TASK 4 REPORT GEM3746G
NEW YORK STATE ELECTRIC & GAS CORPORATION RISK ASSESSMENT FOR THE FORMER COAL GASIFICATION SITE GENEVA, NEW YORK

TECHNICAL REPORT

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EXECUTIVE SUMMARY

The Geneva Coal Gas site is located two miles east of the City of Geneva, Seneca County, New York. The plant was constructed between 1901 and 1903 by the Empire Coke Company and consisted of 31 coke ovens and two gas holders. Expansions in 1909 allowed the facility to produce blue gas (coal gas) in addition to coke. The New York State Electric and Gas Corporation (NYSEG) acquired the controlling interest in the company in 1924 and the plant continued to produce coal gas until 1934. Currently the site is occupied by a NYSEG Service Center. Seneca Lake and a small state park are situated approximately 1000 feet south of the site. Two intermittent site streams flow through the park and discharge into the lake.

A four-phase environmental investigation has been conducted at the Geneva site. Phases one, two and three characterized the nature and distribution of coal gas residues at the site. The fourth phase of the environmental investigation assessed the risks to public health and the environment due to the past waste disposal activities on the Geneva site. The results are presented in this report. This risk assessment follows guidelines established by the National Academy of Sciences, the U.S. Environmental Protection Agency, and previous risk assessments conducted for sites in New York State. Only present site conditions and usage are considered in this risk assessment.

The wastes generated at the Geneva plant included typical coal gas manufacturing residues: tars, sludges, iron oxide impregnated wood chips, and liquid from drip boxes. Although most of the solid and liquid wastes generated by the coal gas operation were collected and sold, a small proportion were disposed of in an unlined area, near one of the small streams, on the east side of the site. In addition, tars and other residues were found

in soils where former gas plant structures (such as gas holders) had been located.

The predominant liquid waste generated at the Geneva site was quench water from the coking operations. Initially this water was discharged to a site stream. In 1923 a concrete-lined sludge basin was constructed and the water was pumped to the basin and allowed to separate. The supernatant was discharged to the site stream while the lower liquid layer was pumped into an 8-inch diameter, 336-foot deep injection well.

The environmental investigation has provided historical, geological, and hydrological information, as well as chemical data for ground water, stream water and sediment, lake sediment, soil, wastes, and air. Samples were analyzed for chemicals commonly found at coal gasification sites including polynuclear aromatic hydrocarbons (PAHs), volatile organic compounds, cyanides, non- chlorinated phenols and metals.

Specific "chemicals of interest" were selected for consideration in the risk assessment. Chemicals were included in the analysis if they were found at the site in elevated concentrations, have the potential for exerting acute or chronic health effects, and/or were present at levels exceeding established guidelines or standards. The assessment integrates two bodies of information for these chemicals: 1) site specific exposure analysis, and 2) health/ environmental effects data. The latter information is taken from the available literature and is often summarized by regulatory agencies (primarily EPA) in the form of "potency factors" or "Acceptable Intake Chronic or Acute Values".

Various transport models are used to estimate exposure point concentrations from laboratory measurements of field samples. In this analysis nominal values are used where data are reported as less than a

detection limit. This permits a better estimate of average exposure concentrations than if the data were ignored or treated as zeros. In such cases, the true value is assumed to be approximately one-half the detection limit.

Twelve exposure scenarios were developed for the site. Each scenario presents a route by which human or non-human receptors may be exposed to the chemicals of interest. Five of the scenarios relate to exposures to workers performing routine work in various site buildings: the Service Building, the garage in the Service Building, the Corporate Meter Building, the Compressor Building and the East Office Building. Exposure to these workers would be via inhalation of volatile constituents which have migrated through cracks and voids in the foundations of these buildings.

Four of the exposure routes deal with workers performing excavation work at the site. Included in these scenarios are routine maintenance of gas lines in "heavily contaminated" and "typical" areas as well as excavation for specific proposed construction projects at the Service Center. Exposure in these scenarios would be through skin contact, inhalation of contaminated dust or vapors, and accidental ingestion of soil.

Although access to much of the site is limited, one scenario was developed to consider the case of children trespassing onto the site in the area of the eastern site stream.

The two remaining scenarios relate to exposures resulting from migration of contaminants off site. One deals with visitors to Seneca Lake State Park who could be exposed to coal tar residues carried off-site in the streams. The other considers Seneca Lake fish and the people who eat them. The chemicals of interest may reach the lake through ground water flow and via the two site streams.

The results of the risk analyses are expressed in two ways in order to distinguish between the risks posed by carcinogens and non-carcinogens. For carcinogens, the risk is given as the lifetime probability of excess cancer associated with a given exposure. In the case of "involuntary environmental risk", incremental lifetime risks of cancer deaths in excess of 1 in 10,000 are generally judged to be unacceptable based on recent EPA policy statements. However, such risk may still be considered acceptable from an occupational standpoint.

Health effects due to non-carcinogens are expressed as Hazard Index Ratios and are calculated according to EPA procedures. Hazard Index Ratios higher than certain values for on-site workers should be interpreted in light of established standards for occupational settings and care taken to limit exposure where such activities are thought to be appropriate.

Calculated risk estimates for the two scenarios relating to on-site routine maintenance excavation are higher than benchmark values. Risks for all other scenarios are lower than these values. Based on this risk assessment, the following recommendations are made: 1) A Health and Safety Plan should be developed for maintenance and other workers performing excavations at the Geneva Site. This plan should include guidance on actions that can be taken to limit skin contact with contaminants, incidental ingestion of dirt, and inhalation of dusts and vapors. An air monitoring program designed to screen air quality for the presence of volatile organic chemicals during the excavation work should also be included, 2) If changes in site use are contemplated, risk estimates should be developed to take into account exposure scenarios which could result from new uses or the conversion of the site facilities.

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1.0 SUMMARY AND RECOMMENDATIONS

This document provides a quantitative public health and environmental risk assessment for the former Geneva (Border City) Coal Gasification Site near Geneva, New York. Its primary objectives are to examine exposure pathways and concentrations and to estimate the potential for effects associated with "Chemicals of Interest" at the Geneva Site under existing conditions. This analysis is referred to as the base case analysis. The risk assessment follows guidelines established by the National Academy of Sciences, by the U.S. Environmental Protection Agency (EPA), and in previous risk assessments conducted for sites within New York State.

The risk assessment analyzes selected "Chemicals of Interest" at the site. These chemicals were chosen based on a set of criteria described in the main body of the report. Generally, chemicals are included in the analysis if they are present at elevated levels, have the potential for exerting acute or chronic health effects, and/or exceed established guidelines or standards. Several classes of chemicals included in the analyses were: a) polynuclear aromatic hydrocarbons, b) volatile organic compounds, c) non-chlorinated phenols, and d) selected inorganic compounds.

Quantitative risk assessment basically involves integrating two bodies of information for the chemicals of interest: a) health/environmental effects data, and, b) site-specific exposure analyses. Health/environmental effects data are information brought together on the basic acute and chronic health and environmental effects of the Chemicals of Interest at a site. Most of this information is taken from available literature and is often summarized by regulatory agencies (primarily EPA) in the form of "potency factors" or "Acceptable Intake Chronic or Acute Values". For the risk assessment in this report, these basic information sources were used along with recent

developments in assessing the potencies of various polynuclear aromatic hydrocarbons (PAHs). These approaches are discussed in the main body of the text.

Site-specific exposure analysis involves identifying human or environmental receptors that may encounter chemicals of interest associated with (i.e., originating from) the site and estimating the exposure concentrations associated with various exposure scenarios. These estimates, when integrated with the health/environmental effects data base, provide the basis for quantifying "risks". Because there is often uncertainty associated with both the health/environmental effects data base as well as the estimates of exposure, it is recognized that risk estimates are made in an arena of uncertainty. Therefore, as outlined in EPA's Risk Assessment Guidance, it is important to include within the analysis key information concerning the sources and degree of uncertainty.

Uncertainty can be dealt with in many ways. In the present risk analysis, where assumptions or estimates have been made concerning loadings of contaminants or exposures, an effort has been made to make these reasonably conservative, i.e., protective of human health. Therefore, although it is recognized that large uncertainties exist in some of the exposure estimates, the analysis attempts to "bound" these conditions. A conservative approach is taken in the face of uncertainty to ensure that the true exposure or risk is less than that estimated in this report. The main body of the text discusses the assumptions, uncertainties, and conservatism associated with each exposure scenario.

The Preliminary Risk Assessment prepared under Task 3 of the NYSEG Program for the Geneva Site provided a starting point for the development of site-specific exposure scenarios. Additional discussions with NYSEG staff

members served to identify and characterize on-site exposure scenarios. Based on the Preliminary Risk Assessment, discussions with NYSEG, and a review of information for the site and surrounding areas, twelve exposure scenarios were developed for the purpose of estimating risks.

Five of these (Scenarios 1 through 5) relate to indoor exposures received by on-site workers performing routine work in various buildings on the site. Here the number of scenarios reflects the different buildings or building areas on-site. These include: the Service Building, the garage in the Service Building, the Corporate Meter Building, the Compressor Building, and the East Office Building.

Four scenarios (6 through 9) relate to workers exposed to chemicals during excavation or construction. These were developed based on information provided by NYSEG on planned construction or possible maintenance activities at the site. These include: the placement of a new water line along the main access way to the Service Building, the construction of a new entrance and elevator for the Service Building, general maintenance of underground gas utility lines, and maintenance of gas lines located in the area exhibiting high concentrations of Chemicals of Interest in soils.

Three of the exposure scenarios (10 through 12) involved off-site receptors. These include: children that may trespass on unfenced NYSEG property and visit the easterly site stream area, people visiting the state park located between the site and Seneca Lake, and people drinking water and/or eating fish from Seneca Lake. Environmental receptors (plants and animals) were also considered as part of these scenarios. An additional exposure route that is discussed in this report concerns users of ground water. This is discussed as a separate case because there are no direct human receptors. However, shallow on-site ground water discharges to the easterly

site stream and is considered in the evaluation of that site stream; deep ground water probably discharges directly to Seneca Lake and has been considered in connection with possible effects on drinking water or fish ingestion.

Exposure concentrations were estimated from data on chemical concentrations in soil, sediment, water, and air obtained during the course of site investigations performed by TRC Environmental Consultants, Inc. (TRC). In some cases, where information was lacking, conservative assumptions were made in order to develop exposure estimates. For example, in evaluating the fate and effects of coke quench wastewater discharged via a deep injection well, it was assumed that all the chemicals discharged down the well (an estimate based on the literature) have reached Seneca Lake over the last thirty years.

Results of the Risk Analyses

The results of the risk analyses are presented in two basic forms. In the case of human health effects associated with exposure to potential carcinogens, risk estimates are expressed as the lifetime probability of excess cancer associated with the given exposure. In numerical terms, these are presented in scientific notation in this report. Thus, a lifetime risk of 1.0E-4 means a lifetime incremental risk of one in ten thousand; a lifetime risk of 1.0E-6 means an incremental lifetime risk of one in one million and so on. In the case of "involuntary environmental risks", incremental lifetime risks of cancer deaths in excess of 1.0E-4 (i.e., one in ten thousand) are generally judged to be unacceptable based on recent EPA policy statements. However, such risks may still be considered acceptable from an occupational standpoint.

The second form in which human health effects are expressed is referred to as the Hazard Index Ratio and is used to evaluate the potential for effects

associated with exposures to non-carcinogens. Hazard Index Ratios are calculated according to a procedure outlined by the EPA. The ratios are viewed only as "benchmarks". Typically, these benchmarks are set at "1" for chronic exposures; a benchmark of "10" is also used in the present analysis for acute exposures. Exceedance of a benchmark ratio does not mean that there will be an associated health effect. Ratios in excess of "1" or "10" should be viewed as an indication that the exposure is above conservatively derived levels. Thus, in the present context, Hazard Index Ratios greater than the benchmark values for on-site workers should be interpreted in light of established standards for occupational settings and care taken to limit exposures where such action is judged to be appropriate. These are discussed further below.

The results of the risk analysis are summarized by major scenario groupings.

Risks to On-Site Workers in Various Buildings - Scenarios 1 through 5 estimate health risks associated with routine work within the various buildings at the Geneva Site. The primary source of exposure in these cases is the entrainment of soil gas into the buildings. Because of the potential importance of this exposure route, the air inside several of the buildings was sampled for select Chemicals of Interest. In all cases, concentrations of chemicals in air were below detection limits. One-half of the detection limit was used as a estimate of the possible concentrations of chemicals in air. This approach is consistent with that typically used in quantitative risk assessment when a chemical has a potential to be present but the levels are below the levels of detection. In some cases, the application of a soil/soil gas model (Appendix A) indicated that exposure concentrations would be well

below the detection limit. In such cases, the estimated value, derived in a conservative manner, is used.

Based on the concentrations either measured or estimated by models, the incremental lifetime cancer risks for the five indoor air scenarios were calculated (Figure 1-1). The figure indicates that all the estimated incremental cancer risks fall within the range of 1.0E-7 and 1.0E-4. These levels are generally considered acceptable depending on site-specific conditions (exposed population size and age, level of certainty). It should be noted that where measurements have been made (Scenarios 1, 2 and 3), benzene levels were below the detection limit. The figure also indicates the incremental lifetime risk associated with exposure to benzene in indoor air at an ambient concentration of 0.01 mg/m^3. Such a level would be considered "typical" of indoor air based on EPA studies. The "risk region" between that associated with "typical" indoor air conditions and one-half the detection limit (i.e., 0.045 mg/m^3) associated with the Geneva indoor air monitoring is considered to represent the level within which the incremental lifetime risk is expected to occur. Based on available information, benzene levels in indoor air are likely to be at or close to ambient levels (within an order-of-magnitude).

It should also be noted that the estimated levels of benzene in indoor air are all less than (i.e., within) the OSHA standard for occupational exposure to this chemical. This standard is currently a one-part-per-million average over an 8-hour workday (Federal Register, December 10, 1985, Vol. 50, No. 237, pp. 50512-50586). On a part-per-million basis, the indoor air concentration of benzene based on air monitoring results from the Service Building was less than 0.03 ppm on average. This concentration is well below the standard.

Hazard Index Ratios for non-carcinogens entering buildings from soil gas are illustrated in Figure 1-2. The results indicate that the ratio for

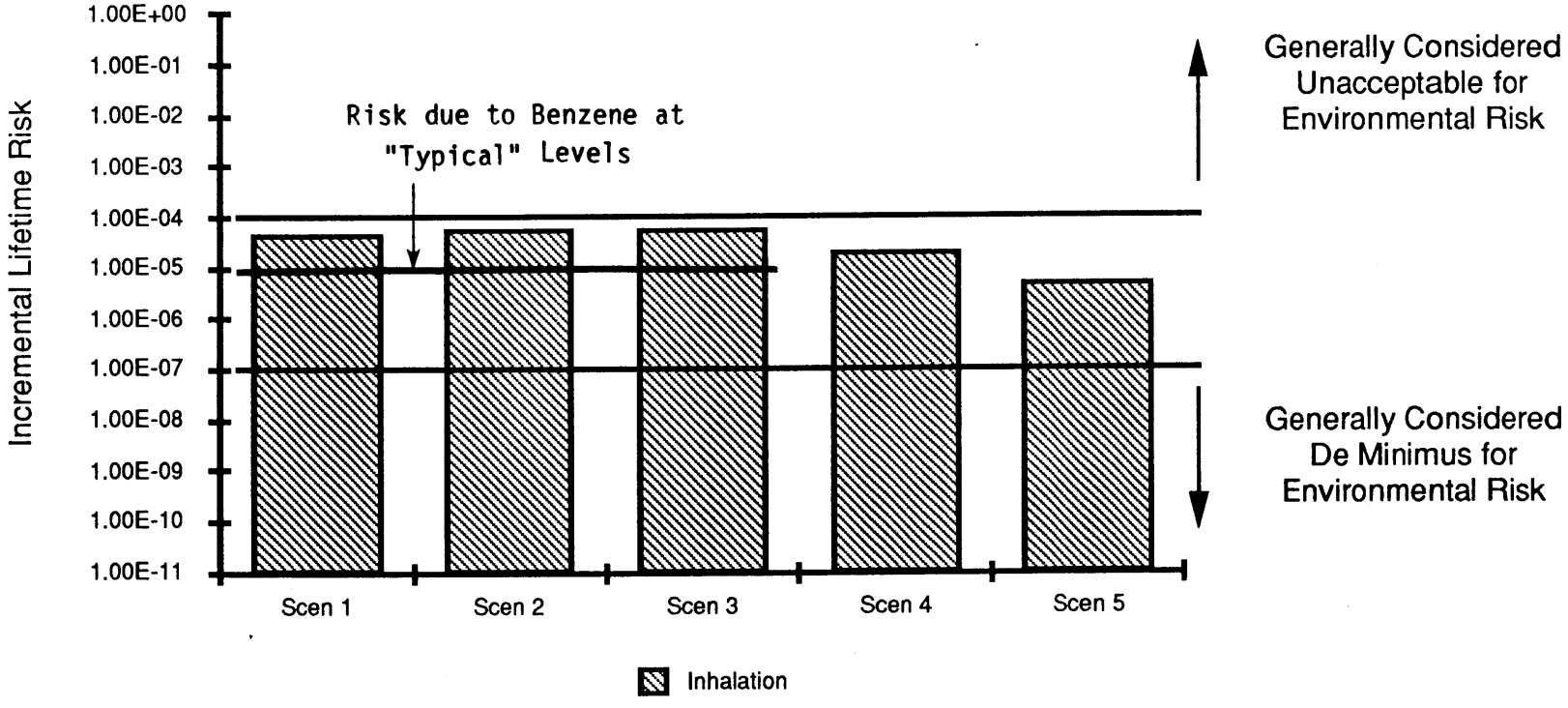


Figure 1-1. Incremental Lifetime Cancer Risks Associated with Indoor Exposures.

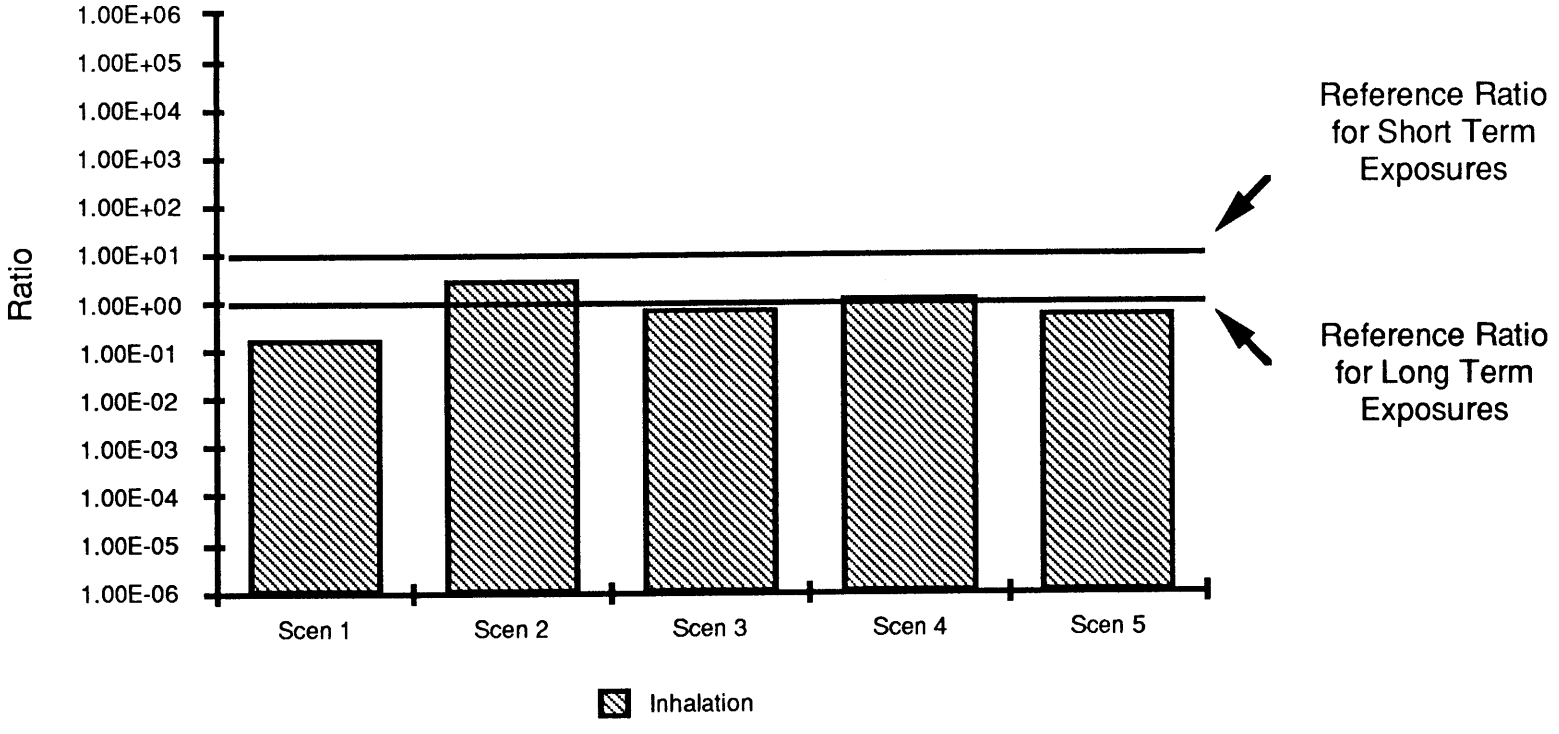


Figure 1-2. Hazard Index Ratios Associated with Indoor Exposures.

Scenario 2 is slightly greater than the "1" benchmark but less than 10. This scenario is associated with work in the garage in the Service Building. Exposure point concentrations are based on the application of predictive models and scaled based on measurements for naphthalene. However, it must be noted that the naphthalene concentrations were all below a detection limit of 0.03 mg/m^3. Therefore, the estimated hazard index ratio, based on one-half of the detection limit of naphthalene, should be viewed as a conservative estimate. Because the resultant ratio value is close to "1", risks are judged to be low.

Exposures to Workers Involved in Various On-Site Excavations - Incremental lifetime risks of cancer to workers involved in various excavations on-site are illustrated in Figure 1-3. Scenarios 6 and 7 involve planned work related to installing the new water line and constructing the garage and new entrance at the service building. Incremental lifetime risks of cancer associated with these planned activities are less than 1.0E-4.

Scenarios 8 and 9 relate to on-site excavations associated with utility maintenance, with specific reference to gas pipelines. Gas pipelines are located throughout the plant property and it is reasonable to expect that these will need maintenance from time to time. Scenario 8 was established as an "average case". Exposure concentrations associated with this case are estimated based on the geometric mean values of photo ionization detector (PID) data for selected test pits (see Appendix A for details). A model was used to estimate the chemical composition of volatiles released from the pits. Here, the expectation was that workers involved in excavating gas pipelines would sometimes be excavating lightly contaminated areas and at other times more heavily contaminated areas. From the standpoint of exposure

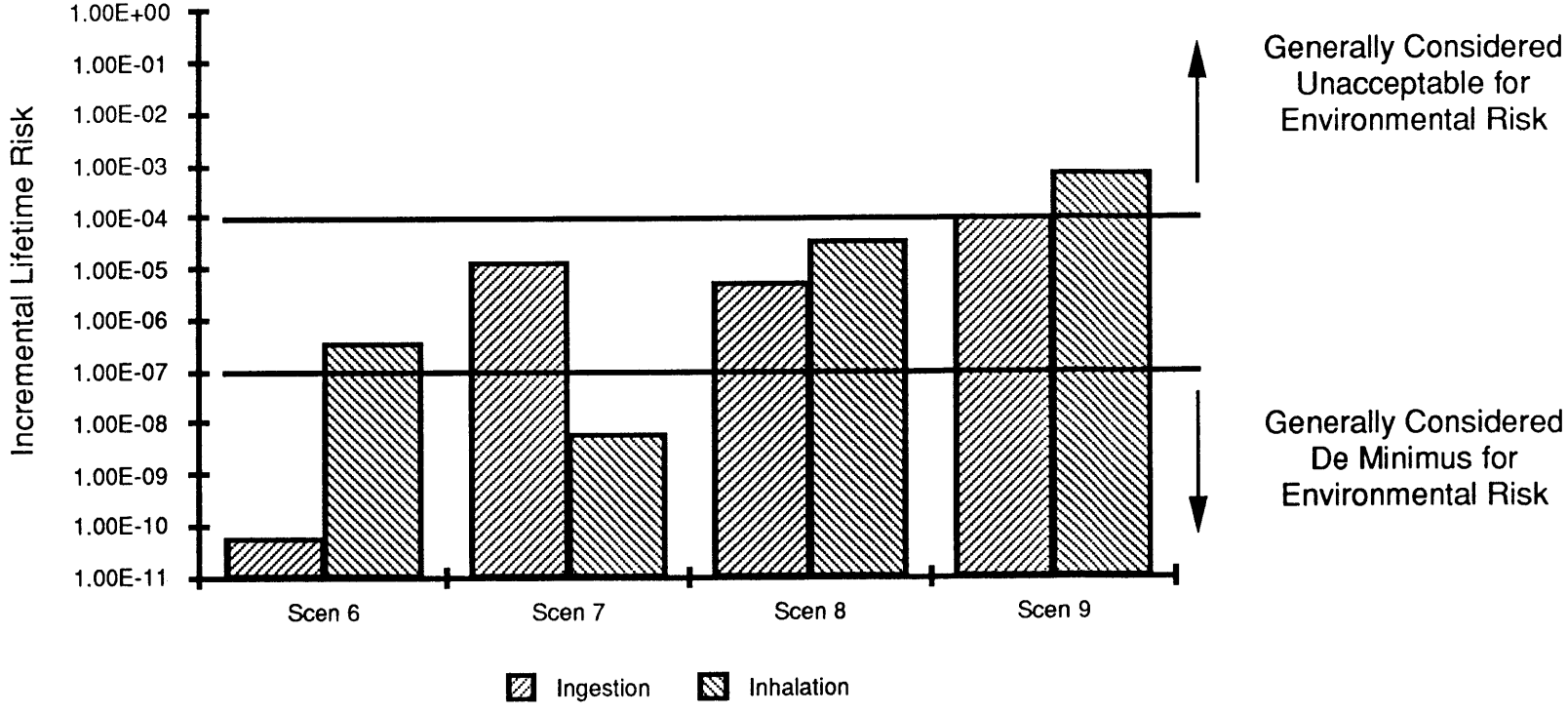


Figure 1-3. Incremental Lifetime Cancer Risks Associated with On-Site Excavations.

over a worker's employment period, the worker would be exposed to an average concentration related to the average value of soil contamination. This is the appropriate calculation for chronic effects.

Scenario 9 was established as the "worst case" with regard to excavations of pipelines on-site. The data for Test Pit 1 exhibited the highest chemical concentrations in soil and these data were used in establishing Exposure Scenario 9. A soil gas model was used to estimate the soil gas concentrations in this pit (again, see Appendix A for details). The use of the Test Pit 1 area as a worst case is considered realistic since there are gas pipelines near this test pit.

For Scenario 8, the average case, lifetime incremental risk of cancer was less than 1.0E-4. However, for Scenario 9, estimated risks exceed 1.0E-4. The main source of risk in both cases was from inhalation of the chemical benzene. For Scenario 8, the average benzene concentration in the pits, as estimated using a soil/soil gas model, is near 16 mg/m^3. Based on limited monitoring data, it appears that this estimated concentration may be high by as much as an order of magnitude or more. Therefore, it is possible that actual incremental risks associated with excavation in the most contaminated area also fall below 1.0E-4.

The Hazard Index Ratios associated with excavation or construction are shown in Figure 1-4. Generally, excavation work related to installing the new water line or constructing the garage and entrance way are below the "benchmarks" for both chronic and short-term effects. Excavations elsewhere on-site (Scenarios 8 and 9) could result in exposures that would exceed the benchmark ratios of 1 and 10. Again, the inhalation route is the primary source of such exceedances. Semivolatile PAH compounds and phenolic compounds are the primary chemicals involved. For the most part, the inhalation of

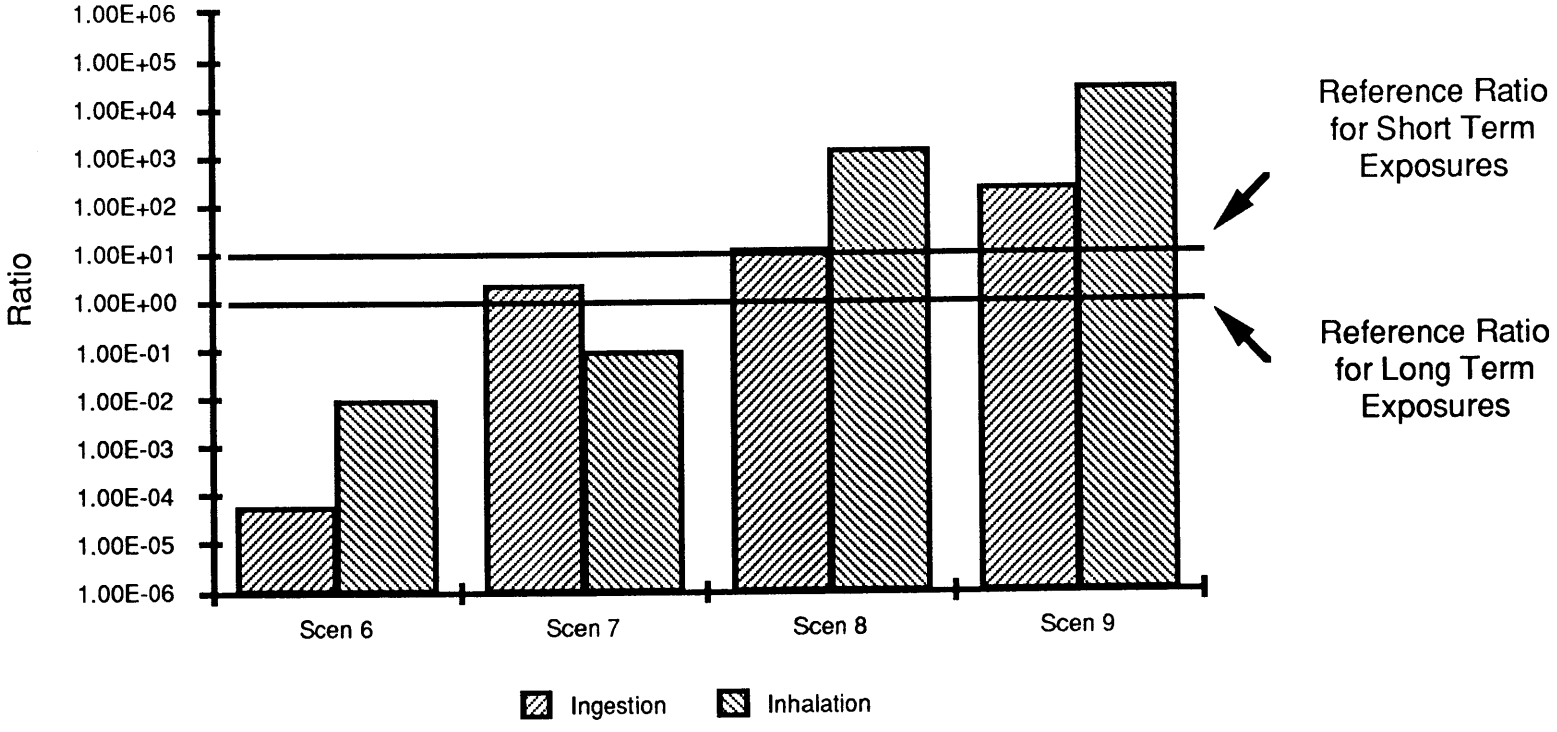


Figure 1-4. Hazard Index Ratios Associated with On-Site Excavations.

vapors rather than the inhalation of chemicals associated with suspended soil particles is the primary transport mechanism.

A review of the estimated exposure estimates for naphthalene and phenolic compounds in air indicate that they are probably high. For Scenario 8, the average case, naphthalene in air within pits is estimated by a soil gas model to be approximately 10 mg/m^3. Based on direct field experience at a number of sites, this is a higher than expected number. Phenolic compounds are estimated to be several mg/m^3 for air within the pit. However, these estimated levels are still less than (i.e., within) OSHA standards for occupational exposures to naphthalene and phenol (used here as a surrogate for other non-chlorinated phenolic compounds). Exposures estimated for Scenario 9 (the worst case) exceeded the OSHA standards for naphthalene and phenol.

Based on the above, this report recommends that NYSEG develop a Health and Safety Plan for excavations on-site. First, it is acknowledged that there is uncertainty in the estimates of exposure to chemicals released to air upon excavation and that estimates presented in this report are probably high. Some of the estimates associated with pipeline excavations result in Hazard Index Ratios that exceed 1 or 10. Some of these exposures are still within acceptable OSHA standards. However, other "worst case" estimates exceed OSHA standards. In addition, PID measurements for some of the tests pits indicate a potential for a release of relatively large amounts of volatile compounds (100s of ppm). A Health and Safety Plan will help ensure that exposures are minimized during excavation.

Off-Site Receptors - NYSEG can take direct measures to address potential exposures to workers at its Geneva Facility. However, of particular interest to the general public and regulatory agencies is the possible off-site

transport of contaminants and the associated potential risks to off-site human and environmental receptors.

Three scenarios are considered for off-site receptors. These included the occasional visit of children to the unfenced NYSEG property near the easterly site stream, children visiting the state park, and people drinking lake water or eating fish from Seneca Lake, and the fish themselves. An additional possible exposure scenario (ground water users) is not quantified because there are no current users of ground water from the site and the discharge of ground water to the site stream or lake is taken into account by evaluating the contribution from the site stream to Seneca Lake.

Incremental risks of cancer associated with the off-site exposures are illustrated in Figure 1-5. All risks fall within the general range of acceptable levels. It should be noted that risks to people drinking water and eating fish from Seneca Lake have been estimated by assuming that all the contaminants that might have been in coke quench wastewater discharged down an on-site deep well have reached Seneca Lake. This is considered a conservative assumption but serves to bound the analysis of risk associated with this potential source. The analysis is described in detail in Appendix A.

Hazard Index Ratios for off-site receptors are illustrated in Figure 1-6. None of the ratios exceeded either the benchmark ratios for short-term or long-term exposures.

Off-Site Environmental Receptors - The primary off-site environmental receptors considered in this risk analysis are fish in Seneca Lake. The easterly site stream does not support a fish population due to its small size and intermittent flow. Visits to the site stream revealed the presence of dense marsh vegetation with no indication of reduction of plant growth in the areas where elevated concentrations of chemicals in soils have been observed.

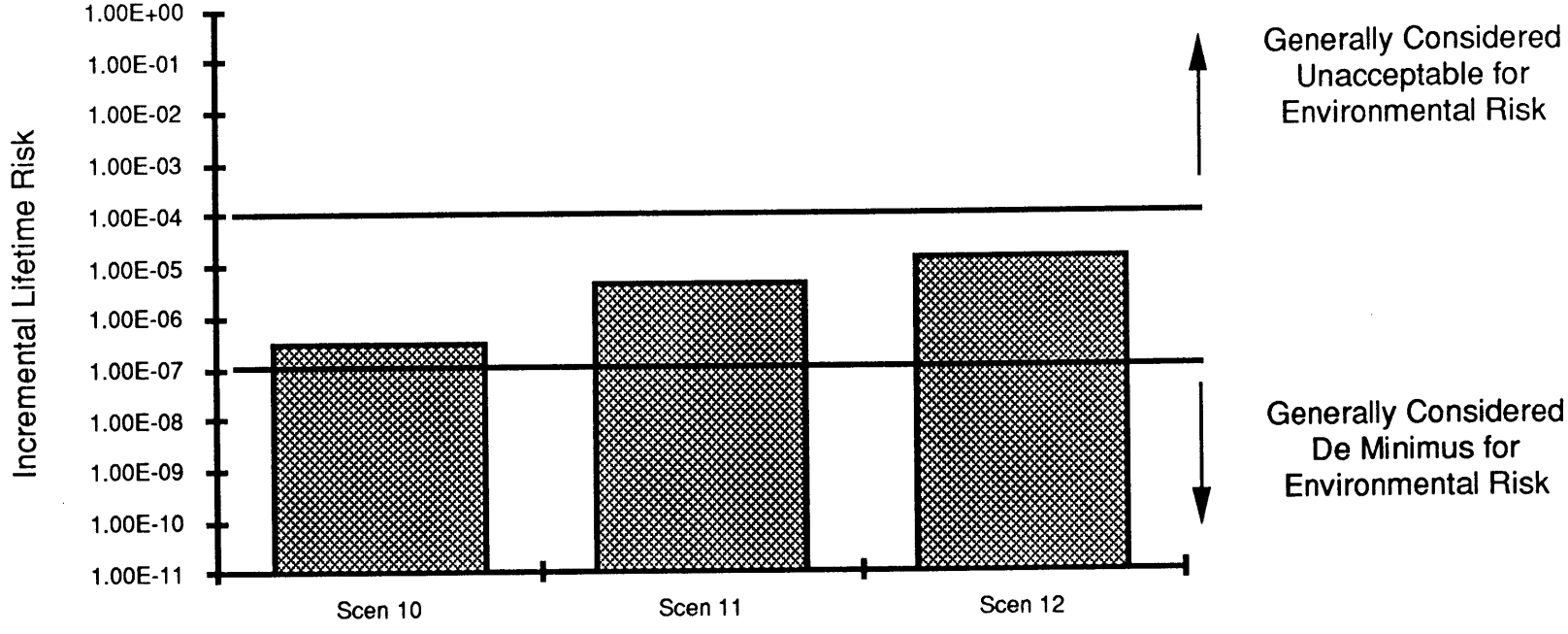


Figure 1-5. Incremental Lifetime Cancer Risks Associated with Off-Site Exposures.

