16	25550			
IRON	14000	200	1	350	6	16	25550	0.014384		
MANGANESE-NONFOOD	440	200	1	350	6	16	25550	0.000452		
NICKEL		200	1	350	6	16	25550			
ARSENIC	6	200	1	350	6	16	25550	0.000006	1.5000	9.2E-06
BARIUM		200	1	350	6	16	25550			
BERYLLIUM		200	1	350	6	16	25550			
CADMIUM-WATER		200	1	350	6	16	25550			
COPPER		200	1	350	6	16	25550			
VANADIUM		200	1	350	6	16	25550			
ZINC		200	1	350	6	16	25550			
TRICHLOROETHENE		200	1	350	6	16	25550		0.0110	
ACENAPHTHENE		200	1	350	6	16	25550			
FLUORENE		200	1	350	6	16	25550			
NAPHTHALENE		200	1	350	6	16	25550			
2-METHYLNAPHTHALENE		200	1	350	6	16	25550			
ACENAPHTHYLENE		200	1	350	6	16	25550			
PHENANTHRENE		200	1	350	6	16	25550			

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-53

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Child Resident

CHILD RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		200	1	350	6	16	2190		0.1000	
2,4-DIMETHYLPHENOL		200	1	350	6	16	2190		0.0200	
4-METHYLPHENOL		200	1	350	6	16	2190		0.0050	
TOLUENE		200	1	350	6	16	2190		0.2000	
AROCLOL-1260		200	1	350	6	16	2190			
PYRENE		200	1	350	6	16	2190		0.0300	
INDENO[1,2,3-C,D]PYRENE	11	200	1	350	6	16	2190	0.00013		
BENZO[B]FLUORANTHENE	22	200	1	350	6	16	2190	0.00026		
FLUORANTHENE		200	1	350	6	16	2190		0.0400	
BENZO[K]FLUORANTHENE		200	1	350	6	16	2190			
CHRYSENE		200	1	350	6	16	2190			
BENZO[A]PYRENE	19	200	1	350	6	16	2190	0.00023		
DIBENZ[A,H]ANTHRACENE		200	1	350	6	16	2190			
BENZ[A]ANTHRACENE	14	200	1	350	6	16	2190	0.00017		
CYANIDE (FREE)		200	1	350	6	16	2190		0.0200	
BENZENE		200	1	350	6	16	2190		0.0030	
ALUMINUM		200	1	350	6	16	2190		1.0000	
Mercury (inorganic)		200	1	350	6	16	2190		0.0003	
IRON	14000	200	1	350	6	16	2190	0.16781	0.3000	5.6E-01
MANGANESE-NONFOOD	440	200	1	350	6	16	2190	0.00527	0.0200	2.6E-01
NICKEL		200	1	350	6	16	2190		0.0200	
ARSENIC	6	200	1	350	6	16	2190	0.00007	0.0003	2.4E-01
BARIUM		200	1	350	6	16	2190		0.0700	
BERYLLIUM		200	1	350	6	16	2190		0.0020	
CADMIUM-WATER		200	1	350	6	16	2190		0.0005	
COPPER		200	1	350	6	16	2190		0.0400	
VANADIUM		200	1	350	6	16	2190		0.0070	
ZINC		200	1	350	6	16	2190		0.3000	
TRICHLOROETHENE		200	1	350	6	16	2190		0.0600	
ACENAPHTHENE		200	1	350	6	16	2190		0.0400	
FLUORENE		200	1	350	6	16	2190		0.0400	
NAPHTHALENE		200	1	350	6	16	2190		0.0400	
2-METHYLNAPHTHALENE		200	1	350	6	16	2190		0.0400	
ACENAPHTHYLENE		200	1	350	6	16	2190		0.0300	
PHENANTHRENE		200	1	350	6	16	2190		0.0300	

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT.N\TMP\REPORT\APPH_SAS.WPD

Page H-54

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Child Resident

CHILD RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE		2300	0.433	0.0300	350	6	16	25550			0.900		
2,4-DIMETHYLPHENOL		2300	0.433	0.1000	350	6	16	25550			0.500		
4-METHYLPHENOL		2300	0.433	0.2500	350	6	16	25550			1.000		
TOLUENE		2300	0.433	0.0300	350	6	16	25550			1.000		
AROCLOR-1260		2300	0.433	0.0600	350	6	16	25550		2.0000	0.950	2.1053	
PYRENE		2300	0.433	0.0300	350	6	16	25550			0.600		
INDENO[1,2,3-C,D]PYRENE	11	2300	0.433	0.0300	350	6	16	25550	.00000169	0.7300	0.500	1.4600	2.5E-06
BENZO[B]FLUORANTHENE	22	2300	0.433	0.0300	350	6	16	25550	.00000338	0.7300	0.500	1.4600	4.9E-06
FLUORANTHENE		2300	0.433	0.0300	350	6	16	25550			0.500		
BENZO[K]FLUORANTHENE		2300	0.433	0.0300	350	6	16	25550		0.0730	0.500	0.1460	
CHRYSENE		2300	0.433	0.0300	350	6	16	25550		0.0073	0.500	0.0146	
BENZO[A]PYRENE	19	2300	0.433	0.0300	350	6	16	25550	.00000292	7.3000	0.500	14.6000	4.3E-05
DIBENZ[A,H]ANTHRACENE		2300	0.433	0.0300	350	6	16	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	14	2300	0.433	0.0300	350	6	16	25550	.00000215	0.7300	0.500	1.4600	3.1E-06
CYANIDE (FREE)		2300	0.433	0.0010	350	6	16	25550			0.720		
BENZENE		2300	0.433	0.0005	350	6	16	25550		0.0290	1.000	0.0290	
ALUMINUM		2300	0.433	0.0100	350	6	16	25550			0.050		
Mercury (inorganic)		2300	0.433	0.0010	350	6	16	25550			0.150		
IRON	14000	2300	0.433	0.0100	350	6	16	25550	.00071623		0.100		
MANGANESE-NONFOOD	440	2300	0.433	0.0100	350	6	16	25550	.00002251		0.030		
NICKEL		2300	0.433	0.0005	350	6	16	25550			0.100		
ARSENIC	6	2300	0.433	0.0010	350	6	16	25550	.00000003	1.5000	0.950	1.5789	4.8E-08
BARIUM		2300	0.433	0.0010	350	6	16	25550			0.050		
BERYLLIUM		2300	0.433	0.0010	350	6	16	25550			0.010		
CADMIUM-WATER		2300	0.433	0.0010	350	6	16	25550			0.025		
COPPER		2300	0.433	0.0010	350	6	16	25550			0.600		
VANADIUM		2300	0.433	0.0010	350	6	16	25550			0.010		
ZINC		2300	0.433	0.0010	350	6	16	25550			0.300		
TRICHLOROETHENE		2300	0.433	0.0005	350	6	16	25550		0.0110	1.000	0.0110	
ACENAPHTHENE		2300	0.433	0.0300	350	6	16	25550			1.000		
FLUORENE		2300	0.433	0.0300	350	6	16	25550			1.000		
NAPHTHALENE		2300	0.433	0.2500	350	6	16	25550			1.000		
2-METHYLNAPHTHALENE		2300	0.433	0.1000	350	6	16	25550			0.500		
ACENAPHTHYLENE		2300	0.433	0.0300	350	6	16	25550			0.600		
PHENANTHRENE		2300	0.433	0.0300	350	6	16	25550			0.600		

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-55

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Child Resident

CHILD RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE		2300	0.433	0.0300	350	6	16	2190		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL		2300	0.433	0.1000	350	6	16	2190		0.0200	0.500	0.01000	
4-METHYLPHENOL		2300	0.433	0.2500	350	6	16	2190		0.0050	1.000	0.00500	
TOLUENE		2300	0.433	0.0300	350	6	16	2190		0.2000	1.000	0.20000	
AROCLOL-1260		2300	0.433	0.0600	350	6	16	2190			0.950		
PYRENE		2300	0.433	0.0300	350	6	16	2190		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	11	2300	0.433	0.0300	350	6	16	2190	.0000197		0.500		
BENZO[B]FLUORANTHENE	22	2300	0.433	0.0300	350	6	16	2190	.0000394		0.500		
FLUORANTHENE		2300	0.433	0.0300	350	6	16	2190		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE		2300	0.433	0.0300	350	6	16	2190			0.500		
CHRYSENE		2300	0.433	0.0300	350	6	16	2190			0.500		
BENZO[A]PYRENE	19	2300	0.433	0.0300	350	6	16	2190	.0000340		0.500		
DIBENZ[A,H]ANTHRACENE		2300	0.433	0.0300	350	6	16	2190			0.500		
BENZ[A]ANTHRACENE	14	2300	0.433	0.0300	350	6	16	2190	.0000251		0.500		
CYANIDE (FREE)		2300	0.433	0.0010	350	6	16	2190		0.0200	0.720	0.01440	
BENZENE		2300	0.433	0.0005	350	6	16	2190		0.0030	1.000	0.00300	
ALUMINUM		2300	0.433	0.0100	350	6	16	2190		1.0000	0.050	0.05000	
Mercury (inorganic)		2300	0.433	0.0010	350	6	16	2190		0.0003	0.150	0.00005	
IRON	14000	2300	0.433	0.0100	350	6	16	2190	.0083560	0.3000	0.100	0.03000	2.8E-01
MANGANESE-NONFOOD	440	2300	0.433	0.0100	350	6	16	2190	.0002626	0.0200	0.030	0.00060	4.4E-01
NICKEL		2300	0.433	0.0005	350	6	16	2190		0.0200	0.100	0.00200	
ARSENIC	6	2300	0.433	0.0010	350	6	16	2190	.0000004	0.0003	0.950	0.00029	1.3E-03
BARIUM		2300	0.433	0.0010	350	6	16	2190		0.0700	0.050	0.00350	
BERYLLIUM		2300	0.433	0.0010	350	6	16	2190		0.0020	0.010	0.00002	
CADMIUM-WATER		2300	0.433	0.0010	350	6	16	2190		0.0005	0.025	0.00001	
COPPER		2300	0.433	0.0010	350	6	16	2190		0.0400	0.600	0.02400	
VANADIUM		2300	0.433	0.0010	350	6	16	2190		0.0070	0.010	0.00007	
ZINC		2300	0.433	0.0010	350	6	16	2190		0.3000	0.300	0.09000	
TRICHLOROETHENE		2300	0.433	0.0005	350	6	16	2190		0.0060	1.000	0.00600	
ACENAPHTHENE		2300	0.433	0.0300	350	6	16	2190		0.0600	1.000	0.06000	
FLUORENE		2300	0.433	0.0300	350	6	16	2190		0.0400	1.000	0.04000	
NAPHTHALENE		2300	0.433	0.2500	350	6	16	2190		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE		2300	0.433	0.1000	350	6	16	2190		0.0400	0.500	0.02000	
ACENAPHTHYLENE		2300	0.433	0.0300	350	6	16	2190		0.0300	0.600	0.01800	
PHENANTHRENE		2300	0.433	0.0300	350	6	16	2190		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-56

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Child Resident

CHILD RESIDENT (RME)
Carcinogenic CDIs and cancer risks
Inhalation of indoor air.

CHEMICAL	IA CONC	IA inhalation rate (m3/hr)	IA exposure time (hr/d)	IA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Inhalation slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		0.96	16	350	6	16	25550			
2,4-DIMETHYLPHENOL		0.96	16	350	6	16	25550			
4-METHYLPHENOL		0.96	16	350	6	16	25550			
TOLUENE		0.96	16	350	6	16	25550			
AROCLOR-1260		0.96	16	350	6	16	25550		2.000	
PYRENE		0.96	16	350	6	16	25550			
INDENO(1,2,3-C,D)PYRENE		0.96	16	350	6	16	25550			
BENZO(B)FLUORANTHENE		0.96	16	350	6	16	25550			
FLUORANTHENE		0.96	16	350	6	16	25550			
BENZO(K)FLUORANTHENE		0.96	16	350	6	16	25550			
CHRYSENE		0.96	16	350	6	16	25550		3.100	
BENZO(A)PYRENE		0.96	16	350	6	16	25550			
DIBENZ(A,H)ANTHRACENE		0.96	16	350	6	16	25550			
BENZ(A)ANTHRACENE		0.96	16	350	6	16	25550			
CYANIDE (FREE)		0.96	16	350	6	16	25550			
BENZENE	.0070	0.96	16	350	6	16	25550	.00055233	0.029	1.6E-05
ALUMINUM		0.96	16	350	6	16	25550			
Mercury (inorganic)		0.96	16	350	6	16	25550			
IRON		0.96	16	350	6	16	25550			
MANGANESE-NONFOOD		0.96	16	350	6	16	25550			
NICKEL		0.96	16	350	6	16	25550			
ARSENIC		0.96	16	350	6	16	25550		15.100	
BARIUM		0.96	16	350	6	16	25550			
BERYLLIUM		0.96	16	350	6	16	25550		8.400	
CADMIUM-WATER		0.96	16	350	6	16	25550		6.300	
COPPER		0.96	16	350	6	16	25550			
VANADIUM		0.96	16	350	6	16	25550			
ZINC		0.96	16	350	6	16	25550			
TRICHLOROETHENE		0.96	16	350	6	16	25550		0.006	
ACENAPHTHENE		0.96	16	350	6	16	25550			
FLUORENE		0.96	16	350	6	16	25550			
NAPHTHALENE	.0026	0.96	16	350	6	16	25550	.00020515		
2-METHYLNAPHTHALENE		0.96	16	350	6	16	25550			
ACENAPHTHYLENE		0.96	16	350	6	16	25550			
PHENANTHRENE		0.96	16	350	6	16	25550			

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-57

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Child Resident

CHILD RESIDENT (RME)
Non-cancer CDIs and hazard quotients (HQs)
Inhalation of indoor air.