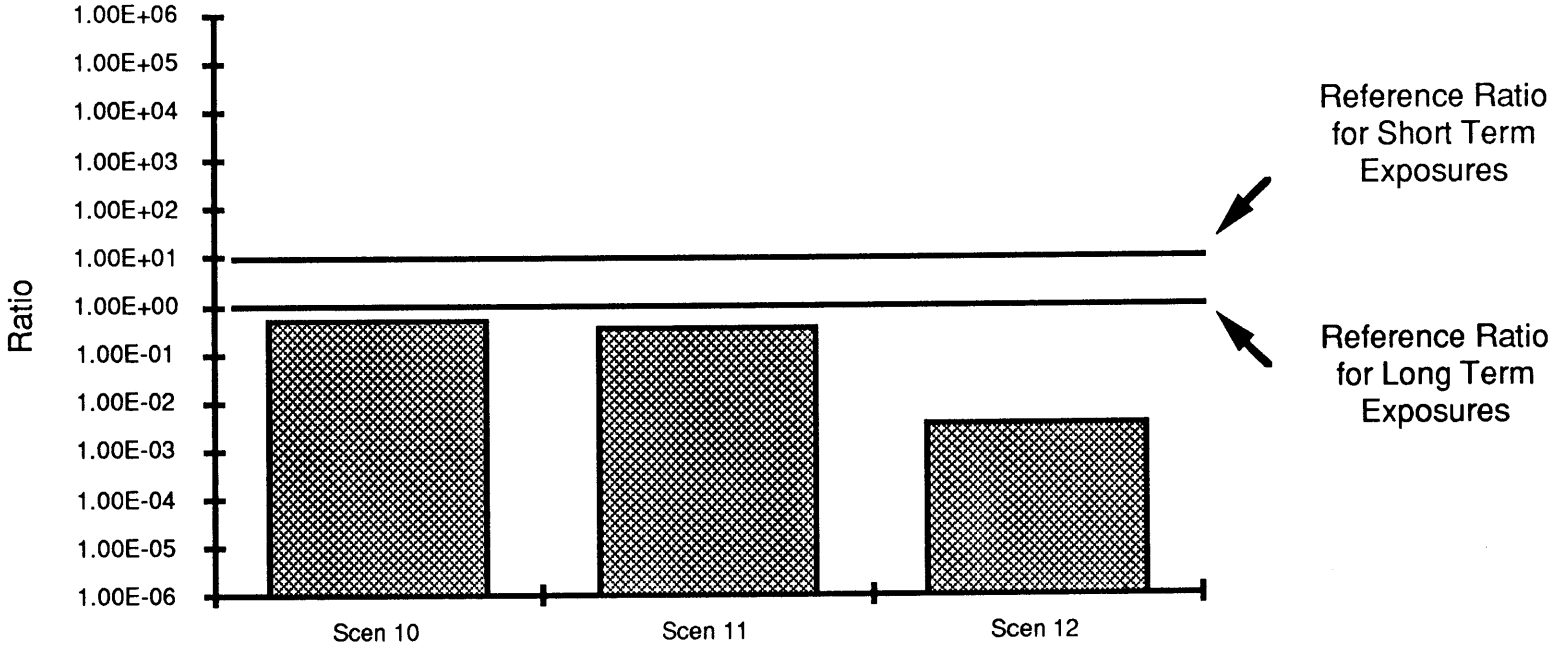


Figure 1-6. Hazard Index Ratios Associated with Off-Site Exposures.

The primary Chemicals of Interest with regard to fish populations in Seneca Lake are PAHs. Sediment samples taken from the lake in the immediate vicinity of the discharge point of the easterly site stream revealed that PAH compounds were present in concentrations less than 1 mg/kg. This is a relatively low concentration and reflective of, at most, light contamination. In fact, the concentrations observed in lake sediments could be reflective of typical ambient levels for these compounds. The result of modeling the distribution of PAH compounds in the lake revealed that sediment levels may be on the order of 0.01 mg/kg and less as a result of input of contaminants due to coke quench wastewater and the site stream. Studies involved in developing sediment criteria for PAH compounds (Alden and Butt, 1987; Chapman et al., 1987) also indicated that the levels measured or estimated in Seneca Lake sediments near the Geneva Site would be considered below concentrations that are generally cause for concern.

Recommendations

This report recommends:

1) A Health and Safety Plan should be developed for maintenance and other excavations that may occur at the Geneva Site. The Health and Safety Plan should include a monitoring program to screen excavations for the presence of volatile organic chemicals in air. Inclusion of limited air monitoring for specific chemicals within pits in some of the more contaminated areas on-site would also serve to refine exposure estimates used in this risk assessment. The Health and Safety Plan should include guidance on actions that can be taken to avoid dermal contact, incidental ingestion of dirt, and inhalation of vapors and dusts.

2) If changes in site use are eventually contemplated, risk estimates that take into account new exposure scenarios should be made.

2.0 INTRODUCTION

2.1 Objectives

This document provides a quantitative Public Health and Environmental Risk Assessment for the former Geneva (Border City) Coal Gasification Site near Geneva, New York. Its primary objectives are to examine exposure pathways and concentrations and to estimate the potential for effects associated with "Chemicals of Interest" at the Geneva Site under existing conditions. This analysis is referred to as the base case analysis. The risk assessment follows guidelines established by the National Academy of Sciences, the U.S. Environmental Protection Agency (EPA), and in previous risk assessments conducted for sites within New York State.

For the base case conditions, a number of site-specific exposure scenarios have been developed to represent potential on-site and off-site situations in which humans or biota may be exposed to chemicals from the site. The analyses do not include "hypothetical scenarios" which currently do not apply to the site. Specifically, the site is viewed as an existing industrial facility and the estimates of risk presented in the document are based on those conditions. Changes in the use of the facility or the efficacy of specific remedial programs are not included as part of this analysis.

Human health risks associated with existing conditions are presented with regard to potential effects of Chemicals of Interest. These effects may include potential risks of cancer or non-cancerous systemic effects. A quantitative risk assessment for carcinogens involves statistically-based estimates that take into account exposure concentrations and the carcinogenic potencies of the chemicals. Health effects associated with exposures to non-carcinogenic chemicals are evaluated with regard to acceptable intake chronic (AIC) or risk reference dose (RfD) values. This approach for

non-cancer effects is most useful when ambient levels of the chemical are below the AIC or RfD thresholds. However, there is often no quantitative way to measure the degree of risk created when concentrations exceed the standard thresholds. This is also the case with water quality or other guidelines used for assessing ecological effects.

Risks to biota adjacent to the site and in Seneca Lake are also evaluated in this analysis. In addition to the use of water quality (threshold) criteria, information was used on the observed effects of Chemicals of Interest on biota in the environment.

Ultimately, the risk assessment presented in this report is expected to be used within a risk management framework. In making decisions concerning what, if anything, should be done at a site (including, for example, the collection of additional data or implementation of a remedial program), the results of the risk assessment should be used in concert with other information on the site. The risk assessment by itself does not answer the question of "What should be done?".

It is important to recognize that the risk assessment does not examine disease incidence among workers or the local population and then attempt to link these conditions with environmental exposure. For many of the specific exposures and health/environmental effects considered here, such an epidemiological study is difficult because of background health effects, difficulty in quantifying exposures, and because other factors (occupation, genetics, diet, lifestyle) may be the cause of any observed effects.

Because of the statistical nature of risk assessments and because of the assumptions that must be made in estimating exposures and health effects, the overall uncertainty in risk assessments is great enough that results should be considered as rough indicators of the probable magnitude of effects, not as precise estimates.

This Health and Environmental Risk Assessment focuses most strongly on the "base case" or "status quo" conditions at the site. However, the results of this study will help decision makers focus on the areas, contaminants, media, pathways, people, flora and fauna of greatest importance at the site, thereby helping to identify appropriate cost-effective remedial alternatives for the site.

2.2 Methodology

The methodology is structured utilizing the most current methods accepted by the US Environmental Protection Agency, as published in the Federal Register (49FR227 et seq.) and in the final "Superfund Public Health Evaluation Manual" (US EPA 540/1-86-060, October 1986). Where assumptions are made, they are realistic but conservative, i.e., protective of public health and environmental quality. In keeping with accepted practices for conducting such assessments, all assumptions are carefully discussed and an assessment made of the uncertainty associated with the overall health and environmental risk estimates.

As detailed in the Task 2 Report, the former coal gasification site near Geneva, NY, contains residues from the normal operation and (partial) on-site disposal of some wastes from the coal gasification works first built between 1901 and 1903 by the Empire Coke Company. Field studies conducted over the last two years have revealed the presence of organic and inorganic contaminants typical of a coal gasification operation in the soils, ground water, surface water, and sediments on and near the site. The compounds measured in elevated concentrations on and near the site include:

- volatile organic compounds (e.g., benzene, toluene, and ethylbenzene),

- acid fraction organic compounds (e.g., non-chlorinated phenols and phenolic compounds),
- base-neutral organic compounds (e.g., several polynuclear aromatic hydrocarbon -- or PAH -- compounds such as naphthalene, acenaphthene, benzo[a]pyrene, and their congeners), and
- inorganic compounds, especially iron, zinc, arsenic, ammonia, and cyanide compounds.

Air monitoring during the excavation of test pits on the site has revealed the presence of some organic compounds in the test pits' soil gas, but it has revealed no contaminants derived from the site in the ambient air. During June 1988, air samples were taken for benzene analyses in the immediate vicinity of an excavation into contaminated sub-surface soils. Although the soils were visibly contaminated and odors were detected, benzene was not detected at or above a detection limit of 0.03 ppm.

The risk assessment follows guidelines established by the National Academy of Sciences, by the U.S. Environmental Protection Agency (EPA), and in previous risk assessments conducted for sites within New York State. This guidance outlines the basic categories of information and estimates that have to be integrated into an assessment of risks. Such assessments involve carrying out the following activities:

- identification of potential hazards (in the present case, this means the identification of particular chemicals that may be hazardous);
- review of information on the toxicity of these chemicals and identification of dose/response relationships;
- identification of potential receptors and assessment of exposure pathways;
- characterization of the risk (this involves considering both dose/response information and estimates of exposure);
- provision of some basis for assessing the magnitude of estimated risks;
- recommendations, if any, concerning the need for additional data.

3.0 SITE CHARACTERIZATION

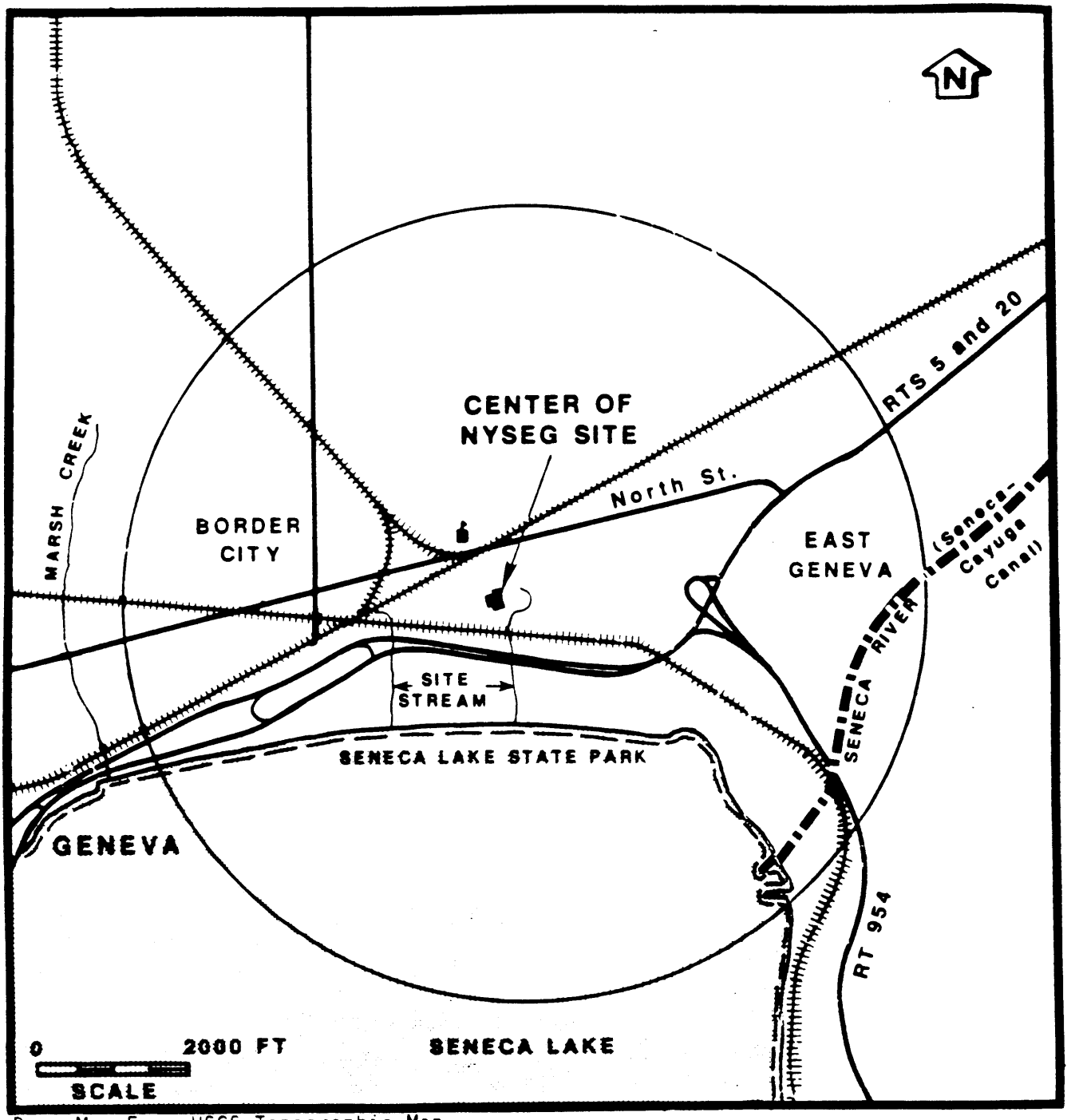
3.1 Site Setting

The site is located two miles east of the City of Geneva, Seneca County, N.Y. (Figure 3-1). The original plant was built between 1901-1903 by the Empire Coke Company and consisted of 31 coke ovens and 2 gas holders. Expansions in 1909 allowed the facility to produce blue gas. In 1914 the plant was sold to Empire Gas and Electric Company, and in 1925, New York Central Electric Corporation gained control of the company. The coal gasification operation officially closed in August 1934, and the property is currently the site of a New York State Electric and Gas Corporation (NYSEG) Service Center. The location of the present site buildings and the configuration of former structures is depicted in Figure 3-2.

3.2 Waste Generation

A historical review of the site and its operations revealed that both solid and liquid wastes were disposed of on-site. The solid wastes included iron oxide-impregnated wood shavings from the purification process and tars. These materials were disposed of in a somewhat confined area in the eastern section of the site and covered once yearly with soil. Also disposed of in this area were process waste water and wastes from drip boxes. Coke quench water was initially discharged to the site stream. In 1923, a concrete-lined sludge basin was built to handle the coke quench water prior to discharge; and in 1927, a 336 foot deep injection well was installed at this site to dispose of the quench water. Other liquid wastes appear to have been disposed of in the eastern area of the site.

A brief description of plant operations is presented here, and waste generation processes are summarized diagrammatically in Figure 3-3.



Base Map From USGS Topographic Map

(circle indicates 1 mile radius from site center)

Figure 3-1 Site Location

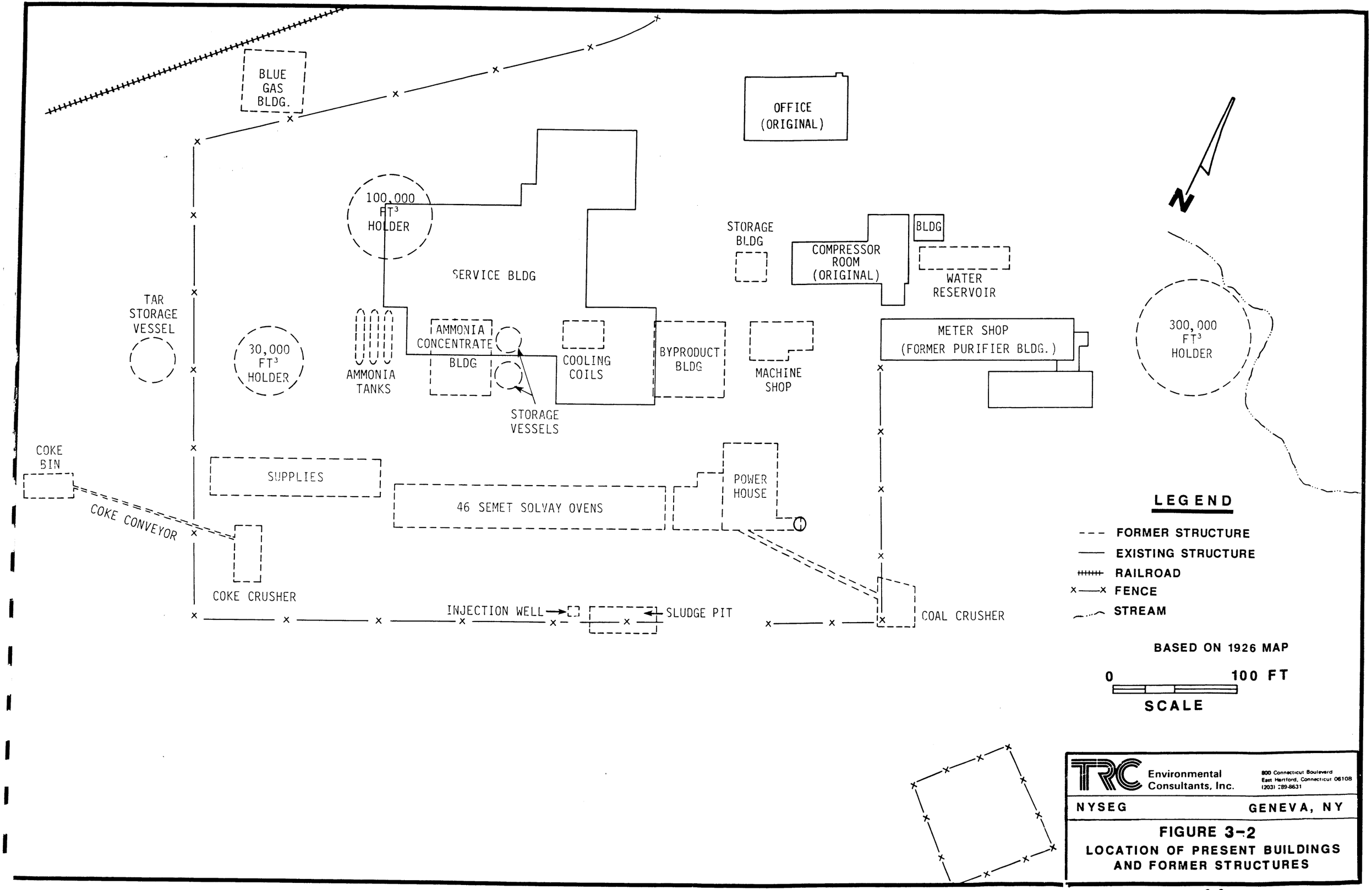


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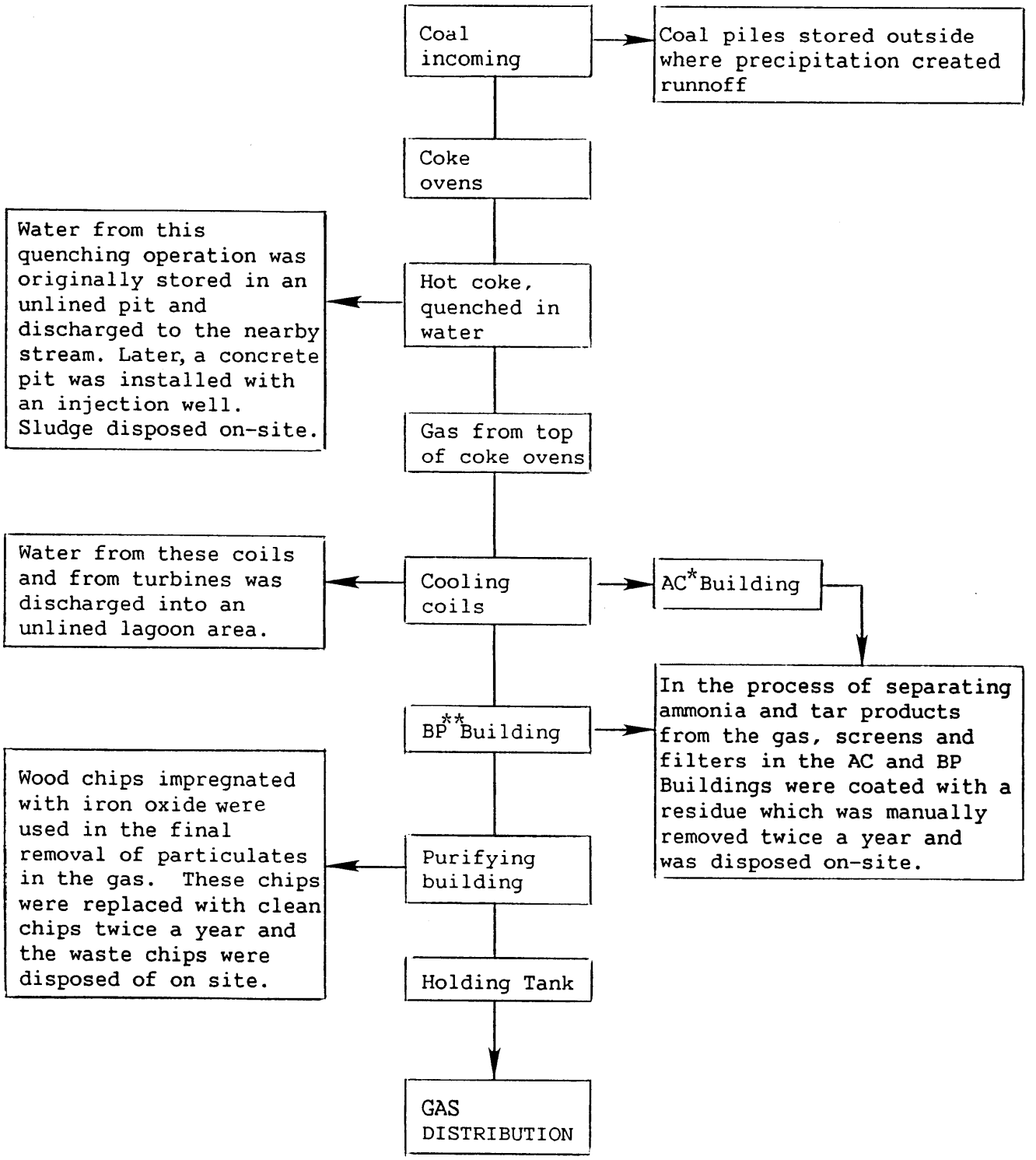
FIGURE 3-2
LOCATION OF PRESENT BUILDINGS AND FORMER STRUCTURES



*AMMONIA CONCENTRATE
**BY-PRODUCT

Figure 3-3 Waste Generation Flow Diagram
Geneva Coal Gasification Plant

Bituminous coal arrived at the site by rail, was stored in piles, crushed, and sent to Semet-Solvay ovens. The coke was pushed out the back of the ovens, quenched by water, graded, and stored in bins until it was shipped by rail.

Gas produced from the heating of the coal was collected from the top of the ovens. The liquid and gas components were separated, and the gaseous portion sent through a series of screens and scrubbers. Tars separated from the gas stream were stored in tanks. Final gas purification occurred in the purifying building and the gas was stored in gas holders prior to distribution.

A small portion of both the solid and liquid wastes generated by the blue gas process were disposed of on-site. Most of the waste materials were collected and sold.

The major source of the solid wastes disposed of on-site was the iron oxide-impregnated shavings from the purifying building. Additional wastes included the tars which accumulated on the wooden and metal screens in the by-product and ammonia concentrate buildings. The majority of these wastes were transported to a disposal area south and southeast of the gas-holder in the eastern portion of the property.

The predominant liquid waste generated at the coke plant was waste water from the coke quenching operation. Initially, this water was discharged to the site stream. However, in 1923 a concrete-lined sludge pit was constructed at the site and the water was pumped to that basin and allowed to separate. The supernatant was discharged to the nearby stream, while the lower liquid layer was pumped into an 8 inch diameter, 336 foot deep injection well.

Other waste water, including discharges from the cooling coils and turbines, was piped to a small holding area from which most of it evaporated. The remainder was discharged to the local stream. Additional sources of liquid wastes were from random tar spillage around the site and from the drip

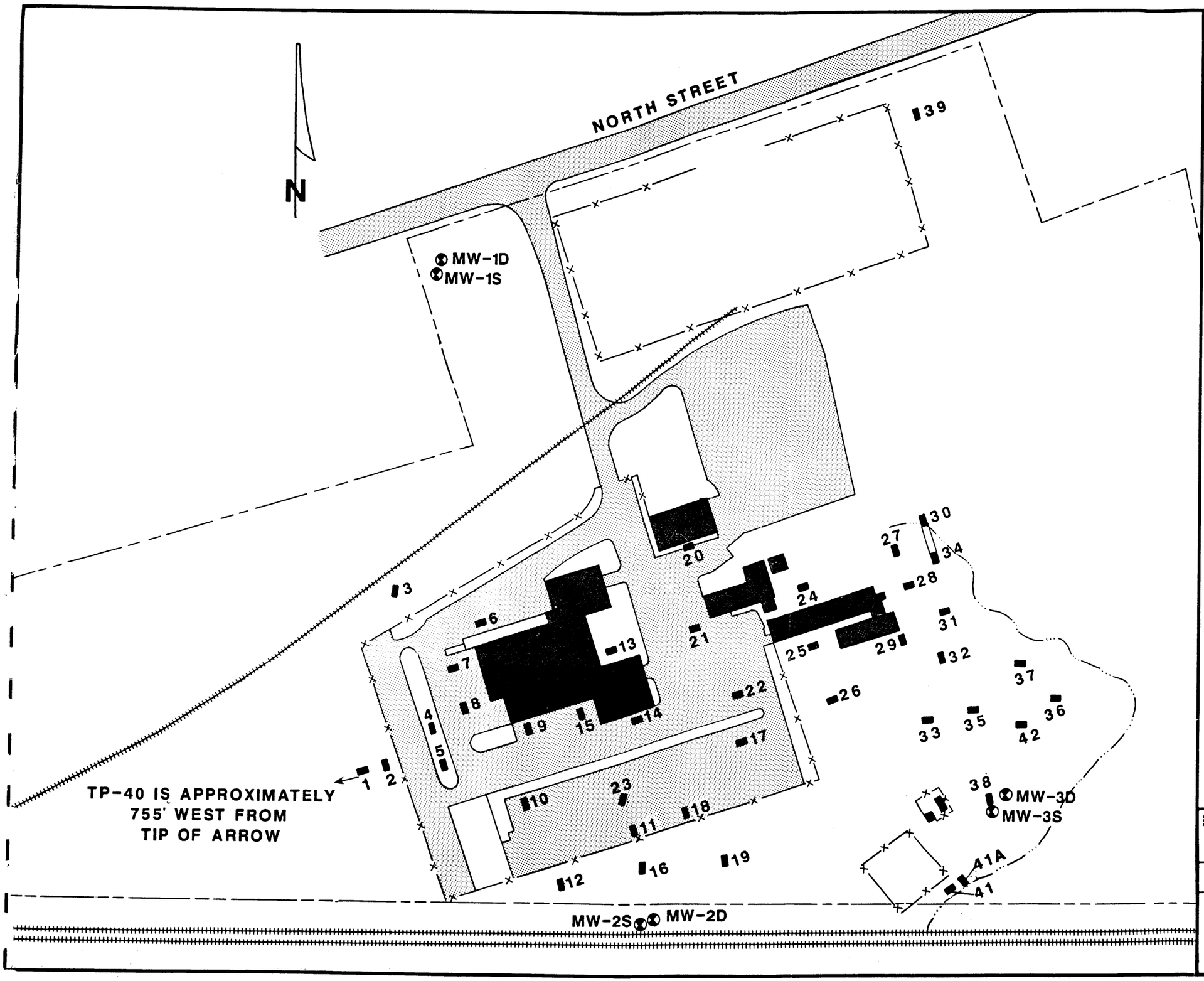
boxes located under equipment or gas lines to collect condensed tar within the system. This latter waste was normally disposed of in the sludge pit, or in the previously described disposal area.

3.3 Summary of Previous Studies

Three phases (tasks) of site investigation have been completed for the NYSEG Geneva Site. The results of TRC's Task 1 investigation, a background study including historical research, geophysical work, air quality monitoring, and Woodward-Clyde Consultants' borings, are presented in the Task 1 report and summarized in the Task 2 report. TRC's Task 2 study consisted of: 1) excavating forty-three test pits, 2) drilling six test borings (3 nests of 1 deep and 1 shallow), 3) installing six monitoring wells, and 4) air quality monitoring to determine background conditions as well as the effects of subsurface work on air quality. Soil samples were collected from the test pits and sediment samples were taken from the site streams. Three rounds of ground water and surface water samples were also collected. All samples were analyzed for purgeable aromatics, PAHs, non-chlorinated phenols and inorganics. Figure 3-4 shows the location of the Task 2 test pits, monitoring wells, and surface water and stream sediment sampling points.

The hydrologic setting, based on water table elevation data gathered during the most recent (Round 4) sampling round on December 15, 1986, is shown in Figure 3-5.

A site stratigraphy was documented with data from test pits and boreholes. Task 2 additionally included a qualitative assessment of the potential risk to human health posed by the contaminants at the site. Details of the Task 2 field investigation and results of the chemical analyses can be found in the Task 2 report (TRC, 1987a).



LEGEND

- PAVED AREA
- UNPAVED AREA
- BUILDING
- FENCE
- NYSEG PROPERTY LINE
- STREAM
- TEST PIT LOCATION
- MONITORING WELL LOCATION

0 100 200 FT

SCALE

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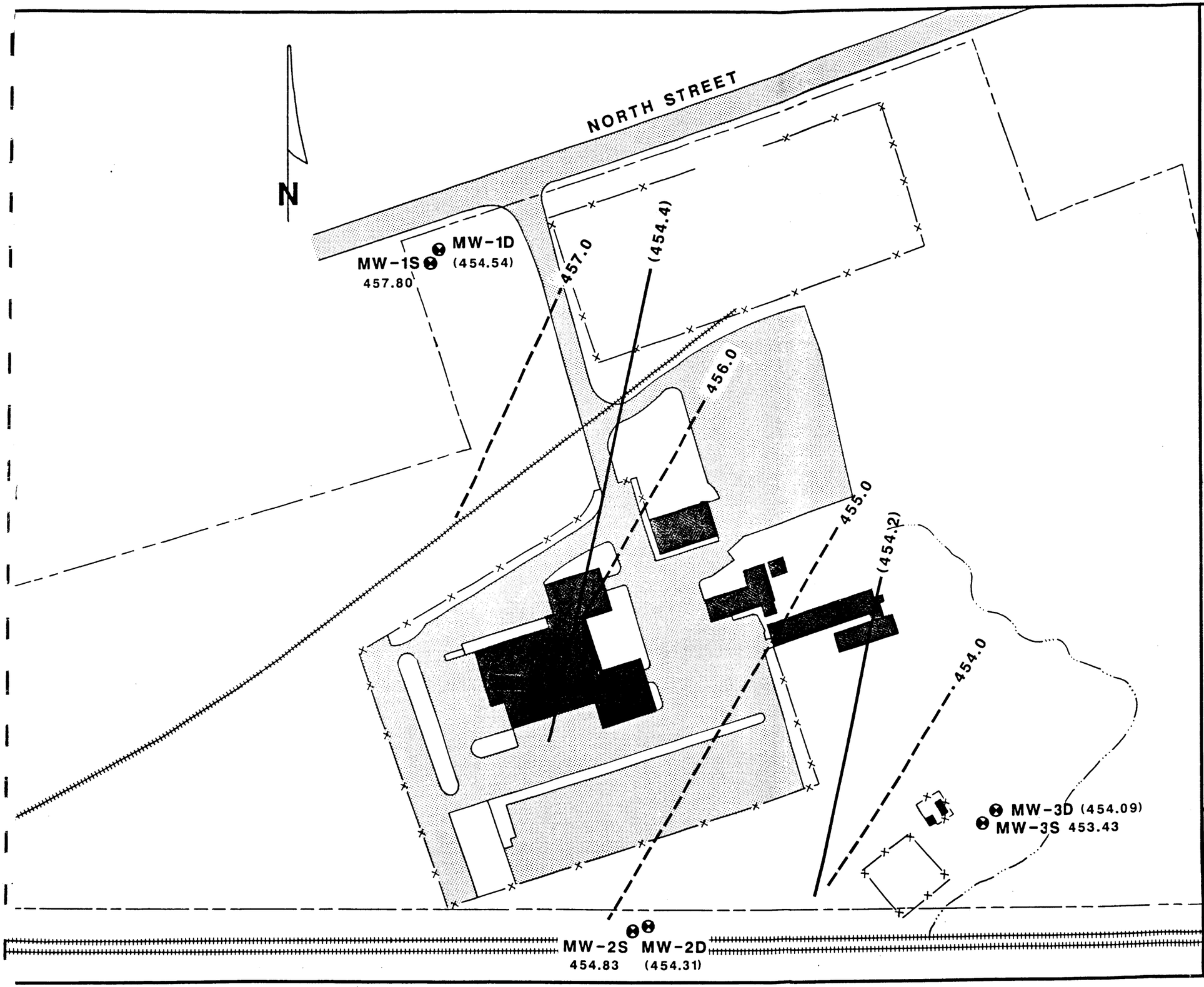
FIGURE 3-4
TASK 2 TEST PIT AND MONITORING WELL LOCATIONS



LEGEND

- PAVED AREA
- UNPAVED AREA
- BUILDING
- FENCE
- NYSEG PROPERTY LINE
- STREAM
- MONITORING WELL LOCATION

WATER LEVEL ELEVATIONS:
ROUND 4 SAMPLING : DEC. 15, 1986

(454.09) ELEVATION IN DEEP WELL

453.43 ELEVATION IN SHALLOW WELL

DEEP WATER CONTOUR

SHALLOW WATER CONTOUR

CONTOUR INTERVALS:

- DEEP - 0.2'
- SHALLOW - 1.0'

0 100 200 FT

SCALE

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FIGURE 3-5

GROUND WATER LEVEL CONTOUR MAP

Findings of the Task 2 field and analytical work include the following:

1) Several plant-related structures and features (such as gas holder foundations and waste disposal areas) were located.

2) Elevated concentrations of coal gas manufacturing residues (e.g., PAHs and ferro-ferric cyanides) were identified in the soil at various points around the site.

3) Coal tar constituents were found in all monitoring wells during at least one ground water sampling round. The New York State total regulated organic compounds standard was not exceeded; however, standards for some individual constituents, e.g., benzene, were exceeded.

4) The shallow and deep ground water flow gradients were found to be to the southeast, toward the eastern site stream.

5) Water and sediment samples from both of the site streams contained PAHs. Concentrations were highest in sediments close to the point where the streams leave the site.

These findings, as well as additional background research, allowed the identification of the following potential human health concerns:

1) Potential direct contact and inhalation risk to workers doing subsurface work (and to a much lesser degree, visitors to the site during this work).

2) Inhalation exposure to workers in crawl spaces and basements of on-site buildings.

3) Potential direct contact risk to people using Seneca Lake Park facilities.

4) Possible contamination of ground water.

The Task 3 field work was based on data requirements developed from the Task 2 findings and the need to provide more detailed information for risk assessment and identification of remedial alternatives. Details of the field activities are described in the Task 3 Field Work Plan (Appendix H of the Task 2 report).

The Task 3 data acquisition objectives included obtaining more detailed information on:

1) the vertical and areal extent of soil contamination,

2) the off-site migration of constituents, and

3) the presence or absence of organic vapors in crawl spaces beneath site buildings.

Results of the Task 3 work are presented in TRC (1987b).

Based on a review of the Task 2 and Task 3 data, a decision was made to collect additional data on indoor air quality. This sampling effort was carried out in April 1988 and focused on specific volatile and semivolatile organic chemicals (benzene, naphthalene, and phenol). Results of this air monitoring sampling effort are presented in Appendix D.

All data used in the Health and Environmental Assessment are presented in the appendices of this report.

4.0 HAZARD IDENTIFICATION

4.1 Imminent Hazards

Based on sampling at the site and several site visits, there do not appear to be imminent hazards related to acutely toxic chemicals, reactive chemicals, fire or explosion. There is no evidence of active seeps of coal tar products into either the easterly or westerly site streams or into Seneca Lake.

4.2 Preliminary Risk Assessment

A preliminary risk assessment was carried out as part of the Task 2 report. This preliminary assessment served as a basis for developing exposure scenarios and identifying information needs prior to performing the quantitative risk assessment. Because the findings of the Preliminary Risk Assessment were largely qualitative in nature, the preliminary conclusions made concerning exposure are appropriately qualified. The major findings of the preliminary risk assessment include:

1) At the Geneva site, the constituents that may currently pose a health risk to potential receptors were originally deposited in the soil.

2) The fate of wastes disposed of via the injection well cannot be determined with accuracy; however, in the opinion of TRC's geologists (see Appendix C) it is concluded that, given the amount of time since the injection last occurred (1934) and the knowledge that subsurface flow is toward and into Seneca Lake, this wastewater has probably reached the lake via deep ground water discharge.

3) Direct runoff may be carrying constituents and particles with constituents adsorbed to them into the stream sediment and water. Both the shallow and deep ground water flow is toward the eastern site stream. Constituents can be leached from the source areas by both infiltrating precipitation and ground water and then transported to the stream.

4) The drainage pipe which enters the western stream may be acting as a pathway for both dissolved constituents and those adsorbed on soil particles entering that stream.

5) Off-site migration of constituents via the two site streams may be occurring. Both streams leave the site through culverts which pass beneath routes 5 and 20, and enter Seneca Park. They flow above ground, first on a natural stream bed and then in an open, lined culvert, for a short distance before entering closed culverts which enter the lake.

6) The constituents entering the ground water are most likely being leached from source areas by infiltrating precipitation. As was noted earlier, concentrations of these constituents decreased when recharge rates were slowest and the ground water table lowest.

7) Volatilization may transport constituents at the site if subsurface soils are disturbed. However, under normal conditions this mechanism does not appear to contribute significantly to the dispersion of volatile organic compounds at the site. (In the quantitative risk assessment, movement of soil gas into buildings is considered as a primary exposure route).

8) Transportation of constituents via adsorption on dust particles also is a potential mechanism, but is not considered to be a problem at this site because of the normally moist conditions at the unpaved regions of the site. Most of the site around the plant buildings is paved. (The exceptions to this are the scenarios where workers are involved in excavations on-site.)

Receptors Identified in Preliminary Assessment

Potential receptors of coal tar constituents originating at the Geneva Site include on-site workers (and to a lesser extent, site visitors) and persons using the Seneca Park facilities. Workers may be exposed through inhalation of volatile components or dust, or through direct skin contact with some constituents. This risk is greatest when excavation work is being performed.

The site streams may be providing a pathway for constituents to move off-site, into Seneca Lake Park. Of particular concern would be those in the stream and lake bed sediments. If this is the case, there is a potential direct contact risk to persons using the park facilities.

Since there are no known domestic wells downgradient of the site, exposure through ingestion of ground water is not thought to be a concern. However, it

is New York State's policy to treat all aquifers (except brine waters) as potential sources of potable water.

4.3 Selection of Chemicals of Interest

This section of the Health and Environmental Assessment establishes a list of contaminants that will be evaluated individually and collectively for the whole site with regard to their health and environmental effects. In this section, we described the selection of a set of compounds -- known as Chemicals of Interest -- to be studied throughout all parts of the assessment and for all media and for all exposure pathways. The selection procedure for these chemicals identifies the "most important" ones present at the site, based on the following factors:

- spatial extent, overall quantity, and maximum concentrations in each medium as revealed by monitoring data;
- past disposal practices for all waste streams, including the hot coke quench water;
- routes of human exposure to contaminants in air, soils, ground water, surface water, sediments;
- bioaccumulation in fish tissue;
- chronic toxicities of the chemicals via these transport routes with special emphasis placed on potential carcinogens. Information from the monitoring data is combined with (i) Acceptable Daily Intake values (ADIs) and Acceptable Intake - Chronic values (AICs) for non-carcinogens and (ii) Cancer Potency Factors (CPFs) for carcinogens to evaluate preliminarily the relative risks posed by the chemicals. In all cases, each chemical that is an EPA or International Agency for Research on Cancer (IARC) Group 1 (known human carcinogen) or Group 2 (probable human carcinogen) will be included as a Chemical of Interest;
- environmental persistence, medium-specific mobility, and ability to bioaccumulate; and
- exceedances of environmental standards.

Based upon all the above considerations, the following groups of chemicals were selected for the risk assessment: polynuclear aromatic hydrocarbon (PAH) compounds, phenolic and volatile organic compounds, and selected inorganic contaminants. These constituents are presented below.

The following eight PAH compounds identified at the site are considered to be potentially carcinogenic by the EPA and are thus evaluated as a group:

benzo(a)pyrene,
benzo(a)anthracene,
benzo(b)fluoranthene,
benzo(k)fluoranthene,
indeno(1,2,3-cd)pyrene,
chrysene,
dibenzo(a,h)anthracene,
benzo(g,h,i)perylene.

Eight other PAH compounds identified at the site are not considered potentially carcinogenic by the EPA. These compounds are evaluated together with the aforementioned PAH compounds with regard to potential systemic health effects because of the chemical similarity among these compounds. The following eight PAH compounds are assumed to act additively with the previously listed compounds:

naphthalene,
fluorene,
anthracene,
phenanthrene,
fluoranthene,
pyrene,
acenaphthylene,
acenaphthene.

Benzene is the only volatile organic compound (VOC) on-site which is considered to be potentially carcinogenic and is therefore evaluated as a carcinogen in this report.

Several additional VOCs (e.g., ethylbenzene, toluene) were observed at the site. These were assumed to act additively and therefore were combined (sum of 8 VOCs) and evaluated with regard to systemic health effects.

A number of non-chlorinated phenolic compounds were present at elevated concentrations and are included among the Chemicals of Interest. None of the following are identified by the EPA or IARC as being potentially carcinogenic and all were evaluated with respect to possible systemic health effects:

2,4-dimethylphenol,
2-nitrophenol,
4-nitrophenol,
2,4-dinitrophenol,
2-methyl-4,6-dinitrophenol,
phenol,
total phenol.

Analyses for a relatively large number of inorganic compounds (metals, in particular) were conducted. Results of these analyses were compared to ground water and surface water standards (TRC, 1987a) and to soil "action" or "guidance" levels developed by the State of New Jersey and the Ontario government (in the absence of similar values for New York State). Based on these evaluations and comparisons, the following inorganic chemicals are included as Chemicals of Interest:

antimony,
arsenic,
cadmium,
lead,
total cyanide,
ferro-ferric cyanide (as CN).

The metal arsenic is considered by the EPA and IARC as a potential carcinogen. All other inorganic compounds are evaluated with regard to potential systemic effects.

4.4 Presentation of Data by Zones

The site was divided into zones associated with each estimated exposure scenario. The Geneva Site is far from homogeneous with respect to natural features or the distribution of contaminants. For example, the Task 2 Report presented and summarized the monitoring data according to where it was collected; i.e., (i) the holder/storage areas, (ii) the east side of the site/disposal areas, (iii) the oven area, (iv) the building areas, and (v) the streams. Working from this initial disaggregation, data were selected for the exposure analyses. These data are presented in Appendices A, B, and C as they relate to specific exposure scenarios. In general, the data are used to estimate mean or worse case exposures.

5.0 DOSE/RESPONSE ASSESSMENT

5.1 Toxicity and Environmental Profiles

Information on the Chemicals of Interest is summarized in Appendix A. This appendix provides the basic physical, chemical, and toxicological data used in assessing health and environmental effects.

As discussed in Section 4, a number of the chemicals on-site are potential carcinogens. These include a number of the PAH compounds, the VOC benzene, and the metal arsenic. For these chemicals, exposures to low doses are evaluated by estimating the potential cancer risks. The EPA has developed Cancer Potency Factors for the following chemicals: B(a)P, benzene, and arsenic. (Note: arsenic is currently undergoing review.)

Most of the potential carcinogens at the site are PAHs. At present, the EPA has published a potency factor for only one of these, B(a)P. (Note: EPA is currently reevaluating this potency factor number and may be adopting an approach essentially similar to that used in this analysis.) In estimating the risks associated with other carcinogenic PAH compounds, B(a)P is often used as a surrogate for the other compounds. It is well recognized that this will overestimate the risks, because B(a)P is one of the most potent chemicals among carcinogenic PAHs. Several groups have been working toward developing relative potency values for other PAH compounds. Chu and Chen (1984), members of of EPA's Cancer Assessment Group (CAG), have carried out an evaluation and estimation of potential carcinogenic risks of PAHs. They point out the limitations of existing and proposed approaches.

Most recently ICF Clement Associates (1987) has conducted an analysis and prepared a report on the potencies of various PAH compounds relative to B(a)P. A distinctive feature of this work is that it presents a biological basis for carcinogenic processes and develops a predictive model based on this

underlying mechanism. The analysis presented here has utilized the point estimates of potency for B(a)P from the ICF Clement model and the relative potencies estimated by ICF Clement for other potentially carcinogenic PAH compounds.

Because B(a)P has often been used as a surrogate for other carcinogenic PAH compounds, we have conducted selected sensitivity analyses to illustrate how the estimate of risks would change if the existing 95% upper limit of risk for B(a)P (as calculated by the EPA) was used as a surrogate for other PAH compounds. Additional sensitivity analyses were conducted to evaluate how the risk estimates are affected by using the EPA potency factor for B(a)P and the relative potency values developed by Chu and Chen (1984).

With regard to non-carcinogens, this report uses the Acceptable Intake Chronic number (AIC) or risk reference dose (RfD) as benchmarks for assessing the potential for non-carcinogenic health effects. These values are presented in Appendix A. The AIC or RfD numbers are "threshold" health effects values below which no effects are expected. To ensure that these benchmarks are set low enough, uncertainty in the supporting data base is taken into account through the application of uncertainty or safety factors.

The AIC and RfD values presented in Appendix A were derived either by the EPA (published values) or by consultants (e.g., Environ) by examining the various studies on the chemical and determining the "No-Observed-Adverse-Effect-Level" commonly referred to as a NOAEL. However, the agency or consultants following agency policy do <u>not</u> simply use the NOAEL, but develop from it a risk reference dose or safe threshold by dividing the NOAEL by a safety factor, resulting in a much lower concentration for the purpose of defining an AIC or RfD. The AIC (or RfD) has been viewed as the amount of a chemical to which a person can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect.

Generally, the safety factors used in deriving an AIC consist of multiples of 10. Each factor represents a specific area of uncertainty inherent in the available data. For example, a safety factor may be developed by taking into account: 1) the expected differences in responsiveness between humans and animals (a factor of 10 applied here), 2) variability among individuals within the human population (a second factor of 10 applied here), and 3) a sparse data base (a third factor of 10). The result is that for many chemicals the AIC is calculated to be 100x less than the NOAEL and for some as much as 1000x less. In the case of the estimated RfD values for PAH compounds (calculated by Environ in a draft report), this uncertainty level (margin of safety) is on the order of 1000.

Because of the margin of safety built into the AIC value, exceedance of the number has no immediate real meaning with regard to specific health effects, the frequency of effects, or the magnitude of effects. However, exceedance of the number should serve as an indicator that the potential for unacceptable exposure does exist and precautions should be taken to limit exposure. In the case of occupational settings, the estimated or measured exposure concentrations should also be compared to applicable OSHA standards.

The carcinogenic potency factors and AIC (RfD) values used in this risk assessment are summarized in Table 5-1.

5.2 Applicable Standards and Guidelines

This section of the Risk Assessment provides information on regulatory standards and guidelines developed by US EPA and the State of New York concerning the Chemicals of Interest (summarized in Table 5-2). In addition to the guidelines provided in Table 5-2, the state regulated total organic compounds in ground water at a level of 100 ug/l. Results of Task 2 and

Table 5-1. Cancer potency factors and Acceptable Chronic and Short-Term (AIC, AIS) values (RfD values) used in this risk assessment.

Chemical of Interest	Oral AIS (mg/kg/d)	Oral AIC (mg/kg/d)	Inhale AIS (mg/kg/d)	Inhale AIC (mg/kg/d)	Oral CPF (mg/kg/d)-1	Inhale CPF (mg/kg/d)-1
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	*	0.01**	*	0.01**	5.7400	.4533
benzo(a)anthracene	*	0.01**	*	0.01**	.8323	.0657
benzo(b)fluoranthene	*	0.01**	*	0.01**	.8036	.0635
benzo(k)fluoranthene	*	0.01**	*	0.01**	.3788	.0299
indeno(1,2,3-cd)pyrene	*	0.01**	*	0.01**	1.3317	.1052
chrysene	*	0.01**	*	0.01**	.0253	.0020
dibenzo(a,h)anthracene	*	0.01**	*	0.01**	6.3714	.5032
benzo(ghi)perylene	*	0.01**	*	0.01**	.1263	.0100
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	*	.005000	*	.005000		
fluorene	*	.005000	*	.005000		
anthracene	*	.000557	*	.000557		
phenanthrene	*	.007000	*	.007000		
fluoranthene	*	.020000	*	.020000		
pyrene	*	.015000	*	.015000		
acenaphthylene	*	.010000	*	.010000		
acenaphthene	*	.200000	*	.200000		
VOC Compounds Considered Potentially Carcinogenic						
benzene					.0520	.0260
VOC Compounds Not Considered Potentially Carcinogenic						
sum of 8 VOCs						
Non-Chlorinated Phenols						
2,4-dimethylphenol	*	.002000	*	.002000		
2-nitrophenol	*	.002000	*	.002000		
4-nitrophenol	*	.002000	*	.002000		
2,4-dinitrophenol	*	.002000	*	.002000		
2-methyl-4,6-dinitroph	*	.002000	*	.002000		
phenol	.100000	.100000	.190000	.020000		
total phenol	*					
Inorganic Compounds						
antimony	*	.000400	*	.000400		
arsenic					15.0000	50.0000
cadmium	*	.000290	*	.000290	NA	6.1000
lead	*	.001400	*	.000430		
total cyanide	*	.020000	*	.020000		
ferro-ferric cyanide (	*	.020000	*	.020000		

* In general the short-term AIS can be estimated at about 10x the AIC value.
** these numbers were estimated based on the AIC avlues observed for non-carcinogenic PAH compounds (from Environ draft report).

Table 5-2. Regulatory criteria and guidance levels for chemicals of interest. Water values are in ug/l.

Chemical or Group	EPA-MCL	EPA-MCLG	TCLP Levels (1b)	1-day HA for Child	10-day HA for Child
	WATER	WATER	WATER (proposed)	WATER (HA = EPA Health Advisory)	WATER
all units in ug/l					
Monocylic Aromatics					
Benzene	5 (1a)	0	70	223	223
Ethylbenzene		680		21,000	2100
Toluene		2000	14,400	18,000	6000
Xylenes		440		12,000	7800
Polycyclic Aromatics					
Acenaphthene					
Acenaphthylene					
Anthracene					
Benzo(a)anthracene					
Benzo(a)pyrene					
Benzo(b)fluoranthene					
Benzo(g,h,i)perylene					
Benzo(k)fluoranthene					
Chrysene					
Dibenzo(a,h)anthracene					
Fluoranthene					
Fluorene					
Ideno(1,2,3-c,d)pyrene					
2-methylnaphthalene					
Naphthalene					
Phenanthrene					
Pyrene					
PAH chemicals					
Phenolics					
2-methylphenol					
4-methylphenol					
o-Cresol			10,000		
p-Cresol			10,000		
Phenol			14,400		
Inorganics					
Antimony					
Arsenic	50	50	5000	50	50
Cadmium	10	5	1000	43	8
Lead	50	20	5000	NA	NA
Total Cyanide				220	220

Chemical or Group	Long-term HA for Child	Long-Term HA for Adult	Lifetime HA for Adult	NAWQC a
	WATER	WATER	WATER	WATER Human Health fish consumption only
all units in ug/l				
Monocylic Aromatics				
Benzene	NA	NA	NA	40 (2)
Ethylbenzene	NA	NA	680	3280
Toluene	NA	NA	2000	424,000
Xylenes	7800	27,300	440	--
Polycyclic Aromatics				
Acenaphthene				
Acenaphthylene				
Anthracene				
Benzo(a)anthracene				
Benzo(a)pyrene				
Benzo(b)fluoranthene				
Benzo(g,h,i)perylene				
Benzo(k)fluoranthene				
Chrysene				
Dibenzo(a,h)anthracene				
Fluoranthene				54
Fluorene				
Ideno(1,2,3-c,d)pyrene				
2-methylnaphthalene				
Naphthalene				
Phenanthrene				
Pyrene				
PAH chemicals				0.0311 (2)
Phenolics				
2-methylphenol				
4-methylphenol				
o-Cresol				
p-Cresol				
Phenol				
Inorganics				
Antimony				45,000
Arsenic	50	50	50	0.0175 (2)
Cadmium	5	18	5	
Lead	NA	NA	20	
Total Cyanide	220	750	750	

Chemical or Group	NAWQC b	NAWQC c	NAWQC d	New York(30)	New York(30)
	WATER Human Health drink.water & fish con.	WATER Aquatic Life fresh acute	WATER Aquatic Life fresh chronic	WATER Groundwater	WATER Surface Water potable
all units in ug/l					
Monocylic Aromatics					
Benzene	0.66 (2)	5300 (4)		ND(standard)	1 (guidance)
Ethylbenzene	1400	32,000 (4)		50 (guidance)	50 (guidance)
Toluene	14,300	17,500 (4)		50 (guidance)	50 (guidance)
Xylenes	--			50 (guidance)	50 (guidance)
Polycyclic Aromatics					
Acenaphthene		1700 (4)	520 (4)	20 (guidance)	20 (standard)
Acenaphthylene				(13)	
Anthracene				50 (guidance)	50 (guidance)
Benzo(a)anthracene				0.002 (guidance)	0.002 (guidance)
Benzo(a)pyrene				ND (standard)	0.002 (guidance)
Benzo(b)fluoranthene				0.002 (guidance)	0.002 (guidance)
Benzo(g,h,i)perylene				(13)	(13)
Benzo(k)fluoranthene				0.002 (guidance)	0.002 (guidance)
Chrysene				0.002 (guidance)	0.002 (guidance)
Dibenzo(a,h)anthracene				(13)	
Fluoranthene	42	3980 (4)		50 (guidance)	50 (guidance)
Fluorene				50 (guidance)	50 (guidance)
Ideno(1,2,3-c,d)pyrene				0.002 (guidance)	0.002 (guidance)
2-methylnaphthalene				(13)	
Naphthalene		2300 (4)	620 (4)	10 (guidance)	10 (standard)
Phenanthrene				50 (guidance)	50 (guidance)
Pyrene				50 (guidance)	50 (guidance)
PAH chemicals	0.0028 (2)			(13)	
Phenolics					
2-methylphenol				(13)	
4-methylphenol				(13)	
o-Cresol				(13)	
p-Cresol				(13)	
Phenol	3500	10,200 (4)	2560 (4)	1 (standard)	1 (standard)
Inorganics					
Antimony	146	9000 (4)	1,600 (4)	3 (guidance)	3 (guidance)
Arsenic	0.0022 (2)	360 (trivalent)	190 (trivalent)	25 (standard)	50 (standard)
Cadmium	10	3.9 (5)	1.1 (5)	10 (standard)	10 (standard)
Lead	50	82 (5)	3.2 (5)	25 (standard)	50 (standard)
Total Cyanide	200	22	5.20	200 (standard)	100 (standard)

Chemical or Group	New York(30)	OSHA	ACGIH	ACGIH	N.Y. Stat
	WATER	AIR	AIR	AIR	AIR
	Aquatic Life	Air	Air	Air	Air
	freshwater	8-hr TWA	TLV	STEL	AAL
all units in ug/l		ppm	ppm	ppm	ug/m3
Monocylic Aromatics					
Benzene		10	10	25	100
Ethylbenzene			100	125	1450
Toluene		200	100	150	7500
Xylenes		100	100	150	1450
Polycyclic Aromatics					
Acenaphthene					
Acenaphthylene					
Anthracene					
Benzo(a)anthracene			200 ug/m3 (12)		
Benzo(a)pyrene			200 ug/m3 (12)		
Benzo(b)fluoranthene					
Benzo(g,h,i)perylene					
Benzo(k)fluoranthene					
Chrysene					
Dibenzo(a,h)anthracene					
Fluoranthene					
Fluorene					
Ideno(1,2,3-c,d)pyrene					
2-methylnaphthalene					
Naphthalene		10	10	15	166.70
Phenanthrene					
Pyrene					
PAH chemicals		150 ug/m3 (13)	200 ug/m3 (12)		
Phenolics					
2-methylphenol					
4-methylphenol					
o-Cresol					73
p-Cresol					73
Phenol	5 (standard)				10
Inorganics					
Antimony					
Arsenic	190-360 (standard)		200 ug/m3		0.67
Cadmium	1.1-3.9 (5)				2
Lead	3.2-82 (5)				
Total Cyanide	5.2-22 (standard)	5000 ug/m3			16.70

Footnotes for Table 5-2.

(1a) EPA MCL is proposed;
(1b) TCLP = Toxic Characteristics Leaching Procedure
(2) Based on carcinogenic risk of 10E-6;
(3) Applicable to a 40 Kg. child;
(4) Insufficient data to develop criteria- Lowest Observed Effect Level;
(5) Hardness dependent criteria- 100 mg/L used;
(5a) Hardness dependent: first value hardness< 75 ppm, second value hardness>75 ppm;
(6) Inhalation route;
(7) Mercury (alkyl);
(8) Mercury (inorganic);
(9) Vapor or fumes;
(10) Mist or dust;
(11) AAL- Acceptable Ambient Levels - New York is one of a few states that has developed such guidelines.
(12) Coal Tar Pitch Volatile Occupational Standard.
(13) This limit was developed for Coke oven emissions.

Task 3 analyses have been compared to the above numbers and the details of such comparisons can be found in those reports (TRC, 1987a, 1987b). Below is a summary of the findings from these comparisons.

Ground Water

The ground water quality was compared to New York State standards and guidance values for class GA ground water. Class GA waters are those which can be used for a potable water supply. Although the ground water downgradient of the site is not being used as a drinking water supply, new NYDEC policy is to evaluate all ground waters as though they are class GA. Studies conducted under Task 2 and 3 indicated that:

1) no samples exceed the total regulated organics value of 100 ug/l;

2) ground water standards or guidance values are exceeded for all six monitoring wells during at least one sampling round; exceedances are most common for the two shallow downgradient wells (MW-2S and MW-3S); chemicals observed to exceed either NYS standards or guidance values include benzene, B(a)P and other PAH compounds, phenols, and a few metals (including antimony, arsenic, cadmium, and lead).

Surface Water (Stream)

The standards and guidance values used to evaluate the site streams are those for Class C (secondary contact recreation and fishing) waters. This is because New York State is currently in the process of upgrading all streams within the State to Class C. The following observations were made:

1) NYS Class C water quality criteria levels of the following chemicals were exceeded on one or more sampling dates - dichlorobenzene, phenol, iron, zinc, and total cyanide.

2) The U.S. EPA has developed criteria for surface water quality and has published freshwater aquatic life toxicity values for several compounds (EPA, 1986). As noted earlier, these are not regulatory values, but can be used as an aid in developing regulatory

criteria. All samples contained concentrations below the above-mentioned toxicity values. Nearly all samples exceeded the New York State standard for iron (0.3 mg/l) and the EPA iron criteria value of 1.0 ppm.

Air Quality

The following observations were made during the site investigation:

1) None of the air samples collected exceeded either OSHA standards or ACGIH TLVs for Chemicals of Interest.

2) In order to regulate the more general situation of annual average ambient concentrations , NYDEC has developed acceptable ambient levels (AALs - presented in Table 5-2) for compounds classified as high and moderate toxicity air contaminants. AALs are calculated by dividing a given compound's TLV by 300. Two of the Organic Vapor Dosimeter (OVD) samples exceeded the AAL for benzene (0.1 mg/m^3). However, the subsurface work which was being conducted while these OVDs were worn would be expected to have only short term impacts on the air quality and not significantly affect the long term ambient conditions.

Additional investigations were carried out in the Service Building as part of an industrial hygiene air quality survey. Results revealed the presence of selected compounds often associated with office operations. None of the Chemicals of Interest were reported to be present in these studies. However, the detection limits reported in this survey for Chemicals of Interest were 1 ppm. As noted in Appendix A and the Task 2 and 3 reports, measurements with a Photoionization Detector (PID) revealed the presence of VOCs (in excess of 1 ppm) in most of the buildings and beneath the Compressor Building. It is not possible to interpret the results of these measurements without more definitive data on the composition of the volatiles. Based on discussions with several state agency personnel involved in routine air quality surveys of indoor air, it is not unusual to obtain these kinds of readings under normal office operating conditions. Thus, the mere presence of VOCs in indoor air is not by itself instructive with regard to potential risks posed by site Chemicals of Interest.

To reduce the uncertainty regarding the composition of volatile organic chemicals within buildings and the potential that some fraction of these may be derived from underlying soil or ground water, an indoor air monitoring program was carried out in April 1988. The details of the survey and results are presented in Appendix D.

6.0 EXPOSURE ASSESSMENT

6.1 Development of Exposure Scenarios

The most critical aspect of a technically sound exposure assessment is the identification of exposure routes, together with the identification of human and non-human receptors. A number of exposure pathways exist at the site. The existence and relative importance of pathways also may change with changes in site use and conditions. Thus, this section clearly articulates the conditions for which the exposure estimates are being made.

The Preliminary Risk Assessment prepared under Task 3 of the NYSEG Program for the Geneva Site provided a starting point for the development of site-specific exposure scenarios. Additional discussions with NYSEG staff members served to identify and characterize on-site exposure scenarios. Based on the Preliminary Risk Assessment, discussions with NYSEG, and a review of information for the site and surrounding areas, twelve exposure scenarios were developed for the purpose of estimating risks. Five of these (Scenarios 1 through 5) relate to indoor exposures received by on-site workers performing routine work in various buildings on the site. Here the number of scenarios reflect the different buildings or building areas on-site. These include: the Service Building, the garage in the Service Building, the Corporate Meter Building, the Compressor Building, and the East Office Building.

Four scenarios (6 through 9) relate to workers exposed to chemicals during excavation or construction. These were developed based on information provided by NYSEG on planned construction or possible maintenance activities at the site. These include: the placement of a new water line along the main access way to the Service Building, the construction of a new entrance and elevator for the Service Building, general maintenance of underground gas utility lines, and, maintenance of gas lines located in the area exhibiting high concentrations of Chemicals of Interest in soils.

Three of the exposure scenarios (10 through 12) involve off-site receptors. These include: children that may trespass on unfenced NYSEG property and visit the easterly site stream area, people visiting the state park located between the site and Seneca Lake, and people drinking water and/or eating fish from Seneca Lake. Environmental receptors (plants and animals) were also considered as part of these scenarios. An additional exposure route that is discussed in this report concerns users of ground water. This is discussed as a separate case because there are no direct human receptors. However, shallow on-site ground water discharges to the easterly site stream and is considered in the evaluation of that site stream; deep ground water probably discharges directly to Seneca Lake and has been considered in connection with possible effects associated with drinking water or fish ingestion.

Each scenario includes particular potential "receptor populations" and a consideration of the pathways by which those receptors may encounter Chemicals of Interest related to the presence of waste residuals at the site. The values and assumptions used for each exposure scenario were prepared after discussion with NYSEG managers and in keeping with generally accepted values in the discipline of risk assessment; the values are not based on detailed study of employment records or on time-budgets for the different groups of workers considered.

The exposure scenarios are described in general below. Specific assumptions and details for each exposure scenario are presented in Appendices A to C.

Scenario No. 1: People Working in Offices in the Service Building

This scenario includes approximately 50 office workers who work primarily indoors. The exposure route evaluated for this group is the movement of

volatile soil gasses from the surrounding soils, through cracks and voids in the concrete slab foundation of the building, and into the office space. Since air monitoring data from inside the building revealed no detectable concentrations of benzene, values of one-half the detection limit) were utilized to estimate the possible concentrations of benzene; these data were also used in conjunction with models to bound air concentrations of other volatile organic compounds observed in soils in the immediate vicinity of the building.

Scenario No. 2: People Working in Garage in the Service Area

This scenario includes a work pool of nine people (3 on day shift and 6 on night shift) who are involved in garage work. The exposure route evaluated for this group is the movement of volatile soil gasses from the surrounding soils, through cracks and voids in the concrete slab foundation and into the garage. Air monitoring data (one-half the detection limit) together with models were used to bound concentrations of volatile organic chemicals as described for Scenario 1.

Scenario No. 3: People Working in Corporate Meter Building

This scenario includes a work pool of six people who work indoors servicing meters. The exposure route evaluated for this group was the movement of volatile soil gasses into the space beneath the building and then through small cracks and spaces in the floor of the building. Air monitoring data from within the building (one-half the detection limit) were used as well as data that reflect soil conditions in the immediate area of the building.

Scenario No. 4: People Working in Compressor Building

This includes a few people who work intermittently in the building. Again, the exposure route that was evaluated was the migration of soil gas

into the building through the floor. The primary data set used was for soils in the immediate vicinity of the building and air measurements made within and beneath the building.

Scenario No. 5: People Working in East Office Building

This includes a pool of about 12 people who are involved in office work. Other individuals may receive training in the classrooms located on the second floor of the building. Here again, the exposure route evaluated was the intrusion of soil gas into the building through the floor. The primary data set used was for soil in the immediate vicinity of the building and indoor and outdoor air measurements.

Scenario No. 6: People Excavating the New Water Line along Main Access Road

At present there are plans to install a new water line along the main access road. This would involve excavation. The potential for exposures of construction workers to Chemicals of Interest was, therefore, evaluated for this specific activity. The exposure routes considered in this evaluation included: inhalation of gasses released from the soil, inhalation of fugitive dusts generated by the excavation, incidental ingestion of dusts or soils by the workers, and dermal penetration from direct contact with dust or soil. The data sets used for these evaluations included soil data from borings made along the main access road.

Scenario No. 7: People Performing New Construction (Superstructure)

There is a tentative plan to construct a new entrance and elevator for the Service Building. Based on previous experience, it is estimated that approximately 10 people would be involved in this construction activity. The

work would involve excavation. Therefore, the following potential exposure routes associated with excavation are included in the analysis: inhalation of gasses released from the soil, inhalation of fugitive dusts generated by the excavation, incidental ingestion of dusts or soils by the workers, and dermal penetration from direct contact with dust or soil. The primary data set used for the analysis was taken from two test pits in the immediate vicinity of the proposed area of construction.

Scenario No. 8: People Excavating for Maintenance of Gas Utility Lines

The site contains a number of gas utility lines. Based on previous experience in conducting risk assessments at similar sites, it is anticipated that these will require maintenance from time to time. Based on experience, it was estimated that approximately three people would be involved in this activity and that repair activity would be required somewhere on-site once every five years. The exposure routes considered are the same as those noted above for other excavation-related activities. The primary data set included all the test pit data with the exception of those test pits that were clearly outside of the immediate plant/gas line area. A "worst case" exposure analysis for this case was carried out under Scenario No. 9 below.

Scenario No. 9: People Excavating for Maintenance of Gas Utility Lines Near Test Pit 1

Test Pit 1 was located near gas lines and had a relatively high degree of contamination in the soils. Therefore, this exposure scenario was viewed as a "worst case" from the standpoint of acute exposures of maintenance workers to site Chemicals of Interest. Routes of exposure are the same as for other excavation-related activities. The primary data set used was for Test Pit 1.

Scenario No. 10: Children Trespassing on NYSEG Property in the Vicinity of the Eastern Site Stream

The area of the eastern site stream is not fenced and access can be gained from walking down the railroad tracks. However, the area does not offer a direct access route for children walking from home to school or from their homes to and from Seneca Lake State Park. Therefore, children are not expected to frequent the site area as a result of routine travel to and from places of interest. Because the state park is separated from the site area by routes 5 and 20, children playing in the park are not expected to visit the easterly site stream on NYSEG property as part of a visit to the park. Further, the marshy and densely vegetated easterly site stream area is not considered to be particularly attractive to children. For all the reasons given above, children would be expected to visit the site stream area, if at all, only a few times in their lifetimes. Such an exposure scenario is included here because it is acknowledged that the area may be visited from time to time. However, to reflect the expected infrequent occurrence, it was assumed that children may make five visits to the site during their childhood and early teen years. Exposure routes considered include dermal contact with soil and incidental ingestion of soil. The primary data set considered included surface soil data for the eastern site stream area.

Scenario No. 11: Visitors to Seneca Lake State Park

This scenario includes exposure of park visitors to contaminants that may have been transported to the park in the easterly site stream. The scenario assumes that individuals will spend time exploring or otherwise playing in the site stream as it passes through the park.

Scenario No. 12: Seneca Lake Receptors

Receptors considered under this exposure analysis include aquatic biota within the lake system (emphasis on fish) and individuals who may eat fish or drink lake water. Two primary exposure routes from the site to the lake are considered. First, the potential transport of contaminants via the site streams to the lake are evaluated. Second, the historical disposal of coke quench water via an injection well is evaluated under the assumption that this material eventually made its way to the Seneca Lake system.

An additional exposure route that is discussed in this report concerns users of ground water. This is discussed as a separate case because there are no direct human receptors. However, shallow on-site ground water discharges to the easterly site stream and is considered in the evaluation of that site stream; deep ground water probably discharges directly to Seneca Lake and has been considered in connection with possible effects on drinking water or fish ingestion. Because this risk assessment evaluates conditions that currently exist at and near the site, possible future users of ground water are not considered as part of this base case. There are no data to suggest that there would be future users of the shallow ground water at the Geneva Site.

6.2 Land Use and Demographics

The physiographic, demographic and geologic setting of the site, as well as a land use analysis of the area within a one mile radius of the site, are discussed in the Task 1 report and are summarized in this section. The City of Geneva is located on the northwest shore of one of the largest of the Finger Lakes, Seneca Lake.

The City of Geneva, with a population of 15,133 (1980 census) is the center of population closest to the former coke plant. Other nearby centers include Waterloo, seven miles east of Geneva, and Seneca Falls, seven miles north.

The land use map developed as part of Task 1 is presented here as Figure 6-1. Approximately one third of the area within a one mile radius of the site is Seneca Lake State Park, or part of Seneca Lake itself. Prior to 1922 the land use along the lake was primarily industrial, including a large brewery and a barrel-making factory. The locations of the site streams relative to the park and Seneca Lake are illustrated in Figure 6-2.