CHEMICAL	IACONC	IA inhalation rate (m3/hr)	IA exposure time (hr/d)	IA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Inhal RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		0.96	16	350	6	16	2190		0.29000	
2,4-DIMETHYLPHENOL		0.96	16	350	6	16	2190			
4-METHYLPHENOL		0.96	16	350	6	16	2190			
TOLUENE		0.96	16	350	6	16	2190		0.11400	
AROCLOR-1260		0.96	16	350	6	16	2190			
PYRENE		0.96	16	350	6	16	2190			
INDENO[1,2,3-C,D]PYRENE		0.96	16	350	6	16	2190			
BENZO[B]FLUORANTHENE		0.96	16	350	6	16	2190			
FLUORANTHENE		0.96	16	350	6	16	2190			
BENZO[K]FLUORANTHENE		0.96	16	350	6	16	2190			
CHRYSENE		0.96	16	350	6	16	2190			
BENZO[A]PYRENE		0.96	16	350	6	16	2190			
DIBENZ[A,H]ANTHRACENE		0.96	16	350	6	16	2190			
BENZ[A]ANTHRACENE		0.96	16	350	6	16	2190			
CYANIDE (FREE)		0.96	16	350	6	16	2190			
BENZENE	.0070	0.96	16	350	6	16	2190	.0064438	0.00170	3.8E+00
ALUMINUM		0.96	16	350	6	16	2190		0.00100	
Mercury (inorganic)		0.96	16	350	6	16	2190		0.00009	
IRON		0.96	16	350	6	16	2190			
MANGANESE-NONFOOD		0.96	16	350	6	16	2190		0.00001	
NICKEL		0.96	16	350	6	16	2190			
ARSENIC		0.96	16	350	6	16	2190		0.00014	
BARIUM		0.96	16	350	6	16	2190		0.00001	
BERYLLIUM		0.96	16	350	6	16	2190			
CADMIUM-WATER		0.96	16	350	6	16	2190			
COPPER		0.96	16	350	6	16	2190			
VANADIUM		0.96	16	350	6	16	2190			
ZINC		0.96	16	350	6	16	2190			
TRICHLOROETHENE		0.96	16	350	6	16	2190			
ACENAPHTHENE		0.96	16	350	6	16	2190			
FLUORENE		0.96	16	350	6	16	2190			
NAPHTHALENE	.0026	0.96	16	350	6	16	2190	.0023934	0.00086	2.8E+00
2-METHYLNAPHTHALENE		0.96	16	350	6	16	2190			
ACENAPHTHYLENE		0.96	16	350	6	16	2190			
PHENANTHRENE		0.96	16	350	6	16	2190			

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

\\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN\TMP\REPORT\APPH_SAS.WPD

Page H-58

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Child Resident

CHILD RESIDENT (RME) .
Cancer Risk and Hazard Index Summary Table

PATHWAY	TOTCR	TOTHI
Incidental ingestion of surface soil.	1.9E-04	1.1E+00
Dermal contact with surface soil.	5.3E-05	7.2E-01
Inhalation of indoor air.	1.6E-05	6.6E+00
Total	2.6E-04	8.4E+00

O'Brien & Gere Engineers, Inc. - 06JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-59

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		480	1	60	1	70	25550			
2,4-DIMETHYLPHENOL		480	1	60	1	70	25550			
4-METHYLPHENOL		480	1	60	1	70	25550			
TOLUENE		480	1	60	1	70	25550			
AROCLO-1260		480	1	60	1	70	25550		2.0000	
PYRENE		480	1	60	1	70	25550			
INDENO[1,2,3-C,D]PYRENE	11	480	1	60	1	70	25550	.00000018	0.7300	1.3E-07
BENZO[B]FLUORANTHENE	22	480	1	60	1	70	25550	.00000035	0.7300	2.6E-07
FLUORANTHENE		480	1	60	1	70	25550			
BENZO[K]FLUORANTHENE		480	1	60	1	70	25550		0.0730	
CHRYSENE		480	1	60	1	70	25550		0.0073	
BENZO[A]PYRENE	19	480	1	60	1	70	25550	.00000031	7.3000	2.2E-06
DIBENZ[A,H]ANTHRACENE		480	1	60	1	70	25550		7.3000	
BENZ[A]ANTHRACENE	14	480	1	60	1	70	25550	.00000023	0.7300	1.6E-07
CYANIDE (FREE)		480	1	60	1	70	25550			
BENZENE		480	1	60	1	70	25550		0.0290	
ALUMINUM		480	1	60	1	70	25550			
Mercury (inorganic)		480	1	60	1	70	25550			
IRON	14000	480	1	60	1	70	25550	.00022544		
MANGANESE-NONFOOD	440	480	1	60	1	70	25550	.00000709		
NICKEL		480	1	60	1	70	25550			
ARSENIC	6	480	1	60	1	70	25550	.00000010	1.5000	1.4E-07
BARIUM		480	1	60	1	70	25550			
BERYLLIUM		480	1	60	1	70	25550			
CADMIUM-WATER		480	1	60	1	70	25550			
COPPER		480	1	60	1	70	25550			
VANADIUM		480	1	60	1	70	25550			
ZINC		480	1	60	1	70	25550		0.0110	
TRICHLOROETHENE		480	1	60	1	70	25550			
ACENAPHTHENE		480	1	60	1	70	25550			
FLUORENE		480	1	60	1	70	25550			
NAPHTHALENE		480	1	60	1	70	25550			
2-METHYLNAPHTHALENE		480	1	60	1	70	25550			
ACENAPHTHYLENE		480	1	60	1	70	25550			
PHENANTHRENE		480	1	60	1	70	25550			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

\\DIV82\PROJECTS\HHR\MISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-60

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of surface soil.

CHEMICAL	SSCONC	SS ingestion rate (mg/d)	Fraction SS ingested from source	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		480	1	60	1	70	365		0.1000	
2,4-DIMETHYLPHENOL		480	1	60	1	70	365		0.0200	
4-METHYLPHENOL		480	1	60	1	70	365		0.0050	
TOLUENE		480	1	60	1	70	365		0.2000	
AROCLOP-1260		480	1	60	1	70	365			
PYRENE		480	1	60	1	70	365		0.0300	
INDENO[1,2,3-C,D]PYRENE	11	480	1	60	1	70	365	0.000012		
BENZO[B]FLUORANTHENE	22	480	1	60	1	70	365	0.000025		
FLUORANTHENE		480	1	60	1	70	365		0.0400	
BENZO[K]FLUORANTHENE		480	1	60	1	70	365			
CHRYSENE		480	1	60	1	70	365			
BENZO[A]PYRENE	19	480	1	60	1	70	365	0.000021		
DIBENZ[A,H]ANTHRACENE		480	1	60	1	70	365			
BENZ[A]ANTHRACENE	14	480	1	60	1	70	365	0.000016		
CYANIDE (FREE)		480	1	60	1	70	365		0.0200	
BENZENE		480	1	60	1	70	365		0.0030	
ALUMINUM		480	1	60	1	70	365		1.0000	
Mercury (inorganic)		480	1	60	1	70	365		0.0003	
IRON	14000	480	1	60	1	70	365	0.015781	0.3000	5.3E-02
MANGANESE-NONFOOD	440	480	1	60	1	70	365	0.000496	0.0200	2.5E-02
NICKEL		480	1	60	1	70	365		0.0200	
ARSENIC	6	480	1	60	1	70	365	0.000007	0.0003	2.3E-02
BARIUM		480	1	60	1	70	365		0.0700	
BERYLLIUM		480	1	60	1	70	365		0.0020	
CADMIUM-WATER		480	1	60	1	70	365		0.0005	
COPPER		480	1	60	1	70	365		0.0400	
VANADIUM		480	1	60	1	70	365		0.0070	
ZINC		480	1	60	1	70	365		0.3000	
TRICHLOROETHENE		480	1	60	1	70	365		0.0060	
ACENAPHTHENE		480	1	60	1	70	365		0.0600	
FLUORENE		480	1	60	1	70	365		0.0400	
NAPHTHALENE		480	1	60	1	70	365		0.0400	
2-METHYLNAPHTHALENE		480	1	60	1	70	365		0.0400	
ACENAPHTHYLENE		480	1	60	1	70	365		0.0300	
PHENANTHRENE		480	1	60	1	70	365		0.0300	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE		5800	0.433	0.0300	60	1	70	25550			0.900		
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70	25550			0.500		
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70	25550			1.000		
TOLUENE		5800	0.433	0.0300	60	1	70	25550			1.000		
AROCLOL-1260		5800	0.433	0.0600	60	1	70	25550		2.0000	0.950	2.1053	
PYRENE		5800	0.433	0.0300	60	1	70	25550			0.600		
INDENO[1,2,3-C,D]PYRENE	11	5800	0.433	0.0300	60	1	70	25550	.000000028	0.7300	0.500	1.4600	4.1E-08
BENZO[B]FLUORANTHENE	22	5800	0.433	0.0300	60	1	70	25550	.000000056	0.7300	0.500	1.4600	8.1E-08
FLUORANTHENE		5800	0.433	0.0300	60	1	70	25550			0.500		
BENZO[K]FLUORANTHENE		5800	0.433	0.0300	60	1	70	25550		0.0730	0.500	0.1460	
CHRYSENE		5800	0.433	0.0300	60	1	70	25550		0.0073	0.500	0.0146	
BENZO[A]PYRENE	19	5800	0.433	0.0300	60	1	70	25550	.000000048	7.3000	0.500	14.6000	7.0E-07
DIBENZ[A,H]ANTHRACENE		5800	0.433	0.0300	60	1	70	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	14	5800	0.433	0.0300	60	1	70	25550	.000000035	0.7300	0.500	1.4600	5.2E-08
CYANIDE (FREE)		5800	0.433	0.0010	60	1	70	25550			0.720		
BENZENE		5800	0.433	0.0005	60	1	70	25550		0.0290	1.000	0.0290	
ALUMINUM		5800	0.433	0.0100	60	1	70	25550			0.050		
Mercury (inorganic)		5800	0.433	0.0010	60	1	70	25550			0.150		
IRON	14000	5800	0.433	0.0100	60	1	70	25550	.000011795		0.100		
MANGANESE-NONFOOD	440	5800	0.433	0.0100	60	1	70	25550	.000000371		0.030		
NICKEL		5800	0.433	0.0005	60	1	70	25550			0.100		
ARSENIC	6	5800	0.433	0.0010	60	1	70	25550	.000000001	1.5000	0.950	1.5789	8.0E-10
BARIUM		5800	0.433	0.0010	60	1	70	25550			0.050		
BERYLLIUM		5800	0.433	0.0010	60	1	70	25550			0.010		
CADMIUM-WATER		5800	0.433	0.0010	60	1	70	25550			0.025		
COPPER		5800	0.433	0.0010	60	1	70	25550			0.600		
VANADIUM		5800	0.433	0.0010	60	1	70	25550			0.010		
ZINC		5800	0.433	0.0010	60	1	70	25550			0.300		
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70	25550		0.0110	1.000	0.0110	
ACENAPHTHENE		5800	0.433	0.0300	60	1	70	25550			1.000		
FLUORENE		5800	0.433	0.0300	60	1	70	25550			1.000		
NAPHTHALENE		5800	0.433	0.2500	60	1	70	25550			1.000		
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70	25550			0.500		
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70	25550			0.600		
PHENANTHRENE		5800	0.433	0.0300	60	1	70	25550			0.600		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT\TMP\REPORT\APPH_SAS.WPD

Page H-62

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with surface soil.

CHEMICAL	SSCONC	Exposed skin surface area to SS (cm2/d)	SS to skin adherence factor (mg/cm2)	Dermal absorption factor	SS exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE		5800	0.433	0.0300	60	1	70	365		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70	365		0.0200	0.500	0.01000	
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70	365		0.0050	1.000	0.00500	
TOLUENE		5800	0.433	0.0300	60	1	70	365		0.2000	1.000	0.20000	
AROCLOR-1260		5800	0.433	0.0600	60	1	70	365			0.950		
PYRENE		5800	0.433	0.0300	60	1	70	365		0.0300	0.600	0.01800	
INDENO[1,2,3-C,D]PYRENE	11	5800	0.433	0.0300	60	1	70	365	.00000195		0.500		
BENZO[B]FLUORANTHENE	22	5800	0.433	0.0300	60	1	70	365	.00000389		0.500		
FLUORANTHENE		5800	0.433	0.0300	60	1	70	365		0.0400	0.500	0.02000	
BENZO[K]FLUORANTHENE		5800	0.433	0.0300	60	1	70	365			0.500		
CHRYSENE		5800	0.433	0.0300	60	1	70	365			0.500		
BENZO[A]PYRENE	19	5800	0.433	0.0300	60	1	70	365	.00000336		0.500		
DIBENZ[A,H]ANTHRACENE		5800	0.433	0.0300	60	1	70	365			0.500		
BENZ[A]ANTHRACENE	14	5800	0.433	0.0300	60	1	70	365	.00000248		0.500		
CYANIDE (FREE)		5800	0.433	0.0010	60	1	70	365		0.0200	0.720	0.01440	
BENZENE		5800	0.433	0.0005	60	1	70	365		0.0030	1.000	0.00300	
ALUMINUM		5800	0.433	0.0100	60	1	70	365		1.0000	0.050	0.05000	
Mercury (inorganic)		5800	0.433	0.0010	60	1	70	365		0.0003	0.150	0.00005	
IRON	14000	5800	0.433	0.0100	60	1	70	365	.00082567	0.3000	0.100	0.03000	2.8E-02
MANGANESE-NONFOOD	440	5800	0.433	0.0100	60	1	70	365	.00002595	0.0200	0.030	0.00060	4.3E-02
NICKEL		5800	0.433	0.0005	60	1	70	365		0.0200	0.100	0.00200	
ARSENIC	6	5800	0.433	0.0010	60	1	70	365	.00000004	0.0003	0.950	0.00029	1.2E-04
BARIUM		5800	0.433	0.0010	60	1	70	365		0.0700	0.050	0.00350	
BERYLLIUM		5800	0.433	0.0010	60	1	70	365		0.0020	0.010	0.00002	
CADMIUM-WATER		5800	0.433	0.0010	60	1	70	365		0.0005	0.025	0.00001	
COPPER		5800	0.433	0.0010	60	1	70	365		0.0400	0.600	0.02400	
VANADIUM		5800	0.433	0.0010	60	1	70	365		0.0070	0.010	0.00007	
ZINC		5800	0.433	0.0010	60	1	70	365		0.3000	0.300	0.09000	
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70	365		0.0060	1.000	0.00600	
ACENAPHTHENE		5800	0.433	0.0300	60	1	70	365		0.0600	1.000	0.06000	
FLUORENE		5800	0.433	0.0300	60	1	70	365		0.0400	1.000	0.04000	
NAPHTHALENE		5800	0.433	0.2500	60	1	70	365		0.0400	1.000	0.04000	
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70	365		0.0400	0.500	0.02000	
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70	365		0.0300	0.600	0.01800	
PHENANTHRENE		5800	0.433	0.0300	60	1	70	365		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT\N.TMP\REPORT\APPH_SAS.WPD

Page H-63

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of subsurface soil.