The original barge canal, constructed about 1825, passed through the center of the area which is presently the state park. With the onset of steam and gasoline engines, waterway traffic abandoned the barge canal and it became an unregulated trash disposal area.

Most of the remaining land in the area surrounding the Geneva facility is agricultural or open space.

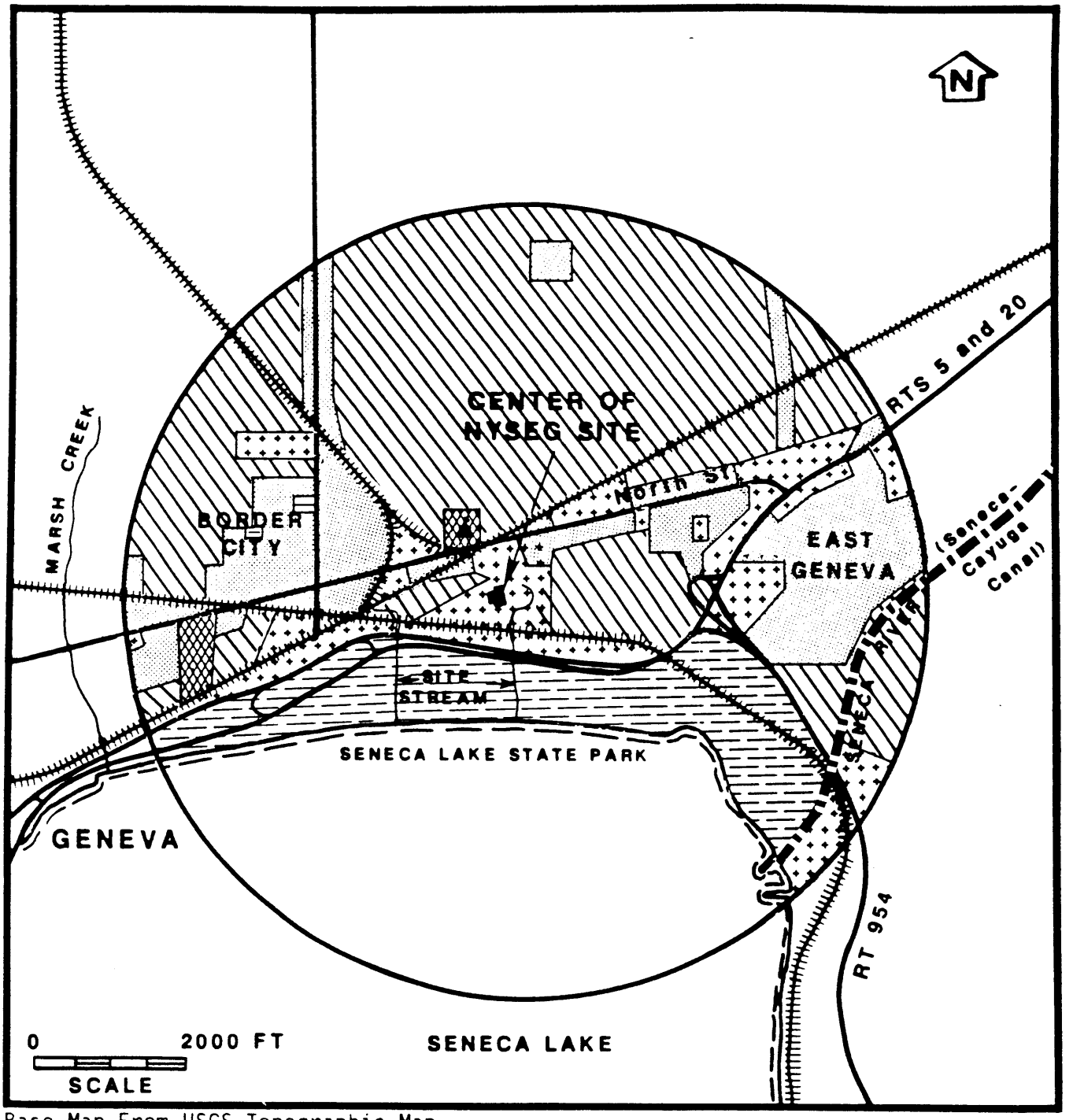
Border City (2000 ft to the west of the site) and East Geneva (3000 ft to the east) are industrial/residential communities. An elementary school with an enrollment of approximately 500 students is located on North Street about 1000 feet west of the site in Border City. Based on an examination of the USGS map for the area and site visits, the Geneva Site (including unfenced areas) does not offer an access route for children traveling to and from school.

The computerized Neighborhood Data Base accessed through CompuServe was used to extract information on the general characteristics of the Ontario New York County area (Zip Code Number 14456). The output from the Neighborhood Report for Zip Code 14456 is presented in Table 6-1.

6.3 Estimating Environmental Concentrations

6.3.1 General

Names and citations for the transport models used to estimate exposure point concentrations from laboratory measurements of field samples are given in Appendices A and C. With one exception, the models used in this analysis



Base Map From USGS Topographic Map

LEGEND:

- OPEN AGRICULTURAL
- COMMERCIAL
- RESIDENTIAL
- OPEN RECREATIONAL
- PUBLIC BUILDINGS

Figure 6-1 Area Land Use Map

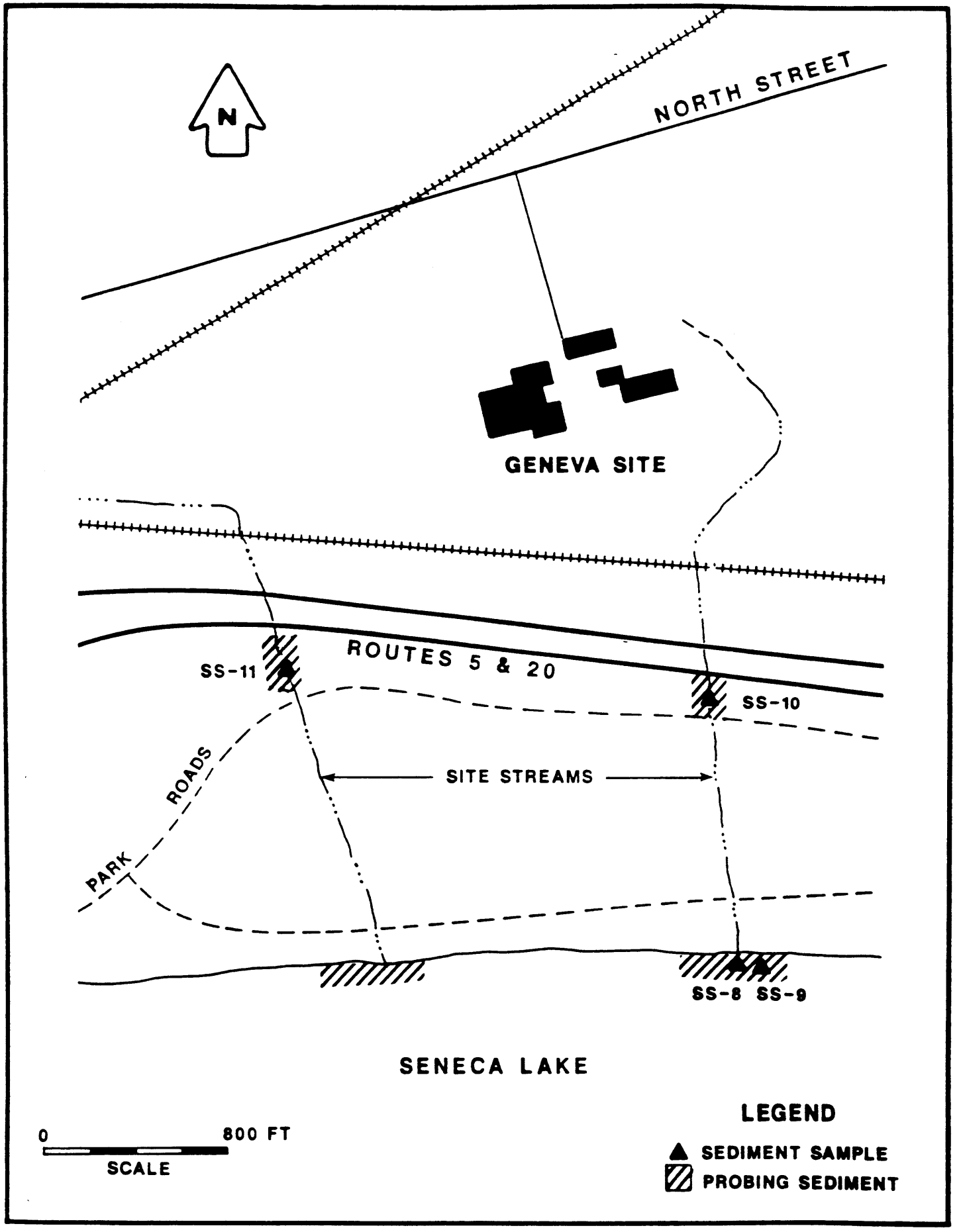


Figure 6-2 Location of Stream and Seneca Lake Sediment Samples and Investigation

Table 6-1. 1987 NEIGHBORHOOD DEMOGRAPHICS REPORT FOR ZIP CODE: 14456 ONTARIO COUNTY, NEW YORK

	1980	1987
TOTAL POPULATION	21391	20983
TOTAL NUMBER OF HOUSEHOLDS	7457	7649
AVERAGE AGE	35.9	37.3
AVERAGE HOUSEHOLD INCOME	$ 17862	$ 28792

AGE GROUPS:	
0 -4	6.1%
5-11	7.9%
12-16	6.1%
17-21	13.2%
22-29	13.4%
30-44	19.0%
45-54	9.1%
55-64	9.9%
65+	15.4%
	100.0%

OCCUPATION:	
EXECUTIVE	8.0%
PROFESSIONAL	14.4%
TECHNICAL	3.2%
SALES	8.6%
CLERICAL	16.2%
PRIVATE	0.4%
SERVICE	18.1%
FARMING	2.4%
CRAFT	11.6%
OPERATOR	13.7%
LABORER	3.5%
	100.0%

RACE:	
WHITE	92.5%
BLACK	5.5%
OTHER	2.0%
	100.0%

HOUSEHOLD INCOME:	
$ 0-14999	28.6%
$15000-24999	19.2%
$25000-34999	20.7%
$35000-49999	18.4%
$50000-74999	10.1%
$75000+	2.9%
	100.0%

TYPES OF HOUSEHOLDS:	
SINGLE PERSON	26.4%
MALE	8.9%
FEMALE	17.5%
FAMILY	69.2%
NON-FAMILY	4.3%
	100.0%

OCCUPIED HOUSING UNITS:	
OWNED	65.6%
RENTED	34.4%
	100.0%

AVERAGE HOME VALUE	$36771
AVERAGE RENT	$ 214

OCCUPIED HOUSING BUILT IN:	
1975-1980	2.8%
1970-1974	4.4%
1960-1969	8.9%
1950-1959	9.5%
1940-1949	6.6%
PRE-1940	67.8%
	100.0%

1. Percentages for age, household income and race reflect 1987 updates. 2. Income figures are expressed in 1980 dollars for 1980 information and in 1987 dollars for 1986.

are well documented and accepted for use in risk assessment. As a caveat, it is always more accurate to have data for exposure point concentrations in the medium of concern at the exposure point of concern, and the use of transport models represents a good faith attempt to estimate unknown values from known values. However, the use of the models does introduce uncertainty into the results. Moreover, the literature contains no generally applicable and accepted model for estimating the equilibrium or steady state concentration of an organic compound in soil gas based on a known concentration of the compound adsorbed to the soil.

Information on the physical and chemical properties of the Chemicals of Interest are presented in Appendix A. These properties were utilized in the modeling of the fate of compounds in various environmental media as discussed in Appendices A and C.

There were a number of situations in which chemicals were detected in some samples and not others. In this analysis, nominal values are used where data are reported as less than a detection limit. This permits a better estimate of average exposure concentrations than if the data were ignored or were treated as zeros. In such cases, the true value is assumed to be approximately one-half the detection limit. The nominal values are shown in italics or bold type in the exhibits presented in Appendices A and B.

6.3.2 Indoor Air Exposures

A major methodological difficulty encountered in assessing risks involved estimating the potential indoor air concentrations of chemicals associated with migration of soil gas into the buildings from the surrounding soils. The potential for this transport route was considered greatest for Scenarios 1, 2, and 3 and involved the Service Building, the garage in the Service Building,

and the Corporate Meter Building. Therefore, to reduce uncertainty associated with estimating exposure point concentrations, indoor air monitoring was carried out in these buildings during April 1988. These data were used together with the soil/soil gas models described below to estimate or bound indoor air exposure point concentrations for these three scenarios. The models alone were used for Scenarios 4 and 5 which involve the Compressor Building and East Office Building. These two buildings are located in areas that exhibit much lower soil contamination than the Service or Corporate Meter Buildings.

The soil/soil gas model used to estimate concentrations of Chemicals of Interest is based on the concept of fugacity (i.e., chemical partitioning in various media) which relates to the manner in which a compound partitions among various environmental media. The approach taken was supported by discussions with senior authorities in fate modeling. The model has not undergone field or laboratory testing to assess its accuracy and/or to determine its range of applicability for different compounds, different soil conditions and different soil depths. The literature contains no generally applicable and accepted models for estimating the steady state concentration of an organic compound in indoor air based on a known or estimated concentration of the compound in soil gas.

For those chemicals and scenarios for which the model was used, it was assumed that the indoor air in a building has a concentration equal to one-tenth percent (0.001) of the estimated equilibrium soil gas concentration, a conservative assumption. The factor of 0.001 is a multiplicative combination of 1) a factor of 0.1 (relative to estimated equilibrium) to estimate the long-term steady state concentration of an organic compound in soil gas undergoing pumping, and 2) a factor of 0.01 to estimate the relative rate of entrainment of soil gas as part of the overall indoor air concentration.

The estimated chemical concentrations of benzene (a potential carcinogen) and naphthalene (a non-carcinogen) are presented below to illustrate the levels of some of the more important chemicals for indoor air. Measured values were below the detection limit. Therefore, for the purpose of estimating risks a value of one-half the detection limit was used. This approach is consistent with that typically used in quantitative risk assessment when a chemical has a potential to be present but the levels are below the levels of detection.

Location	Benzene (mg/m^3)	Naphthalene (mg/m^3)
Service Building	<0.045(a)	0.0016 (c)
Garage in Service Building	<0.045(a)	<0.015 (a)
Corporate Meter Building	<0.045(a)	0.00018(b)
Compressor Building	0.039(c)	0.00044(c)
East Office Building	0.005(c)	0.00044(c)

(a) based on measured values (one-half the detection limit);
(b) based on models but using measured data for benzene to scale results;
(c) based on models alone.

Information on typical benzene concentrations in air are available from various studies. Singh et al. (1983) measured the concentrations in outdoor air in 10 cities throughout the country. The average for these ten cities was 0.0126 mg/m^3.

The Singh numbers are all for outdoor air. Results of EPA's TEAM study have shown that indoor air exhibits even higher levels of these same chemicals and that their presence is related to routine daily activities in the home or office. In the case of benzene, the arithmetic mean concentrations measured by personal monitors (predominantly indoor air) were .031 mg/m^3 and .027 mg/m^3 for night and day respectively while outdoor air had concentrations of 0.0086 mg/m^3 and 0.0095 mg/m^3 for night and day. The TEAM study also reported on the maximum concentrations of benzene detected in their study. These were 0.51 mg/m^3 and 0.27 mg/m^3 for night and day exposures, respectively.

In comparison to the results of the TEAM study the following observations are made:

1) benzene concentrations in the Service Building during April 1988 were less than 0.09 mg/m^3; the estimated concentration of one-half the detection limit is 0.045 mg/m^3; such levels would be judged to fall into the general range of indoor air concentrations reported for the TEAM indoor air study; it is noted that the actual concentration of benzene in the Service Building was not obtained; all data were below the detection limit which - for this study - was somewhat above the levels that are typically observed in indoor air; thus, the data (one-half the detection limit) are used to provide a bound on exposure and risk estimates;

2) given that exposures are in the general range of typical indoor air conditions, the estimated risks associated with benzene in these buildings may actually be very close to "ambient" risks for indoor occupational settings.

Appendix A provides details on all estimated exposure concentrations for other Chemicals of Interest.

6.3.3 Exposures Related to Excavations

The exposure point concentrations associated with these exposure scenarios are presented in Appendix A. All estimates are based on currently used exposure models and are related to measurements made by PID for Chemicals of Interest in air within the test pits or to these chemicals in soil.

Estimated exposures to benzene volatilizing from the excavations were calculated as follows:

Scenario	Air Concentration (mg/m^3)
6	0.31
7	0.0004
8	16.50
9	328.00

As can be seen, the exposure models generate relatively high exposure levels for benzene in air around excavations into benzene-contaminated soils. As this report was being prepared, air sampling was carried out on June 13, 1988 in the immediate vicinity of an excavation into an area of visible contamination. Odors were released from the excavation and the field investigators characterized the area as representative of sub-surface contamination for the site. Two samples were collected. Results indicated that benzene levels in air were less than 0.1 and 0.3 mg/m^3. These measured levels are considerably less than those estimated for contaminated areas on site (Scenarios 8 and 9). Thus, it is concluded that exposures to gases released from excavations are probably overestimated by one or more orders of magnitude.

6.3.4 Exposures Related to Contact with Stream Areas

These exposure scenarios involved people in the park and the occasional visit of children to the stream area on-site. Exposure concentrations were estimated directly from stream bed and/or surface soil concentrations for the areas of interest. Exposure concentrations are presented in Appendix B.

6.3.5 Stream Flow to Seneca Lake

The methods used to estimate the loadings of Chemicals of Interest to Seneca Lake are discussed in Appendix C. Basically, in the case of the two site streams (easterly and westerly) the method used was to estimate loading as the product of the chemical concentrations measured in water and an estimated stream flow. Based on the site visits and discussions with NYDEC personnel, mean annual stream flows for the easterly stream are estimated to be between 0.1 and 1 cfs; stream flow for the westerly stream probably does not exceed 0.1 cfs.

Possible loadings of organic chemicals to Seneca Lake via the site streams are presented in Appendix C for the easterly and westerly site streams. The estimates presented in the tables are based on mean stream flows of 0.1 cfs. Two key qualifications must be made with regard to these estimates. First, they are based on measurements made on-site and not at the point of stream discharge to the lake. Second, most of the VOCs will probably be lost from the site stream before the stream actually reaches and discharges to the lake.

6.3.6 Deep Ground Water Discharge of Coke Quench Wastewater

The method used to estimate loadings to the lake of deep ground water discharge of coke quench wastewater is described in Appendix C. The approach involves estimating the quantity of the quench water injected into the deep well on-site, estimating the characteristics of the wastewater (loading of chemicals to the well), and assuming that all the coke quench wastewater reached Seneca Lake over a thirty year period. The estimated loadings associated with the coke quench wastewater are presented in Appendix C.

6.3.7 Users of Ground Water

There are two important aquifers in the Geneva area. In the center of the valleys, the unconsolidated materials serve as an aquifer and in inter-valley areas, the bedrock is most commonly used as a water source. Two distinct bedrock formations, the Onondaga Limestone and the Camillus Shale, are used as aquifers in the Geneva area.

Figure 6-3 shows the location of wells in the site area. The on-site injection well (37-12) is the only well completed in the Camillus Shale. Two other wells (56-14 and SE-233) are bedrock wells completed in the Onondaga Limestone. All other reported wells within one mile of the site are completed in the glacial unconsolidated sediments.

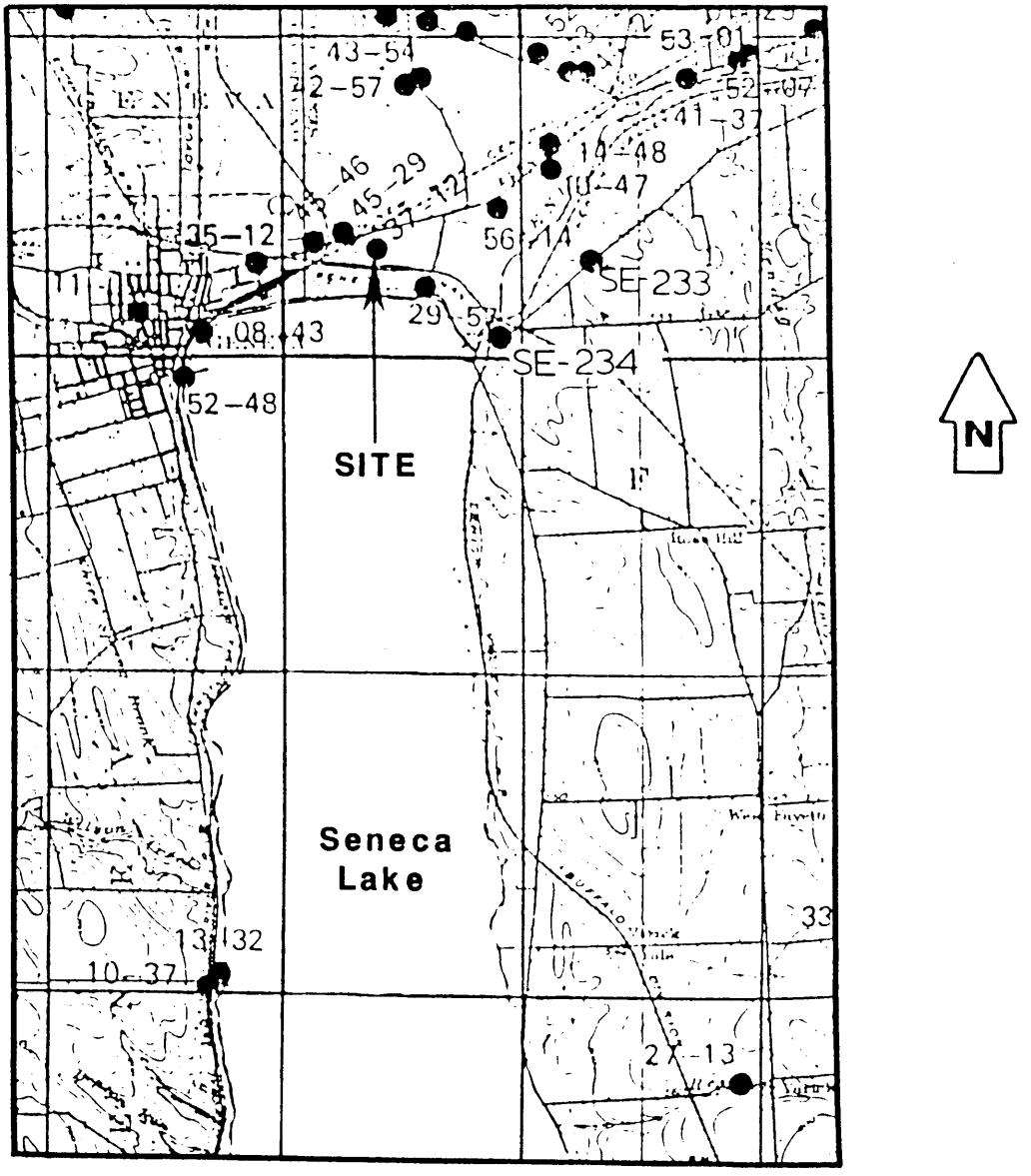


Figure 6-3. Locations of wells in the site area.

The bedrock aquifers are mostly confined by the relatively impermeable silts and clays which overlay them. Wells which penetrate the confining layers commonly flow freely at the surface because of these artesian conditions. Based on geological data for the area, TRC concludes that the regional flow of ground water within the bedrock is toward the regional ground water sink, Seneca Lake. TRC also concludes that regional ground water flow in the unconsolidated aquifer is toward Seneca Lake.

TRC (1987a, 1987b) has evaluated the direction of flow and potential receptors of shallow ground water at the Geneva Site. Based on the initial round of ground water elevation measurements, the ground water contour map for both the shallow and deep wells indicates ground water flow to the southeast and toward the easterly stream. Data for the three later dates show similar flow patterns, although the gradients vary slightly, possibly due to seasonal variations in precipitation recharge. A major "receptor" of Chemicals of Interest in the upper ground water horizons is expected to be the easterly site stream. The potential risks associated with discharge of this stream to Seneca Lake are evaluated as part of Scenario 12.

There are no existing domestic wells downgradient of the Geneva Site. Therefore, under existing conditions, contaminated ground water on-site is not posing a measurable risk to ground water users in the area. The scenario has been included for the sake of completeness. However, in the analysis presented here, the risks associated with contaminated ground water are evaluated in terms of its ultimate entry to Seneca Lake (Scenario 12). This would occur either via discharge to the site stream (where shallow ground water currently appears to flow) or via the deep discharge associated with coke quench water placed in the deep well on-site.

7.0 RISK CHARACTERIZATION

7.1 Estimation of Human Dose

This step of the risk assessment converts estimated exposure concentrations in environmental media to annual average doses in units of: 1) milligram of compound per day, or 2) milligram of compound per day per kilogram of body weight. As described in detail in the appendices, equations (simple exposure models) are used to estimate the chronic (and perhaps acute) dose of each Chemical of Interest, averaged over a year. Because the toxicity constants (ADIs, AICs, and AISs) are based on exposure dose and not on absorbed dose, it is not appropriate to estimate the efficiency of absorption via the gut and the lung, i.e., the potencies already incorporate information on those effects. There may, however, be certain "matrix effects" associated with differences between media in which the chemical is received. Such matrix effects can alter the bioavailability of the chemical.

Estimated exposure concentrations and assumptions for the models used to estimate exposures to people involved in the various scenarios identified for the site are presented in the appendices. However, a few points about the exposure models are mentioned here. The model for inhalation of gases and the model for inhalation of fugitive dust assume a constant breathing rate and 100 percent retention of the active ingredient reaching the airway. The model for inadvertent ingestion of dirt adhered to the skin during manual labor assumes a constant amount of ingestion per day and a 50 percent matrix effect (attenuation) relative to the laboratory conditions from which the toxicological potency value was prepared. The model for dermal penetration of organic compounds contained in dirt adhered to skin during manual labor assumes: 1) that 12 percent of the active ingredient in the adhered dirt will penetrate the skin in an 8-hour workday, and 2) that workers have different amounts of exposed skin during different activities.

All doses are estimated in units of mg/day, either as the Average Daily Dose on a single day [denoted ADD (day)] during which exposure occurs, or as the Average Daily Dose averaged over a lifetime [denoted ADD (life)] during which exposure occurs on certain work days.

Estimates of ADD (day) and ADD (life) are presented in spreadsheet format for each of the exposure scenarios, exposure routes, and Chemicals of Interest in either Appendix A or Appendix B.

7.2 Estimation of Risk

Estimates of risk were developed for individual carcinogens and non-carcinogens as well as for mixtures of the two. The latter is necessary because a variety of chemicals are found at the Geneva Site. The quantification of potential risks is based on the guidance published by the EPA on estimating risks of carcinogenic and non-carcinogenic mixtures (50 FR 1170 et seq., 9 January 1985). Risk estimates for chemical mixtures are generally based on the assumption of additivity unless there is information to the contrary. In the present case, most of the chemicals posing risks to humans are aromatic hydrocarbons. The assumption of additivity of effects appears to be justified for the potential carcinogenic effects of these compounds (ICF Clement, 1987).

In accordance with current EPA guidance, the assumption of additive effects is generally made for non-carcinogens in order to calculate a Hazard Index Ratio. However, it is also generally recognized, as stated in the EPA's guidance, that this may not be a good assumption because of differences in target organs, application of uncertainty factors, and differences in modes of actions of chemicals. However, the Hazard Index is currently identified in EPA guidance as a means of identifying situations where additional attention should be given.

The estimate of human health effects from exposure to carcinogens via the inhalation and the ingestion pathways first involves estimating average lifetime dose as follows:

ADD (life) = ADD (day) * Exposure Period/Lifetime

where:

ADD (life) = Average Daily Dose over a Life (mg/d)
ADD (day) = Average Daily Dose on a Day of Exposure (mg/d)
Exposure Period = Number of Days of Exposure; and
Lifetime = Number of days in a 70 year lifetime.

The equation for estimating "Incremental Lifetime Risk" from exposure to carcinogens (by compound and by pathway) is:

Risk = Cancer Potency Factor * ADD (life)/Body Weight

where:

Risk (Incremental Lifetime Risk) = Probability that person will manifest cancer, during lifetime, from the particular exposure condition;

Cancer Potency Factor (CPF) for a compound = The slope of the dose/response curve for cancers estimated for the specific Chemical of Interest [(mg/kg/day)-1]; different CPF values may be estimated for ingestion and inhalation; such values are published by EPA's Cancer Assessment Group or have been estimated by other private or public organizations;

Body Weight = Average body weight of the target group of interest; because CPF values are presented on a per unit kg body weight basis (mg/kg/day)-1, the average dose must be converted to a per unit body weight basis;

The "total" risk posed by a mixture of carcinogens is estimated as the sum of the risks for the individual chemicals.

The equation for estimating Hazard Index "Ratios" for exposure to non-carcinogens (by compound and by pathway) is:

Ratio = (ADD(day)/Body Weight)/AIC

where:

Ratio = Average Daily Dose on a day of exposure relative to the Acceptable Intake Chronic value;

AIC = Acceptable Intake Chronic value for a compound using inhalation or ingestion values as appropriate (mg/kg/day); these values are either published by the EPA or have been estimated by private or other public organizations.

In the absence of specific information on possible synergisms or antagonisms between or among chemicals, a total Hazard Index Ratio is estimated by summing the ratios for each compound. Individual or summed ratio values in excess of "1" are considered as "benchmarks" for indicating the potential for some (generally sublethal) health effects as a result of chronic (i.e., long-term) exposures. Ratio values in excess of "10" are considered in this document as "benchmarks" indicating the potential for some acute (generally sublethal) effects related to short-term exposures. This convention holds for doses that act on the same target organ/system or by the same mechanism. These assumptions and methods for estimating the "Ratio" and the "Risk" are conservative, i.e., protective of human health or environmental quality.

An alternate method for estimating "risks" associated with non-carcinogens is to utilize information on the dose/response effects of the Chemicals of Interest. Such information is very limited. Data regarding effects on humans are often only available for situations involving high exposures, often in occupational settings. Dose/response estimates of non-cancer health risks are not presented in this report. However, it is reiterated that the Hazard Index is highly conservative inasmuch as safety (uncertainty) factors on the order of 100 to 1000 are built into the calculation of the underlying AIC values.

All estimates of risk have been calculated using computer-based spreadsheets. The calculations are presented in Appendix A (on-site receptors) and Appendix B (off-site receptors).

7.3 Presentation of Risk

Presentation Format

All calculations of risks are presented in Appendix A and B. These results are summarized in graphical form in this section. The results of the risk analysis are presented in two basic forms. In the case of human health effects associated with exposure to potential carcinogens, risk estimates are expressed as the lifetime probability of excess cancer associated with the given exposure. In numerical terms, these are presented in scientific notation in this report. Thus, a lifetime risk of 1.0E-4 means a lifetime incremental risk of one in ten thousand; a lifetime risk of 1.0E-6 means an incremental lifetime risk of one in one million and so on.

As a guide to the interpretation of estimates for the incremental lifetime risk of exposures to potential carcinogens at a site, the EPA has issued various guidance documents, including "Interim Guidance on Compliance with Applicable or Relevant and Appropriated Requirements" (US EPA, OSWER Directive 9234.0-05, dated 9 July 1987). Although this document does not apply directly to the site for a variety of reasons (including the fact that the document concerns goals for remediation, not assessment of base case conditions for workers), it does offer a guide post for assessing the importance of lifetime risks at a site. The criteria offered include: "When Maximum Contaminant Levels (MCLs) do not exist for contaminants identified at the site, cleanup levels should be set using chemical-specific advisory levels. Cleanup levels should be selected such that the total risk of all contaminants falls within the acceptable risk range of 1.0E-4 to 1.0E-7 . . ."

(page 9). The figures summarizing cancer risk estimates for the present analysis include horizontal lines at the 1.0E-4 and 1.0E-7 levels. Risks above 1.0E-4 are described here as "generally unacceptable for environmental risk", and risks below 1.0E-7 are described here as "generally considered de minimus for environmental risk". The word "environmental" is underscored because often in occupational settings, risks are viewed differently than for settings in which the exposures are not work-related or are involuntary.

In the cases of exposure to non-carcinogens, the Hazard Index Ratio is used. As noted in previous sections, the fundamental principles used to construct the AIC or RfD utilized in calculating the Hazard Index Ratio are predicated on long term or chronic (usually measured in years) exposures and health effects. To gauge shorter exposures, EPA intends to prepare a consistent set of Acceptable Intake Subchronic (AIS) values, but such a tabulation does not now exist. Generally, AIS values are equal to or larger than AIC values for a particular compound. In the absence of compound-specific AIS values that could form the denominator of a ratio for assessing the importance of short term exposures to non-carcinogens, this analysis interprets a Ratio (defined above with the AIC) falling under 10 as a general guide post for judging the acceptability of a short term exposure.

In this section of the report, the figures presented on the Hazard Index Ratios have horizontal lines drawn at "1" and "10". As noted already, ratios in excess of "1" should be viewed as benchmarks with regard to the potential for chronic (generally sublethal) effects; ratios in excess of "10" should be viewed as benchmarks with regard to the potential for acute (generally sublethal) effects.

Risks to On-Site Workers in Various Buildings

Scenarios 1 through 5 estimate health risks associated with routine work within the various buildings at the Geneva Site. The source of exposure to Chemicals of Interest in all these cases is the entrainment of soil gas into the buildings. Exposure estimates were derived by making measurements of the concentrations of chemicals in indoor air and/or by using models. The uncertainties associated with exposure estimates derived by applying models have already been discussed.

The incremental lifetime cancer risks for the five indoor air scenarios are presented in Figure 7-1. The figure indicates that estimated risks for Scenarios 1 through 5 (within all buildings) fall within the 1.0E-4 to 1.0E-7 range. These levels are generally considered acceptable depending on site-specific conditions (exposed population size and age, level of certainty). It should be noted that where measurements have been made (Scenarios 1, 2 and 3), benzene levels were below the detection limit. The figure also indicates the incremental lifetime risk associated with exposure to benzene in air at a concentration of 0.01 mg/m^3. Such a level would be considered "typical" of indoor air based on EPA's TEAM Study. This study was carried out in New Jersey and California. The "risk region" between that associated with "typical" indoor air conditions and one-half the detection limit associated with the Geneva indoor air monitoring (average of 0.045 mg/m^3) is considered to represent the level within which the incremental lifetime risk is expected to occur. Based on available information, benzene levels in the Service Building are likely to be close to typical indoor levels.