CHEMICAL	SB CONC	SB ingestion rate (mg/d)	Fraction SB ingested from source	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		480	1	60	1	70	25550			
2,4-DIMETHYLPHENOL		480	1	60	1	70	25550			
4-METHYLPHENOL		480	1	60	1	70	25550			
TOLUENE		480	1	60	1	70	25550			
AROCLOR-1260		480	1	60	1	70	25550		2.0000	
PYRENE	1600	480	1	60	1	70	25550	.0000258		
INDENO[1,2,3-C,D]PYRENE	430	480	1	60	1	70	25550	.0000069	0.7300	5.1E-06
BENZO[B]FLUORANTHENE	910	480	1	60	1	70	25550	.0000147	0.7300	1.1E-05
FLUORANTHENE	1800	480	1	60	1	70	25550	.0000290		
BENZO[K]FLUORANTHENE	410	480	1	60	1	70	25550	.0000066	0.0730	4.8E-07
CHRYSENE	900	480	1	60	1	70	25550	.0000145	0.0073	1.1E-07
BENZO[A]PYRENE	770	480	1	60	1	70	25550	.0000124	7.3000	9.1E-05
DIBENZ[A,H]ANTHRACENE	19	480	1	60	1	70	25550	.0000003	7.3000	2.2E-06
BENZ[A]ANTHRACENE	950	480	1	60	1	70	25550	.0000153	0.7300	1.1E-05
CYANIDE (FREE)		480	1	60	1	70	25550			
BENZENE		480	1	60	1	70	25550		0.0290	
ALUMINUM		480	1	60	1	70	25550			
Mercury (inorganic)		480	1	60	1	70	25550			
IRON	128521	480	1	60	1	70	25550	.0020696		
MANGANESE-NONFOOD	430	480	1	60	1	70	25550	.0000069		
NICKEL		480	1	60	1	70	25550			
ARSENIC	86	480	1	60	1	70	25550	.0000014	1.5000	2.1E-06
BARIUM		480	1	60	1	70	25550			
BERYLLIUM		480	1	60	1	70	25550			
CADMIUM-WATER		480	1	60	1	70	25550			
COPPER		480	1	60	1	70	25550			
VANADIUM	89	480	1	60	1	70	25550	.0000014		
ZINC		480	1	60	1	70	25550			
TRICHLOROETHENE		480	1	60	1	70	25550		0.0110	
ACENAPHTHENE		480	1	60	1	70	25550			
FLUORENE		480	1	60	1	70	25550			
NAPHTHALENE	1600	480	1	60	1	70	25550	.0000258		
2-METHYLNAPHTHALENE		480	1	60	1	70	25550			
ACENAPHTHYLENE		480	1	60	1	70	25550			
PHENANTHRENE		480	1	60	1	70	25550			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-64

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of subsurface soil.

CHEMICAL	SB CONC	SB ingestion rate (mg/d)	Fraction SB ingested from source	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		480	1	60	1	70	365		0.1000	
2,4-DIMETHYLPHENOL		480	1	60	1	70	365		0.0200	
4-METHYLPHENOL		480	1	60	1	70	365		0.0050	
TOLUENE		480	1	60	1	70	365		0.2000	
AROCLOR-1260		480	1	60	1	70	365			
PYRENE	1600	480	1	60	1	70	365	0.00180	0.0300	6.0E-02
INDENO[1,2,3-C,D]PYRENE	430	480	1	60	1	70	365	0.00048		
BENZO[B]FLUORANTHENE	910	480	1	60	1	70	365	0.00103		
FLUORANTHENE	1800	480	1	60	1	70	365	0.00203	0.0400	5.1E-02
BENZO[K]FLUORANTHENE	410	480	1	60	1	70	365	0.00046		
CHRYSENE	900	480	1	60	1	70	365	0.00101		
BENZO[A]PYRENE	770	480	1	60	1	70	365	0.00087		
DIBENZ[A,H]ANTHRACENE	19	480	1	60	1	70	365	0.00002		
BENZ[A]ANTHRACENE	950	480	1	60	1	70	365	0.00107		
CYANIDE (FREE)		480	1	60	1	70	365		0.0200	
BENZENE		480	1	60	1	70	365		0.0030	
ALUMINUM		480	1	60	1	70	365		1.0000	
Mercury (inorganic)		480	1	60	1	70	365		0.0003	
IRON	128521	480	1	60	1	70	365	0.14487	0.3000	4.8E-01
MANGANESE-NONFOOD	430	480	1	60	1	70	365	0.00048	0.0200	2.4E-02
NICKEL		480	1	60	1	70	365		0.0200	
ARSENIC	86	480	1	60	1	70	365	0.00010	0.0003	3.2E-01
BARIUM		480	1	60	1	70	365		0.0700	
BERYLLIUM		480	1	60	1	70	365		0.0020	
CADMIUM-WATER		480	1	60	1	70	365		0.0005	
COPPER		480	1	60	1	70	365		0.0400	
VANADIUM	89	480	1	60	1	70	365	0.00010	0.0070	1.4E-02
ZINC		480	1	60	1	70	365		0.3000	
TRICHLOROETHENE		480	1	60	1	70	365		0.0060	
ACENAPHTHENE		480	1	60	1	70	365		0.0600	
FLUORENE		480	1	60	1	70	365		0.0400	
NAPHTHALENE	1600	480	1	60	1	70	365	0.00180	0.0400	4.5E-02
2-METHYLNAPHTHALENE		480	1	60	1	70	365		0.0400	
ACENAPHTHYLENE		480	1	60	1	70	365		0.0300	
PHENANTHRENE		480	1	60	1	70	365		0.0300	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-65

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with subsurface soil.

CHEMICAL	SBCONC	Exposed skin surface area to SB (cm2/d)	SB to skin adherence factor (mg/cm2)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted slope factor	Cancer risk
ETHYLBENZENE		5800	0.433	0.0300	60	1	70	25550			0.900		
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70	25550			0.500		
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70	25550			1.000		
TOLUENE		5800	0.433	0.0300	60	1	70	25550			1.000		
AROCLOL-1260		5800	0.433	0.0600	60	1	70	25550		2.0000	0.950	2.1053	
PYRENE	1600	5800	0.433	0.0300	60	1	70	25550	.00000404		0.600		
INDENO[1,2,3-c,d]PYRENE	430	5800	0.433	0.0300	60	1	70	25550	.00000109	0.7300	0.500	1.4600	1.6E-06
BENZO[B]FLUORANTHENE	910	5800	0.433	0.0300	60	1	70	25550	.00000230	0.7300	0.500	1.4600	3.4E-06
FLUORANTHENE	1800	5800	0.433	0.0300	60	1	70	25550	.00000455		0.500		
BENZO[K]FLUORANTHENE	410	5800	0.433	0.0300	60	1	70	25550	.00000104	0.0730	0.500	0.1460	1.5E-07
CHRYSENE	900	5800	0.433	0.0300	60	1	70	25550	.00000227	0.0073	0.500	0.0146	3.3E-08
BENZO[A]PYRENE	770	5800	0.433	0.0300	60	1	70	25550	.00000195	7.3000	0.500	14.6000	2.8E-05
DIBENZ[A,H]ANTHRACENE	19	5800	0.433	0.0300	60	1	70	25550	.00000005	7.3000	0.500	14.6000	7.0E-07
BENZ[A]ANTHRACENE	950	5800	0.433	0.0300	60	1	70	25550	.00000240	0.7300	0.500	1.4600	3.5E-06
CYANIDE (FREE)		5800	0.433	0.0010	60	1	70	25550			0.720		
BENZENE		5800	0.433	0.0005	60	1	70	25550		0.0290	1.000	0.0290	
ALUMINUM		5800	0.433	0.0100	60	1	70	25550			0.050		
Mercury (inorganic)		5800	0.433	0.0010	60	1	70	25550			0.150		
IRON	128521	5800	0.433	0.0100	60	1	70	25550	.00010828		0.100		
MANGANESE-NONFOOD	430	5800	0.433	0.0100	60	1	70	25550	.00000036		0.030		
NICKEL		5800	0.433	0.0005	60	1	70	25550			0.100		
ARSENIC	86	5800	0.433	0.0010	60	1	70	25550	.00000001	1.5000	0.950	1.5789	1.1E-08
BARIUM		5800	0.433	0.0010	60	1	70	25550			0.050		
BERYLLIUM		5800	0.433	0.0010	60	1	70	25550			0.010		
CADMIUM-WATER		5800	0.433	0.0010	60	1	70	25550			0.025		
COPPER		5800	0.433	0.0010	60	1	70	25550			0.600		
VANADIUM	89	5800	0.433	0.0010	60	1	70	25550	.00000001		0.010		
ZINC		5800	0.433	0.0010	60	1	70	25550			0.300		
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70	25550		0.0110	1.000	0.0110	
ACENAPHTHENE		5800	0.433	0.0300	60	1	70	25550			1.000		
FLUORENE		5800	0.433	0.0300	60	1	70	25550			1.000		
NAPHTHALENE	1600	5800	0.433	0.2500	60	1	70	25550	.00003370		1.000		
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70	25550			0.500		
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70	25550			0.600		
PHENANTHRENE		5800	0.433	0.0300	60	1	70	25550			0.600		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-66

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with subsurface soil.

CHEMICAL	SB CONC	Exposed skin surface area to SB (cm ² /d)	SB to skin adherence factor (mg/cm ²)	Dermal absorption factor	SB exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE		5800	0.433	0.0300	60	1	70	365		0.1000	0.900	0.09000	
2,4-DIMETHYLPHENOL		5800	0.433	0.1000	60	1	70	365		0.0200	0.500	0.01000	
4-METHYLPHENOL		5800	0.433	0.2500	60	1	70	365		0.0050	1.000	0.00500	
TOLUENE		5800	0.433	0.0300	60	1	70	365		0.2000	1.000	0.20000	
AROCLOR-1260		5800	0.433	0.0600	60	1	70	365			0.950		
PYRENE	1600	5800	0.433	0.0300	60	1	70	365	.0002831	0.0300	0.600	0.01800	1.6E-02
INDENO[1,2,3-C,D]PYRENE	430	5800	0.433	0.0300	60	1	70	365	.0000761		0.500		
BENZO[B]FLUORANTHENE	910	5800	0.433	0.0300	60	1	70	365	.0001610		0.500		
FLUORANTHENE	1800	5800	0.433	0.0300	60	1	70	365	.0003185	0.0400	0.500	0.02000	1.6E-02
BENZO[K]FLUORANTHENE	410	5800	0.433	0.0300	60	1	70	365	.0000725		0.500		
CHRYSENE	900	5800	0.433	0.0300	60	1	70	365	.0001592		0.500		
BENZO[A]PYRENE	770	5800	0.433	0.0300	60	1	70	365	.0001362		0.500		
DIBENZ[A,H]ANTHRACENE	19	5800	0.433	0.0300	60	1	70	365	.0000034		0.500		
BENZ[A]ANTHRACENE	950	5800	0.433	0.0300	60	1	70	365	.0001681		0.500		
CYANIDE (FREE)		5800	0.433	0.0010	60	1	70	365		0.0200	0.720	0.01440	
BENZENE		5800	0.433	0.0005	60	1	70	365		0.0030	1.000	0.00300	
ALUMINUM		5800	0.433	0.0100	60	1	70	365		1.0000	0.050	0.05000	
Mercury (inorganic)		5800	0.433	0.0010	60	1	70	365		0.0003	0.150	0.00005	
IRON	128521	5800	0.433	0.0100	60	1	70	365	.0075797	0.3000	0.100	0.03000	2.5E-01
MANGANESE-NONFOOD	430	5800	0.433	0.0100	60	1	70	365	.0000254	0.0200	0.030	0.00060	4.2E-02
NICKEL		5800	0.433	0.0005	60	1	70	365		0.0200	0.100	0.00200	
ARSENIC	86	5800	0.433	0.0010	60	1	70	365	.0000005	0.0003	0.950	0.00029	1.8E-03
BARIUM		5800	0.433	0.0010	60	1	70	365		0.0700	0.050	0.00350	
BERYLLIUM		5800	0.433	0.0010	60	1	70	365		0.0020	0.010	0.00002	
CADMIUM-WATER		5800	0.433	0.0010	60	1	70	365		0.0005	0.025	0.00001	
COPPER		5800	0.433	0.0010	60	1	70	365		0.0400	0.600	0.02400	
VANADIUM	89	5800	0.433	0.0010	60	1	70	365	.0000005	0.0070	0.010	0.00007	7.5E-03
ZINC		5800	0.433	0.0010	60	1	70	365		0.3000	0.300	0.09000	
TRICHLOROETHENE		5800	0.433	0.0005	60	1	70	365		0.0060	1.000	0.00600	
ACENAPHTHENE		5800	0.433	0.0300	60	1	70	365		0.0600	1.000	0.06000	
FLUORENE		5800	0.433	0.0300	60	1	70	365		0.0400	1.000	0.04000	
NAPHTHALENE	1600	5800	0.433	0.2500	60	1	70	365	.0023590	0.0400	1.000	0.04000	5.9E-02
2-METHYLNAPHTHALENE		5800	0.433	0.1000	60	1	70	365		0.0400	0.500	0.02000	
ACENAPHTHYLENE		5800	0.433	0.0300	60	1	70	365		0.0300	0.600	0.01800	
PHENANTHRENE		5800	0.433	0.0300	60	1	70	365		0.0300	0.600	0.01800	

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-67

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Incidental ingestion of ground water.

CHEMICAL	GWCONC	GW ingestion rate (l/hour)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE	590.00	0.01	1	60	1	70	25550	.00000020		
2,4-DIMETHYLPHENOL	150.00	0.01	1	60	1	70	25550	.00000005		
4-METHYLPHENOL	23.00	0.01	1	60	1	70	25550	.00000001		
TOLUENE	93.00	0.01	1	60	1	70	25550	.00000003		
AROCLO-1260		0.01	1	60	1	70	25550		2.0000	
PYRENE	440.00	0.01	1	60	1	70	25550	.00000015		
INDENO[1,2,3-C,D]PYRENE		0.01	1	60	1	70	25550		0.7300	
BENZO[B]FLUORANTHENE	200.00	0.01	1	60	1	70	25550	.00000007	0.7300	4.9E-08
FLUORANTHENE	430.00	0.01	1	60	1	70	25550	.00000014		
BENZO[K]FLUORANTHENE	72.00	0.01	1	60	1	70	25550	.00000002	0.0730	1.8E-09
CHRYSENE	160.00	0.01	1	60	1	70	25550	.00000005	0.0073	3.9E-10
BENZO[A]PYRENE	180.00	0.01	1	60	1	70	25550	.00000006	7.3000	4.4E-07
DIBENZ[A,H]ANTHRACENE		0.01	1	60	1	70	25550		7.3000	
BENZ[A]ANTHRACENE	180.00	0.01	1	60	1	70	25550	.00000006	0.7300	4.4E-08
CYANIDE (FREE)	5300.00	0.01	1	60	1	70	25550	.00000178		
BENZENE	980.00	0.01	1	60	1	70	25550	.00000033	0.0290	9.5E-09
ALUMINUM	142000.00	0.01	1	60	1	70	25550	.00004764		
Mercury (inorganic)		0.01	1	60	1	70	25550			
IRON	350540.00	0.01	1	60	1	70	25550	.00011760		
MANGANESE-NONFOOD	7987.00	0.01	1	60	1	70	25550	.00000268		
NICKEL	200.00	0.01	1	60	1	70	25550	.00000007		
ARSENIC	0.07	0.01	1	60	1	70	25550	.00000000	1.5000	3.6E-11
BARIUM	3000.00	0.01	1	60	1	70	25550	.00000101		
BERYLLIUM		0.01	1	60	1	70	25550			
CADMIUM-WATER	7.00	0.01	1	60	1	70	25550	.00000000		
COPPER	440.00	0.01	1	60	1	70	25550	.00000015		
VANADIUM	240.00	0.01	1	60	1	70	25550	.00000008		
ZINC		0.01	1	60	1	70	25550		0.0110	
TRICHLOROETHENE		0.01	1	60	1	70	25550			
ACENAPHTHENE	460.00	0.01	1	60	1	70	25550	.00000015		
FLUORENE	250.00	0.01	1	60	1	70	25550	.00000008		
NAPHTHALENE	4800.00	0.01	1	60	1	70	25550	.00000161		
2-METHYLNAPHTHALENE	530.00	0.01	1	60	1	70	25550	.00000018		
ACENAPHTHYLENE	250.00	0.01	1	60	1	70	25550	.00000008		
PHENANTHRENE	680.00	0.01	1	60	1	70	25550	.00000023		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-68

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Incidental ingestion of ground water.