It should also be noted that the estimated levels of benzene in indoor air are all less than (i.e., within) the OSHA standard for occupational exposure to this chemical. This standard is currently a one-part-per-million average

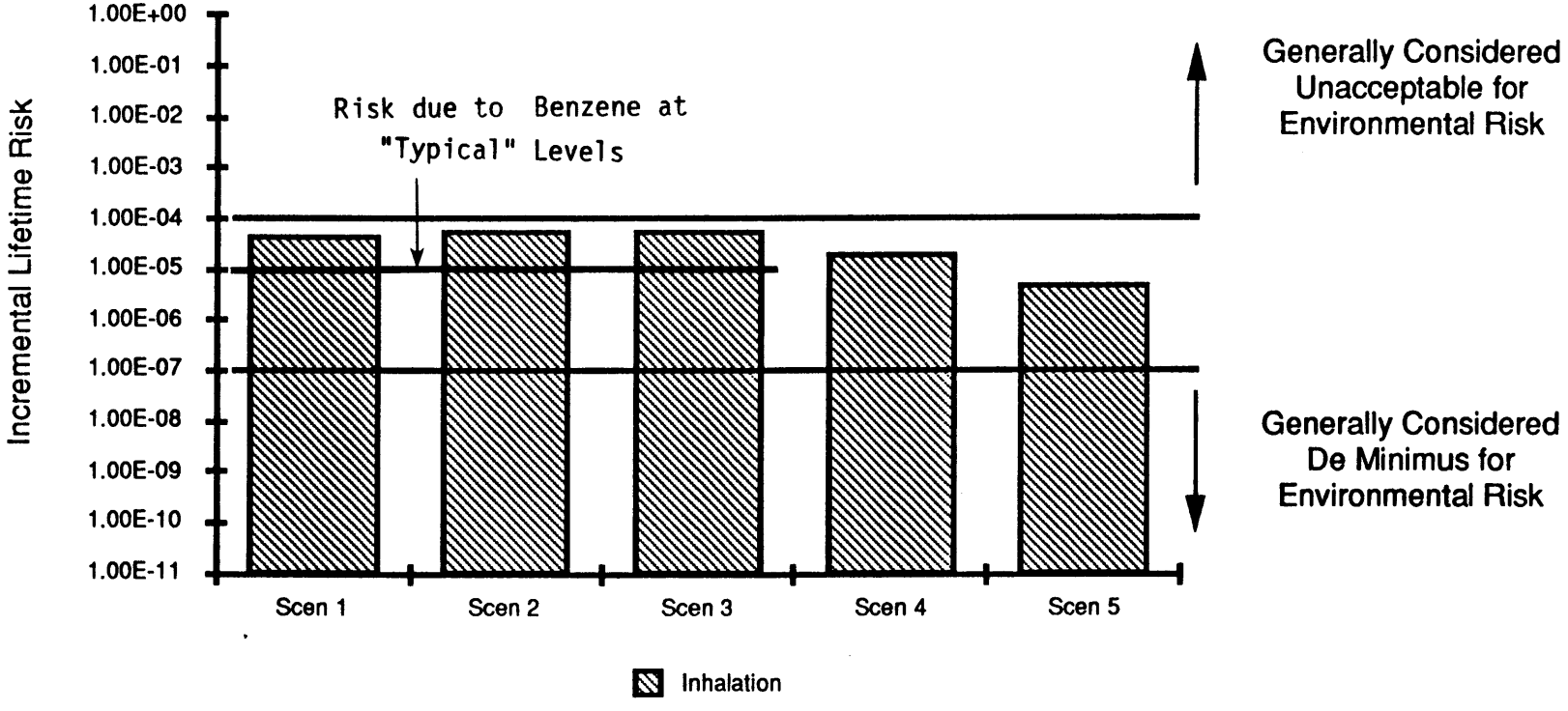


Figure 7-1. Incremental Lifetime Cancer Risks Associated with Indoor Exposures.

over an 8-hour workday (Federal Register December 10, 1985 Vol. 50, No. 237, pp. 50512-50586). On a part-per-million basis, the measured indoor air concentration of benzene in the Service Building was less than 0.03 ppm.

Hazard Index Ratios for non-carcinogens entering buildings from soil gas are illustrated in Figure 7-2. The results indicate that the ratio for Scenario 2 is slightly greater than the "1" benchmark but less than 10. This scenario is associated with work in the garage in the Service Building. Exposure point concentrations are based on the application of predictive models and scaled based on measurements for naphthalene. However, it must be noted that the naphthalene concentrations were all below a detection limit of 0.03 mg/m^3. Therefore, the estimated hazard index ratio as estimated using one-half the detection limit of naphthalene should be viewed as a conservative estimate. Because the resultant ratio value is close to "1", risks are judged to be low. The calculated Hazard Index Ratios for all other indoor scenarios were less than "1". Therefore, risks associated with these scenarios would also be judged to be low (i.e., within acceptable levels).

Exposures to Workers Involved in Various On-Site Excavations

Incremental lifetime risks of cancer to workers involved in excavations on-site are illustrated in Figure 7-3. Scenarios 6 and 7 involve planned work related to installing the new water line and constructing the garage and new entrance at the Service Building. Incremental lifetime risks of cancer associated with these planned activities are all less than 1.0E-4.

Scenarios 8 and 9 relate to on-site excavations associated with utility maintenance with specific reference to gas pipelines. Gas pipelines are located throughout the plant property. Scenario 8 represents the "average case" of exposure associated with on-site pipeline excavation. For this scenario, the estimated lifetime incremental risk of cancer is less than

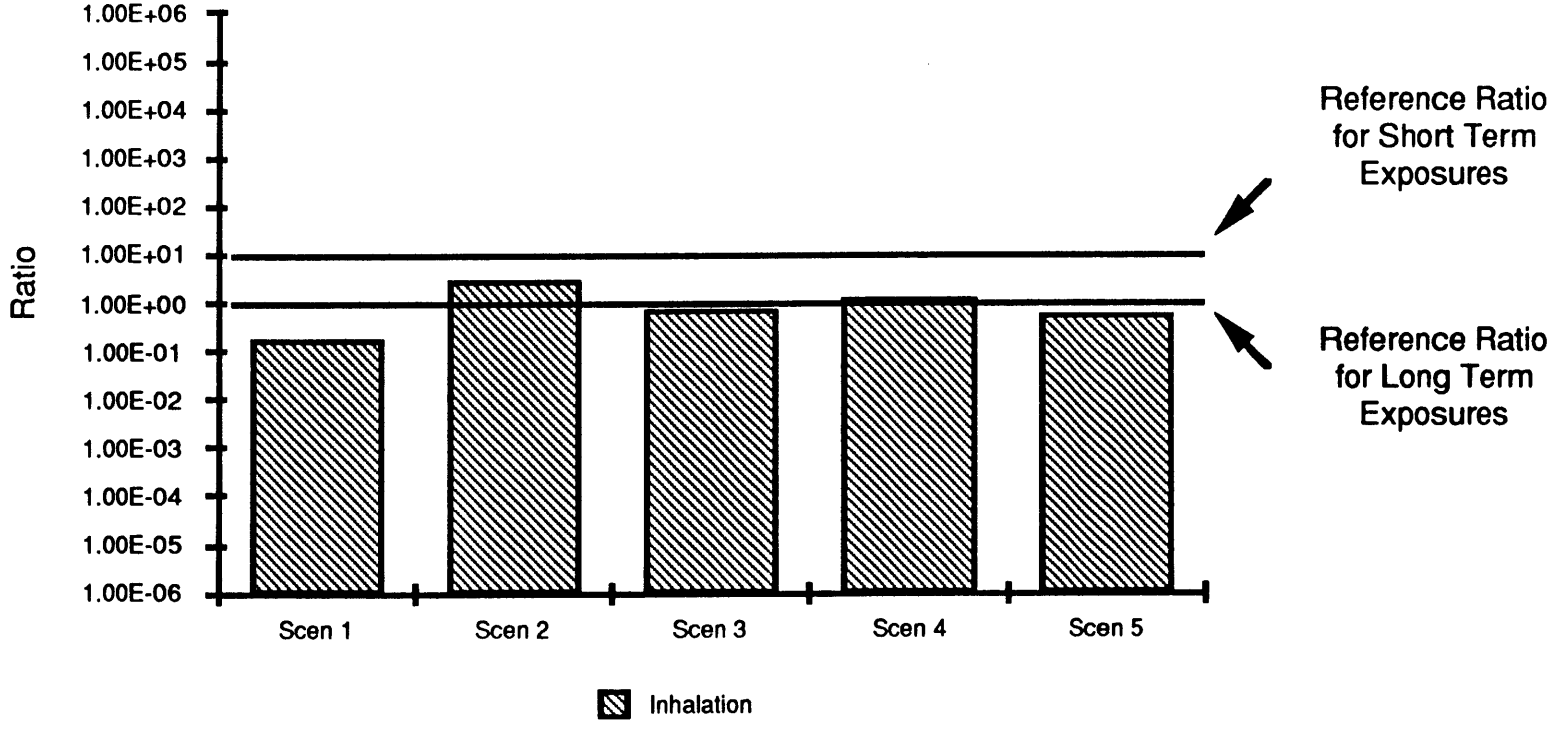


Figure 7-2. Hazard Index Ratios Associated with Indoor Exposures.

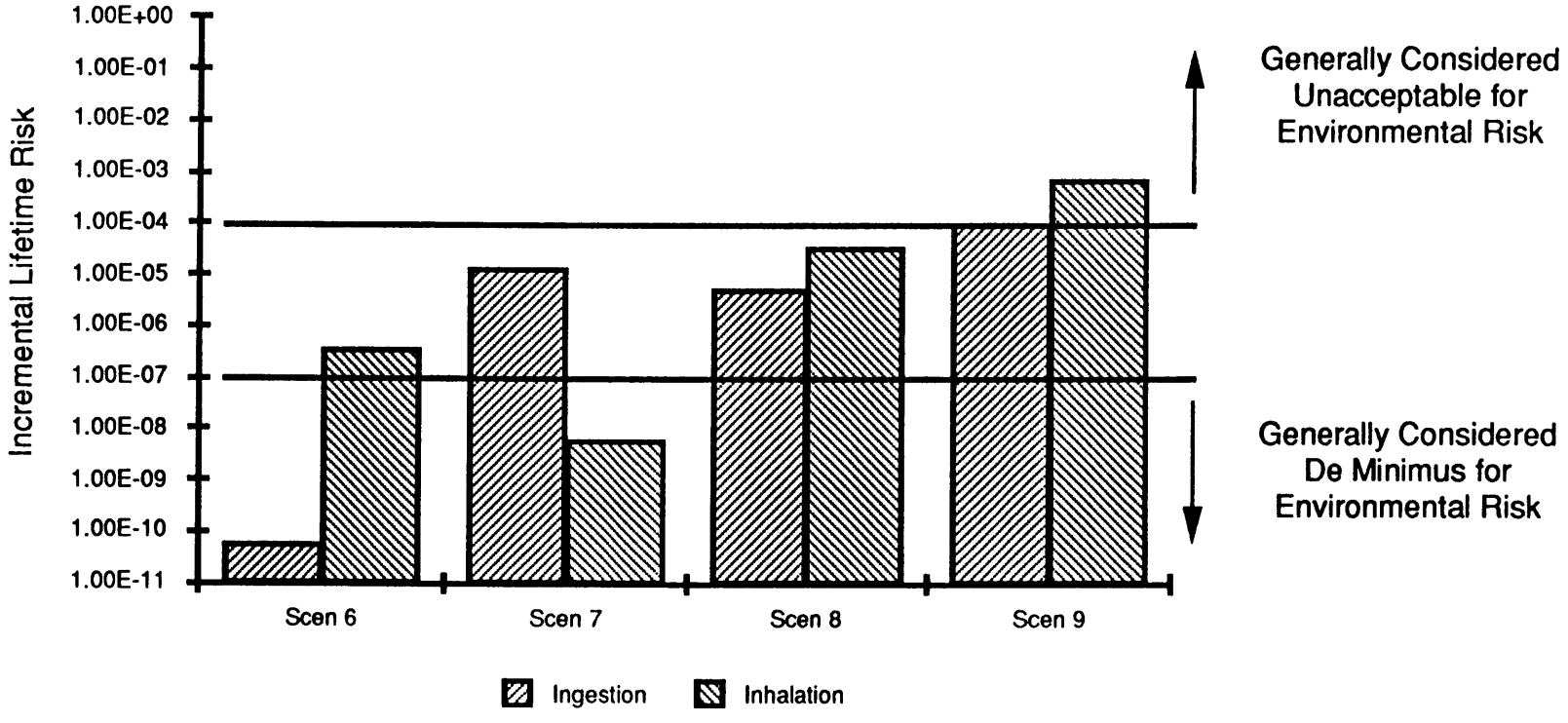


Figure 7-3. Incremental Lifetime Cancer Risks Associated with On-Site Excavations.

1.0E-4. Scenario 9 represents the "worst case" of exposure associated with pipeline excavation. For this exposure scenario the estimated incremental lifetime risks of cancer exceed 1.0E-4.

The main source of cancer risk associated with on-site excavations is release of the chemical compound benzene from the soil and subsequent exposure via inhalation. For the average case (Scenario 8), the average benzene concentration in the pits is estimated near 16 mg/m^3. This number exceeds any of the measurements of benzene obtained on-site using OVD personal monitors or Tenax Tubes (TRC, 1987b). However, these monitors were exposed to ambient conditions outside the test pits and are not necessarily reflective of air within the pits. Additional air sampling carried out on June 13 1988 at an on-site excavation indicated that benzene was below detection limits of 0.1 and 0.3 mg/m^3. Thus, the estimated exposure concentrations of benzene around excavations may be high by an order of magnitude or more. It should also be noted that air measurements taken with a PID instrument revealed VOC concentrations on the order of 100s of ppm in pits or released from pit soil samples; however, benzene most likely represents only a fraction of the total VOCs.

The estimated Hazard Index Ratios associated with excavation or construction are shown in Figure 7-4. Generally excavation work related to installing the new water line and anticipated new superstructure and elevator construction in the Service Building entrance way area are below the "benchmarks" for both chronic and short-term effects. Excavations elsewhere on-site (Scenarios 8 and 9) could result in exposures that would exceed the benchmark ratios of 1 and 10. Again, the inhalation route is the primary source of such exceedances. Semivolatile PAH compounds and phenolics are the most important chemicals involved. For the most part the inhalation of vapors

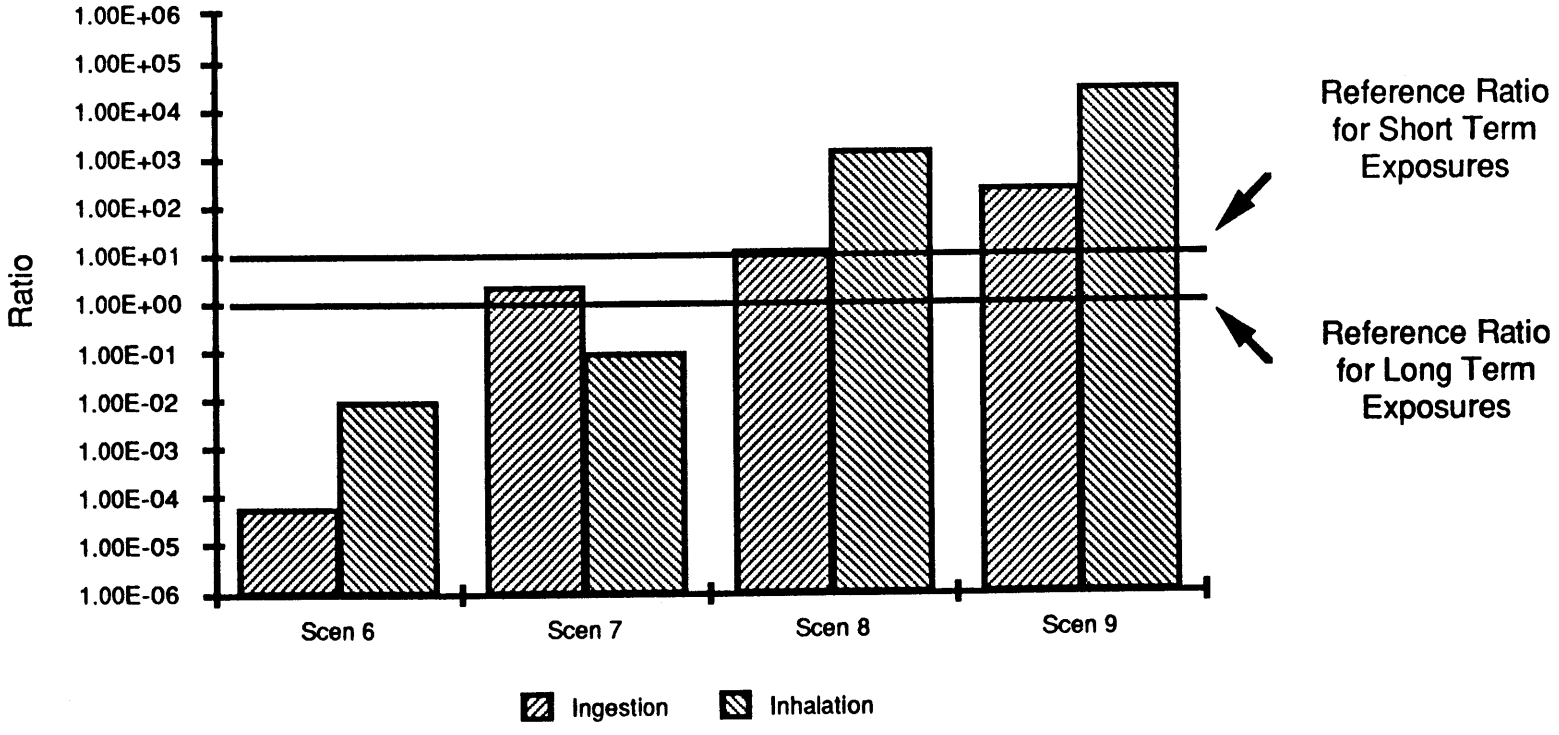


Figure 7-4. Hazard Index Ratios Associated with On-Site Excavations.

rather than chemicals associated with suspended soil particles is the primary transport mechanism. A review of estimated exposure concentrations (Appendix A) indicates that they are probably high. For Scenario 8, the average case, naphthalene in air within the pits is estimated by a soil gas model to be approximately 10 mg/m^3. Based on direct experience at several other coal tar sites, this is a higher than expected number. Phenolic compound concentrations are estimated to be several mg/m^3 for air within the pits. However, these levels are still less than (i.e., within) OSHA standards for occupational exposures to naphthalene and phenol (used here as a surrogate for other non-chlorinated phenolic compounds). Exposures estimated for Scenario 9 (the worst case) exceed the OSHA standards for naphthalene and phenol.

Based on the above, this report recommends that NYSEG develop a Health and Safety Plan for excavations on-site. First, it is acknowledged that there is uncertainty in the estimates of exposure to chemicals released to air upon excavation and that estimates presented in this report are probably high. Some of the estimates associated with pipeline excavations result in Hazard Index Ratios that exceed 1 or 10. Some of these exposures are still within acceptable OSHA standards. However, other "worst case" estimates exceed OSHA standards. In addition, PID measurements for some of the tests pits indicate a potential for a release of relatively large amounts of volatile compounds (100s of ppm). A Health and Safety Plan will help ensure that exposures are minimized during excavation.

Off-Site Receptors

Three scenarios were considered for off-site receptors. These included the infrequent visit of children to the unfenced NYSEG property near the easterly site stream, children visiting the state park, and Seneca Lake receptors (humans drinking lake water or eating fish, and the fish

themselves). An additional possible exposure scenario (ground water users) is not quantified because there are no current users of ground water from the site. The discharge of ground water to the site stream or lake is taken into account by evaluating the contributions from the site stream or from deep bedrock to Seneca Lake.

Incremental risks of cancer associated with the off-site exposures are illustrated in Figure 7-5. All risks are judged to be within the general range of acceptable levels. It should be noted that risks to people drinking water and eating fish from Seneca Lake have been estimated by assuming that all the contaminants that might have been in coke quench wastewater discharged down an on-site deep well have reached Seneca Lake (see Appendix C for details).

Hazard Index Ratios for off-site receptors are illustrated in Figure 7-6. None of the ratios exceed either the ratio for short-term or long-term exposures.

Off-Site Environmental Receptors

The primary off-site receptors considered in this risk analysis are fish in Seneca Lake. The easterly site stream does not support a fish population due to its small size and intermittent flow. Visits to the eastern site stream revealed the presence of dense marsh vegetation with no indication of reduction of plant growth in the areas where elevated concentrations of chemicals in soils have been observed.

The primary Chemicals of Interest with regard to fish populations in Seneca Lake are PAHs. Sediment samples taken from the lake in the immediate vicinity of the discharge point of the easterly site stream revealed that PAH concentrations were less than 1 mg/kg. This is a relatively low concentration

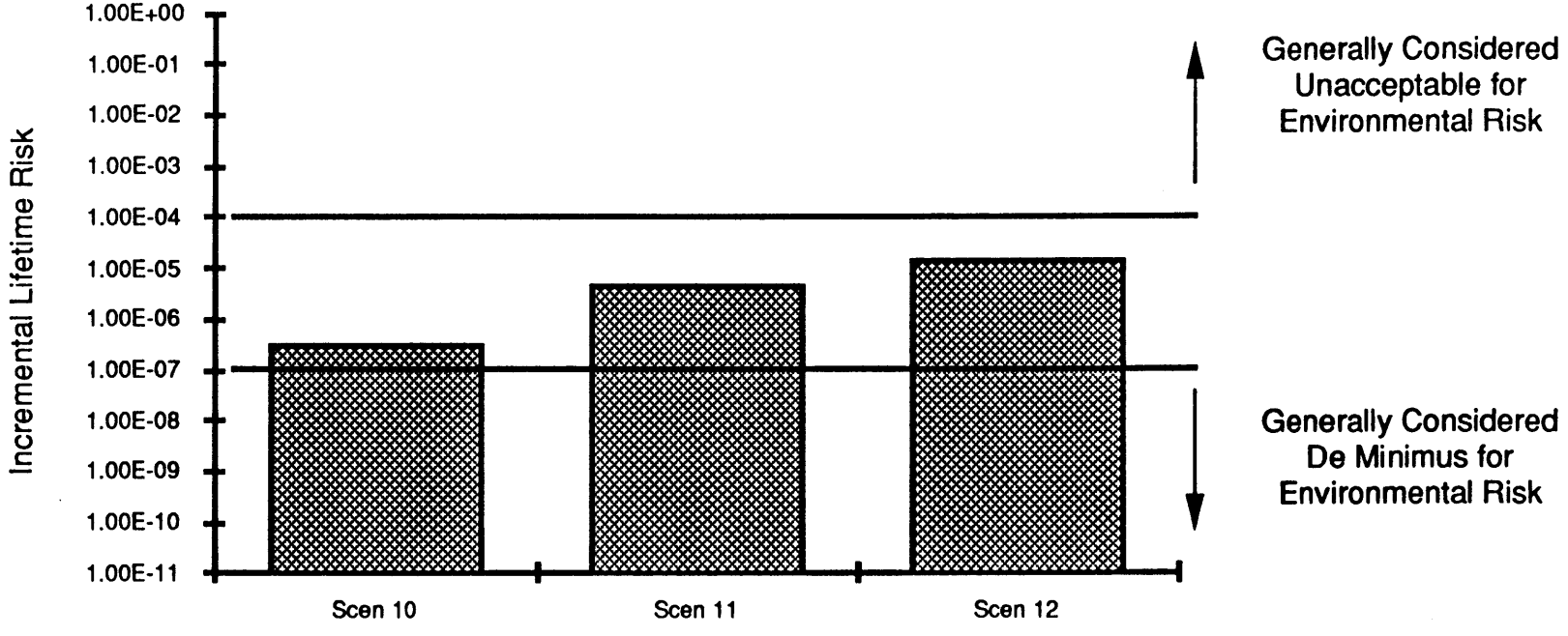


Figure 7-5. Incremental Lifetime Cancer Risks Associated with Off-Site Exposures.

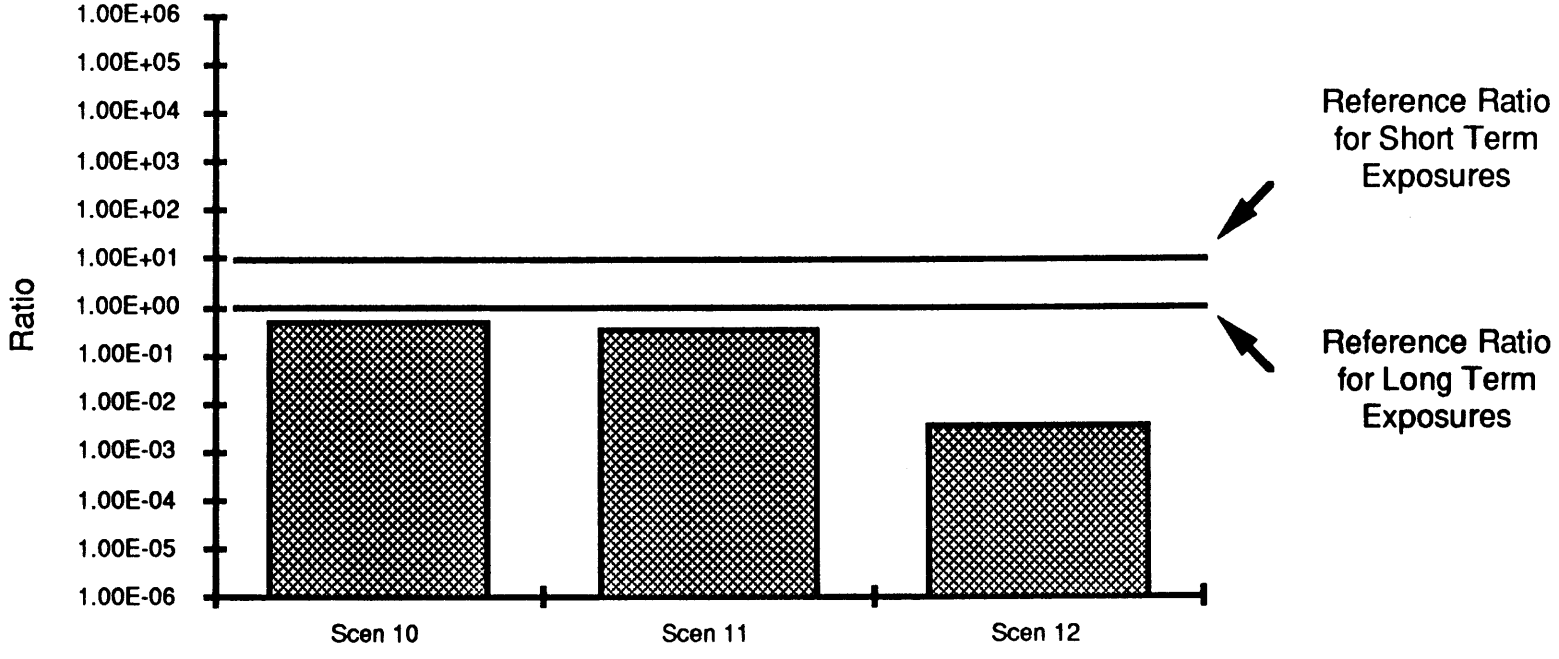


Figure 7-6. Hazard Index Ratios Associated with Off-Site Exposures.

and reflective of, at most, light contamination. In fact, the levels observed in lake sediments could be reflective of typical ambient levels for these compounds. Distribution models of PAH compounds in the lake (Appendix C) revealed that sediment levels of these chemicals may be elevated on the order of 0.01 mg/kg or less as a result of input of contaminants due to coke quench wastewater and the site stream. A summary of reported PAH values in aquatic and marine sediments worldwide is presented in Table 7-1 for the purpose of comparison with data obtained by TRC (1987b) for nearshore Seneca Lake. As can be seen from the table, the concentrations of PAH compounds in nearshore Seneca Lake are well within the levels observed in other aquatic environments and considerably below those that are recognized as being contaminated by PAH compounds.

The concentrations of PAH compounds in nearshore sediments of Seneca Lake are below levels that are generally considered to pose risks to aquatic biota. Chapman et al. (1987) recently noted that four independent approaches to developing sediment quality criteria were yielding similar values for selected contaminants of interest. In the case of PAHs, the approaches indicated that sediment levels in the range of 2 to 12 mg/kg have been shown to pose minimal effects or represent the lowest concentrations at which biological effects have been shown (or suggested) to occur. The levels of PAHs in lake sediment near the Geneva Site are less than these levels. Alden and Butt (1987) have also noted that sediment PAH levels of generally less than a few ppm "total" PAH result in few biological effects. Overall, therefore, the levels of PAH compounds actually present in the lake in the vicinity of the Geneva Site or resulting from discharges from the site are not considered to pose a significant risk to fish in the lake.

Table 7-1 Reported Levels of Total Polyaromatic Hydrocarbons (PAHs) in Aquatic or Marine Sediments (1). Data for Lake Seneca (TRC, 1987 b) are presented in bold type.

Environment	Concentration (mg/kg)	Reference
Total		
Alaska	0.005 - 0.113	Laflamme and Hites 1978
Abyssal Plains	0.018 - 0.097	Windsor and Hites 1979
South Baltic Sea	0.05	Law and Andrulewicz 1983
Abyssal Plains	0.055	Laflamme and Hites 1978
Walvis Bay, Africa	0.068	Laflamme and Hites 1978
Pennsyvania Creek	0.10	Herbes 1981
South Georgia Island	0.10	Platt and Mackie 1979
N. A. Continental Slope	0.120	Windsor and Hites 1979
Mono Lake, CA	0.157 -0.399	Laflamme and Hites 1978
Massachusetts Bay, MA	0.16	Windsor and Hites 1979
N. A. Continental Rise	0.16	Windsor and Hites 1979
Mediterranean	0.198 - 0.37	Mille et al. 1981
Franklin Basin, GOM	0.2	Windsor and Hites 1979
Casco Bay, ME	0.215	Larsen et al. 1983
Baltic Sea	0.258	Poutanen et al. 1981
West Norway	0.284	Bjorseth et al. 1979
Gulf of Finland	0.437	Poutanen et al. 1981
Jordan Basin, GOM	0.5	Windsor and Hites 1979
Lake Erie	0.53	Eadie et al. 1982
Murray Basin, GOM	0.54	Windsor and Hites 1979
Wilkinson Basin, GOM	0.54 - 0.87	Windsor and Hites 1979
Gulf of Maine	0.5430	Laflamme and Hites 1978
Amazon River System	0.544	Platt and Mackie 1979
Neckar, Rhine, and Danube Rivers	0.6	Hagenmaier and Kaut 1981
Buzzards Bay, MA	0.8	Hites et al. 1977
Falmouth Marsh, MA	0.8	Youngblood and Blumer 1975
Buzzards Bay, MA	0.803	Laflamme and Hites 1978
Lake Seneca (nearshore)	**0.82**	**TRC (1987 b)**
Mediterranean at Cote Bleue	1.232	Mille et al. 1982
Penobscot Bay, ME, outer region	1.564	Johnson et al. 1985
Severn Estuary	1.6 - 26	John et al. 1979
Cariaco Trench	1.756	Laflamme and Hites 1978
South Baltic Sea	2.55	Law and Andrulewicz 1983
Massachusetts Bay, MA	3.4	Windsor and Hites 1979
Lake Erie	3.75	Eadie et al. 1982
The Graves/Boston Harbor	3.8035	Shiaris and Jambard-Sweet 1986
Buzzards Bay, Ma	4.0	Youngblood and Blumer 1975
Adirondack Lakes	4 - 12	Heit et al. 1981
Penobscot Bay, ME, inner region	4.9	Johnson et al. 1985
Tamar Estuary	4.9	Readman et al. 1982
New York Bight	4.97	Reid et al. 1982
Buzzards Bay, Ma	5	Youngblood and Blumer 1975

Mediterranean at Monaco	5 - 10	Mille et al. 1982
New York Bight	5.8	Laflamme and Hites 1978
Boston Harbor	8.5	Windsor and Hites 1979
Pettaquamacutt R. RI	10	Hites et al. 1980
Boston Harbor	11	Shiaris and Jambard-Sweet 1986
Commencement Bay WA	12.9	Malins et al. 1982
Mediterranean at Les Embiez	13 - 15	Mille et al. 1982
Casco Bay, ME	14.4	Larsen et al. 1983
Long Island Sound	33	Reid et al. 1982
Newton Creek NY	42	Anderson 1982
Neckar, Rhine, and Danube Rivers	44.5	Hagenmaier and Kaut 1981
Elliot Bay Pier 54/ WA	50	Malins et al. 1982
New Bedford Harbor, MA	63	Youngblood and Blumer 1975
Charles R. MA	82	Windsor and Hites 1979
Charles River, MA	87	Laflamme and Hites 1978
Chelsea River, MA	97	Shiaris and Jambard-Sweet 1986
West Norway (Max)	99	Bjorseth et al. 1979
Charles River, MA	120	Windsor and Hites 1979
Elizabeth R. VA	157	Bieri et al. in press
Mediterranean at Cote Bleue	232	Mille et al. 1982
Boston Harbor Aquarium/Fort Point	364	Shiaris and Jambard-Sweet 1986
Island End R. Boston MA	566	unpublished data

(1) In most cases values Represent Averages of larger data bases. In some cases ranges are reported. In many cases mean values have been calculated from data presented by the authors; data are from an unpublished data base maintained by C. Menzie (TRC).

7.4 Uncertainty Analysis

7.4.1 Uncertainty in Exposure Estimates

Exposure concentrations at receptor points were estimated for most of the exposure scenarios. Some of the major sources of uncertainty associated with the estimates are presented below.

Scenarios 1 through 5

The transport pathway for Chemicals of Interest involved migration of soil gas from beneath the buildings, through the foundations, and into the buildings. The main sources of uncertainty include:

1) Although data were obtained on the levels of selected Chemicals of Interest in indoor air, all data were reported as less than a detection limit. Risk estimates were based on one-half of these detection limits; therefore, these estimates "bound" the risk rather than providing more precise estimates. These measured concentrations for selected Chemicals of Interest were used to "bound" concentrations of other chemicals through the use of a soil/soil gas model.

2) In some cases, estimates of soil gas concentrations were made from data on soil concentrations in test pits around the building by first assuming equilibrium conditions (see Appendix A). Such methods are not generally used.

3) Because scenarios 1-5 assume entrainment of soil gas into the buildings, conditions in the soil are not at equilibria; i.e., the soil gas is continually being removed under these scenarios.

4) Based on data derived from radon soil gas investigative programs, it was roughly estimated that soil gas in the buildings (on the building side of the foundation) would be one percent of the concentrations in the soil; investigators working on the radon soil gas program noted that there was much uncertainty on this transfer rate and that it would ultimately depend on the thickness of the foundation walls and floors, number of cracks or openings, physical characteristics of the soil, and nature of air handling equipment inside the building.

Scenarios 6-9

1) The major sources of uncertainty in these scenarios concern the estimates made regarding generation of gasses and suspended soil particles during the excavation operations; several analytical models were used to make these estimates (see Appendix A). It was also assumed that workers would not be taking any special precautions to limit exposure. For scenarios 8 and 9, the levels of gasses at the point of exposure were estimated to be fairly high; based on limited field monitoring data, it is possible that exposure estimates may be too high by an order of magnitude or more, thereby producing a conservative estimate of risk.

Scenario 10-11

1) These scenarios involved the incidental contact and ingestion of Chemicals of Interest associated with soils and stream sediments on-site and in the state park; primary assumptions concerned the frequency of contact, the amount of soil on the skin during each contact, and the amount of soil incidentally ingested during each contact. All these numbers are realistically conservative.

Scenario 12

This scenario involved Seneca Lake receptors. Major sources of uncertainty are listed below.

1) The method employed in this analysis of PAH loading to the lake via the site stream (included in the risk estimates) should have resulted in an overestimate of loading by using data for the more contaminated of the on-site water monitoring stations and by using the upper estimated range for stream flow; no data were available on actual loading or on the concentrations of the Chemicals of Interest in stream water as it entered the lake.

2) The method used in this analysis of PAH loading to the lake via deep ground water containing coke quench wastewater should have resulted in a realistic "worse case" analysis as discussed in Appendix C.

3) A fugacity model (see Appendix C) was used to estimate partitioning of chemicals among various media (fish, water, sediment) in the lake. Lake characteristics were estimated for this purpose and rates for biodegradation of PAH compounds in the environment (half-life of five years) and metabolism in fish (half-life of two weeks) were used; these are supported by the literature and are likely to be conservative.

As a means of placing the estimated loadings of PAH compounds from the site to Seneca Lake in perspective, comparisons are made to other sources of these same compounds to the lake. Principal PAH sources for the lake probably include atmospheric deposition and runoff. Data from the literature are used to provide rough estimates of the annual contributions from these sources to Seneca Lake. The basis for these calculations can be found in Appendix C.

Estimates of atmospheric loading of six PAH compounds (anthracene, phenanthrene, pyrene, benz(a)anthracene, perylene, and benzo(a)pyrene) into Seneca Lake (based on the work of Eisenreich et al., 1981) are compared to stream loading estimation of the same six chemicals.

There are probably a variety of non-point sources of PAH compounds to Seneca Lake. As has been discussed in numerous reports on PAH compounds in the environment, these chemicals are generated as part of a wide variety of activities. A predominant source is combustion. The highways and roadways along the lake are probably a major source of the chemicals. Highways and roadways have been shown to contain relatively high levels of PAH and other chemicals in stormwater runoff (Ammon, 1980; Zawlocki, 1981). In addition, boating operations and marinas would also contribute these chemicals to the lake. The contributions of these sources are not estimated in this report. However, estimates are provided for one of the many non-point sources - urban runoff. Estimates of loadings to the lake via urban runoff have been developed for the northern area of the lake and specifically for the city of Geneva and surrounding developed areas. All calculations are presented in Appendix C.

For the six PAH compounds considered in this analysis (see above), the relative contributions due to atmospheric deposition, urban runoff from the Geneva area, and site stream runoff (high estimate) are shown in Figure 7-7.