CHEMICAL	GWCONC	GW ingestion rate (1/hour)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE	590.00	0.01	1	60	1	70	365	.0000139	0.1000	1.4E-04
2,4-DIMETHYLPHENOL	150.00	0.01	1	60	1	70	365	.0000035	0.0200	1.8E-04
4-METHYLPHENOL	23.00	0.01	1	60	1	70	365	.0000005	0.0050	1.1E-04
TOLUENE	93.00	0.01	1	60	1	70	365	.0000022	0.2000	1.1E-05
AROCLOR-1260		0.01	1	60	1	70	365			
PYRENE	440.00	0.01	1	60	1	70	365	.0000103	0.0300	3.4E-04
INDENO[1,2,3-C,D]PYRENE		0.01	1	60	1	70	365			
BENZO[B]FLUORANTHENE	200.00	0.01	1	60	1	70	365	.0000047		
FLUORANTHENE	430.00	0.01	1	60	1	70	365	.0000101	0.0400	2.5E-04
BENZO[K]FLUORANTHENE	72.00	0.01	1	60	1	70	365	.0000017		
CHRYSENE	160.00	0.01	1	60	1	70	365	.0000038		
BENZO[A]PYRENE	180.00	0.01	1	60	1	70	365	.0000042		
DIBENZ[A,H]ANTHRACENE		0.01	1	60	1	70	365			
BENZ[A]ANTHRACENE	180.00	0.01	1	60	1	70	365	.0000042		
CYANIDE (FREE)	5300.00	0.01	1	60	1	70	365	.0001245	0.0200	6.2E-03
BENZENE	980.00	0.01	1	60	1	70	365	.0000230	0.0030	7.7E-03
ALUMINUM	142000.00	0.01	1	60	1	70	365	.0033346	1.0000	3.3E-03
Mercury (inorganic)		0.01	1	60	1	70	365		0.0003	
IRON	350540.00	0.01	1	60	1	70	365	.0082319	0.3000	2.7E-02
MANGANESE-NONFOOD	7987.00	0.01	1	60	1	70	365	.0001876	0.0200	9.4E-03
NICKEL	200.00	0.01	1	60	1	70	365	.0000047	0.0200	2.3E-04
ARSENIC	0.07	0.01	1	60	1	70	365	.0000000	0.0003	5.6E-06
BARIUM	3000.00	0.01	1	60	1	70	365	.0000705	0.0700	1.0E-03
BERYLLIUM		0.01	1	60	1	70	365		0.0020	
CADMIUM-WATER	7.00	0.01	1	60	1	70	365	.0000002	0.0005	3.3E-04
COPPER	440.00	0.01	1	60	1	70	365	.0000103	0.0400	2.6E-04
VANADIUM	240.00	0.01	1	60	1	70	365	.0000056	0.0070	8.1E-04
ZINC		0.01	1	60	1	70	365		0.3000	
TRICHLOROETHENE		0.01	1	60	1	70	365		0.0060	
ACENAPHTHENE	460.00	0.01	1	60	1	70	365	.0000108	0.0600	1.8E-04
FLUORENE	250.00	0.01	1	60	1	70	365	.0000059	0.0400	1.5E-04
NAPHTHALENE	4800.00	0.01	1	60	1	70	365	.0001127	0.0400	2.8E-03
2-METHYLNAPHTHALENE	530.00	0.01	1	60	1	70	365	.0000124	0.0400	3.1E-04
ACENAPHTHYLENE	250.00	0.01	1	60	1	70	365	.0000059	0.0300	2.0E-04
PHENANTHRENE	680.00	0.01	1	60	1	70	365	.0000160	0.0300	5.3E-04

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT\TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE	590.00	5800	1.000	1	60	1	70
2,4-DIMETHYLPHENOL	150.00	5800	0.110	1	60	1	70
4-METHYLPHENOL	23.00	5800	0.110	1	60	1	70
TOLUENE	93.00	5800	1.000	1	60	1	70
AROCLOR-1260		5800	1.600	1	60	1	70
PYRENE	440.00	5800	0.530	1	60	1	70
INDENO[1,2,3-C,D]PYRENE		5800	1.900	1	60	1	70
BENZO[B]FLUORANTHENE	200.00	5800	1.200	1	60	1	70
FLUORANTHENE	430.00	5800	0.360	1	60	1	70
BENZO[K]FLUORANTHENE	72.00	5800	1.100	1	60	1	70
CHRYSENE	160.00	5800	0.810	1	60	1	70
BENZO[A]PYRENE	180.00	5800	1.200	1	60	1	70
DIBENZ[A,H]ANTHRACENE		5800	2.700	1	60	1	70
BENZ[A]ANTHRACENE	180.00	5800	0.810	1	60	1	70
CYANIDE (FREE)	5300.00	5800	0.001	1	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
ETHYLBENZENE	25550	.00011480		0.900		
2,4-DIMETHYLPHENOL	25550	.00000321		0.500		
4-METHYLPHENOL	25550	.00000049		1.000		
TOLUENE	25550	.00001810		1.000		
AROCLOR-1260	25550		2.0000	0.950	2.1053	
PYRENE	25550	.00004538		0.600		
INDENO[1,2,3-C,D]PYRENE	25550		0.7300	0.500	1.4600	
BENZO[B]FLUORANTHENE	25550	.00004670	0.7300	0.500	1.4600	6.8E-05
FLUORANTHENE	25550	.00003012		0.500		
BENZO[K]FLUORANTHENE	25550	.00001541	0.0730	0.500	0.1460	2.2E-06
CHRYSENE	25550	.00002522	0.0073	0.500	0.0146	3.7E-07
BENZO[A]PYRENE	25550	.00004203	7.3000	0.500	14.6000	6.1E-04
DIBENZ[A,H]ANTHRACENE	25550		7.3000	0.500	14.6000	
BENZ[A]ANTHRACENE	25550	.00002837	0.7300	0.500	1.4600	4.1E-05
CYANIDE (FREE)	25550	.00000103		0.720		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE	980.00	5800	0.110	1	60	1	70
ALUMINUM	142000.00	5800	0.001	1	60	1	70
Mercury (inorganic)		5800	0.001	1	60	1	70
IRON	350540.00	5800	0.001	1	60	1	70
MANGANESE-NONFOOD	7987.00	5800	0.001	1	60	1	70
NICKEL	200.00	5800	0.001	1	60	1	70
ARSENIC	0.07	5800	0.001	1	60	1	70
BARIUM	3000.00	5800	0.001	1	60	1	70
BERYLLIUM		5800	0.001	1	60	1	70
CADMIUM-WATER	7.00	5800	0.001	1	60	1	70
COPPER	440.00	5800	0.001	1	60	1	70
VANADIUM	240.00	5800	0.001	1	60	1	70
ZINC		5800	0.001	1	60	1	70
TRICHLOROETHENE		5800	0.230	1	60	1	70
ACENAPHTHENE	460.00	5800	0.130	1	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
BENZENE	25550	.00002098	0.0290	1.000	0.0290	6.1E-07
ALUMINUM	25550	.00002763		0.050		
Mercury (inorganic)	25550			0.150		
IRON	25550	.00006821		0.100		
MANGANESE-NONFOOD	25550	.00000155		0.030		
NICKEL	25550	.00000004		0.100		
ARSENIC	25550	.00000000	1.5000	0.950	1.5789	2.2E-11
BARIUM	25550	.00000058		0.050		
BERYLLIUM	25550			0.010		
CADMIUM-WATER	25550	.00000000		0.025		
COPPER	25550	.00000009		0.600		
VANADIUM	25550	.00000005		0.010		
ZINC	25550			0.300		
TRICHLOROETHENE	25550		0.0110	1.000	0.0110	
ACENAPHTHENE	25550	.00001164		1.000		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-71

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)
FLUORENE	250.00	5800	0.170	1	60	1	70
NAPHTHALENE	4800.00	5800	0.070	1	60	1	70
2-METHYLNAPHTHALENE	530.00	5800	0.069	1	60	1	70
ACENAPHTHYLENE	250.00	5800	0.530	1	60	1	70
PHENANTHRENE	680.00	5800	0.530	1	60	1	70

CHEMICAL	Averaging time (cancer) (d)	CDI (mg/kg-day)	Oral slope factor 1/(mg/kg-day)	GI absorption factor	Adjusted SF	Cancer risk
FLUORENE	25550	.00000827		1.000		
NAPHTHALENE	25550	.00006538		1.000		
2-METHYLNAPHTHALENE	25550	.00000712		0.500		
ACENAPHTHYLENE	25550	.00002578		0.600		
PHENANTHRENE	25550	.00007013		0.600		

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

F:\DIV82\PROJECTS\HHRAMISC.PR\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-72

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)
ETHYLBENZENE	590.00	5800	1.000	1	60	1	70
2,4-DIMETHYLPHENOL	150.00	5800	0.110	1	60	1	70
4-METHYLPHENOL	23.00	5800	0.110	1	60	1	70
TOLUENE	93.00	5800	1.000	1	60	1	70
AROCLO-1260		5800	1.600	1	60	1	70
PYRENE	440.00	5800	0.530	1	60	1	70
INDENO(1,2,3-C,D)PYRENE		5800	1.900	1	60	1	70
BENZO(B)FLUORANTHENE	200.00	5800	1.200	1	60	1	70
FLUORANTHENE	430.00	5800	0.360	1	60	1	70
BENZO(K)FLUORANTHENE	72.00	5800	1.100	1	60	1	70
CHRYSENE	160.00	5800	0.810	1	60	1	70
BENZO(A)PYRENE	180.00	5800	1.200	1	60	1	70
DIBENZ(A,H)ANTHRACENE		5800	2.700	1	60	1	70
BENZ(A)ANTHRACENE	180.00	5800	0.810	1	60	1	70
CYANIDE (FREE)	5300.00	5800	0.001	1	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
ETHYLBENZENE	365	.0080360	0.1000	0.900	0.09000	8.9E-02
2,4-DIMETHYLPHENOL	365	.0002247	0.0200	0.500	0.01000	2.2E-02
4-METHYLPHENOL	365	.0000345	0.0050	1.000	0.00500	6.9E-03
TOLUENE	365	.0012667	0.2000	1.000	0.20000	6.3E-03
AROCLO-1260	365			0.950		
PYRENE	365	.0031763	0.0300	0.600	0.01800	1.8E-01
INDENO(1,2,3-C,D)PYRENE	365			0.500		
BENZO(B)FLUORANTHENE	365	.0032689		0.500		
FLUORANTHENE	365	.0021084	0.0400	0.500	0.02000	1.1E-01
BENZO(K)FLUORANTHENE	365	.0010787		0.500		
CHRYSENE	365	.0017652		0.500		
BENZO(A)PYRENE	365	.0029420		0.500		
DIBENZ(A,H)ANTHRACENE	365			0.500		
BENZ(A)ANTHRACENE	365	.0019858		0.500		
CYANIDE (FREE)	365	.0000722	0.0200	0.720	0.01440	5.0E-03

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm2)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)
BENZENE	980.00	5800	0.110	1	60	1	70
ALUMINUM	142000.00	5800	0.001	1	60	1	70
Mercury (inorganic)		5800	0.001	1	60	1	70
IRON	350540.00	5800	0.001	1	60	1	70
MANGANESE-NONFOOD	7987.00	5800	0.001	1	60	1	70
NICKEL	200.00	5800	0.001	1	60	1	70
ARSENIC	0.07	5800	0.001	1	60	1	70
BARIUM	3000.00	5800	0.001	1	60	1	70
BERYLLIUM		5800	0.001	1	60	1	70
CADMIUM-WATER	7.00	5800	0.001	1	60	1	70
COPPER	440.00	5800	0.001	1	60	1	70
VANADIUM	240.00	5800	0.001	1	60	1	70
ZINC		5800	0.001	1	60	1	70
TRICHLOROETHENE		5800	0.230	1	60	1	70
ACENAPHTHENE	460.00	5800	0.130	1	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
BENZENE	365	.0014683	0.0030	1.000	0.00300	4.9E-01
ALUMINUM	365	.0019341	1.0000	0.050	0.05000	3.9E-02
Mercury (inorganic)	365	.0000000	0.0003	0.150	0.00005	
IRON	365	.0047745	0.3000	0.100	0.03000	1.6E-01
MANGANESE-NONFOOD	365	.0001088	0.0200	0.030	0.00060	1.8E-01
NICKEL	365	.0000027	0.0200	0.100	0.00200	1.4E-03
ARSENIC	365	.0000000	0.0003	0.950	0.00029	3.4E-06
BARIUM	365	.0000409	0.0700	0.050	0.00350	1.2E-02
BERYLLIUM	365	.0000000	0.0020	0.010	0.00002	
CADMIUM-WATER	365	.0000001	0.0005	0.025	0.00001	7.6E-03
COPPER	365	.0000060	0.0400	0.600	0.02400	2.5E-04
VANADIUM	365	.0000033	0.0070	0.010	0.00007	4.7E-02
ZINC	365	.0000000	0.3000	0.300	0.09000	
TRICHLOROETHENE	365	.0000000	0.0060	1.000	0.00600	
ACENAPHTHENE	365	.0008145	0.0600	1.000	0.06000	1.4E-02

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-74

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Dermal contact with ground water.

CHEMICAL	GWCONC	Exposed skin surface area to GW (cm ²)	Permeability constant (cm/hr)	GW exposure time (hours/day)	GW exposure frequency (days/yr)	Exposure duration (yrs)	Body weight (kg)
FLUORENE	250.00	5800	0.170	1	60	1	70
NAPHTHALENE	4800.00	5800	0.070	1	60	1	70
2-METHYLNAPHTHALENE	530.00	5800	0.069	1	60	1	70
ACENAPHTHYLENE	250.00	5800	0.530	1	60	1	70
PHENANTHRENE	680.00	5800	0.530	1	60	1	70

CHEMICAL	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Oral RfD (mg/kg-day)	GI absorption factor	Adjusted C RfD	Hazard Quotient
FLUORENE	365	.0005789	0.0400	1.000	0.04000	1.4E-02
NAPHTHALENE	365	.0045764	0.0400	1.000	0.04000	1.1E-01
2-METHYLNAPHTHALENE	365	.0004981	0.0400	0.500	0.02000	2.5E-02
ACENAPHTHYLENE	365	.0018047	0.0300	0.600	0.01800	1.0E-01
PHENANTHRENE	365	.0049088	0.0300	0.600	0.01800	2.7E-01

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLT\TMP\REPORT\APPH_SAS.WPD

Page H-75

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Carcinogenic CDIs and cancer risks
Inhalation of ambient air.