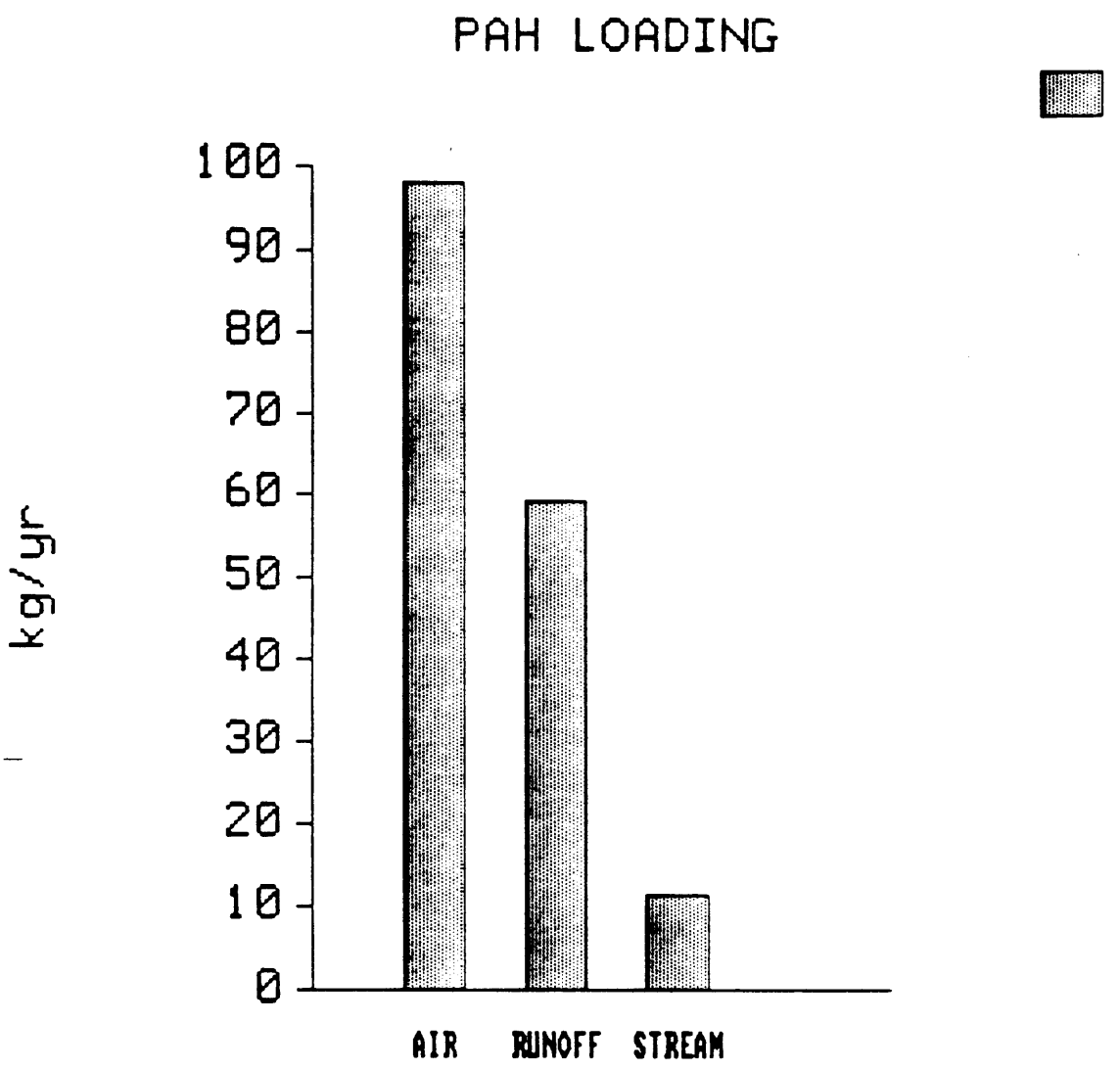


Figure 7-7. Relative loadings of the sum of six PAH compounds to Lake Seneca due to atmospheric input, urban runoff from the Geneva area, and the site streams (maximum input).

As the figure indicates, a major source of PAH compounds to Seneca Lake is atmospheric deposition with urban runoff also making an important contribution.

7.4.2 Uncertainty in Health Effects Estimates

There are uncertainties associated with both the estimates of risk from carcinogens and non-carcinogens. The difficulty in extrapolating from data on high doses to animals to low doses in humans is well recognized and will not be discussed in detail here. However, the method used to estimate risks associated with exposure to carcinogenic PAH compounds is relatively new, and, therefore, is discussed here. In this assessment, the relative potency method developed by ICF Clement (1987) was used. We believe this is the best interim method for calculating such risks. However, there are two other methods that could have been considered. These are 1) the relative potency method using the EPA CAG number for B(a)P and the relative potencies estimated for other PAH compounds by Chu and Chen of the EPA CAG, and 2) using B(a)P as a surrogate for all PAH compounds.

For the case of ingestion of fish, the use of the EPA CAG approach allowing for relative potency would have resulted in a risk estimate that was 50% higher than the one generated in this document. If all the PAH compounds were treated as if they were B(a)P, then the risk estimate would have been about eight times higher. Differences in estimates among the three methods will not be the same for all scenarios. Because B(a)P is so much more potent than most of the other PAH compounds, its relative concentration in samples contributes substantially to the relative risks of the samples. Obviously the lower the B(a)P levels in a particular sample the more disparate the estimates of risk become between analyses in which relative potency has been taken into account and the method in which the potency factor for B(a)P is used for all PAH chemicals.

With regard to non-carcinogens, this report has used the Acceptable Intake Chronic number (AIC) or Risk Reference Dose (RfD) as benchmarks. These are threshold values which compensate for uncertainty through the application of safety factors. The AIC or RfD values used in this report were derived either by the EPA (published values) or consultants (e.g., Environ) by examination of the various studies on the chemical ingestion and determining the No-Observed-Adverse-Effect-Level (NOAEL). However, the EPA (or consultants following EPA policy) do not simply use the NOAEL, but develop from it an AIC or RfD by dividing this NOAEL by a safety factor. The AIC or RfD has been viewed as the amount of a chemical to which a person can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering deleterious effects.

Generally, the safety factors used in deriving an AIC consist of multiples of 10. Each factor (of 10) represents a specific area of uncertainty inherent in the available data. For example, a safety factor may be developed by taking into account: 1) the expected differences in responsiveness between humans and animals (a factor of 10 applied here), 2) variability among individuals within the human population (a second factor of 10 applied here), and 3) a sparse data base (a third factor of 10). The result is that for many chemicals the AIC is calculated to be 100x less than the NOAEL and for some as much as 1000x less. In the case of the estimated AIC values for PAH compounds, this uncertainty level (margin of safety) is on the order of 1000.

Because of the margin of safety built into the AIC value, exceedance of the number has no immediate real meaning with regard to specific health effects, the frequency of effects, or the magnitude of effects. However, exceedance of the number should serve as a warning that the potential for unacceptable exposure does exist and precautions should be taken to limit exposure.

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APPENDIX A

ESTIMATES OF HUMAN HEALTH RISKS FOR WORKERS ON-SITE

Appendix A

Estimates of Human Health Risks for Workers on Site

A.1 Objective of this Appendix

This Appendix presents the details of the human health risk assessment for workers at the Geneva (Border City) Coal Gasification Site near Geneva, NY. This technical Appendix assumes that the reader is familiar with the site in question and that the reader understands the fundamentals and practice of exposure and risk assessment.

All exhibits appear at the end of the Appendix. The last section of this Appendix contains a glossary of common terms and abbreviations used in the exhibits.

A.2. Introduction to the Site

As detailed in the Task 2 Report, the former coal gasification site near Geneva, NY, contains residues from the normal operation and (partial) on-site disposal of some wastes from the coal gasification works first built between 1901 and 1903 by the Empire Coke Company. Over the years, subsequent owners expanded the plant from its original 31 coke ovens and two gas holders. The coal gasification operation officially closed in 1934, and the site is now used as a service center by the New York State Electric & Gas Corporation. The site is surrounded by agricultural land to the North, by commercial and residential land to the East and to the West, and by Seneca Lake State Park along the lake shore to the South.

The site has several buildings where NYSEG employees work on a regular or intermittent basis: a Main or Service Building, with a Garage internal to a portion of the first floor; a Corporate Meter Building; a Compressor Building; and an East Office Building. In addition, employees or other workers may — from time to time — construct new facilities on the property or maintain gas lines now

located on the property. The main site has a chain-link security fence to limit access to the site by members of the general public.

A.3 Methodology of this Study

The exposure and risk assessment methodology used in this Appendix follows (i) the most current methods accepted by the US Environmental Protection Agency, as published in the Federal Register (49FR227 et seq.) and in the final "Superfund Public Health Evaluation Manual" (US EPA 540/1-86-060, October 1986), (ii) the most current methods accepted by the NYS Department of Environmental Conservation, and (iii) the most recent guidance and results developed under the Gas Research Institute's Program for Management of Former Manufactured Gas Plant Sites. Where assumptions were made, they were realistic but conservative, i.e., protective of public health and environmental quality. This Appendix focuses most strongly on the "base case" or "status quo" conditions at the site, and the results of this study will help managers focus on the areas, contaminants, media, pathways, people, flora, and fauna of greatest importance at the site for current conditions.

Following the guidelines accepted by the US EPA and New York State, the basic components of a public health and environmental risk assessment will be organized and presented as follows:

- Hazard Identification — Selection of the Chemicals of Interest
- Dose Response Assessment — Chemical and Toxicological Properties of the Chemicals of Interest
- Exposure Pathways and Target Populations
- Estimation of Exposure Concentrations
- Estimation of Human Doses
- Estimation of Human Health Effects
- Discussion of Results
- Discussion of Key Uncertainties

A.4 Hazard Identification and Selection of the Chemicals of Interest

NYSEG and TRC Environmental Environmental Consultants, Inc. have had GC or GC-MS measurements made of the concentrations of many organic chemicals present in samples of these environmental media from the site proper or its surroundings: ground water (in samples from monitoring wells), surface soils and subsurface (in samples from the surface and from test pits), stream water (in grab samples), and stream and lake sediments (in grab samples). The analytical laboratories also measured the presence of inorganic species, especially certain heavy metals, in these media. TRC used a portable photo-ionization meter to measure the presence of (mixed) volatile organic compounds in or near the test pits and interiors of the buildings, and, in supplemental measurements, TRC used charcoal tubes, filters and XAD tubes, and impingers to collect air samples for GC analysis of volatile organic compounds in two main buildings on the site.

In general, the field studies conducted over the last two years have revealed the presence of organic and inorganic contaminants typical of a coal gasification operation in the soils, ground water, surface water, sediments, and air at and near the site. The compounds measured in elevated concentrations include:

- volatile organic compounds (e.g., benzene, toluene, and some chlorinated hydrocarbons),
- acid fraction organic compounds (e.g., nonchlorinated phenols and phenolic compounds),
- base-neutral organic compounds (especially polycyclic aromatic hydrocarbons -- or PAHs -- such as naphthalene, acenaphthene, benzo(a)pyrene, and their congeners), and
- inorganic compounds.

Air monitoring during the excavation of test pits on the site revealed the presence of some organic compounds in the test pits' soil gas and in the ambient air directly adjacent to the test pits. The supplemental indoor air monitoring in two buildings found that all concentrations of benzene, naphthalene, and phenol are below the levels of detection used.

More specifically, the reports from the various monitoring activities indicate that a total of 50 different organic and inorganic chemical species have been measured at least once in at least one of the environmental media. Exhibit A-1 lists these 50 different chemical species, grouped by major chemical characteristics. Because these compounds differ in concentration, in prevalence, in physical/chemical properties, in toxicological properties, and in environmental mobility, it is important to identify the most important ones for detailed study in the risk assessment. We selected a subset of compounds — called Chemicals of Interest for the site — for individual and collective study throughout all parts of the report and for all media and for all pathways according to the principles and methods detailed in the next paragraph.

The selection procedure identified the the Chemicals of Interest for the site based on these factors:

- spatial extent, overall quantity, and maximum concentrations in each medium as revealed by monitoring data;
- past disposal practices for all waste streams, including the hot coke quench water;
- routes of exposure to contaminants in air, soils, ground water, surface water, sediments, and bioaccumulated in fish tissue;
- chronic toxicities of the chemicals via these transport routes with special emphasis placed on potential carcinogens. The selection method combined information from the monitoring data with (i) Acceptable Intake-Chronic values (AICs; sometimes also called Reference Doses or RfDs) for noncarcinogens and (ii) Cancer Potency Factors (CPFs) for carcinogens to evaluate preliminarily the relative risks posed by the chemicals. In all cases, each chemical that is an EPA/IARC Group 1 (known human carcinogen) or Group 2 (probable human carcinogen) was included as a Chemical of Interest; and
- other general properties such as environmental persistence, medium-specific mobility, and ability to bioaccumulate.

Exhibit A-2 shows the final list of Chemicals of Interest selected for detailed study in this report. The final list contains 16 PAH compounds (equally divided between those considered potentially carcinogenic and those not so considered), 9 volatile organic compounds (benzene, considered carcinogenic, and 8 other compounds), 7 non-chlorinated phenolic compounds, and 6

inorganic species (four heavy metals and two types of cyanides). These Chemicals of Interest are grouped in Exhibit A-2 according to toxicological information developed below. These Chemicals of Interest represent the most important, prevalent, and toxic chemicals at the site.

For the Chemicals of Interest, Exhibit A-3 summarizes the key physical and chemical properties used later in the study as variables and parameters in models for the transport and fate of the compounds in the environment. (The values in regular typeface are referenced to authoritative sources; the values in italic typeface are estimated for this study according to the best information and methods available.) When taken together and used in an appropriate transport model, the values in Exhibit A-3 show the tendency of a particular compound to move and/or accumulate in a particular environmental medium (as discussed in a later section of this Appendix).

A.5 Dose Response Assessment — Toxicological Properties of the Chemicals of Interest

Exhibit A-4 summarizes the key toxicological properties of the Chemicals of Interest used later in the study as variables and parameters in models for estimating human health effects. Exhibit A-4 groups the compounds according to generally recognized categories — either (i) as compounds generally considered as carcinogenic (by the US EPA and/or other toxicological authorities) or (ii) as compounds generally not considered carcinogenic (by the same groups or persons). The compounds grouped as carcinogens by the US EPA are further grouped according to the weight of evidence supporting the finding; this practice parallels a similar one developed by the International Agency for Research on Cancer (IARC). The compounds grouped as noncarcinogens (and therefore considered as systemic toxicants) are not divided further into subgroups. This Appendix does not take into account other adverse health effects which may be associated with certain chemicals in some situations, including — but not limited to — mutagenic, teratogenic, reproductive, or neurotoxic effects.

As summarized from reports published recently by the US EPA and Environ Corporation, the first page of Exhibit A-4 presents (i) Cancer Potency Factors (CPFs), (ii) Acceptable Intake-Subchronic values (AISs), and (iii) Acceptable

Intake-Chronic values (AICs; sometimes also called Reference Doses or RfDs) for both the ingestion (or oral) and inhalation pathways of exposure. Similarly, as summarized from a recent report by ICF Clement Corporation, the second page of Exhibit A-4 presents the carcinogenic potencies for the first 8 PAH compounds as estimated relative to the potency of benzo(a)pyrene. Note that the analyses in this Appendix do not distinguish between or among target organs for compounds considered as carcinogens or as noncarcinogens.

The third page of Exhibit A-4 presents the values for AISs, AICs, and CPFs for both ingestion and inhalation that are used in the calculations in this Appendix. The entries are based on EPA values where available, ICF Clement relative potencies for the PAHs considered carcinogenic, and surrogate default values to account for possible adverse systemic effects to PAH compounds. Because phenol alone has published AIS values for systemic effects, the analyzes in this Appendix rely on the more numerous and consistent AIC values for evaluating possible adverse systemic effects, even if the exposures are short in duration or subchronic in intensity.

A.6 Exposure Pathways and Target Populations

The most critical aspect of an exposure assessment is the identification of exposure routes together with the identification of human and nonhuman receptors. The analyses in this Appendix consider 9 different scenarios that can lead to chronic or transient exposures to workers:

- People Working in Offices in the Service Building,
- People Working in the Garage in the Service Building,
- People Working in the Corporate Meter Building, the former Purifier Building,
- People Working in the Compressor Building,
- People Working in the East Office Building,
- People Excavating a New Water Line along the Main Access Road,
- People Performing New Construction (the Superstructure of an Entrance and Elevator)

- People Excavating for Maintenance of Gas Utility Lines (generally throughout the site), and
- People Excavating for Maintenance of Gas Utility Lines Near Test Pit 1 (a highly contaminated area).

Exhibit A-5.1 (for Scenario 1) through Exhibit A-5.9 (for Scenario 9) present the details of the exposure scenarios and the target populations for each of the situations analyzed in this Appendix. The first five scenarios consider long-term exposures to workers in buildings and the last four scenarios consider shorter-term exposures to workers outside. The first five scenarios involve greater numbers of people over a longer time than do the last four scenarios.

The first five scenarios focus on the inhalation of organic compounds originating from soil gases entrained into the building air as the key exposure pathway (but the supplemental indoor air measurements on which the risk calculations are based also bound indoor sources of three compounds). In contrast, each of the next four scenarios considers four pathways of exposure: (i) inhalation of organic compounds originating from soil gases, (ii) inhalation of organic and inorganic compounds contained in fugitive dust elevated by activities in the field, (iii) (inadvertent) ingestion of organic and inorganic compounds contained in dirt adhered to skin during heavy labor, and (iv) dermal penetration of organic compounds also contained in dirt adhered to skin during heavy labor.

Exhibits A-5.1 through A-5.9 present the detailed values and assumptions used to quantify the frequency, duration, and intensity of each of the activities that cause exposures in each scenario and for each exposure pathway. The values and assumptions used for each scenario were prepared after discussion with NYSEG employees and in keeping with generally accepted values in the discipline of risk assessment; the values are not based on detailed study of employment records or on time-budgets for the different groups of workers considered. Further the values do not assume the use of personal protective equipment

A.7 Estimation of Exposure Concentrations

Exhibits A-5.1 through A-5.9 also name and give citations for the transport models used to estimate exposure point concentrations from laboratory measurements of field samples. With one exception discussed below, the

models used in this analysis are well documented and accepted for use in risk assessment.

For Scenarios 1, 2, and 3, the estimates of exposure point concentrations rest on the supplemental indoor air measurements for benzene and naphthalene made in two buildings as a way to measure two of the most important Chemical of Interest directly and as a way to estimate the concentrations of other volatile and semivolatile compounds using the models below scaled to predict the measured concentrations. For Scenarios 4, 5, 6, 7, 8, and 9, the estimates of exposure point concentrations rest fundamentally on laboratory measurements of soil samples from the numerous test pits dug over the last two years. For Scenario 8, the estimates of exposure point concentrations also rely heavily on measurements of disturbed soil samples made with a portable OVA (photodetection) meter calibrated to benzene.

All the estimates of exposure point concentrations rest on the assumptions (i) that certain averages of the data are representative of the area and the activity under analysis and (ii) that various theories of mass transport within and between environmental media hold for the particular transport and fate models. However, certain caveats are important:

As a first caveat, it is always more accurate to have data — rather than estimates — for exposure point concentrations in the medium of concern at the exposure point or concern. For example, the benzene data measured in the two buildings bound and support the analyses for Scenarios 1, 2, and 3. The use of transport models for the other scenarios represents a good faith attempt to estimate unknown values from known values. However, the use of the models does introduce uncertainty into the results.

As a second caveat for the scenarios involving the use of models for the generation and transport of soil gas, the literature contains no generally applicable and accepted model for estimating the (equilibrium or steady state) concentration of an organic compound in soil gas based on a known concentration of the compound adsorbed to the soil. The analyses in this Appendix rest on a model based on the concept of fugacity as first relayed in a personal communication by A.Q. Eschenroeder and subsequently supported by two other senior authorities in transport modeling. The model has not

undergone full field or laboratory testing to assess its accuracy and/or to determine its range of applicability for different compounds, different soil conditions, and different depths.

As a third caveat for the scenarios involving the use of models for the generation and transport of soil gas, the literature contains no generally applicable and accepted models for estimating the (steady state) concentration of an organic compound in indoor air based on a known or estimated concentration of the compound in soil gas. This is less of an issue for Scenarios 1, 2, and 3 now that the supplemental measurements for benzene (taken as half the detection limit) can be used to estimate the carcinogenic risk and to scale the estimates of exposure point concentrations for the other compounds. For the other indoor scenarios without direct indoor measurements, this risk assessment assumes that the indoor air in a building has a concentration equal to one tenth percent (or a factor of 0.001) of the estimated equilibrium soil gas concentration, a conservative assumption. This overall factor of 0.001 is a multiplicative combination of (i) a factor of 0.1 to estimate the long term steady state concentration of an organic compound in soil gas undergoing pumping relative to the compound's theoretical equilibrium concentration and (ii) a factor of 0.01 to estimate the relative rate of entrainment of soil gas as a part of the overall indoor air concentration. To the extent that this assumption of 0.01 is true for the second factor, buildings with high air flow and short residence times (with little or no air recirculation) may cleanse the most volatile organic compounds (e.g., benzene) from the soil beneath the foundation in a short time (e.g., months or tens of months). Because benzene is volatile and designated as a carcinogen, the risk attributable to it in indoor air may decline over a period as the reservoir of the compound in the soil declines due the pumping effect of the building.

As a fourth caveat, portable photodetection meters, originally designed as field screening instruments, produce results with poor sensitivity, poor specificity, and poor reproducibility. As explained in Exhibit A-5.8, the exposure point concentration for the inhalation of gases in Scenario 8 is estimated using (i) equilibrium concepts to estimate the relative composition of the diluted soil gas and (ii) the geometric mean of OVA measurements of disturbed soil samples to estimate the overall intensity of the exposure. Given the field data, no better

method exists to estimate the exposure point concentration, but the method used here has more uncertainty associated with it than the methods used for the other scenarios.

A.8 Estimation of Human Doses

Exhibits A-5.1 through A-5.9 also present the values and assumptions for the models used to estimate exposures to people performing heavy labor at certain locations outdoors. The model for inhalation of gases and the model for inhalation of fugitive dust assume a constant breathing rate and 100 percent retention of the active ingredient reaching the airway. The model for inadvertent ingestion of dirt adhered to the skin during manual labor assumes a constant amount of ingestion per day and a 50 percent matrix effect (attenuation) relative to the laboratory conditions from which the toxicological potency value was prepared. The model for dermal penetration of organic compounds contained in dirt adhered to skin during manual labor assumes (i) that 12 percent of the active ingredient in the adhered dirt will penetrate the skin in an 8-hour workday and (ii) that workers have different amounts of exposed skin during different activities.

All doses are estimated in units of mg/day of the active ingredient (AI) — either (i) as the Average Daily Dose on a single day [denoted ADD (day)] during which exposure occurs or (ii) as the Average Daily Dose averaged over a lifetime [denoted ADD (life)] during which exposure occurs on certain work days.

A.9 Estimation of Human Health Effects

Exhibits A-6.1 through A-6.9 present the spreadsheets which estimate the exposures and possible human health effects for the 9 scenarios identified above. Each of the spreadsheets follows a common design which presents, in order: (i) the laboratory measurements of concentrations of the Chemicals of Interest in the field samples, (ii) the estimated exposure point concentration for each medium, (iii) the estimated Average Daily Dose on a day of exposure [denoted ADD (day)] for each pathway, (iv) the estimated Average Daily Dose averaged over a lifetime during which exposure occurs on certain work days [denoted ADD (life)] for each pathway, (v) the estimated "Ratio" from exposure to noncarcinogens (ingested and inhaled) as explained below, and (vi) the

"Estimated (Lifetime Incremental) Risk" from exposure to carcinogens (ingested and inhaled) also as discussed below.

In the columns of the spreadsheet showing the results of the laboratory measurements of the field samples, the figures in the regular typeface indicate values reported by the laboratory that fall above the limit of detection for the analytical method, while the figures in the italic typeface indicate a value assumed in this analysis (usually equal to one-half of the detection limit) for samples reported as below the detection limit. In some cases, the number of assumed values exceeds the number of known values for a particular scenario. The final column for the data — the column labeled "Average" — is the straight (unweighted) arithmetic average of the measured and assumed values in the previous columns.

The formulae used to estimate the human health effects from exposure to carcinogens and noncarcinogens via the inhalation and the ingestion pathways follow:

$$ADD\ (life) = ADD\ (day) \bullet Days_{exposure} / Days_{life}$$

where:

ADD (life)	=	Average Daily Dose over a Life (mg/d)
ADD (day)	=	Average Daily Dose on a Day of Exposure (mg/d)
$Days_{exposure}$	=	Number of Days that exposure occurs in a life (number)
$Days_{life}$	=	Number of Days in a life (in 70 years) (number)

The equation for estimating "Incremental Lifetime Risk" from exposure to carcinogens (by compound and by pathway) is:

$$Risk = ADD\ (life) \bullet CPF / M\ adult$$

where:

Risk (Incremental Lifetime Risk)

= Probability that person will manifest cancer, during lifetime, from exposure (dimensionless; 0 < range < 1)

ADD (life) = Average Daily Dose of a compound, averaged over life during which exposure occurs, (mg/d)

CPF = Cancer Potency Factor for a compound, using ingestion or inhalation values as appropriate (mg/kg/day)-1

M adult = Mass of an adult
= 70 kg

In the absence of specific information on possible synergisms or antagonisms between or among chemicals, a total incremental lifetime cancer risk is estimated by summing the values for each compound.

The equation for estimating "Ratio" for exposure to noncarcinogens (by compound and by pathway) is:

$$\text{Ratio} = \text{ADD (day)} \;/\; \text{AIC} \cdot \text{M adult}$$

where:

Ratio = Ratio of Average Daily Dose on a Day of Exposure to the Acceptable Intake Chronic (dimensionless; 0 < range < ∞)

ADD (day) = Average Daily Dose of a compound on a day during which exposure occurs, (mg/d)

AIC = Acceptable Intake Chronic value for a Compound using inhalation or ingestion values as appropriate (mg/kg/day)

M adult = Mass of an adult
= 70 kg

Again, in the absence of specific information on possible synergisms or antagonisms between or among chemicals, a total Fraction of Acceptable Intake is estimated by summing the values for each compound. Strictly, this assumption holds for doses that act on the same target organ/system or by the same mechanism.

These assumptions and methods above for estimating the "Ratio" and the "Risk" are conservative, i.e., protective of human health and environmental quality.

A.10 Discussion of Results

As a guide to the interpretation of estimates for the incremental lifetime risk of exposures at a site, the US EPA has issued various guidance documents, including one titled "Interim Guidance on Compliance with Applicable or Relevant and Appropriated Requirements" (US EPA, OSWER Directive 9234.0-05, dated 9 July 1987). Although this document does not apply directly to the site for a variety of reasons (including the fact that the document concerns goals for remediation, not assessment of base case conditions for workers), it does offer guide posts for assessing the importance of lifetime risks at a site:

> "When MCLs do not exist for contaminants identified at the site, cleanup levels should be set using chemical-specific advisory levels. Cleanup levels should be selected such that the total risk of all contaminants falls within the acceptable risk range of 10^{-4} to 10^{-7}....." (page 9)

In the same guidance document, US EPA offers other guide posts for the assessment for noncarcinogenic exposures:

> "... In cases where noncarcinogens are present, cleanup levels should be based on acceptable levels of exposure as determined by the Reference Dose, taking into account the effects of other contaminants at the site." (page 9)

The AIC values used in the denominator of the "Ratio" in this study are often based on the Reference Doses (RfDs) mentioned in the guidance — or on toxicological concepts and values closely analogous to the Reference Doses.

The fundamental principles used to construct the Reference Doses and the Ratio test are predicated on long term (or chronic; usually measured in years) exposures and health effects. To gauge shorter exposures, US EPA intends to prepare a consistent set of AIS values (Acceptable Intake — Subchronic values), but such a tabulation does not now exist. Generally, AIS values are equal to or larger than AIC values for a particular compound. In the absence of compound-specific AIS values that could form the denominator of a ratio for assessing the importance of short term exposures to noncarcinogens, this Appendix interprets a Ratio (defined above with the AIC) falling under 10 as a general guide post for judging the acceptability of a short term exposure.

A.11 Discussion of Key Uncertainties

The estimates of health effects in this Appendix have many uncertainties associated with them, as is common for all risk assessments. Uncertainties propagate through a series of calculations. While it is highly unlikely that the uncertainties will combine in a purely additive or multiplicative way to produce the theoretically largest possible uncertainty, it is true that the overall uncertainty in a calculation can never be smaller than the uncertainty associated with the least certain step in the chain. For example, US EPA and other authoritative sources generally regard CPFs and AICs as having a factor of 10 uncertainty on either side of the point estimate presented in a table, so the overall range of uncertainty of the estimates in this Appendix can be no smaller that a factor of 100 wide, centered on the point estimates.

Even given the direct measurements of indoor air quality which provide an estimate of the exposure and risk (by taking the estimated concentration equal to half the detection limit), the greatest (but not quantifiable) uncertainties associated with the transport models in this Appendix concern (i) the generally untested method used to estimate equilibrium or steady state concentration of an organic compound in a soil gas given the concentration of that compound adsorbed to the soil and (ii) the generally untested assumption that soil gas infiltrates the foundation at a rate sufficient to contribute one percent of the indoor air volume on a regular basis. Other parameters have lesser uncertainties associated with them as well, but some of them may have strong effects if a full sensitivity analysis were conducted as a part of the continuing work on the site.

• • • • •

Glossary of Common Terms and Abbreviations Used in the Exhibits

AIC	=	Acceptable Intake - Chronic
AIS	=	Acceptable Intake - Subchronic
CPF	=	Cancer Potency Factor
Environ	=	Environ, Inc.
ICF	=	ICF, Inc.
Koc	=	Partition coefficient between water and organic carbon
Kow	=	Partition coefficient between water and octanol
NA	=	Not Available
nos	=	not otherwise specified
PAH	=	Polycyclic Aromatic Hydrocarbons
Rel Pot	=	Relative Potency
VOC	=	Volatile Organic Compounds
Wt of Ev	=	Weight of Evidence used by the US EPA

Exhibit A-1

Chemicals Detected at the Site at Least Once

PAH Compounds

benzo(a)pyrene
benzo(a)anthracene
benzo(b)fluoranthene
benzo(k)fluoranthene
indeno(1,2,3-cd)pyrene
chrysene
dibenzo(a,h)anthracene
benzo(ghi)perylene
naphthalene
fluorene
anthracene
phenanthrene
fluoranthene
pyrene
acenaphthylene
acenaphthene

Other Base Neutral Compounds

bis(2-ethylhexyl)phthalate

Volatile Compounds

benzene
1,2-trans-dichloroethylene
trichloroethylene
chlorobenzene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
ethylbenzene
toluene

Non-Chlorinated Phenols

2,4-dimethylphenol
2-dinitrophenol
4-nitrophenol
2,4-dinitrophenol
2-methyl-4,6-dinitrophenol
phenol
total phenol

Inorganic Species

antimony
arsenic
beryllium
cadmium
chromium
copper
iron
lead
mercury
nickel
selenium
zinc

cyanide-total
ferro-ferric cyanide (as CN)
sulfate

Other Measurements

organic nitrogen
total organic carbon

Exhibit A-2

Chemicals of Interest

PAH Compounds Considered Potentially Carcinogenic

benzo(a)pyrene
benzo(a)anthracene
benzo(b)fluoranthene
benzo(k)fluoranthene
indeno(1,2,3-cd)pyrene
chrysene
dibenzo(a,h)anthracene
benzo(ghi)perylene

PAH Compounds Not Considered Potentially Carcinogenic

naphthalene
fluorene
anthracene
phenanthrene
fluoranthene
pyrene
acenaphthylene
acenaphthene

VOC Compounds Considered Carcinogenic

benzene

VOC Compounds Not Considered Carcinogenic

Group of 8 VOCs (see list below)

Non-Chlorinated Phenols

2,4-dimethylphenol
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
2-methyl-4,6-dinitrophenol
phenol
total phenol

Inorganic Compounds

antimony
arsenic
cadmium
lead
total cyanide
ferro-ferric cyanide (as CN)

.....