CHEMICAL	AACONC	AA inhalation rate (m3/hr)	AA exposure time (hr/d)	AA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Inhalation slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		1.68	8	60	1	70	25550			
2,4-DIMETHYLPHENOL		1.68	8	60	1	70	25550			
4-METHYLPHENOL		1.68	8	60	1	70	25550			
TOLUENE		1.68	8	60	1	70	25550			
AROCLOR-1260		1.68	8	60	1	70	25550		2.000	
PYRENE		1.68	8	60	1	70	25550			
INDENO[1,2,3-C;D]PYRENE		1.68	8	60	1	70	25550			
BENZO[B]FLUORANTHENE		1.68	8	60	1	70	25550			
FLUORANTHENE		1.68	8	60	1	70	25550			
BENZO[K]FLUORANTHENE		1.68	8	60	1	70	25550			
CHRYSENE		1.68	8	60	1	70	25550			
BENZO[A]PYRENE		1.68	8	60	1	70	25550		3.100	
DIBENZ[A,H]ANTHRACENE		1.68	8	60	1	70	25550			
BENZ[A]ANTHRACENE		1.68	8	60	1	70	25550			
CYANIDE (FREE)		1.68	8	60	1	70	25550			
BENZENE	0.050	1.68	8	60	1	70	25550	.000022544	0.029	6.5E-07
ALUMINUM		1.68	8	60	1	70	25550			
Mercury (inorganic)		1.68	8	60	1	70	25550			
IRON		1.68	8	60	1	70	25550			
MANGANESE-NONFOOD		1.68	8	60	1	70	25550			
NICKEL		1.68	8	60	1	70	25550			
ARSENIC		1.68	8	60	1	70	25550		15.100	
BARIUM		1.68	8	60	1	70	25550			
BERYLLIUM		1.68	8	60	1	70	25550		8.400	
CADMIUM-WATER		1.68	8	60	1	70	25550		6.300	
COPPER		1.68	8	60	1	70	25550			
VANADIUM		1.68	8	60	1	70	25550			
ZINC		1.68	8	60	1	70	25550			
TRICHLOROETHENE		1.68	8	60	1	70	25550		0.006	
ACENAPHTHENE		1.68	8	60	1	70	25550			
FLUORENE		1.68	8	60	1	70	25550			
NAPHTHALENE	0.017	1.68	8	60	1	70	25550	.000007665		
2-METHYLNAPHTHALENE		1.68	8	60	1	70	25550			
ACENAPHTHYLENE		1.68	8	60	1	70	25550			
PHENANTHRENE		1.68	8	60	1	70	25550			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-76

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Inhalation of ambient air.

CHEMICAL	AACONC	AA inhalation rate (m3/hr)	AA exposure time (hr/d)	AA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Inhal RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		1.68	8	60	1	70	365		0.29000	
2,4-DIMETHYLPHENOL		1.68	8	60	1	70	365			
4-METHYLPHENOL		1.68	8	60	1	70	365			
TOLUENE		1.68	8	60	1	70	365		0.11400	
AROCLOR-1260		1.68	8	60	1	70	365			
PYRENE		1.68	8	60	1	70	365			
INDENO[1,2,3-C,D]PYRENE		1.68	8	60	1	70	365			
BENZO[B]FLUORANTHENE		1.68	8	60	1	70	365			
FLUORANTHENE		1.68	8	60	1	70	365			
BENZO[K]FLUORANTHENE		1.68	8	60	1	70	365			
CHRYSENE		1.68	8	60	1	70	365			
BENZO[A]PYRENE		1.68	8	60	1	70	365			
DIBENZ[A,H]ANTHRACENE		1.68	8	60	1	70	365			
BENZ[A]ANTHRACENE		1.68	8	60	1	70	365			
CYANIDE (FREE)		1.68	8	60	1	70	365			
BENZENE	0.050	1.68	8	60	1	70	365	.0015781	0.00170	9.3E-01
ALUMINUM		1.68	8	60	1	70	365		0.00100	
Mercury (inorganic)		1.68	8	60	1	70	365		0.00009	
IRON		1.68	8	60	1	70	365			
MANGANESE-NONFOOD		1.68	8	60	1	70	365		0.00001	
NICKEL		1.68	8	60	1	70	365			
ARSENIC		1.68	8	60	1	70	365			
BARIUM		1.68	8	60	1	70	365		0.00014	
BERYLLIUM		1.68	8	60	1	70	365		0.00001	
CADMIUM-WATER		1.68	8	60	1	70	365			
COPPER		1.68	8	60	1	70	365			
VANADIUM		1.68	8	60	1	70	365			
ZINC		1.68	8	60	1	70	365			
TRICHLOROETHENE		1.68	8	60	1	70	365			
ACENAPHTHENE		1.68	8	60	1	70	365			
FLUORENE		1.68	8	60	1	70	365			
NAPHTHALENE	0.017	1.68	8	60	1	70	365	.0005365	0.00086	6.3E-01
2-METHYLNAPHTHALENE		1.68	8	60	1	70	365			
ACENAPHTHYLENE		1.68	8	60	1	70	365			
PHENANTHRENE		1.68	8	60	1	70	365			

O'Brien & Gere Engineers, Inc. - 07JAN99 - RAPROG7.SAS

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC.PRJ\NIMOFLT.N.TMP\REPORT\APPH_SAS.WPD

Page H-77

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Construction Wkr

ADULT CONSTRUCTION WORKER (RME)
Cancer Risk and Hazard Index Summary Table

PATHWAY	TOTCR	TOTHI
Incidental ingestion of surface soil.	2.9E-06	1.0E-01
Dermal contact with surface soil.	8.8E-07	7.1E-02
Incidental ingestion of subsurface soil.	1.2E-04	1.0E+00
Dermal contact with subsurface soil.	3.8E-05	3.9E-01
Incidental ingestion of ground water.	5.5E-07	6.2E-02
Dermal contact with ground water.	7.3E-04	1.9E+00
Inhalation of ambient air.	6.5E-07	1.6E+00
Total	8.9E-04	5.1E+00

January 7, 1999

I:\DIV82\PROJECTS\HHRAMISC\PRJ\NIMOFLTN.TMP\REPORT\APPH_SAS.WPD

Page H-78

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Church Worker

ADULT WORKER (RME)
Carcinogenic CDIs and cancer risks
Inhalation of indoor air.

CHEMICAL	IACONC	IA inhalation rate (m3/hr)	IA exposure time (hr/d)	IA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (cancer) (d)	CDI (mg/kg-day)	Inhalation slope factor 1/(mg/kg-day)	Cancer risk
ETHYLBENZENE		1.02	4	250	25	70	25550			
2,4-DIMETHYLPHENOL		1.02	4	250	25	70	25550			
4-METHYLPHENOL		1.02	4	250	25	70	25550			
TOLUENE		1.02	4	250	25	70	25550			
AROCLOR-1260		1.02	4	250	25	70	25550		2.000	
PYRENE		1.02	4	250	25	70	25550			
INDENO[1,2,3-C,D]PYRENE		1.02	4	250	25	70	25550			
BENZO[B]FLUORANTHENE		1.02	4	250	25	70	25550			
FLUORANTHENE		1.02	4	250	25	70	25550			
BENZO[K]FLUORANTHENE		1.02	4	250	25	70	25550			
CHRYSENE		1.02	4	250	25	70	25550			
BENZO[A]PYRENE		1.02	4	250	25	70	25550		3.100	
DIBENZ[A,H]ANTHRACENE		1.02	4	250	25	70	25550			
BENZ[A]ANTHRACENE		1.02	4	250	25	70	25550			
CYANIDE (FREE)		1.02	4	250	25	70	25550			
BENZENE	0.00126	1.02	4	250	25	70	25550	.00001796	0.029	5.2E-07
ALUMINUM		1.02	4	250	25	70	25550			
Mercury (inorganic)		1.02	4	250	25	70	25550			
IRON		1.02	4	250	25	70	25550			
MANGANESE-NONFOOD		1.02	4	250	25	70	25550			
NICKEL		1.02	4	250	25	70	25550			
ARSENIC		1.02	4	250	25	70	25550		15.100	
BARIUM		1.02	4	250	25	70	25550			
BERYLLIUM		1.02	4	250	25	70	25550		8.400	
CADMIUM-WATER		1.02	4	250	25	70	25550		6.300	
COPPER		1.02	4	250	25	70	25550			
VANADIUM		1.02	4	250	25	70	25550			
ZINC		1.02	4	250	25	70	25550			
TRICHLOROETHENE		1.02	4	250	25	70	25550		0.006	
ACENAPHTHENE		1.02	4	250	25	70	25550			
FLUORENE		1.02	4	250	25	70	25550			
NAPHTHALENE	0.01100	1.02	4	250	25	70	25550	.00015684		
2-METHYLNAPHTHALENE		1.02	4	250	25	70	25550			
ACENAPHTHYLENE		1.02	4	250	25	70	25550			
PHENANTHRENE		1.02	4	250	25	70	25550			

O'Brien & Gere Engineers, Inc. - 10FEB99 - RAPROG7.SAS

February 10, 1999

I:\DIV76\PROJECTS\111808\15_RPTS\HHRA\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Church Worker

ADULT WORKER (RME)
Non-cancer CDIs and hazard quotients (HQs)
Inhalation of indoor air.

CHEMICAL	IA CONC	IA inhalation rate (m3/hr)	IA exposure time (hr/d)	IA exposure frequency (d/yr)	Exposure duration (yrs)	Body weight (kg)	Averaging time (non-cancer) (d)	CDI (mg/kg-day)	C Inhal RfD (mg/kg-day)	Hazard Quotient
ETHYLBENZENE		1.02	4	250	25	70	9125		0.29000	
2,4-DIMETHYLPHENOL		1.02	4	250	25	70	9125			
4-METHYLPHENOL		1.02	4	250	25	70	9125			
TOLUENE		1.02	4	250	25	70	9125		0.11400	
AROCLOR-1260		1.02	4	250	25	70	9125			
PYRENE		1.02	4	250	25	70	9125			
INDENO(1,2,3-C,D)PYRENE		1.02	4	250	25	70	9125			
BENZO(B)FLUORANTHENE		1.02	4	250	25	70	9125			
FLUORANTHENE		1.02	4	250	25	70	9125			
BENZO(K)FLUORANTHENE		1.02	4	250	25	70	9125			
CHRYSENE		1.02	4	250	25	70	9125			
BENZO(A)PYRENE		1.02	4	250	25	70	9125			
DIBENZO(A,H)ANTHRACENE		1.02	4	250	25	70	9125			
BENZ(A)ANTHRACENE		1.02	4	250	25	70	9125			
CYANIDE (FREE)		1.02	4	250	25	70	9125			
BENZENE	0.00126	1.02	4	250	25	70	9125	.00005030	0.00170	3.0E-02
ALUMINUM		1.02	4	250	25	70	9125		0.00100	
Mercury (inorganic)		1.02	4	250	25	70	9125		0.00009	
IRON		1.02	4	250	25	70	9125			
MANGANESE-NONFOOD		1.02	4	250	25	70	9125		0.00001	
NICKEL		1.02	4	250	25	70	9125			
ARSENIC		1.02	4	250	25	70	9125			
BARIUM		1.02	4	250	25	70	9125		0.00014	
BERYLLIUM		1.02	4	250	25	70	9125		0.00001	
CADMIUM-WATER		1.02	4	250	25	70	9125			
COPPER		1.02	4	250	25	70	9125			
VANADIUM		1.02	4	250	25	70	9125			
ZINC		1.02	4	250	25	70	9125			
TRICHLOROETHENE		1.02	4	250	25	70	9125			
ACENAPHTHENE		1.02	4	250	25	70	9125			
FLUORENE		1.02	4	250	25	70	9125			
NAPHTHALENE	0.01100	1.02	4	250	25	70	9125	.00043914	0.00086	5.1E-01
2-METHYLNAPHTHALENE		1.02	4	250	25	70	9125			
ACENAPHTHYLENE		1.02	4	250	25	70	9125			
PHENANTHRENE		1.02	4	250	25	70	9125			

O'Brien & Gere Engineers, Inc. - 10FEB99 - RAPROG7.SAS

February 10, 1999

\\DIV76\PROJECTS\1118081\5_RPTS\HHRA\APPH_SAS.WPD

Appendix H

NiMo MGP Site Fulton, NY - Area 2 Church Worker

ADULT WORKER (RME)
Cancer Risk and Hazard Index Summary Table

PATHWAY	TOTCR	TOTHI
Inhalation of indoor air.	5.2E-07	5.4E-01
Total	5.2E-07	5.4E-01

O'Brien & Gere Engineers, Inc. - 10FEB99 - RAPROG7.SAS

February 10, 1999

F:\DIV76\PROJECTS\1118081\5_RPTS\HHRA\APPH_SAS.WPD

EXHIBIT A

Henristic Model for Predicating the Intrnsion Rate of Contaminant Vapors into Bnildings

Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings

Paul C. Johnson* and Robert A. Ettinger

Shell Development, Westhollow Research Center, Houston, Texas 77251

NOTICE

This material may be protected by copyright law (Title 17 U.S. Code).

The intrusion into and subsequent accumulation of contaminant vapors in buildings and family dwellings is of concern for health and safety reasons. When preparing environmental and health risk assessments, one must be able to quantify this exposure pathway in order to decide if site-specific conditions correspond to unacceptable indoor contaminant vapor concentrations. For cases in which contaminated-site soil cleanup levels can be negotiated based on site-specific conditions, a related problem is the determination of residual contaminant levels below which associated adverse health effect risks are deemed negligible. Unfortunately, there are currently no accepted models for predicting vapor intrusion rates, and there is considerable debate over which transport mechanisms govern the process. This paper presents a heuristic model for screening-level calculations. It incorporates both convective and diffusive mechanisms, as well as contaminant soil, and building foundation properties. Sample calculations are presented for a range of parameter values to illustrate use of the model and the relative contributions of individual transport mechanisms.

Introduction

The intrusion and subsequent accumulation of radon vapors in commercial buildings and family dwellings has received considerable attention in the last decade. Of growing interest is the related problem of vapor transport from contaminated soils into buildings and dwellings. When preparing health and environmental risk assessments, regulators may require one to determine a residual contaminant level below which the associated adverse health effect risk is deemed negligible. To accomplish this, however, predictive transport models are required. Despite the attention focused on radon intrusion, no such validated models are available.

The current level of understanding is that both diffusion and convection contribute to vapor intrusion, and specific site characteristics will determine the significance of each. Nazaroff et al. (1) attempted to correlate radon concentrations in basements with building ambient pressure differences, wind speed, temperature differences, soil radon activity, and indoor air-exchange rates. In summary, for the three dwellings studied, typical building underpressurizations (ambient basement pressure drop) ranged between 1 and 50 Pa, and radon intrusion rates increased with increasing building underpressurization. Through the use of a tracer gas and controlled building underpressurization, Nazaroff et al. (2) studied the coupling between building underpressurization, induced soil depressurization, and flow of soil gas to a building. In another field study, Hodgson et al. (3) studied the transport of vapors from a landfill to a residential basement; they concluded that convective transport was negligible for the conditions at that site. By building a scale model of a building, Arnold (4) attempted to correlate building underpressurization, wind speed, soil type, soil gas intrusion rates, and pressure distributions in surrounding soils.

Attempts to model radon intrusion have produced both semianalytical solutions and detailed numerical codes. Landman (5), who considered only vapor-phase diffusion,

modeled radon transport through cracks in slabs and predicted that a slab with 1% open cracks by area will reduce the radon flux by 75% relative to the case of a bare dirt floor. Landman and Cohen (6) later tried to simplify this analysis and incorporate convective transport. Other authors, such as Zapalac (7), have attempted to model and measure radon fluxes through intact (i.e., no macroscopic cracks) concrete barriers.

Recently, numerical models have been employed by Garbesi and Sextro (8) and Loureiro et al. (9). The former model soil gas entry through "permeable" walls, rather than through cracks and openings, and predict reasonable soil gas entry rates for the cases studied. The latter couple soil gas flow field solutions with a contaminant transport model to predict radon intrusion rates through cracks and openings in basement floors and walls. It should be noted that one must be careful when extending results and conclusions from radon intrusion studies to the problem addressed in this study. In the case of radon intrusion, vapors are typically generated within the soil matrix adjacent to the foundation, while contaminant vapors of the type discussed in this report must migrate from a source located a distance from the building.

The goal of this work is similar to those of Nazaroff (10) and Nazaroff and Sextro (11); we want to develop a less computationally complex screening-level model for estimating contaminant vapor intrusion rates. Nazaroff (10) outlined a semianalytical approach for predicting indoor radon concentrations in the limit of convective-dominated transport, while Nazaroff and Sextro (11) described a more empirical technique based on a site-specific in situ measurement. Here we utilize the results and observations of these authors to formulate a heuristic model for predicting the intrusion rate of contaminant vapors into buildings through foundations in a more general scenario: contaminant vapors originating an arbitrary distance away from a building. This model can be used as a risk assessment screening-level tool; it can be used to identify sites, or contaminant levels, for which contaminant exposures through a vapor inhalation pathway may cause adverse health effects. It can also be used as a tool to help identify sites where more detailed numerical simulations or field sampling are appropriate. Below, the basis for the model is discussed, model equations are derived, and sample calculations are presented that illustrate the use of the model.

Heuristic Model Basis

While the formal development of the heuristic model is presented below, it is necessary to identify relevant phenomena that govern contaminant vapor transport into dwellings. In the following section, a dimensional analysis is conducted to assess the relative importance of each phenomenon. The transport of contaminants through soil matrices is often modeled by solving the following transport equation:

$$\frac{\partial \sum_i \epsilon_i C_i}{\partial t} + \sum_i u_i \nabla C_i = \sum_i \nabla \cdot D_i^{\text{eff}} \nabla C_i + \sum_i R_i \quad (1)$$

where i is a subscript that specifies the phase (i.e., v = vapor, s = sorbed, f = free phase or precipitate, and m = soil moisture), t is time (s), ϵ_i is the volume fraction of phase i (volume of phase i /volume of soil, dimensionless), C_i is the concentration of contaminant in phase i (mass/volume of phase i , g/cm³), u_i is the Darcy velocity vector associated with phase i (cm/s), ∇ is the del operator (1/cm), D_i^{eff} is the effective porous medium diffusion coefficient of contaminant in phase i (cm²/s), and R_i is the formation rate of contaminant in phase i (g/cm³-s).

For the special case where residual contaminant levels are low enough that no contaminant free-liquid/precipitate phase is present in the soil pores, under equilibrium conditions contaminant levels in the vapor, sorbed, and soil moisture phases are often assumed to be proportional to each other and the total contaminant level [Johnson et al. (12)]. Equation 1 can then be written in terms of a single phase concentration. One can assume, without any loss of generality, that contaminant levels in the soil moisture and vapor phases are related by a Henry's law constant, H (cm³ of H₂O/cm³ of vapor):

$$C_v = HC_m \quad (2)$$

A similar equation can be written for the relationship between sorbed and soil moisture phases, except that H is replaced by a sorption coefficient. If one assumes that diffusive transport is significant only in the vapor and soil moisture phases, then it follows from eq 2 that

$$\sum_i \nabla \cdot D_i^{\text{eff}} \nabla C_i = \nabla \cdot (D_v^{\text{eff}} + D_m^{\text{eff}}/H) \nabla C_v = \nabla \cdot D^{\text{eff}} \nabla C_v \quad (3)$$

where D^{eff} , defined by eq 3, is the "effective porous medium diffusion coefficient based on vapor-phase concentrations". The effective porous medium diffusion coefficients (D_m^{eff} and D_v^{eff}) are related to the pure component molecular diffusivities in water and air, $D^{\text{H}_2\text{O}}$ and D^{air} , total soil porosity, $\epsilon_T = (\epsilon_v + \epsilon_m)$, vapor-filled porosity, ϵ_v , and moisture-filled porosity, ϵ_m , by the Millington-Quirk [Bruell and Hoag (13)] expression:

$$D_m^{\text{eff}} = D^{\text{H}_2\text{O}} \epsilon_m^{3.33} / \epsilon_T^2 \quad (4)$$

and

$$D_v^{\text{eff}} = D^{\text{air}} \epsilon_v^{3.33} / \epsilon_T^2 \quad (5)$$

where ϵ_m and ϵ_v are related to ϵ_T , the moisture content θ_m (cm³ of H₂O/g of soil), and the bulk soil density ρ_b (g/cm³):

$$\epsilon_m = \theta_m \rho_b \quad (6)$$

and

$$\epsilon_v = \epsilon_T - \theta_m \rho_b \quad (7)$$

For most compounds (except those with very small Henry's law constants), the contribution due to diffusion through the soil moisture will be insignificant in comparison with vapor-phase diffusion.

For the purpose of this analysis, we also assume that significant convective transport occurs only in the vapor phase, and vapor flow is described by Darcy's law:

$$u_v = -\frac{k_v}{\mu} \nabla P \quad (8)$$

where k_v is the soil permeability to vapor flow (cm²), μ is the vapor viscosity (g/cm-s), P is the pressure in the vapor phase (g/cm-s²), and u_v is the vapor-phase mass-average velocity (cm/s).

Table I. Dependence of Pe on Soil Type*

soil type	permeability, k_v (darcy or 10^{-8} cm ²)	Pe
silt	0.01-0.1	0.08-0.08
silty sand	0.1-1	0.08-0.8
fine sand	1-10	0.8-8
medium sand	10-100	8-80

* $Pe = (k_v \Delta P L_D / D^{\text{eff}} \mu L_P)$, where $\Delta P_r = 10$ Pa = 100 g/cm-s² = 10^{-4} atm; $D^{\text{air}} = 0.087$ cm²/s (benzene at 20 °C); $D^{\text{H}_2\text{O}} = 1.0 \times 10^{-5}$ cm²/s; $H = 0.18$ cm³ of H₂O/cm³ of vapor (benzene at 20 °C); $\epsilon_T = 0.38$; $\theta_m = 0.07$ g of H₂O/g of soil (sandy soil at field capacity moisture content); $\rho_b = 1.7$ g of soil/cm³ of soil; $\mu = 1.8 \times 10^{-4}$ g/cm-s; $L_D = L_P$; $D^{\text{eff}} = D_v^{\text{eff}} = 0.087$ cm²/s $\times (0.26^{3.33}/0.38^2) = 6.8 \times 10^{-5}$ cm²/s.

Inserting eqs 3 and 8 into eq 1 and nondimensionalizing the resulting equation yields

$$\frac{\partial \sum_i \epsilon_i C_i^*}{\partial t^*} - \left(\frac{L_P}{L_D} \right) (\nabla^* P^*) \cdot (\nabla^* C_v^*) = \nabla^* \cdot \left[\frac{D^{\text{eff}} \mu L_P}{k_v \Delta P_r L_D} \right] \nabla^* C_v^* + \sum_i R_i^* \quad (9)$$

where ΔP_r is the reference or characteristic indoor-outdoor pressure difference and * denotes nondimensional variables:

$$C_i^* = C_i / C_r, \quad \nabla^* = L_D \nabla, \quad P^* = P / \Delta P_r, \\ t^* = t (k_v \Delta P_r / L_P L_D \mu), \quad R_i^* = R_i L_P L_D \mu / C_r k_v \Delta P_r$$

where C_r , L_D , and L_P are characteristic concentration, diffusion pathway length, and convection pathway length values, respectively, chosen to give the dependent concentration variable and derivatives of C_i^* and P^* magnitudes of order unity. Then the dimensionless group

$$[k_v \Delta P_r L_D / D^{\text{eff}} \mu L_P] = Pe \quad (10)$$

determines the relative significance of convective and diffusive transport mechanisms. Here Pe is the Peclet number, expressed in terms of the driving pressure ΔP_r . If $Pe \gg 1$, convective transport dominates; if $Pe \ll 1$, diffusive transport dominates. Note that the Peclet number defined by eq 10 contains two length scales L_D and L_P . This is appropriate for the problem of contaminant vapor intrusion into buildings, where the characteristic length scales for diffusion and convection may be quite different. Logical choices for L_D and L_P are the contaminant source-basement separation and the distance between ground surface and the basement floor, respectively.

It is useful to examine the magnitude of Pe before formulating any simpler vapor intrusion models. Based on the Nazaroff et al. (1, 2) studies, typical values of ΔP_r are 1-10 Pa (10-100 g/cm-s²), so we will choose the following representative parameter values: $\Delta P_r = 10$ Pa = 100 g/cm-s² = 10^{-4} atm; $D^{\text{air}} = 0.087$ cm²/s (benzene at 20 °C); $D^{\text{H}_2\text{O}} = 1.0 \times 10^{-5}$ cm²/s; $H = 0.18$ cm³ of H₂O/cm³ of vapor (benzene at 20 °C); $\epsilon_T = 0.38$; $\theta_m = 0.07$ g of H₂O/g of soil (sandy soil at field capacity moisture content); $\rho_b = 1.7$ g of soil/cm³ of soil; $\mu = 1.8 \times 10^{-4}$ g/cm-s; $L_D = L_P$. Table I presents values for Pe for different soil types. While θ_m , ϵ_T , ρ_b , and hence D^{eff} will vary with soil type, it has been assumed that all soils listed in Table I have similar total porosities, soil moisture contents, and bulk densities (an assumption that would not be valid for comparing sandy and clayey soils). The diffusion coefficients in water and air are also compound-specific; however, compounds whose molecular weights range from 70 to 300 have diffusion coefficients that differ by only a factor of ~ 2 [Lyman et al. (14)]. Of the parameters appearing in eq 10, the soil

Air Stream

Figure 1

permeability is not across be seen soil type is that convection is reasonable range included

Formulation

This chemical (i.e., H) to produce calculation: unsaturated it is not this however occur intrusion contaminant transport

At (nonconvective) shows source the vapor transport. We build are not (i) through (elec) (ii) in the vapor from (iii) for the source near (iv) below

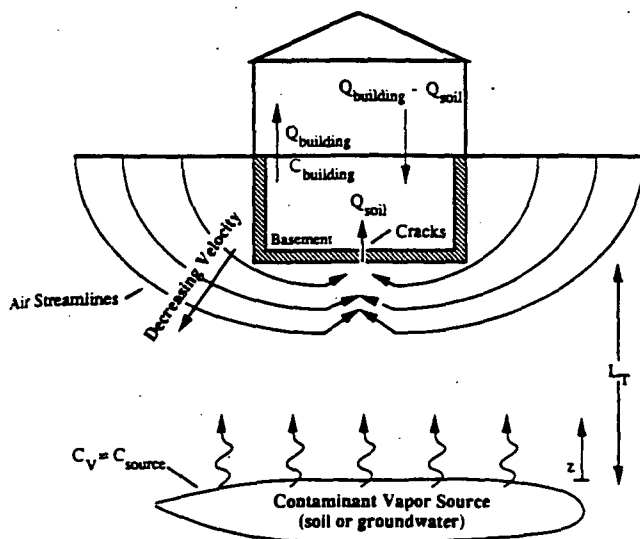


Figure 1. Vapor intrusion scenario.

permeability, k_v , is the most variable at any given site; it is not unusual for k_v to vary by 3 orders of magnitude across a site the size of a typical residential lot. As can be seen in Table I, Pe ranges between 0.01 and 100 for the soil types listed there. The significance of this observation is that any vapor intrusion model based only on either convective or diffusive transport mechanisms cannot reasonably describe the relevant phenomena over the typical range of soil types. Any proposed model, therefore, must include both transport mechanisms.

Formulation of the Heuristic Model

This discussion will be limited to problems in which chemical or biological transformations are not significant (i.e., $R_i = 0$). Recall that the goal of this development is to produce a predictive model suitable for screening-level calculations. Given that biological transformations in the unsaturated zone are presently not very well understood, it is not appropriate to attempt to incorporate them into this level of modeling. The reader should understand, however, that degradation due to microorganisms does occur; any model that includes them will predict lower intrusion rates than the model presented here (unless the contaminant of concern is produced by the biological transformation).

At this point we will restrict the analysis to steady-state (nondiminishing source) problems, although it will be shown later how one might adapt the results to diminishing source problems. Figure 1 presents a simplified sketch of the problem under consideration, in which a contaminant vapor source of concentration C_{source} is located some distance L_T below the floor of a basement or building slab. We want to predict the intrusion rate of vapors into the building. To accomplish this, the following assumptions are made:

- (i) Contaminant vapors enter structures primarily through cracks and openings in the walls and foundation (electrical outlets, wall-floor seams, sump drains, etc.).
- (ii) Convective transport is likely to be most significant in the region very close to a basement, or foundation, and vapor velocities decrease rapidly with increasing distance from a structure.
- (iii) Vapor-phase diffusion is the dominant mechanism for transporting contaminant vapors from contaminant sources located away from the foundation to the soil region near the foundation.
- (iv) All contaminant vapors originating from directly below the basement will enter the basement, unless the

floor and walls are perfect vapor barriers.

Assumption i reflects the current thinking that vapor intrusion is mainly due to cracks, seams, and openings in basement floors and walls, while ii and iii are based on the analysis presented above, the Peclet numbers appearing in Table I, and analogy to known solutions of fluid mechanics problems. In this simplistic model, contaminants volatilize from the source and diffuse toward the foundation. When convection is significant, they are "swept" into the building through cracks; otherwise, the contaminant vapors diffuse through the cracks and openings. Assumption iv restricts contaminant vapors from leaking around a building to ground surface and, therefore, adds a level of conservation to the model. Vapor leakage to the surface will be significant whenever the resistance to transport into a building is much greater than the resistance to transport to ground surface, such as buildings built on relatively intact slab foundations. It should be noted that the final results will not be limited by the validity of assumption i; if one follows the analysis below for the case where vapors are transported through intact porous walls, the final equations are identical in form with the results presented below (this will be shown later).