Group of 8 VOCs:

trans-1,2-dichloroethylene
trichloroethylene
chlorobenzene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
ethylbenzene
toluene

Physical/Chemical Properties

Chemical of Interest	Source of Chem/Phys Props	MW Molecular Weight (daltons)	S Water Solubility (ppm)	Vp Vapor Pressure (mm Hg)	Hc Henry's Law (atm•m3/mol)	H Henry's Law (-)	Koc Wat/Carb (ml/g)	log 10 Kow Oct/Wat (-)	(C) Relative Photo Ionization Sensitivity
PAH Compounds Considered Potentially Carcinogenic									
benzo(a)pyrene	A	252	1.20E-03	5.60E-09	1.55E-06	6.44E-05	5.50E+06	6.06	*0.90*
benzo(a)anthracene	A	228	5.70E-03	2.20E-08	1.16E-06	4.82E-05	1.38E+06	5.60	*0.90*
benzo(b)fluoranthene	A	252	1.40E-02	5.00E-07	1.19E-05	4.95E-04	5.50E+05	6.06	*0.90*
benzo(k)fluoranthene	A	252	4.30E-03	5.10E-07	3.94E-05	1.64E-03	5.50E+05	6.06	*0.90*
indeno(1,2,3-cd)pyrene	A	276	5.30E-04	1.00E-10	6.86E-08	2.85E-06	1.60E+06	6.50	*0.90*
chrysene	A	228	1.80E-03	6.30E-09	1.05E-06	4.36E-05	2.00E+05	5.61	*0.90*
dibenzo(a,h)anthracene	A	278	5.00E-04	1.00E-10	7.33E-08	3.05E-06	3.30E+06	6.80	*0.90*
benzo(ghi)perylene	A	276	7.00E-04	1.03E-10	5.34E-08	2.22E-06	1.60E+06	6.51	*0.90*
PAH Compounds Not Considered Potentially Carcinogenic									
naphthalene	B	128	3.44E+01	8.70E-02	4.26E-04	1.77E-02	1.42E+03	3.37	*0.90*
fluorene	A	116	1.69E+00	7.10E-04	6.42E-05	2.67E-03	7.30E+03	4.20	*0.90*
anthracene	A	178	4.50E-02	1.95E-04	1.02E-03	4.24E-02	1.40E+04	4.45	*0.90*
phenanthrene	A	178	1.00E+00	6.80E-04	1.59E-04	6.61E-03	1.40E+04	4.46	*0.90*
fluoranthene	A	202	2.06E-01	5.00E-06	6.46E-06	2.68E-04	3.80E+04	4.90	*0.90*
pyrene	A	202	1.32E-01	2.50E-06	5.04E-06	2.09E-04	3.80E+04	4.88	*0.90*
acenaphthylene	A	152	3.93E+00	2.90E-02	1.48E-03	6.15E-02	2.50E+03	3.70	*0.90*
acenaphthene	A	154	3.42E+00	1.55E-03	9.20E-05	3.82E-03	4.60E+03	4.00	*0.90*
VOC Compounds Considered Carcinogenic									
benzene	A	78	1.75E+03	9.52E+01	5.59E-03	2.32E-01	8.30E+01	2.12	1.00
VOC Compounds Not Considered Carcinogenic									
avg properties of 8 VOCs	A	123	1.11E+03	5.41E+01	5.07E-03	2.11E-01	8.77E+02	2.80	*0.91*
Non-Chlorinated Phenols									
2,4-dimethylphenol	B	122	1.70E+01	6.00E-02	5.67E-04	2.35E-02	2.17E+02	2.50	*0.90*
2-nitrophenol	B	139	2.10E+03	1.00E+00	8.71E-05	3.62E-03	4.40E+01	1.76	*0.90*
4-nitrophenol	B	139	2.10E+03	1.00E+00	8.71E-05	3.62E-03	4.40E+01	1.76	*0.90*
2,4-dinitrophenol	A	184	5.60E+03	1.49E-05	6.45E-10	2.68E-08	1.66E+01	1.50	*0.90*
2-methyl-4,6-dinitrophenol	G	213	5.60E+03	1.49E-05	6.45E-10	2.68E-08	1.66E+01	1.50	*0.90*
phenol	A	94	9.30E+04	3.41E-01	4.54E-07	1.89E-05	1.42E+01	1.46	*0.90*
total phenol									
Inorganic Compounds									
antimony	A	122		1.00E+00					0.00
arsenic	A	75		0.00E+00					0.00
cadmium	A	112		0.00E+00					0.00
lead	A	207		0.00E+00					0.00
total cyanide									
ferro-ferric cyanide (as CN)									

Sources:

A: Superfund Public Health Evaluation Manual, Exhibit C-1, US EPA, 540/1-86/060, October 1986

B: Chemical, Physical, and Biological Properties of Compunds Present at Hazardous Waste Sites Prepared for the US EPA by Clement Associates, September 1985

C: Instruction Manual for H•Hu Model PI 101 with estimated values shown in italic face

Physical/Chemical Properties

Chemical of Interest	Mol Wt (daltons)	Schmidt (-)	Schmidt Source	Est LeBas Add V Incrs (R) (cm3/mol)	Source	Air Diff Coeff (30 deg C) (cm2/sec)	Air Diff Coeff Source	keff Diff Constant (m/hr)
PAH Compounds Considered Potentially Carcinogenic:						ok		ok
benzo(a)pyrene	252	2.8	E	223.1	H	5.6E-02	H	5.40E-03
benzo(a)anthracene	228	2.8	E	211.1	H	5.8E-02	H	5.57E-03
benzo(b)fluoranthene	252	2.8	E	226.4	H	5.6E-02	H	5.36E-03
benzo(k)fluoranthene	252	2.8	E	226.4	H	5.6E-02	H	5.36E-03
indeno(1,2,3-cd)pyrene	276	2.8	E	238.9	H	5.4E-02	H	5.21E-03
chrysene	228	2.8	E	211.1	H	5.8E-02	H	5.57E-03
dibenzo(a,h)anthracene	278	2.8	E	254.9	H	5.3E-02	H	5.05E-03
benzo(ghi)perylene	276	2.8	E	238.0	H	5.4E-02	H	5.22E-03
PAH Compounds Not Considered Potentially Carcinogenic:								
naphthalene	128	2.1	E	125.5	H	7.6E-02	H	7.32E-03
fluorene	116	2.1	E	159.7	H	6.9E-02	H	6.65E-03
anthracene	178	2.1	E	167.2	H	6.5E-02	H	6.28E-03
phenanthrene	178	2.1	E	167.2	H	6.5E-02	H	6.28E-03
fluoranthene	202	2.8	E	182.6	H	6.2E-02	H	5.99E-03
pyrene	202	2.8	E	181.7	H	6.2E-02	H	6.00E-03
acenaphthylene	152	2.1	E	143.4	H	7.1E-02	H	6.80E-03
acenaphthene	154	2.1	E	147.1	H	7.0E-02	H	6.72E-03
VOC Compounds Considered Carcinogenic:								
benzene	78	1.7	E	na	na	9.2E-02	I	8.88E-03
VOC Compounds Not Considered Carcinogenic:								
sum of 8 VOCs	123	2.1	E	109.7		8.1E-02	avg	7.78E-03
Non-Chlorinated Phenols								
2,4-dimethylphenol	122	2.1	E	133.0		7.5E-02	H	7.17E-03
2-nitrophenol	139	2.1	E	119.7		7.7E-02	H	7.41E-03
4-nitrophenol	139	2.1	E	119.7		7.7E-02	H	7.41E-03
2,4-dinitrophenol	184	2.1	E	126.4		7.4E-02	H	7.09E-03
2-methyl-4,6-dinitrophenol	213	2.8	E	149.7		6.8E-02	H	6.52E-03
phenol	94	1.7	E	93.1		8.9E-02	H	8.58E-03
total phenol								
Inorganic Compounds:								
antimony	122							
arsenic (& compounds)	75							
cadmium	112							
lead	207							
cyanide (total, nos)								
ferro-ferric cyanide (as CN)								

Sources for Chemical/Physical Properties:

E = adapted from Shen, T.T., 1980, Estimation of Hazardous Organic Compounds from Waste Disposal Sites, APCA.
H = estimated from Eq 17-12 (FSG) and Table 17-5 (LeBas) in Handbook of Chemical Property Estimation Methods, Lyman, W.J. et al, 1982, McGraw Hill
I = Superfund Exposure Assessment Manual for USEPA, Versar, Draft 1986

Exhibit A-4, page 1
Toxicological Properties

Chemical of Interest	(A) Oral EPA CPF (mg/kg/d)-1	(A) Oral EPA Wt of Ev (-)	(A) Inhale EPA CPF (mg/kg/d)-1	(A) Inhale EPA Wt of Ev (-)	(A) Oral AIS EPA (mg/kg/d)	(A) Oral AIC EPA, Environ (mg/kg/d)	(A) Inhale AIS EPA (mg/kg/d)	(A) Inhale AIC EPA, Environ (mg/kg/d)
PAH Compounds Considered Potentially Carcinogenic								
benzo(a)pyrene	11.5	B2	6.1	B2				
benzo(a)anthracene		B2		B2				
benzo(b)fluoranthene		B2		B2				
benzo(k)fluoranthene		D		D				
indeno(1,2,3-cd)pyrene		C		C				
chrysene		B2		B2				
dibenzo(a,h)anthracene		B2		B2				
benzo(ghi)perylene								
PAH Compounds Not Considered Potentially Carcinogenic						Environ		Environ
naphthalene						0.005000		0.005000
fluorene								
anthracene						0.000557		0.000557
phenanthrene						0.007000		0.007000
fluoranthene						0.020000		0.020000
pyrene						0.015000		0.015000
acenaphthylene						0.010000		0.010000
acenaphthene						0.200000		0.200000
VOC Compounds Considered Carcinogenic								
benzene	0.052	A	0.026	A				
VOC Compounds Not Considered Carcinogenic								
sum of 8 VOCs								
Non-Chlorinated Phenols								
2,4-dimethylphenol								
2-nitrophenol								
4-nitrophenol								
2,4-dinitrophenol						0.002000		
2-methyl-4,6-dinitrophenol								
phenol					0.100000	0.100000	0.190000	0.020000
total phenol								
Inorganic Compounds								
antimony						0.000400		
arsenic	15	A	50	A				
cadmium	NA		6.1	A		0.000290		
lead						0.001400		0.000430
total cyanide						0.020000		
ferro-ferric cyanide (as CN)						0.020000		

Sources:

A = Superfund Public Health Evaluation Manual, 1986, Final, US EPA
d = Health Assessment Document for Nickel and Nickel Compounds, 1986, Final, US EPA
e = Chu, M.L., Chen, C.W. Evaluation and Estimation of Potential Carcinogenic Risks of PAHs, 1984
f = Compatative Potency Approach ... PAHs in the Environment, Jan 87, Draft, ICF-Clement Associates

Exhibit A-4, page 2
Toxicological Properties

Chemical of Interest	(f) Oral CPF ICF (mg/kg/d)-1	(f) Inhale CPF ICF (mg/kg/d)-1	(f) Rel Pot ICF (-)
PAH Compounds Considered Potentially Carcinogenic			
benzo(a)pyrene	5.7400	0.4533	1.0000
benzo(a)anthracene			0.1450
benzo(b)fluoranthene			0.1400
benzo(k)fluoranthene			0.0660
indeno(1,2,3-cd)pyrene			0.2320
chrysene			0.0044
dibenzo(a,h)anthracene			1.1100
benzo(ghi)perylene			0.0220
PAH Compounds Not Considered Potentially Carcinogenic			
naphthalene			
fluorene			
anthracene			
phenanthrene			
fluoranthene			
pyrene			
acenaphthylene			
acenaphthene			
VOC Compounds Considered Carcinogenic			
benzene			
VOC Compounds Not Considered Carcinogenic			
sum of 8 VOCs			
Non-Chlorinated Phenols			
2,4-dimethylphenol			
2-nitrophenol			
4-nitrophenol			
2,4-dinitrophenol			
2-methyl-4,6-dinitrophenol			
phenol			
total phenol			
Inorganic Compounds			
antimony			
arsenic			
cadmium			
lead			
total cyanide			
ferro-ferric cyanide (as CN)			

Exhibit A-4, page 3

Toxicological Properties

Values Used in this Risk Assessment for the Geneva Site

Chemical of Interest	Oral AIS (mg/kg/d)	Oral AIC (mg/kg/d)	Inhale AIS (mg/kg/d)	Inhale AIC (mg/kg/d)	Oral CPF (mg/kg/d)-1	Inhale CPF (mg/kg/d)-1
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene		0.010000		0.010000	5.7400	0.4533
benzo(a)anthracene		0.010000		0.010000	0.8323	0.0657
benzo(b)fluoranthene		0.010000		0.010000	0.8036	0.0635
benzo(k)fluoranthene		0.010000		0.010000	0.3788	0.0299
indeno(1,2,3-cd)pyrene		0.010000		0.010000	1.3317	0.1052
chrysene		0.010000		0.010000	0.0253	0.0020
dibenzo(a,h)anthracene		0.010000		0.010000	6.3714	0.5032
benzo(ghi)perylene		0.010000		0.010000	0.1263	0.0100
PAH Compounds Not Considered Potentially Carcinogenic						
		Environ		Environ		
naphthalene		0.005000		0.005000		
fluorene		0.005000		0.005000		
anthracene		0.000557		0.000557		
phenanthrene		0.007000		0.007000		
fluoranthene		0.020000		0.020000		
pyrene		0.015000		0.015000		
acenaphthylene		0.010000		0.010000		
acenaphthene		0.200000		0.200000		
VOC Compounds Considered Carcinogenic						
benzene					0.0520	0.0260
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs						
Non-Chlorinated Phenols						
2,4-dimethylphenol		0.002000		0.002000		
2-nitrophenol		0.002000		0.002000		
4-nitrophenol		0.002000		0.002000		
2,4-dinitrophenol		0.002000		0.002000		
2-methyl-4,6-dinitrophenol		0.002000		0.002000		
phenol	0.100000	0.100000	0.190000	0.020000		
total phenol						
Inorganic Compounds						
antimony		0.000400		0.000400		
arsenic					15.0000	50.0000
cadmium		0.000290		0.000290	NA	6.1000
lead		0.001400		0.000430		
total cyanide		0.020000		0.020000		
ferro-ferric cyanide (as CN)		0.020000		0.020000		

Family of Exhibits A-5

Scenario: 1 People Working in Offices in the Service Building

Case / Timing:	Base Case — Independent of Construction
Employees?	Yes
Adults or Children?	Adults
Activity:	Office Work
Indoors / Outdoors:	Indoors, with building surrounded by pavement
Number of People (Pool):	50
Frequency of Use:	Work Days
Duration of Use:	35 years
Hours of Use:	8 hours/work day
Days of Week:	5
Weeks per Year:	50

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Exposure Point Concentration:
   Dilution scaled to match indoor benzene data

   Primary Data Sets:
   - Soils: TPs 6, 7, 8, 9
   - Indoor Air: Indoor benzene average =0.045 mg / m3
     = detection limit / 2

   Secondary Data Sets: (not used in calculations)
   - For Indoor Air: Indoor OVA Readings calibrated to benzene
     - First Floor: 1.2 ppm
     - Second Floor: 0.5 ppm

   Inhalation Rate: 1.00 m^3/hr

Scenario: 2 People Working in Garage in the Service Building

Case / Timing:	Base Case — Independent of Construction
Employees?	Yes
Adults or Children?	Adults
Activity:	Garage Work
Indoors / Outdoors:	Indoors, with building surrounded by pavement
Number of People (Pool):	9 total (3 on day shift and 6 on night shift)
Frequency of Use:	Work Days
Duration of Use:	35 years
Hours of Use:	8 hours/work day
Days of Week:	5
Weeks per Year:	50

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Exposure Point Concentration: Dilution scaled to match indoor benzene and naphthalene data

   Primary Data Sets:

   Soils: TPs 13, 14, 15

   Indoor Air: Indoor benzene average = 0.045 mg / m3
   = detection limit / 2

   Secondary Data Sets: (not used in calculations)

   For Indoor Air: Indoor OVA Readings calibrated to benzene

   First Floor: 3.0 ppm

   Inhalation Rate: 1.25 m^3/hr

Scenario: 3 People Working in Corporate Meter Building (former Purifier Building)

Case / Timing:	Base Case — Independent of Construction
Employees?	Yes
Adults or Children?	Adults
Activity:	Repair Meters (large units)
Indoors / Outdoors:	Indoors, with with dirt (or water) basement floor
Number of People (Pool):	6
Frequency of Use:	Work Days
Duration of Use:	35 years
Hours of Use:	8 hours/work day
Days of Week:	5
Weeks per Year:	50

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Exposure Point Concentration:

   Dilution scaled to match indoor benzene and naphthalene data

   Primary Data Sets:

   Soils: TPs 24, 25, 27, 28, 29; SS 6

   Indoor Air: Indoor benzene average = 0.045 mg / m3

   = detection limit / 2

   Secondary Data Sets: (not used in calculations)

   For Indoor Air: Indoor OVA Readings calibrated to benzene

   Meter Storage: 10.0 ppm (with 0 in crawl space)

   Coffee Room: 7.0 to 9.0 ppm

   Loading Dock: 2.5 to 3.0 ppm

   Inhalation Rate: 1.25 m^3/hr

Scenario: 4 People Working in Compressor Building

Case / Timing:	Base Case — Independent of Construction
Employees?	Yes
Adults or Children?	Adults
Activity:	Work Intermittently in Building
Indoors / Outdoors:	Indoors
Number of People (Pool):	A few
Frequency of Use:	Work Days
Duration of Use:	35 years
Hours of Use:	4 hours/work day
Days of Week:	4
Weeks per Year:	50

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Steady State Concentration in Soil Gas:
   10 percent of equilibrium concentration

   Assumption for Estimating Exposure Point Concentration:
   1 percent of building air comes from soil gas

   Primary Data Sets:
   For Soils: TPs 21, 24

   Secondary Data Sets: (not used in calculations)
   For Indoor Air: Indoor OVA Readings calibrated to benzene

Control Room:	12.0 ppm (with 3.0 ppm reading in crawl space below)
Calibration Room:	1.0 ppm
Transmission Room:	150.0 ppm
Welding Shop:	0.7 ppm
Storage Area:	2.3 ppm

   Inhalation Rate: 1.25 m^3/hr

Scenario: 5 People Working in East Office Building

Case / Timing:	Base Case — Independent of Construction
Employees?	Yes
Adults or Children?	Adults
Activity:	Janitor Storage Area on First Floor
	Office Work and Classrooms on Second Floor
Indoors / Outdoors:	Indoors
Number of People (Pool):	12
Frequency of Use:	Work Days
Duration of Use:	35 years
Hours of Use:	8 hours/work day
Days of Week:	5
Weeks per Year:	50

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Steady State Concentration in Soil Gas:
   10 percent of equilibrium concentration

   Assumption for Estimating Exposure Point Concentration:
   1 percent of building air comes from soil gas

   Primary Data Sets:
   For Soils: TP 20 (with all values below detection limits)

   Secondary Data Sets: (not used in calculations)
   For Indoor Air: Indoor OVA Readings calibrated to benzene
   First Floor: 1.5 ppm
   Second Floor: 2.5 ppm
   For Outdoor Air: Outdoor OVA Readings calibrated to benzene
   0.0 to 1.0 ppm in air in trenches during
   old sewer line excavation nearest this building

   Inhalation Rate: 1.00 m^3/hr

Scenario: 6 People Excavating New Water Line along Main Access Road

Case / Timing:	Base Case — Excavation of New Water Line along Main Access Road
Employees?	Yes, or Independent Construction Workers
Adults or Children?	Adults
Activity:	Excavation and Installation of New Water Line
Indoors / Outdoors:	Outdoors
Number of People (Pool):	4
Frequency of Use:	Once in Lifetime
Duration of Use:	One Week in Lifetime
Hours of Use:	8 hours/work day
Days of Week:	5
Weeks per Year:	One Week in Lifetime

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Exposure Point Concentration:
   10 percent of soil gas concentration

   Primary Data Sets:

   For Soils: Borings 17, 18, 19, 20, and 21 monitored by Woodward-Clyde (1984)

   Inhalation Rate: 2.00 m^3/hr

2. Inhalation of Fugitive Dust

   Compounds: All Chemicals of Interest

   Models Used: Bulldozer Model [US EPA (1983)]

   Near Field Box Model [Pasquill (1975), Horst (1979)]

   Primary Data Sets:

   For Soils: Same

   Inhalation Rate: 2.00 m^3/hr

3. Ingestion of Dust or Soil

   Compounds: All Chemicals of Interest

   Models Used: Simple Ingestion

   Primary Data Sets:

   For Soils: Same

   Ingestion Rate of Dust or Soil: 200 mg/day

   Matrix Effect: 50 percent

4. Dermal Penetration from Contact with Dust or Soil:

   Compounds: All Organic Chemicals of Interest

   Models Used: Simple Fraction per Day

   Primary Data Sets:

   For Soils: Same

   Body Parts (Skin) Covered with Dust or Soil: 2 Hands, 2 Forearms, 2 Upper Arms, Parts of Head, Neck, and Torso

   Area of Skin Covered with Dust or Soil: 6,300 cm^2

   Amount of Dust or Soil on Skin: 0.5 mg/cm^2

   Percent or Penetration in a Full Work Day: 12 percent

Scenario: 7 People Performing New Construction (Superstructure)

Case / Timing:	Base Case — Superstructure Construction for New Entrance and Elevator for Service Bldg
Employees?	Yes, or Independent Construction Workers
Adults or Children?	Adults
Activity:	Construction
Indoors / Outdoors:	Outdoors
Number of People (Pool):	10
Frequency of Use:	Work Days for 4 Months (80 Work Days)
Duration of Use:	Once in Lifetime
Hours of Use:	8 hours / work day
Days of Week:	5
Weeks per Year:	na

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Diffusion Through Dry Soil [Currie (1960, 1961) and Millington and Quirk (1961)]

   Near Field Box Model [Pasquill (1975), Horst (1979)]

   Exposure Point Concentration:

   Primary Data Sets:

   For Soils: TPs 13, 14

   Inhalation Rate: 1.50 m^3/hr

2. Inhalation of Fugitive Dust — Pathway Not Estimated for Lack of Data

   Compounds: All Chemicals of Interest
   Models Used: None — Pathway Not Estimated for Lack of Data
   Primary Data Sets:
   For Soils: Same
   Inhalation Rate: na

3. Ingestion of Dust or Soil

   Compounds: All Chemicals of Interest
   Models Used: Simple Ingestion
   Primary Data Sets:
   For Soils: Same
   Ingestion Rate of Dust or Soil: 100 mg/day
   Matrix Effect: 50 percent

4. Dermal Penetration from Contact with Dust or Soil:

   Compounds: All Organic Chemicals of Interest
   Models Used: Simple Fraction per Day
   Primary Data Sets:
   For Soils: Same
   Body Parts (Skin) Covered with Dust or Soil: 2 Hands, 2 Forearms, 2 Upper Arms, Parts of Head, Neck, and Torso
   Area of Skin Covered with Dust or Soil: 6,300 cm^2
   Amount of Dust or Soil on Skin: 0.5 mg/cm^2
   Percent or Penetration in a Full Work Day: 12 percent

Scenario: 8 People Excavating for Maintenance of Gas Utility Lines

Case / Timing:	Base Case — Emergency Excavation and Maintenance
Employees?	Yes
Adults or Children?	Adults
Activity:	Emergency Excavation and Maintenance
Indoors / Outdoors:	Outdoors
Number of People (Pool):	3
Frequency of Use:	1 Event every 5 Years
Duration of Use:	20 Years
Hours of Use:	8 Hours / Work Day for 2 Work Days
Days of Week:	na
Weeks per Year:	na

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Exposure Point Concentration:

   10 percent of soil gas concentration

   Primary Data Sets:

   For Soils: All TPs <u>except</u> :
   TPs 12, 16, 19, and
   TPs 27, 28, and
   TPs 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, and
   TPs 40, 41, 41A, 42

   For Gas: Geometric Mean of measurements of disturbed TP soil samples by OVA meter calibrated to benzene and values of nondetect set equal to 1 ppmv, an assumed limit of detection (GM = 8.6 ppmv from these data)

   Inhalation Rate: 2.00 m^3/hr

2. Inhalation of Fugitive Dust

   Compounds: All Chemicals of Interest

   Models Used: Bulldozer Model [US EPA (1983)]
   Near Field Box Model [Pasquill (1975), Horst (1979)]

   Primary Data Sets:

   For Soils: Same

   Inhalation Rate: 2.00 m^3/hr

3. Ingestion of Dust or Soil

   Compounds: All Chemicals of Interest

   Models Used: Simple Ingestion

   Primary Data Sets:

   For Soils: Same

   Ingestion Rate of Dust or Soil: 200 mg/day

   Matrix Effect: 50 percent

4. Dermal Penetration from Contact with Dust or Soil:

   Compounds: All Organic Chemicals of Interest

   Models Used: Simple Fraction per Day

   Primary Data Sets:

   For Soils: Same

   Body Parts (Skin) Covered with Dust or Soil: 2 Hands, 2 Forearms, 2 Upper Arms, Parts of Head, Neck, and Torso

   Area of Skin Covered with Dust or Soil: 6,300 cm^2

   Amount of Dust or Soil on Skin: 0.5 mg/cm^2

   Percent or Penetration in a Full Work Day: 12 percent

Scenario: 9 People Excavating for Maintenance of Gas Utility Lines Near Test Pit 1

Case / Timing:	Base Case —Emergency Excavation and Maintenance
Employees?	Yes
Adults or Children?	Adults
Activity:	Emergency Excavation and Maintenance
Indoors / Outdoors:	Outdoors
Number of People (Pool):	3
Frequency of Use:	1 Event every 5 Years
Duration of Use:	20 Years
Hours of Use:	8 Hours / Work Day for 2 Work Days
Days of Week:	na
Weeks per Year:	na

Pathways & Compounds Modeled, Models Used, Data Sets, Key Assumptions:

1. Inhalation of Gases

   Compounds: All Organic Chemicals of Interest

   Models Used: Equilibrium soil gas concentration estimated from concentration in soil samples from test pits [Eschenroeder, A.Q. (1987) pers. comm.]

   Assumption for Estimating Exposure Point Concentration:

   1 percent of soil gas concentration

   Primary Data Sets:

   For Soils: TP 1

   Inhalation Rate: 2.00 m^3/hr

2. Inhalation of Fugitive Dust

   Compounds: All Chemicals of Interest

   Models Used: Bulldozer Model [US EPA (1983)]
   Near Field Box Model [Pasquill (1975), Horst (1979)]

   Primary Data Sets:

   For Soils: Same

   Inhalation Rate: 2.00 m^3/hr

3. Ingestion of Dust or Soil

   Compounds: All Chemicals of Interest

   Models Used: Simple Ingestion

   Primary Data Sets:

   For Soils: Same

   Ingestion Rate of Dust or Soil: 200 mg/day

   Matrix Effect: 50 percent

4. Dermal Penetration from Contact with Dust or Soil:

   Compounds: All Organic Chemicals of Interest

   Models Used: Simple Fraction per Day

   Primary Data Sets:

   For Soils: Same

   Body Parts (Skin) Covered with Dust or Soil: 2 Hands, 2 Forearms, 2 Upper Arms, Parts of Head, Neck, and Torso

   Area of Skin Covered with Dust or Soil: 6,300 cm^2

   Amount of Dust or Soil on Skin: 0.5 mg/cm^2

   Percent or Penetration in a Full Work Day: 12 percent

References for the Models Cited in this Exhibit

Currie, J.A. (1960) Gaseous Diffusion in Porous Media, Part 2: Dry Granular Materials, Brit Journ. of Appl. Physics, 11:318-324.

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27 March 1989

Exhibit A-6.1, page 1
Scenario 1

Chemical of Interest	TP Soils TP-6* (ppm)	TP Soils TP-7* (ppm)	TP Soils TP-8* (ppm)	TP Soils TP-9* (ppm)	TP Soils Average (ppm)
PAH Compounds Considered Potentially Carcinogenic					
benzo(a)pyrene	1.30E+01	1.20E+01	8.00E+00	*1.00E+00*	8.50E+00
benzo(a)anthracene	1.20E+01	1.90E+01	7.00E+00	*1.00E+00*	9.75E+00
benzo(b)fluoranthene	3.20E+01	2.80E+01	8.00E+00	*1.00E+00*	1.73E+01
benzo(k)fluoranthene	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00
indeno(1,2,3-cd)pyrene	5.00E+00	7.00E+00	*1.00E+00*	*1.00E+00*	3.50E+00
chrysene	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00
dibenzo(a,h)anthracene	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00
benzo(ghi)perylene	9.00E+00	9.00E+00	*1.00E+00*	*1.00E+00*	5.00E+00
PAH Compounds Not Considered Potentially Carcinogenic					
naphthalene	*1.00E+00*	*1.00E+00*	8.40E+01	*1.00E+00*	2.18E+01
fluorene	*1.00E+00*	5.00E+00	1.90E+01	*1.00E+00*	6.50E+00
anthracene	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00
phenanthrene	1.50E+01	4.00E+01	3.60E+01	*1.00E+00*	2.30E+01
fluoranthene	2.10E+01	1.90E+01	1.20E+01	*1.00E+00*	1.33E+01
pyrene	1.50E+01	1.50E+01	8.00E+00	9.00E+00	1.18E+01
acenaphthylene	*1.00E+00*	*1.00E+00*	8.00E+00	*1.00E+00*	2.75E+00
acenaphthene	*1.00E+00*	*1.00E+00*	2.00E+00	*1.00E+00*	1.25E+00
VOC Compounds Considered Carcinogenic					
benzene	*5.00E-02*	1.00E-01	1.15E+01	1.60E+00	3.31E+00
VOC Compounds Not Considered Carcinogenic					
sum of 8 VOCs	*4.00E-01*	8.00E-02	3.26E+01	1.22E+01	1.13E+01
Non-Chlorinated Phenols					
2,4-dimethylphenol	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*	5.00E-01
2-nitrophenol	*1.50E+00*	*1.50E+00*	6.00E+00	*1.50E+00*	2.63E+00
4-nitrophenol	*1.00E+00*	*1.00E+00*	1.00E+01	*1.00E+00*	3.25E+00
2,4-dinitrophenol	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	6.00E+01
2-methyl-4,6-dinitrophenol	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*	2.20E+01
phenol	*1.00E+00*	*1.00E+00*	4.00E+00	*1.00E+00*	1.75E+00
total phenol					
Inorganic Compounds					
antimony	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	2.50E-01
arsenic	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	2.50E-01
cadmium	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	5.00E-02
lead	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	2.50E-01
total cyanide	4.50E+02	1.20E+02	7.00E-01	1.40E+02	1.78E+02
ferro-ferric cyanide (as CN)	4.10E+02	1.20E+02	*5.00E-02*	1.30E+02	1.65E+02

Exhibit A-6.1, page 2
Scenario 1

Chemical of Interest	Copy of TP Soils Average (ppm)	Estimated Exp Point Conc in Inhaled Gases (mg Al/m3)	Estimated ADD (day) from Inhaled Gases (mg/d)	Estimated ADD (life) from Inhaled Gases (mg/d)	Estimated Health Effects Ratio via Inhale Non Carcs (--)	Estimated Health Effects Incremental Lifetime Risk via Inhale Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	8.50E+00	4.83E-10	3.87E-09	1.33E-09	5.52E-09	8.60E-12
benzo(a)anthracene	9.75E+00	1.65E-09	1.32E-08	4.54E-09	1.89E-08	4.27E-12
benzo(b)fluoranthene	1.73E+01	7.53E-08	6.03E-07	2.07E-07	8.61E-07	1.88E-10
benzo(k)fluoranthene	1.00E+00	1.45E-08	1.16E-07	3.97E-08	1.65E-07	1.70E-11
indeno(1,2,3-cd)pyrene	3.50E+00	3.03E-11	2.42E-10	8.32E-11	3.46E-10	1.25E-13
chrysene	1.00E+00	1.06E-09	8.48E-09	2.91E-09	1.21E-08	8.29E-14
dibenzo(a,h)anthracene	1.00E+00	4.48E-12	3.59E-11	1.23E-11	5.12E-11	8.85E-14
benzo(ghi)perylene	5.00E+00	3.37E-11	2.69E-10	9.25E-11	3.85E-10	1.32E-14
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	2.18E+01	1.32E-03	1.05E-02	3.62E-03	3.01E-02	
fluorene	6.50E+00	1.15E-05	9.23E-05	3.17E-05	2.64E-04	
anthracene	1.00E+00	1.47E-05	1.18E-04	4.04E-05	3.02E-03	
phenanthrene	2.30E+01	5.27E-05	4.22E-04	1.45E-04	8.61E-04	
fluoranthene	1.33E+01	4.55E-07	3.64E-06	1.25E-06	2.60E-06	
pyrene	1.18E+01	3.14E-07	2.52E-06	8.64E-07	2.40E-06	
acenaphthylene	2.75E+00	3.29E-04	2.63E-03	9.03E-04	3.75E-03	
acenaphthene	1.25E+00	5.05E-06	4.04E-05	1.39E-05	2.88E-06	
VOC Compounds Considered Carcinogenic						
benzene	3.31E+00	4.50E-02	3.60E-01	1.24E-01		4.59E-05
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	1.13E+01	1.32E-02	1.06E-01	3.63E-02		
Non-Chlorinated Phenols						
2,4-dimethylphenol	5.00E-01	2.63E-04	2.11E-03	7.24E-04	1.51E-02	
2-nitrophenol	2.63E+00	1.05E-03	8.39E-03	2.88E-03	6.00E-02	
4-nitrophenol	3.25E+00	1.30E-03	1.04E-02	3.57E-03	7.42E-02	
2,4-dinitrophenol	6.00E+01	4.70E-07	3.76E-06	1.29E-06	2.69E-05	
2-methyl-4,6-dinitrophenol	2.20E+01	1.73E-07	1.38E-06	4.74E-07	9.86E-06	
phenol	1.75E+00	1.13E-05	9.03E-05	3.10E-05	6.45E-05	
total phenol						
Inorganic Compounds						
antimony	2.50E-01					
arsenic	2.50E-01					
cadmium	5.00E-02					
lead	2.50E-01					
total cyanide	1.78E+02					
ferro-ferric cyanide (as CN)	1.65E+02					
				Total =	1.87E-01	4.59E-05

* Test pit is paved.

Chemical of Interest	TP Soils TP-13 (ppm)	TP Soils TP-14* (ppm)	TP Soils TP-15* (ppm)	TP Soils Average (ppm)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	2.30E+01	1.10E+02	3.00E+02	1.44E+02
benzo(a)anthracene	2.10E+01	9.60E+01	7.90E+02	3.02E+02
benzo(b)fluoranthene	7.00E+01	5.60E+01	4.00E+02	1.75E+02
benzo(k)fluoranthene	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00
indeno(1,2,3-cd)pyrene	2.50E+01	3.00E+00	3.00E+02	1.09E+02
chrysene	*1.00E+00*	3.40E+01	*1.00E+00*	1.20E+01
dibenzo(a,h)anthracene	5.20E+01	2.20E+01	*1.00E+00*	2.50E+01
benzo(ghi)perylene	5.00E+01	6.50E+01	*1.00E+00*	3.87E+01
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	2.31E+02	*1.00E+00*	5.54E+03	1.92E+03
fluorene	4.40E+01	5.20E+01	1.50E+03	5.32E+02
anthracene	2.30E+01	7.30E+01	5.30E+02	2.09E+02
phenanthrene	2.50E+01	1.92E+02	1.20E+03	4.72E+02
fluoranthene	5.00E+01	2.52E+02	6.90E+02	3.31E+02
pyrene	2.30E+01	1.81E+02	4.70E+02	2.25E+02
acenaphthylene	4.12E+02	1.90E+01	5.30E+02	3.20E+02
acenaphthene	2.35E+02	3.90E+01	*1.00E+00*	9.17E+01
VOC Compounds Considered Carcinogenic				
benzene	1.00E-01	4.30E-01	7.81E+00	2.78E+00
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs	8.00E-02	8.30E-01	2.01E+02	6.72E+01
Non-Chlorinated Phenols				
2,4-dimethylphenol	*5.00E-01*	*5.00E-01*	5.40E+02	1.80E+02
2-nitrophenol	*1.50E+00*	*1.50E+00*	*1.50E+00*	1.50E+00
4-nitrophenol	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00
2,4-dinitrophenol	*6.00E+01*	*6.00E+01*	*6.00E+01*	6.00E+01
2-methyl-4,6-dinitrophenol	*2.20E+01*	4.60E+02	*2.20E+01*	1.68E+02
phenol	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00
total phenol				
Inorganic Compounds				
antimony	*2.50E-01*	*2.50E-01*	*2.50E-01*	2.50E-01
arsenic	*2.50E-01*	*2.50E-01*	*2.50E-01*	2.50E-01
cadmium	*5.00E-02*	*5.00E-02*	*5.00E-02*	5.00E-02
lead	*2.50E-01*	*2.50E-01*	*2.50E-01*	2.50E-01
total cyanide	4.40E+01	1.60E+02	7.00E+02	3.01E+02
ferro-ferric cyanide (as CN)	3.90E+01	1.50E+02	6.80E+02	2.90E+02

Exhibit A-6.2, page 2
Scenario 2

Chemical of Interest	Copy of TP Soils Average (ppm)	Estimated Exp Point Conc in Inhaled Gases (mg Al/m3)	Estimated ADD (day) from Inhaled Gases (mg/d)	Estimated ADD (life) from Inhaled Gases (mg/d)	Estimated Health Effects Ratio via Inhale Non Carcs (--)	Estimated Health Effects Incremental Lifetime Risk via Inhale Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	1.44E+02	2.11E-09	2.11E-08	7.25E-09	3.02E-08	4.69E-11
benzo(a)anthracene	3.02E+02	1.32E-08	1.32E-07	4.53E-08	1.88E-07	4.25E-11
benzo(b)fluoranthene	1.75E+02	1.97E-07	1.97E-06	6.76E-07	2.81E-06	6.13E-10
benzo(k)fluoranthene	1.00E+00	3.72E-09	3.72E-08	1.28E-08	5.31E-08	5.46E-12
indeno(1,2,3-cd)pyrene	1.09E+02	2.43E-10	2.43E-09	8.35E-10	3.48E-09	1.26E-12
chrysene	1.20E+01	3.27E-09	3.27E-08	1.12E-08	4.67E-08	3.20E-13
dibenzo(a,h)anthracene	2.50E+01	2.88E-11	2.88E-10	9.90E-11	4.12E-10	7.11E-13
benzo(ghi)perylene	3.87E+01	6.70E-11	6.70E-10	2.30E-10	9.57E-10	3.28E-14
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	1.92E+03	3.00E-02	3.00E-01	1.03E-01	8.57E-01	
fluorene	5.32E+02	2.43E-04	2.43E-03	8.34E-04	6.94E-03	
anthracene	2.09E+02	7.89E-04	7.89E-03	2.71E-03	2.02E-01	
phenanthrene	4.72E+02	2.78E-04	2.78E-03	9.56E-04	5.68E-03	
fluoranthene	3.31E+02	2.92E-06	2.92E-05	1.00E-05	2.08E-05	
pyrene	2.25E+02	1.55E-06	1.55E-05	5.31E-06	1.47E-05	
acenaphthylene	3.20E+02	9.84E-03	9.84E-02	3.38E-02	1.41E-01	
acenaphthene	9.17E+01	9.52E-05	9.52E-04	3.27E-04	6.80E-05	
VOC Compounds Considered Carcinogenic						
benzene	2.78E+00	4.50E-02	4.50E-01	1.55E-01		5.74E-05
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	6.72E+01	2.02E-02	2.02E-01	6.93E-02		
Non-Chlorinated Phenols						
2,4-dimethylphenol	1.80E+02	2.44E-02	2.44E-01	8.39E-02	1.75E+00	
2-nitrophenol	1.50E+00	1.54E-04	1.54E-03	5.30E-04	1.10E-02	
4-nitrophenol	1.00E+00	1.03E-04	1.03E-03	3.53E-04	7.34E-03	
2,4-dinitrophenol	6.00E+01	1.21E-07	1.21E-06	4.16E-07	8.64E-06	
2-methyl-4,6-dinitrophenol	1.68E+02	3.39E-07	3.39E-06	1.16E-06	2.42E-05	
phenol	1.00E+00	1.66E-06	1.66E-05	5.70E-06	1.19E-05	
total phenol						
Inorganic Compounds						
antimony	2.50E-01					
arsenic	2.50E-01					
cadmium	5.00E-02					
lead	2.50E-01					
total cyanide	3.01E+02					
ferro-ferric cyanide (as CN)	2.90E+02					
				Total =	2.98E+00	5.74E-05

* Test pit is paved.