In addition to assumptions i-iv listed above, there are also assumptions inherent in the simplistic mathematical models described below. One-dimensional transport models form the basis for the heuristic model; therefore, it is assumed that the soil is homogeneous within any horizontal plane with respect to effective diffusion coefficients (heterogeneity in the vertical direction is accounted for). Also, it is assumed that convective vapor flow in the region near the foundation is uniform. This assumption, however, does not preclude application of the model to scenarios where there is a uniform layer of gravel adjacent to the foundation; in fact, the idealization described in assumption ii accurately represents this scenario, and one only needs to be sure to predict the soil gas entry rate based on properties of this region (and not the permeability of surrounding soils).

In the following, the heuristic vapor intrusion model is formulated by combining approximate mathematical descriptions of the relevant transport phenomena:

(a) **Diffusive Transport from the Source to a Region near the Structure.** As described above, it is assumed that contaminant vapors are transported from the contaminant source to a region near the structure, primarily by a molecular diffusion through pore vapor and soil moisture phases. The rate can be approximated by the expression

$$E_1 = A_B (C_{\text{source}} - C_{\text{soil}}) D_T^{\text{eff}} / L_T \quad (11)$$

where E_1 is the mass-transport rate toward the structure (g/s), A_B is the cross-sectional area through which vapors pass (cm^2), C_{source} is the vapor concentration at the contaminant source (g/cm^3), C_{soil} is the vapor concentration in the region near the structure (g/cm^3), L_T is the distance from contaminant source to foundation (cm), and D_T^{eff} is the "overall" effective porous media diffusion coefficient based on vapor-phase concentrations for the region between the source and foundation (cm^2/s).

The cross-sectional area, A_B , can be approximated by the total basement area (floor and walls). Assuming that convection, when significant, is only dominant in a region very near the foundation allows us to approximate the total diffusion length, L_T , as the distance between the source and foundation. The soil permeability to vapor flow, building underpressurization, and physical setting will determine the actual thickness of the convection-dominated region, which will increase with increasing permea-

bility to vapor flow and increased building underpresurization. In general, the unsaturated soil zone may be composed of several soil types with varying moisture contents and porosities, and the effective overall diffusion coefficient for a region between $z = 0$ and $z = L_T$ is

$$D_T^{\text{eff}}/L_T = \left[\int_0^{L_T} dz/D^{\text{eff}}(z) \right]^{-1} \quad (12)$$

where $D^{\text{eff}}(z)$ is the effective porous media diffusion coefficient at z , which is a function of the contaminant type and soil characteristics as defined by eqs 3-7.

For systems composed of n distinct soil layers defined by thicknesses L_i and uniform effective overall porous media diffusion coefficients D_i^{eff} , eq 12 reduces to

$$D_T^{\text{eff}}/L_T = \left[\sum_{i=0}^n L_i/D_i^{\text{eff}} \right]^{-1} \quad (13)$$

(b) **Transport from Soil Gas into Building.** The transport of contaminants from soil gas adjacent to a foundation is assumed to occur by a combination of convective and diffusive transport mechanisms. As a first approximation, the steady-state, one-dimensional solution to eq 9 for vapor transport through a crack (or porous medium) with a constant uniform convective velocity ($Q_{\text{soil}}/A_{\text{crack}}$) is used to predict the total rate of contaminant intrusion into a building:

$$E = Q_{\text{soil}} C_{\text{soil}} - \frac{Q_{\text{soil}}(C_{\text{soil}} - C_{\text{building}})}{[1 - \exp(Q_{\text{soil}} L_{\text{crack}}/D_{\text{crack}} A_{\text{crack}})]} \quad (14)$$

where E is the entry rate of contaminant into the building (g/s), Q_{soil} is the volumetric flow rate of soil gas into the building (cm^3/s), D_{crack} is the effective vapor-pressure diffusion coefficient through the crack (cm^2/s), L_{crack} is the thickness of the foundation (cm), C_{building} is the contaminant vapor concentration in the building (g/cm^3), and A_{crack} is the area of cracks/openings through which contaminant vapors enter the building (cm^2).

The only "unknown" in eqs 11 and 14 is the soil gas contaminant concentration, C_{soil} , which can be obtained by requiring that the rates E_1 and E be equal at steady state. The result

$$C_{\text{soil}} = \left[C_{\text{source}} \left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{soil}} L_T} \right] \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) - 1 \right] + C_{\text{building}} \right] / \left[\left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{soil}} L_T} \right] \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) - 1 \right] + \exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) \right] \quad (15)$$

can be substituted into eq 14 to obtain E , the rate of contaminant entry into a building through the foundation:

$$E = \left[\frac{D_T^{\text{eff}} A_B C_{\text{source}}}{L_T} \right] \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) - \left[\frac{C_{\text{building}}}{C_{\text{source}}} \right] \right] / \left[\left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{soil}} L_T} \right] \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) - 1 \right] + \exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) \right] \quad (16)$$

When eq 16 is written this way, E is the product of the steady-state diffusive rate of contaminant transport from a source to a bare dirt floor foundation (first term on

right-hand side) and a factor containing a number of dimensionless groups whose significance will be discussed below.

Indoor Air Quality. Equation 16 can be incorporated into a steady-state mass balance for a basement (or building) to produce an explicit expression for the indoor contaminant vapor. Assuming no other contaminant sources or sinks (i.e., sorption to walls or furniture) and a well-mixed building, this expression can be written

$$Q_{\text{building}} C_{\text{building}} = E \quad (17)$$

where Q_{building} denotes the basement (or building) ventilation rate, expressed as a volumetric flow rate. Often, this term is expressed as the product of an "air-exchange rate" and a basement (or building) volume; however, here these terms are combined into Q_{building} . Substituting eq 16 into eq 17 and rearranging yields

$$C_{\text{building}} = \left[C_{\text{building}}^* \times \exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) \right] / \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) + \left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{building}} L_T} \right] + \left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{soil}} L_T} \right] \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) - 1 \right] \right] \quad (18)$$

where

$$C_{\text{building}}^* = \left[\frac{D_T^{\text{eff}} A_B C_{\text{source}}}{Q_{\text{building}} L_T} \right] \quad (19)$$

In eqs 18 and 19, C_{building}^* represents the indoor vapor concentration corresponding to the case where vapors diffuse from the source to a bare soil foundation. As will be derived later, this is the limiting case in which Q_{soil} becomes very small and the diffusional resistance through the basement floors/walls is significantly less than the diffusional resistance through the soil zone between the contaminant vapor source and building. Equation 18 can also be arranged to produce the "attenuation coefficient" α :

$$\alpha = C_{\text{building}}/C_{\text{source}} \quad (20)$$

or equivalently

$$\alpha = \left[\left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{building}} L_T} \right] \times \exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) \right] / \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) + \left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{building}} L_T} \right] + \left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{soil}} L_T} \right] \left[\exp \left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \right) - 1 \right] \right] \quad (21)$$

Both eqs 18 and 21 depend on three dimensionless groups:

$$\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \quad \frac{D_T^{\text{eff}} A_B}{Q_{\text{building}} L_T} \quad \frac{Q_{\text{soil}}}{Q_{\text{building}}}$$

The first represents the equivalent Peclet number for transport through the foundation, the second is the attenuation coefficient (as defined in eq 20) for diffusion-dominated transport from a constant source to a bare dirt floor, and the third is the attenuation coefficient for con-

vector
build
At
dicte
verif
incor
withi
(a)
vector
baser

lin

If the
0), th
conve
conce
baser
limit
 $\alpha \rightarrow$
 $Q_{\text{soil}} L$
the c
cont
they
walls
(b)
is the
ment

Equa
cause
coeff
secon
is a r
to th
D_{crack}
D_T^{eff}
unles
 $\alpha \rightarrow$
atter
adja
D_{crack}
walls
conc
(c)
seale
mod
vapo
conc

Sam
Or
pred
for a

vectorial transport from a source located adjacent to the building.

At this point it is useful to examine the behavior predicted by eq 21 in certain limiting situations, in order to verify that the mathematics represents the phenomena incorporated into their derivation and that the results fall within appropriate bounds:

(a) $(Q_{\text{soil}} L_{\text{crack}} / D_{\text{crack}} A_{\text{crack}}) \rightarrow \infty$. In this limit convection is the dominant transport mechanism through the basement (building) floor and walls. Equation 21 becomes

$$\lim_{\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \rightarrow \infty} \alpha \rightarrow \frac{\left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{building}} L_T} \right]}{\left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{soil}} L_T} \right] + 1} \quad (22)$$

If the source lies directly beneath the foundation ($L_T \rightarrow 0$), then $\alpha \rightarrow Q_{\text{soil}} / Q_{\text{building}}$, which is the proper result for convection-dominated transport of a vapor stream with concentration C_{source} . If the source is "far" from the basement (i.e., $D_T^{\text{eff}} A_B / Q_{\text{soil}} L_T \rightarrow 0$), then transport is limited by diffusion from the source to foundation, and $\alpha \rightarrow D_T^{\text{eff}} A_B / Q_{\text{building}} L_T$. Note that in the limit $Q_{\text{soil}} L_{\text{crack}} / D_{\text{crack}} A_{\text{crack}} \rightarrow \infty$ the results are independent of the cracked area of the floor and walls. This is because contaminant vapors are swept into the building as fast as they are transported to the soil adjacent to the floor and walls.

(b) $(Q_{\text{soil}} L_{\text{crack}} / D_{\text{crack}} A_{\text{crack}}) \rightarrow 0$. In this limit diffusion is the dominant transport mechanism through the basement floor and walls, and eq 21 reduces to

$$\lim_{\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}}} \rightarrow 0} \alpha \rightarrow \frac{\left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{building}} L_T} \right]}{1 + \left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{building}} L_T} \right] + \left[\frac{D_T^{\text{eff}} A_B L_{\text{crack}}}{D_{\text{crack}} A_{\text{crack}} L_T} \right]} \quad (23)$$

Equation 23 contains two dimensionless groups. As discussed above, $D_T^{\text{eff}} A_B / Q_{\text{building}} L_T$ represents the attenuation coefficient for diffusive transport to a bare dirt floor. The second dimensionless group, $D_T^{\text{eff}} A_B L_{\text{crack}} / D_{\text{crack}} A_{\text{crack}} L_T$, is a measure of the diffusion rates through the soil relative to those through the floor and walls. If $D_T^{\text{eff}} A_B L_{\text{crack}} / D_{\text{crack}} A_{\text{crack}} L_T \ll 1$, then $\alpha \rightarrow D_T^{\text{eff}} A_B / Q_{\text{building}} L_T$ because $D_T^{\text{eff}} A_B / Q_{\text{building}} L_T$ will typically be much less than unity unless $Q_{\text{building}} \rightarrow 0$. If $D_T^{\text{eff}} A_B L_{\text{crack}} / D_{\text{crack}} A_{\text{crack}} L_T \gg 1$, then $\alpha \rightarrow D_{\text{crack}} A_{\text{crack}} / Q_{\text{building}} L_{\text{crack}}$, which is the appropriate attenuation coefficient for transport from a source located adjacent to the floor and walls. When $D_T^{\text{eff}} A_B L_{\text{crack}} / D_{\text{crack}} A_{\text{crack}} L_T \gg 1$, then diffusion through the floor and walls is the rate limiting mechanism, and there is a vapor concentration "buildup" below the building or basement.

(c) $Q_{\text{building}} \rightarrow 0$. This limit corresponds to a perfectly sealed basement, Q_{soil} must also approach zero, and the model predicts that $\alpha \rightarrow 1$; that is, the indoor contaminant vapor concentration approaches the contaminant vapor concentration in the soil gas.

Sample Calculations

On the basis of the analysis above, it appears that model predictions fall correctly within the appropriate bounds for all limiting cases examined. These results, however,

Table II. Parameter Values Used To Generate Figures 2-5

$A_B = 7 \text{ m} \times 10 \text{ m} + 2(2 \text{ m} \times 7 \text{ m}) + 2(2 \text{ m} \times 10 \text{ m}) = 138 \text{ m}^2 = 138 \times 10^4 \text{ cm}^2$
$L_{\text{crack}} = 6 \text{ in.} = 15 \text{ cm}$
$Q_{\text{building}} = 7 \text{ m} \times 10 \text{ m} \times 3 \text{ m} \times 0.5 \text{ volume exchanges/h} = 105 \text{ m}^3/\text{h} = 2.9 \times 10^4 \text{ cm}^3/\text{s}$
$D^{\text{air}} = 0.087 \text{ cm}^2/\text{s}$ (benzene)
$D^{\text{H}_2\text{O}} = 1.0 \times 10^{-6} \text{ cm}^2/\text{s}$
$H = 0.18 \text{ cm}^3$ of $\text{H}_2\text{O}/\text{cm}^3$ of air (benzene)
$\theta_m = 0.07 \text{ g}$ of $\text{H}_2\text{O}/\text{g}$ of soil
$\epsilon_T = 0.38 \text{ cm}^3/\text{cm}^3$ of soil
$\rho_b = 1.7 \text{ g}/\text{cm}^3$
$\Delta P = 1.0 \text{ Pa} = 10 \text{ g}/\text{cm} \cdot \text{s}^2$

give no indication of what "typical" values of these dimensionless groups might be. It is useful at this point, therefore, to examine model predictions for a sample case. Consider a $10 \text{ m} \times 7 \text{ m} \times 3 \text{ m}$ (length $\times$ width $\times$ height) basement whose floor lies 2 m below grade. It is assumed that the floor/wall cracks and openings are filled with dust and dirt characterized by a density, porosity, and moisture content similar to that of the underlying soil. Model parameters A_B , L_{crack} , Q_{building} , D^{air} , $D^{\text{H}_2\text{O}}$, H , θ_m , ϵ_T , and ρ_b are given in Table II. The remaining unspecified parameters are the convective flow rate from the soil into the basement, Q_{soil} , the area of cracks, A_{crack} , and the distance between the contaminant source and the foundation, L_T . The soil gas flow rate, Q_{soil} , is likely to be dependent on the basement crack area, A_{crack} , soil type and stratigraphy, building underpressurization, and basement geometry. For simplicity, however, we will estimate Q_{soil} as suggested by Nazaroff (10):

$$Q_{\text{soil}} = \frac{2\pi\Delta P k_v X_{\text{crack}}}{\mu \ln [2Z_{\text{crack}}/r_{\text{crack}}]} \frac{r_{\text{crack}}}{Z_{\text{crack}}} \ll 1 \quad (24)$$

Equation 24 is an analytical solution for flow to a cylinder of length X_{crack} and radius r_{crack} located a depth Z_{crack} below ground surface; this is an idealized model for soil gas flow to cracks located at floor/wall seams. Here ΔP , k_v , and μ are as defined above. For this sample problem, $Z_{\text{crack}} = 2 \text{ m}$ (as stated above), X_{crack} is taken to be the total floor/wall seam perimeter distance (34 m), and for consistency r_{crack} is given by

$$r_{\text{crack}} = \eta A_B / X_{\text{crack}} \quad (25)$$

where the ratio $\eta = A_{\text{crack}} / A_B$, so that $0 \leq \eta \leq 1$. For reference, $\eta = 0.01$ corresponds to $r_{\text{crack}} = 4.1 \text{ cm}$ for the values of A_B and X_{crack} given above; $r_{\text{crack}} = 1 \text{ cm}$ corresponds to $\eta = 0.0025$.

In the Nazaroff et al. studies (1, 2), estimates for Q_{soil} are in the $280\text{--}2800 \text{ cm}^3/\text{s}$ ($1\text{--}10 \text{ m}^3/\text{h}$) range, for induced building underpressurizations of $5\text{--}30 \text{ Pa}$ and very permeable soils ($k_v > 10^{-8} \text{ cm}^2$). Note that $1 \text{ m}^3/\text{h}$ corresponds to $\sim 1\%$ of the assumed total basement air exchange rate ($0.5/\text{h}$). For the purpose of this sample calculation we choose $\Delta P = 1 \text{ Pa}$ ($10 \text{ g}/\text{cm} \cdot \text{s}^2$), which is probably a reasonable long-term average value for screening calculations.

Figure 2 presents soil gas flow rates predicted by eq 24 for $\eta = 0.01$ and $\eta = 0.001$. This figure illustrates the strong dependence of Q_{soil} on soil type, and a weaker dependence on crack size (as reflected in the value of η). For very permeable soils ($k_v \geq 10^{-6} \text{ cm}^2$), the predicted Q_{soil} values are of the same order of magnitude as the values observed by Nazaroff (1, 2). For example, $Q_{\text{soil}} = 260 \text{ cm}^3/\text{s}$ for $\eta = 0.01$ and $k_v = 1 \times 10^{-6} \text{ cm}^2$. For reference, medium sandy soils correspond to $10^{-7} < k_v < 10^{-6} \text{ cm}^2$.

Figures 3-5 present predicted attenuation coefficients α , for $\eta = 0.01$, and $\eta = 0.001$, as a function of k_v , for L_T

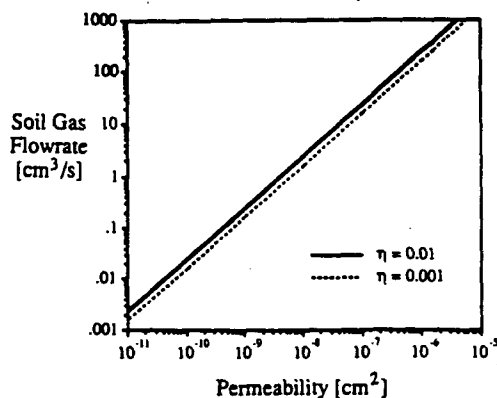


Figure 2. Dependence of soil gas entry flow rates, Q_{soil} , on soil permeability, k_v , as predicted by eq 24 for the parameters listed in Table II.

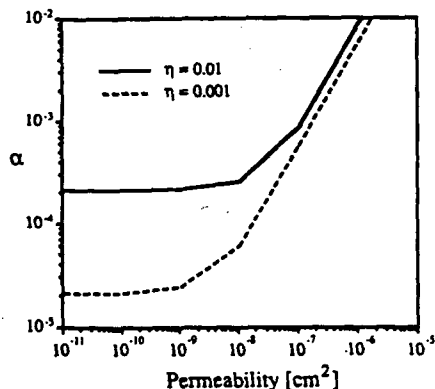


Figure 3. Dependence of attenuation coefficient, α , on soil permeability, k_v , as predicted by eq 21 for the parameters listed in Table II and $L_T = 0$.

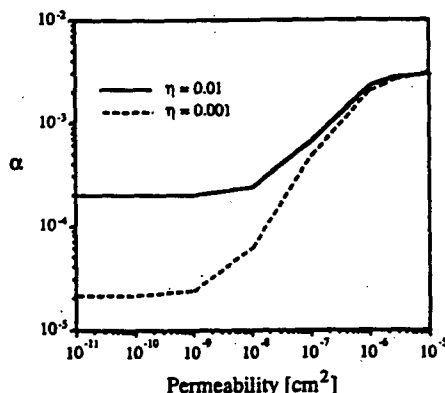


Figure 4. Dependence of attenuation coefficient, α , on soil permeability, k_v , as predicted by eq 21 for the parameters listed in Table II and $L_T = 100$ cm.

$= 0, 100$, and 1000 cm. Recall that $\alpha = C_{building}/C_{source}$, and it is a measure of both the indoor contaminant vapor concentration and contaminant vapor intrusion rate. The results are plotted in this way to facilitate comparison with numerical modeling results presented by Loureiro et al. (9). Figure 3 corresponds to the case where the contaminant vapor source lies adjacent to the building foundation ($L_T = 0$) and is roughly equivalent to the radon intrusion scenario modeled by these authors. The screening model predicts results that are in good qualitative and quantitative agreement with the detailed numerical modeling results [i.e., see Loureiro et al. (9), Figure 11]; both predict that α (and hence the intrusion rate) is independent of k_v for "small" values of k_v , and becomes proportional to k_v at "large" values of k_v . The transition between these two regimes occurs near $k_v = 10^{-6}$ cm². For $k_v < 10^{-6}$ cm², the

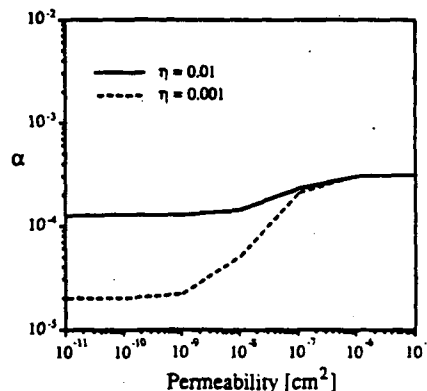


Figure 5. Dependence of attenuation coefficient, α , on soil permeability, k_v , as predicted by eq 21 for the parameters listed in Table II and $L_T = 1000$ cm.

soil gas flow rate through the cracks becomes so low that diffusion is the dominant transport mechanism and α is therefore independent of k_v . For $k_v > 10^{-6}$ cm², on the other hand, containment vapors are swept into the building primarily by convection. In this limit, $\alpha \rightarrow Q_{soil}/Q_{building}$ and becomes proportional to the resistance to flow (as measured by k_v). In this case the proposed screening model predicts $0.001 < \alpha < 0.01$ for $10^{-7} < k_v < 10^{-6}$ cm², which happens to fall in the range of values typically reported for radon intrusion studies. Figure 3 also indicates that the screening model predicts a dependence of intrusion rate and attenuation on the size of the crack, with the effect being more pronounced at lower permeabilities. As the crack size decreases, resistance to both diffusive transport and soil gas flow increases; thus, α is always predicted to be less for $\eta = 0.001$ than for $\eta = 0.01$. The decrease in flow rate predicted by eq 24 is apparently not as significant, however, as the increased resistance to diffusion through foundation cracks. Thus, for practical purposes, it can be concluded that the effect of crack size on contaminant vapor intrusion rates will be relatively insignificant in the limit of convective-dominated transport.

Figures 4 and 5 present model predictions for cases where the contaminant vapor source is located some distance L_T away from the foundation. In each figure the dependence of α on k_v is a sigmoidal-shaped curve, where α becomes independent of k_v in the limits of "large" and "small" soil permeabilities. In the limit of less permeable soils, soil gas flow rates are so low that vapor intrusion is governed entirely by the relative rates of diffusion through the soil and foundation. As the soil becomes more permeable, the "sweeping" of contaminant vapors into the building by soil gas flow increases the intrusion rate. At some point, however, diffusion from the containment vapor source to the region of soil gas flow limits the rate of contaminant vapor transport. For highly permeable soils, therefore, α becomes independent of k_v and only weakly dependent on foundation properties. The transition between Figures 4 and 5 also illustrates that α and the intrusion rate become less dependent on foundation properties as L_T increases. This is evidenced by the convergence of the "low" and "high" k_v asymptotes, and the $\eta = 0.001$ and $\eta = 0.01$ predictions as L_T increases; in the limit $L_T \rightarrow \infty$, diffusion through soil becomes the limiting transport mechanism.

Figures 3–5 illustrate the necessity of developing models that incorporate both convective and diffusive transport mechanisms. Single transport process based models cannot predict the wide range of behavior exhibited in these figures, nor can they explain the difference in the obser-

vation of Hor vapors. Illustration on the pend media porosity, e, predic charac tion. It is n howev a reali effect diction and lar for η c corres 0.01 co of bas. It s predic dimen The re corres.

Extension Found

In tl vapor walls, On the proac equiv

$$\alpha = \left[\frac{D_{soil}}{D_{crack}} + \frac{L_T}{k_v} \right]^{-1}$$

which D_{crack} through is repl 4–7 ar and 2 result cracks unifor theref lower this is found that it = D_{soil} .

Extension

Eq vapor of the reasor and d for lo when

vations of Nazaroff (1, 2) for radon intrusion, and those of Hodgson et al. (3) for vapor transport of contaminant vapors from a landfill. The sample calculations also illustrate that the soil type can have a significant impact on the indoor vapor concentration, since Q_{soil} will be dependent on the soil permeability, and the effective porous media diffusion coefficient is sensitive to changes in soil porosity and moisture content. Being an analytical solution, eq 21 is easily used to study the sensitivity of model predictions over a range of reasonable soil and building characteristics. The major limitation to practical applications of the model is the lack of site-specific η values. It is not likely that such values can be easily measured; however, one can use the model to examine predictions for a realistic range of such values in order to determine the effect of this parameter at any given site. Clearly, predictions are insensitive to η in the limit of "permeable" soils and large source-foundation separations. A realistic range for η can be proposed by considering physical realizations corresponding to specific values of η . For example, $\eta = 0.01$ corresponds to a 1-cm-wide crack running the length of basement floor/walls every 100 cm.

It should be noted that Figures 2-5 contain model predictions for specific soil characteristics and building dimensions and are presented for illustrative purposes. The results should not be extrapolated to other sites not corresponding to the chosen parameters.

Extension of Theory to Relatively Permeable Foundation Walls

In the work of Garbesi and Sextro (8) it is assumed that vapor intrusion occurs through permeable below-grade walls, rather than through foundation cracks and openings. On the basis of this assumption, one can follow the approach used to derive eq 21 to obtain the following equivalent expression:

$$\alpha = \left[\frac{D_T^{eff} A_B}{Q_{building} L_T} \exp\left(\frac{Q_{soil} L_F}{D^F A_B}\right) \right] / \left[\exp\left(\frac{Q_{soil} L_F}{D^F A_B}\right) + \frac{D_T^{eff} A_B}{Q_{building} L_T} + \frac{D_T^{eff} A_B}{Q_{soil} L_T} \left[\exp\left(\frac{Q_{soil} L_F}{D^F A_B}\right) - 1 \right] \right] \quad (26)$$

which is similar to eq 21, except A_{crack} is replaced by A_B , D_{crack} is replaced by D^F , the effective diffusion coefficient through the porous foundation floor and walls, and L_{crack} is replaced by the foundation/wall thickness L_F . Equations 4-7 and 12 should be used to calculate D^F . While eqs 26 and 21 appear similar, they can predict quite different results. Equation 26 is independent of the area of cracks/openings because intrusion is assumed to occur uniformly over the floor/wall area. For a given Q_{soil} , therefore, the soil gas velocity through the floor/walls is lower for the permeable floor/wall case. The impact of this is that eq 26 may predict that transport through the foundation is diffusion dominated, while eq 21 predicts that it is convection dominated, for a given Q_{soil} and $D_{crack} = D^F$.

Extension of the Theory to Transient Problems

Equation 21 provides a screening estimate of indoor vapor concentrations, but does not account for depletion of the contaminant vapor source. This assumption is reasonable when short-term exposures are being estimated and does provide a conservative (upper bound) estimate for long-term exposures. There are situations, however, when more realistic long-term exposure estimates are de-

sired and it is unlikely that the source will remain constant for a long period of time (usually ~70 years for most exposure estimates). Many processes can contribute to an unsteady source, including the depletion due to transport away from the source, biodegradation, and chemical reaction. Of the three processes, the depletion due to transport is most often modeled, due to the current uncertain quantification of the other two. A first-order estimate of whether or not significant changes will occur over a given time period τ is obtained by calculating the mass of contaminant emitted from the source over that time period (τE) and comparing it with the initial residual contaminant mass in the soil directly below the building ($\rho_b C_R \Delta H_c A_B$):

$$\tau E = \rho_b C_R \Delta H_c A_B \quad (27)$$

where C_R and ΔH_c denote the average residual contaminant level in the soil (g/g of soil) and the thickness of the vertical interval (cm) over which the contaminant is distributed, respectively, and E is given by eq 16. If the left-hand side of eq 27 is greater than the initial mass of contaminant right-hand side, then it is possible that the contaminant lying beneath (or adjacent to) the building will eventually volatilize and enter the building. The validity of this assumption will depend on site characteristics.

The simplest extension of the model is derived by invoking the quasi-steady-state assumption used by Thibodeaux and Hwang (15) for single-component contaminants or mixtures of compounds having similar vapor pressures and molecular weights. In this approach it is recognized that the source-building separation increases with time due to depletion; however, it is assumed that the rate at which a steady-state vapor concentration profile is established is much greater than the rate at which depletion occurs. At any time, therefore, the emission rate is given by eq 16 with L_T replaced by the source-building separation at that time. Implicit in this approach is the assumption that depletion occurs first from the layers of contaminant closest to the building floor and walls, and a hypothetical "depletion zone" grows with time. In a sense, the mass of contaminant incorporated in the soil "dries up", beginning at the edge closest to the building. This is a reasonable assumption for diffusion-dominated transport to the building-soil interface, but not valid for convection-dominated transport from contaminated soil adjacent to a building floor. With this limitation in mind, eq 16 combined with a mass balance provides a mathematical expression of the quasi-steady-state assumption:

$$\rho_b C_R A_B \frac{d\delta}{dt} = \left[\frac{D_T^{eff} A_B C_{source}}{(L_T^0 + \delta)} \right] \left[\exp\left(\frac{Q_{soil} L_{crack}}{D_{crack} A_{crack}}\right) - \frac{\left[\frac{C_{building}}{C_{source}} \right]}{\left[\frac{D_T^{eff} A_B}{Q_{soil} (L_T^0 + \delta)} \right]} \times \left[\exp\left(\frac{Q_{soil} L_{crack}}{D_{crack} A_{crack}}\right) - 1 \right] + \exp\left(\frac{Q_{soil} L_{crack}}{D_{crack} C_{crack}}\right) \right] \quad (28)$$

where δ , t , and L_T^0 denote the "depletion zone" thickness ($\delta = 0$ at $t = 0$) (cm), time (s), and initial contaminant-building floor separation (cm), respectively. Equation 28 can be rearranged and rewritten in the form

$$d\delta^*/dt = \psi/(\beta + \delta^*) \quad (29)$$

where

$$\delta^* = \delta/L_T^0 \quad (30)$$