Chemical of Interest	TP Soil TP-27 (ppm)	TP Soil TP-28 (ppm)	TP Soil TP-24 (ppm)	TP Soil TP-25 (ppm)	TP Soil TP-29 (ppm)	Boring SS-6 (ppm)	Average (ppm)
PAH Compounds Considered Potentially Carcinogenic							
benzo(a)pyrene	3.00E+01	5.10E+01	*1.00E+00*	1.20E+01	*1.00E+00*	2.95E-01	1.59E+01
benzo(a)anthracene	3.00E+01	4.70E+01	*1.00E+00*	2.20E+01	2.00E+01	5.40E-01	2.01E+01
benzo(b)fluoranthene	3.00E+01	7.50E+01	*1.00E+00*	1.20E+01	2.00E+01	1.36E+00	2.32E+01
benzo(k)fluoranthene	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.85E-01	8.64E-01
indeno(1,2,3-cd)pyrene	*1.00E+00*	2.10E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.85E-01	4.21E+00
chrysene	*1.00E+00*	1.00E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	3.90E-01	2.40E+00
dibenzo(a,h)anthracene	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	3.00E-01	8.83E-01
benzo(ghi)perylene	*1.00E+00*	2.20E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	6.00E-01	4.43E+00
PAH Compounds Not Considered Potentially Carcinogenic							
naphthalene	3.00E+01	3.20E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	4.17E+00	1.15E+01
fluorene	*1.00E+00*	3.50E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.90E-01	6.55E+00
anthracene	*1.00E+00*	4.40E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	3.45E-01	8.06E+00
phenanthrene	*1.00E+00*	1.20E+02	*1.00E+00*	*1.00E+00*	*1.00E+00*	3.10E-01	2.07E+01
fluoranthene	*1.00E+00*	8.40E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.80E-01	1.47E+01
pyrene	*1.00E+00*	6.50E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.70E-01	1.15E+01
acenaphthylene	*1.00E+00*	2.20E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.95E-01	4.38E+00
acenaphthene	*1.00E+00*	3.00E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.80E-01	5.71E+00
VOC Compounds Considered Carcinogenic							
benzene	4.00E-01	1.50E+00	3.90E-01	9.20E-01	8.20E-01	2.50E-01	7.13E-01
VOC Compounds Not Considered Carcinogenic							
sum of 8 VOCs	7.80E+00	1.83E+01	1.00E-01	4.00E-01	7.00E-01	2.30E-01	4.59E+00
Non-Chlorinated Phenols							
2,4-dimethylphenol	*6.00E+00*	*6.00E+00*	*6.00E+00*	*6.00E+00*	*6.00E+00*	1.73E+00	5.29E+00
2-nitrophenol	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	4.35E+02	8.08E+01
4-nitrophenol	*1.00E+01*	*1.00E+01*	*1.00E+00*	*1.00E+01*	*1.00E+01*	3.46E+00	7.41E+00
2,4-dinitrophenol	*6.50E+01*	*6.50E+01*	*6.50E+01*	*6.50E+01*	*6.50E+01*	1.73E+01	5.71E+01
2-methyl-4,6-dinitrophenol	*4.30E+01*	*4.30E+01*	*4.30E+01*	*4.30E+01*	*4.30E+01*	1.52E+01	3.84E+01
phenol	*6.00E+00*	*6.00E+00*	*6.00E+00*	*6.00E+00*	*6.00E+00*	1.73E+00	5.29E+00
total phenol							
Inorganic Compounds							
antimony	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*		2.50E-01
arsenic	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	3.40E+00	7.75E-01
cadmium	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	2.64E+00	4.82E-01
lead	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	9.64E+03	1.61E+03
total cyanide	8.10E+03	2.30E+03	3.60E+01	1.00E+04	1.30E+04	4.57E+03	6.33E+03
ferro-ferric cyanide (as CN)	7.60E+03	1.70E+03	3.60E+01	8.90E+03	1.30E+04	2.52E+03	5.63E+03

* Test pit is paved.

Exhibit A-6.3, page 2
Scenario 3

Chemical of Interest	Copy of TP Soils Average (ppm)	Estimated Exp Point Conc in Inhaled Gases (mg Al/m3)	Estimated ADD (day) from Inhaled Gases (mg/d)	Estimated ADD (life) from Inhaled Gases (mg/d)	Estimated Health Effects: Ratio via Inhale Non Carcs (--)	Estimated Health Effects: Incremental Lifetime Risk via Inhale Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	1.59E+01	2.33E-10	2.33E-09	7.99E-10	3.32E-09	5.17E-12
benzo(a)anthracene	2.01E+01	8.78E-10	8.78E-09	3.01E-09	1.25E-08	2.83E-12
benzo(b)fluoranthene	2.32E+01	2.61E-08	2.61E-07	8.97E-08	3.73E-07	8.13E-11
benzo(k)fluoranthene	8.64E-01	3.22E-09	3.22E-08	1.11E-08	4.60E-08	4.72E-12
indeno(1,2,3-cd)pyrene	4.21E+00	9.39E-12	9.39E-11	3.23E-11	1.34E-10	4.85E-14
chrysene	2.40E+00	6.55E-10	6.55E-09	2.25E-09	9.35E-09	6.40E-14
dibenzo(a,h)anthracene	8.83E-01	1.02E-12	1.02E-11	3.50E-12	1.46E-11	2.52E-14
benzo(ghi)perylene	4.43E+00	7.69E-12	7.69E-11	2.64E-11	1.10E-10	3.76E-15
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	1.15E+01	1.80E-04	1.80E-03	6.18E-04	5.14E-03	
fluorene	6.55E+00	2.99E-06	2.99E-05	1.03E-05	8.55E-05	
anthracene	8.06E+00	3.05E-05	3.05E-04	1.05E-04	7.83E-03	
phenanthrene	2.07E+01	1.22E-05	1.22E-04	4.20E-05	2.50E-04	
fluoranthene	1.47E+01	1.30E-07	1.30E-06	4.47E-07	9.29E-07	
pyrene	1.15E+01	7.96E-08	7.96E-07	2.73E-07	7.58E-07	
acenaphthylene	4.38E+00	1.35E-04	1.35E-03	4.63E-04	1.93E-03	
acenaphthene	5.71E+00	5.94E-06	5.94E-05	2.04E-05	4.24E-06	
VOC Compounds Considered Carcinogenic						
benzene	7.13E-01	4.50E-02	4.50E-01	1.55E-01		5.74E-05
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	4.59E+00	1.38E-03	1.38E-02	4.74E-03		
Non-Chlorinated Phenols						
2,4-dimethylphenol	5.29E+00	7.18E-04	7.18E-03	2.46E-03	5.13E-02	
2-nitrophenol	8.08E+01	8.32E-03	8.32E-02	2.86E-02	5.95E-01	
4-nitrophenol	7.41E+00	7.63E-04	7.63E-03	2.62E-03	5.45E-02	
2,4-dinitrophenol	5.71E+01	1.15E-07	1.15E-06	3.96E-07	8.23E-06	
2-methyl-4,6-dinitrophenol	3.84E+01	7.75E-08	7.75E-07	2.66E-07	5.54E-06	
phenol	5.29E+00	8.79E-06	8.79E-05	3.02E-05	6.28E-05	
total phenol						
Inorganic Compounds						
antimony	2.50E-01					
arsenic	7.75E-01					
cadmium	4.82E-01					
lead	1.61E+03					
total cyanide	6.33E+03					
ferro-ferric cyanide (as CN)	5.63E+03					
				Total =	7.16E-01	5.74E-05

* Test pit is paved.

Chemical of Interest	TP Soil TP-21* (ppm)	TP Soil TP-24 (ppm)	TP Soil Average (ppm)
PAH Compounds Considered Potentially Carcinogenic			
benzo(a)pyrene	*1.00E+00*	*1.00E+00*	1.00E+00
benzo(a)anthracene	*1.00E+00*	*1.00E+00*	1.00E+00
benzo(b)fluoranthene	*1.00E+00*	*1.00E+00*	1.00E+00
benzo(k)fluoranthene	*1.00E+00*	*1.00E+00*	1.00E+00
indeno(1,2,3-cd)pyrene	*1.00E+00*	*1.00E+00*	1.00E+00
chrysene	*1.00E+00*	*1.00E+00*	1.00E+00
dibenzo(a,h)anthracene	*1.00E+00*	*1.00E+00*	1.00E+00
benzo(ghi)perylene	*1.00E+00*	*1.00E+00*	1.00E+00
PAH Compounds Not Considered Potentially Carcinogenic			
naphthalene	*1.00E+00*	*1.00E+00*	1.00E+00
fluorene	*1.00E+00*	*1.00E+00*	1.00E+00
anthracene	*1.00E+00*	*1.00E+00*	1.00E+00
phenanthrene	*1.00E+00*	*1.00E+00*	1.00E+00
fluoranthene	*1.00E+00*	*1.00E+00*	1.00E+00
pyrene	*1.00E+00*	*1.00E+00*	1.00E+00
acenaphthylene	*1.00E+00*	*1.00E+00*	1.00E+00
acenaphthene	*1.00E+00*	*1.00E+00*	1.00E+00
VOC Compounds Considered Carcinogenic			
benzene	4.00E-01	3.90E-01	3.95E-01
VOC Compounds Not Considered Carcinogenic			
sum of 8 VOCs	9.00E-01	1.00E-01	5.00E-01
Non-Chlorinated Phenols			
2,4-dimethylphenol	*5.00E-01*	*6.00E+00*	3.25E+00
2-nitrophenol	*1.50E+00*	*1.00E+01*	5.75E+00
4-nitrophenol	*1.00E+00*	*1.00E+00*	1.00E+00
2,4-dinitrophenol	*6.00E+01*	*6.50E+01*	6.25E+01
2-methyl-4,6-dinitrophenol	*2.20E+01*	*4.30E+01*	3.25E+01
phenol	*1.00E+00*	*6.00E+00*	3.50E+00
total phenol			
Inorganic Compounds			
antimony	*2.50E-01*	*2.50E-01*	2.50E-01
arsenic	*2.50E-01*	*2.50E-01*	2.50E-01
cadmium	*5.00E-02*	*5.00E-02*	5.00E-02
lead	*2.50E-01*	*2.50E-01*	2.50E-01
total cyanide	2.60E+01	3.60E+01	3.10E+01
ferro-ferric cyanide (as CN)	2.50E+01	3.60E+01	3.05E+01

* Test pit is paved.

Exhibit A-6.4, page 2

Scenario 4

Chemical of Interest	Copy of TP Soils Average (ppm)	Estimated Exp Point Conc in Inhaled Gases (mg Al/m3)	Estimated ADD (day) from Inhaled Gases (mg/d)	Estimated ADD (life) from Inhaled Gases (mg/d)	Estimated Health Effects Ratio via Inhale Non Carcs (--)	Estimated Health Effects Incremental Lifetime Risk via Inhale Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	1.00E+00	4.18E-10	2.09E-09	5.75E-10	2.99E-09	3.72E-12
benzo(a)anthracene	1.00E+00	1.25E-09	6.24E-09	1.71E-09	8.91E-09	1.61E-12
benzo(b)fluoranthene	1.00E+00	3.21E-08	1.61E-07	4.41E-08	2.29E-07	4.00E-11
benzo(k)fluoranthene	1.00E+00	1.06E-07	5.32E-07	1.46E-07	7.60E-07	6.24E-11
indeno(1,2,3-cd)pyrene	1.00E+00	6.36E-11	3.18E-10	8.74E-11	4.55E-10	1.31E-13
chrysene	1.00E+00	7.79E-09	3.90E-08	1.07E-08	5.57E-08	3.05E-13
dibenzo(a,h)anthracene	1.00E+00	3.30E-11	1.65E-10	4.53E-11	2.36E-10	3.26E-13
benzo(ghi)perylene	1.00E+00	4.95E-11	2.48E-10	6.81E-11	3.54E-10	9.69E-15
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	1.00E+00	4.46E-04	2.23E-03	6.12E-04	6.37E-03	
fluorene	1.00E+00	1.31E-05	6.53E-05	1.79E-05	1.86E-04	
anthracene	1.00E+00	1.08E-04	5.41E-04	1.49E-04	1.39E-02	
phenanthrene	1.00E+00	1.69E-05	8.43E-05	2.32E-05	1.72E-04	
fluoranthene	1.00E+00	2.52E-07	1.26E-06	3.47E-07	9.01E-07	
pyrene	1.00E+00	1.97E-07	9.84E-07	2.70E-07	9.38E-07	
acenaphthylene	1.00E+00	8.79E-04	4.39E-03	1.21E-03	6.28E-03	
acenaphthene	1.00E+00	2.97E-05	1.48E-04	4.08E-05	1.06E-05	
VOC Compounds Considered Carcinogenic						
benzene	3.95E-01	3.95E-02	1.97E-01	5.42E-02		2.01E-05
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	5.00E-01	4.29E-03	2.15E-02	5.90E-03		
Non-Chlorinated Phenols						
2,4-dimethylphenol	3.25E+00	1.26E-02	6.30E-02	1.73E-02	4.50E-01	
2-nitrophenol	5.75E+00	1.69E-02	8.45E-02	2.32E-02	6.04E-01	
4-nitrophenol	1.00E+00	2.94E-03	1.47E-02	4.04E-03	1.05E-01	
2,4-dinitrophenol	6.25E+01	3.60E-06	1.80E-05	4.95E-06	1.29E-04	
2-methyl-4,6-dinitrophenol	3.25E+01	1.87E-06	9.37E-06	2.57E-06	6.69E-05	
phenol	3.50E+00	1.66E-04	8.31E-04	2.28E-04	5.93E-04	
total phenol						
Inorganic Compounds						
antimony	2.50E-01					
arsenic	2.50E-01					
cadmium	5.00E-02					
lead	2.50E-01					
total cyanide	3.10E+01					
ferro-ferric cyanide (as CN)	3.05E+01					
				Total =	1.19E+00	2.01E-05

* Test pit is paved.

Chemical of Interest	TP Soil TP-20 (ppm)	TP Soil Average (ppm)
PAH Compounds Considered Potentially Carcinogenic		
benzo(a)pyrene	*1.00E+00*	1.00E+00
benzo(a)anthracene	*1.00E+00*	1.00E+00
benzo(b)fluoranthene	*1.00E+00*	1.00E+00
benzo(k)fluoranthene	*1.00E+00*	1.00E+00
indeno(1,2,3-cd)pyrene	*1.00E+00*	1.00E+00
chrysene	*1.00E+00*	1.00E+00
dibenzo(a,h)anthracene	*1.00E+00*	1.00E+00
benzo(ghi)perylene	*1.00E+00*	1.00E+00
PAH Compounds Not Considered Potentially Carcinogenic		
naphthalene	*1.00E+00*	1.00E+00
fluorene	*1.00E+00*	1.00E+00
anthracene	*1.00E+00*	1.00E+00
phenanthrene	*1.00E+00*	1.00E+00
fluoranthene	*1.00E+00*	1.00E+00
pyrene	*1.00E+00*	1.00E+00
acenaphthylene	*1.00E+00*	1.00E+00
acenaphthene	*1.00E+00*	1.00E+00
VOC Compounds Considered Carcinogenic		
benzene	*5.00E-02*	5.00E-02
VOC Compounds Not Considered Carcinogenic		
sum of 8 VOCs	*4.00E-01*	4.00E-01
Non-Chlorinated Phenols		
2,4-dimethylphenol	*5.00E-01*	5.00E-01
2-nitrophenol	*1.50E+00*	1.50E+00
4-nitrophenol	*1.00E+00*	1.00E+00
2,4-dinitrophenol	*6.00E+01*	6.00E+01
2-methyl-4,6-dinitrophenol	*2.20E+01*	2.20E+01
phenol	*1.00E+00*	1.00E+00
total phenol		
Inorganic Compounds		
antimony	*2.50E-01*	2.50E-01
arsenic	*2.50E-01*	2.50E-01
cadmium	*5.00E-02*	5.00E-02
lead	*2.50E-01*	2.50E-01
total cyanide	4.10E+00	4.10E+00
ferro-ferric cyanide (as CN)	2.90E+00	2.90E+00

* Test pit is paved.

Exhibit A-6.5, page 2
Scenario 5

Chemical of Interest	Copy of TP Soils Average (ppm)	Estimated Exp Point Conc in Inhaled Gases (mg Al'm3)	Estimated ADD (day) from Inhaled Gases (mg/d)	Estimated ADD (life) from Inhaled Gases (mg/d)	Estimated Health Effects Ratio via Inhale Non Carcs (--)	Estimated Health Effects Incremental Lifetime Risk via Inhale Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	1.00E+00	4.18E-10	3.35E-09	1.15E-09	4.78E-09	7.44E-12
benzo(a)anthracene	1.00E+00	1.25E-09	9.98E-09	3.43E-09	1.43E-08	3.22E-12
benzo(b)fluoranthene	1.00E+00	3.21E-08	2.57E-07	8.82E-08	3.67E-07	8.00E-11
benzo(k)fluoranthene	1.00E+00	1.06E-07	8.51E-07	2.92E-07	1.22E-06	1.25E-10
indeno(1,2,3-cd)pyrene	1.00E+00	6.36E-11	5.09E-10	1.75E-10	7.27E-10	2.63E-13
chrysene	1.00E+00	7.79E-09	6.23E-08	2.14E-08	8.91E-08	6.10E-13
dibenzo(a,h)anthracene	1.00E+00	3.30E-11	2.64E-10	9.06E-11	3.77E-10	6.51E-13
benzo(ghi)perylene	1.00E+00	4.95E-11	3.96E-10	1.36E-10	5.66E-10	1.94E-14
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	1.00E+00	4.46E-04	3.57E-03	1.22E-03	1.02E-02	
fluorene	1.00E+00	1.31E-05	1.04E-04	3.59E-05	2.98E-04	
anthracene	1.00E+00	1.08E-04	8.65E-04	2.97E-04	2.22E-02	
phenanthrene	1.00E+00	1.69E-05	1.35E-04	4.63E-05	2.75E-04	
fluoranthene	1.00E+00	2.52E-07	2.02E-06	6.93E-07	1.44E-06	
pyrene	1.00E+00	1.97E-07	1.58E-06	5.41E-07	1.50E-06	
acenaphthylene	1.00E+00	8.79E-04	7.03E-03	2.41E-03	1.00E-02	
acenaphthene	1.00E+00	2.97E-05	2.38E-04	8.16E-05	1.70E-05	
VOC Compounds Considered Carcinogenic						
benzene	5.00E-02	5.00E-03	4.00E-02	1.37E-02		5.10E-06
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	4.00E-01	3.44E-03	2.75E-02	9.44E-03		
Non-Chlorinated Phenols						
2,4-dimethylphenol	5.00E-01	1.94E-03	1.55E-02	5.32E-03	1.11E-01	
2-nitrophenol	1.50E+00	4.41E-03	3.53E-02	1.21E-02	2.52E-01	
4-nitrophenol	1.00E+00	2.94E-03	2.35E-02	8.08E-03	1.68E-01	
2,4-dinitrophenol	6.00E+01	3.46E-06	2.77E-05	9.51E-06	1.98E-04	
2-methyl-4,6-dinitrophenol	2.20E+01	1.27E-06	1.02E-05	3.49E-06	7.25E-05	
phenol	1.00E+00	4.75E-05	3.80E-04	1.30E-04	2.71E-04	
total phenol						
Inorganic Compounds						
antimony	2.50E-01					
arsenic	2.50E-01					
cadmium	5.00E-02					
lead	2.50E-01					
total cyanide	4.10E+00					
ferro-ferric cyanide (as CN)	2.90E+00					
					---	---
				Total =	5.74E-01	5.10E-06

* Test pit is paved.

Soil Concentrations in Test Pits / Borings -->>

Chemical of Interest	Boring B-17 (ppm)	Boring B-18 (ppm)	Boring B-19 (ppm)	Boring B-20 (ppm)	Boring B-21 (ppm)	Boring Average (ppm)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	3.00E-03	*1.00E-03*	1.40E-02	*1.00E-03*	*1.00E-03*	4.00E-03
benzo(a)anthracene	9.00E-03	*1.00E-03*	1.80E-02	3.00E-03	1.70E-02	9.60E-03
benzo(b)fluoranthene	6.50E-03	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	2.10E-03
benzo(k)fluoranthene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
indeno(1,2,3-cd)pyrene	1.00E-03	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
chrysene	1.40E-02	1.40E-02	6.60E-02	9.00E-03	1.10E-01	4.26E-02
dibenzo(a,h)anthracene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
benzo(ghi)perylene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
fluorene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
anthracene	1.20E-03	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.04E-03
phenanthrene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
fluoranthene	2.80E-03	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.36E-03
pyrene	2.00E-03	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.20E-03
acenaphthylene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
acenaphthene	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	*1.00E-03*	1.00E-03
VOC Compounds Considered Carcinogenic						
benzene	6.30E-02	2.00E-02	*2.50E-02*	*2.50E-02*	*2.50E-02*	3.16E-02
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	3.16E-01	2.00E-01	*2.50E-02*	*2.50E-02*	*2.50E-02*	1.18E-01
Non-Chlorinated Phenols						
2,4-dimethylphenol						
2-nitrophenol						
4-nitrophenol						
2,4-dinitrophenol						
2-methyl-4,6-dinitrophenol						
phenol						
total phenol						
Inorganic Compounds						
antimony						
arsenic						
cadmium						
lead						
total cyanide						
ferro-ferric cyanide (as CN)						

foc (loam) = 0.028

Scenario 6

Chemical of Interest	Estimated Exposure Point Concentrations -->> Conc in Inhaled Gases (mg Al/m3)	Conc from Inhaled Fug Dust (mg Al/m3)	Conc in Ingested Dirt (mg Al/kg)	Conc in Adhered Dirt (mg Al/kg)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	1.67E-10	1.12E-06	4.00E-03	4.00E-03
benzo(a)anthracene	1.20E-09	2.69E-06	9.60E-03	9.60E-03
benzo(b)fluoranthene	6.74E-09	5.88E-07	2.10E-03	2.10E-03
benzo(k)fluoranthene	1.06E-08	2.80E-07	1.00E-03	1.00E-03
indeno(1,2,3-cd)pyrene	6.36E-12	2.80E-07	1.00E-03	1.00E-03
chrysene	3.32E-08	1.19E-05	4.26E-02	4.26E-02
dibenzo(a,h)anthracene	3.30E-12	2.80E-07	1.00E-03	1.00E-03
benzo(ghi)perylene	4.95E-12	2.80E-07	1.00E-03	1.00E-03
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	4.46E-05	2.80E-07	1.00E-03	1.00E-03
fluorene	1.31E-06	2.80E-07	1.00E-03	1.00E-03
anthracene	1.12E-05	2.91E-07	1.04E-03	1.04E-03
phenanthrene	1.69E-06	2.80E-07	1.00E-03	1.00E-03
fluoranthene	3.43E-08	3.81E-07	1.36E-03	1.36E-03
pyrene	2.36E-08	3.36E-07	1.20E-03	1.20E-03
acenaphthylene	8.79E-05	2.80E-07	1.00E-03	1.00E-03
acenaphthene	2.97E-06	2.80E-07	1.00E-03	1.00E-03
VOC Compounds Considered Carcinogenic				
benzene	3.16E-01	8.85E-06	3.16E-02	3.16E-02
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs	1.02E-01	3.31E-05	1.18E-01	1.18E-01
Non-Chlorinated Phenols				
2,4-dimethylphenol				
2-nitrophenol				
4-nitrophenol				
2,4-dinitrophenol				
2-methyl-4,6-dinitrophenol				
phenol				
total phenol				
Inorganic Compounds				
antimony				
arsenic				
cadmium				
lead				
total cyanide				
ferro-ferric cyanide (as CN)				

Exhibit A-6.6, page 3

Scenario 6

Estimated Average Daily Dose on a Day of Exposure -->>

Chemical of Interest	ADD (day) from Inhaled Gases (mg/d)	ADD (day) from Inhaled Fug Dust (mg/d)	ADD (day) from Ingested Dirt (mg/d)	ADD (day) from Adhered Dirt (mg/d)	ADD (day) from Two Inhale Pathways (mg/d)	ADD (day) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	2.68E-09	1.79E-05	4.00E-07	1.51E-06	1.79E-05	1.91E-06
benzo(a)anthracene	1.92E-08	4.30E-05	9.60E-07	3.63E-06	4.30E-05	4.59E-06
benzo(b)fluoranthene	1.08E-07	9.41E-06	2.10E-07	7.94E-07	9.52E-06	1.00E-06
benzo(k)fluoranthene	1.70E-07	4.48E-06	1.00E-07	3.78E-07	4.65E-06	4.78E-07
indeno(1,2,3-cd)pyrene	1.02E-10	4.48E-06	1.00E-07	3.78E-07	4.48E-06	4.78E-07
chrysene	5.31E-07	1.91E-04	4.26E-06	1.61E-05	1.91E-04	2.04E-05
dibenzo(a,h)anthracene	5.28E-11	4.48E-06	1.00E-07	3.78E-07	4.48E-06	4.78E-07
benzo(ghi)perylene	7.93E-11	4.48E-06	1.00E-07	3.78E-07	4.48E-06	4.78E-07
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	7.13E-04	4.48E-06	1.00E-07	3.78E-07	7.18E-04	4.78E-07
fluorene	2.09E-05	4.48E-06	1.00E-07	3.78E-07	2.54E-05	4.78E-07
anthracene	1.80E-04	4.66E-06	1.04E-07	3.93E-07	1.85E-04	4.97E-07
phenanthrene	2.70E-05	4.48E-06	1.00E-07	3.78E-07	3.15E-05	4.78E-07
fluoranthene	5.49E-07	6.09E-06	1.36E-07	5.14E-07	6.64E-06	6.50E-07
pyrene	3.78E-07	5.38E-06	1.20E-07	4.54E-07	5.75E-06	5.74E-07
acenaphthylene	1.41E-03	4.48E-06	1.00E-07	3.78E-07	1.41E-03	4.78E-07
acenaphthene	4.75E-05	4.48E-06	1.00E-07	3.78E-07	5.20E-05	4.78E-07
VOC Compounds Considered Carcinogenic						
benzene	5.05E+00	1.42E-04	3.16E-06	1.19E-05	5.05E+00	1.51E-05
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	1.62E+00	5.30E-04	1.18E-05	4.47E-05	1.62E+00	5.65E-05
Non-Chlorinated Phenols						
2,4-dimethylphenol						
2-nitrophenol						
4-nitrophenol						
2,4-dinitrophenol						
2-methyl-4,6-dinitrophenol						
phenol						
total phenol						
Inorganic Compounds						
antimony						
arsenic						
cadmium						
lead						
total cyanide						
ferro-ferric cyanide (as CN)						

AF = 1.96E-04 **Scenario 6**

Estimated Average Daily Dose over a Life of Exposure -->>

Chemical of Interest	ADD (life) from Inhaled Gases (mg/d)	ADD (life) from Inhaled Fug Dust (mg/d)	ADD (life) from Ingested Dirt (mg/d)	ADD (life) from Adhered Dirt (mg/d)	ADD (life) from Two Inhale Pathways (mg/d)	ADD (life) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	5.24E-13	3.51E-09	7.83E-11	2.96E-10	3.51E-09	3.74E-10
benzo(a)anthracene	3.75E-12	8.42E-09	1.88E-10	7.10E-10	8.42E-09	8.98E-10
benzo(b)fluoranthene	2.11E-11	1.84E-09	4.11E-11	1.55E-10	1.86E-09	1.96E-10
benzo(k)fluoranthene	3.33E-11	8.77E-10	1.96E-11	7.40E-11	9.10E-10	9.35E-11
indeno(1,2,3-cd)pyrene	1.99E-14	8.77E-10	1.96E-11	7.40E-11	8.77E-10	9.35E-11
chrysene	1.04E-10	3.73E-08	8.34E-10	3.15E-09	3.75E-08	3.98E-09
dibenzo(a,h)anthracene	1.03E-14	8.77E-10	1.96E-11	7.40E-11	8.77E-10	9.35E-11
benzo(ghi)perylene	1.55E-14	8.77E-10	1.96E-11	7.40E-11	8.77E-10	9.35E-11
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	1.40E-07	8.77E-10	1.96E-11	7.40E-11	1.40E-07	9.35E-11
fluorene	4.09E-09	8.77E-10	1.96E-11	7.40E-11	4.96E-09	9.35E-11
anthracene	3.52E-08	9.12E-10	2.04E-11	7.69E-11	3.61E-08	9.73E-11
phenanthrene	5.28E-09	8.77E-10	1.96E-11	7.40E-11	6.16E-09	9.35E-11
fluoranthene	1.07E-10	1.19E-09	2.66E-11	1.01E-10	1.30E-09	1.27E-10
pyrene	7.40E-11	1.05E-09	2.35E-11	8.88E-11	1.13E-09	1.12E-10
acenaphthylene	2.75E-07	8.77E-10	1.96E-11	7.40E-11	2.76E-07	9.35E-11
acenaphthene	9.30E-09	8.77E-10	1.96E-11	7.40E-11	1.02E-08	9.35E-11
VOC Compounds Considered Carcinogenic						
benzene	9.89E-04	2.77E-08	6.18E-10	2.34E-09	9.89E-04	2.96E-09
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	3.18E-04	1.04E-07	2.31E-09	8.74E-09	3.18E-04	1.11E-08
Non-Chlorinated Phenols						
2,4-dimethylphenol						
2-nitrophenol						
4-nitrophenol						
2,4-dinitrophenol						
2-methyl-4,6-dinitrophenol						
phenol						
total phenol						
Inorganic Compounds						
antimony						
arsenic						
cadmium						
lead						
total cyanide						
ferro-ferric cyanide (as CN)						

Scenario 6

Estimated Health Effects -->>

Chemical of Interest	Ratio via Inhale Non Carcs (--)	Ratio via Ingest Non Carcs (--)	Incremental Lifetime Risk via Inhale Carcs (prob)	Incremental Lifetime Risk via Ingest Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	2.56E-05	2.73E-06	2.27E-11	3.07E-11
benzo(a)anthracene	6.15E-05	6.56E-06	7.91E-12	1.07E-11
benzo(b)fluoranthene	1.36E-05	1.43E-06	1.69E-12	2.26E-12
benzo(k)fluoranthene	6.64E-06	6.83E-07	3.89E-13	5.06E-13
indeno(1,2,3-cd)pyrene	6.40E-06	6.83E-07	1.32E-12	1.78E-12
chrysene	2.73E-04	2.91E-05	1.07E-12	1.44E-12
dibenzo(a,h)anthracene	6.40E-06	6.83E-07	6.30E-12	8.51E-12
benzo(ghi)perylene	6.40E-06	6.83E-07	1.25E-13	1.69E-13
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	2.05E-03	1.37E-06		
fluorene	7.25E-05	1.37E-06		
anthracene	4.73E-03	1.27E-05		
phenanthrene	6.42E-05	9.76E-07		
fluoranthene	4.74E-06	4.64E-07		
pyrene	5.48E-06	5.46E-07		
acenaphthylene	2.01E-03	6.83E-07		
acenaphthene	3.71E-06	3.41E-08		
VOC Compounds Considered Carcinogenic				
benzene			3.67E-07	2.20E-12
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol				
2-nitrophenol				
4-nitrophenol				
2,4-dinitrophenol				
2-methyl-4,6-dinitrophenol				
phenol				
total phenol				
Inorganic Compounds				
antimony				
arsenic				
cadmium				
lead				
total cyanide				
ferro-ferric cyanide (as CN)				
Subtotals for Pathways =	9.35E-03	6.07E-05	3.67E-07	5.82E-11
Totals for Pathways =	9.41E-03		3.68E-07	

Soil Concentrations in Test Pits ->

Chemical of Interest	TP Soil TP-13 (ppm)	TP Soil TP-14* (ppm)	TP Soil Average (ppm)
PAH Compounds Considered Potentially Carcinogenic			
benzo(a)pyrene	2.30E+01	1.10E+02	6.65E+01
benzo(a)anthracene	2.10E+01	9.60E+01	5.85E+01
benzo(b)fluoranthene	7.00E+01	5.60E+01	6.30E+01
benzo(k)fluoranthene	*1.00E+00*	*1.00E+00*	1.00E+00
indeno(1,2,3-cd)pyrene	2.50E+01	3.00E+00	1.40E+01
chrysene	*1.00E+00*	3.40E+01	1.75E+01
dibenzo(a,h)anthracene	5.20E+01	2.20E+01	3.70E+01
benzo(ghi)perylene	5.00E+01	6.50E+01	5.75E+01
PAH Compounds Not Considered Potentially Carcinogenic			
naphthalene	2.31E+02	*1.00E+00*	1.16E+02
fluorene	4.40E+01	5.20E+01	4.80E+01
anthracene	2.30E+01	7.30E+01	4.80E+01
phenanthrene	2.50E+01	1.92E+02	1.09E+02
fluoranthene	5.00E+01	2.52E+02	1.51E+02
pyrene	2.30E+01	1.81E+02	1.02E+02
acenaphthylene	4.12E+02	1.90E+01	2.16E+02
acenaphthene	2.35E+02	3.90E+01	1.37E+02
VOC Compounds Considered Carcinogenic			
benzene	1.00E-01	4.30E-01	2.65E-01
VOC Compounds Not Considered Carcinogenic			
sum of 8 VOCs	8.00E-02	8.30E-01	4.55E-01
Non-Chlorinated Phenols			
2,4-dimethylphenol	*5.00E-01*	*5.00E-01*	5.00E-01
2-nitrophenol	*1.50E+00*	*1.50E+00*	1.50E+00
4-nitrophenol	*1.00E+00*	*1.00E+00*	1.00E+00
2,4-dinitrophenol	*6.00E+01*	*6.00E+01*	6.00E+01
2-methyl-4,6-dinitrophenol	*2.20E+01*	4.60E+02	2.41E+02
phenol	*1.00E+00*	*1.00E+00*	1.00E+00
total phenol			
Inorganic Compounds			
antimony	*2.50E-01*	*2.50E-01*	2.50E-01
arsenic	*2.50E-01*	*2.50E-01*	2.50E-01
cadmium	*5.00E-02*	*5.00E-02*	5.00E-02
lead	*2.50E-01*	*2.50E-01*	2.50E-01
total cyanide	4.40E+01	1.60E+02	1.02E+02
ferro-ferric cyanide (as CN)	3.90E+01	1.50E+02	9.45E+01

* Test pit is paved.

Chemical of Interest	Estimated Exposure Point Concentrations -->> Conc in Inhaled Gases (mg Al/m3)	Conc from Inhaled Fug Dust (mg Al/m3)	Conc in Ingested Dirt (mg Al/kg)	Conc in Adhered Dirt (mg Al/kg)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	2.70E-10	not est	6.65E+01	6.65E+01
benzo(a)anthracene	7.31E-10	not est	5.85E+01	5.85E+01
benzo(b)fluoranthene	1.95E-08	not est	6.30E+01	6.30E+01
benzo(k)fluoranthene	1.03E-09	not est	1.00E+00	1.00E+00
indeno(1,2,3-cd)pyrene	8.35E-12	not est	1.40E+01	1.40E+01
chrysene	1.37E-09	not est	1.75E+01	1.75E+01
dibenzo(a,h)anthracene	1.11E-11	not est	3.70E+01	3.70E+01
benzo(ghi)perylene	2.67E-11	not est	5.75E+01	5.75E+01
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	6.81E-04	not est	1.16E+02	1.16E+02
fluorene	7.50E-06	not est	4.80E+01	4.80E+01
anthracene	5.87E-05	not est	4.80E+01	4.80E+01
phenanthrene	2.07E-05	not est	1.09E+02	1.09E+02
fluoranthene	4.11E-07	not est	1.51E+02	1.51E+02
pyrene	2.17E-07	not est	1.02E+02	1.02E+02
acenaphthylene	2.32E-03	not est	2.16E+02	2.16E+02
acenaphthene	4.92E-05	not est	1.37E+02	1.37E+02
VOC Compounds Considered Carcinogenic				
benzene	4.23E-04	not est	2.65E-01	2.65E-01
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs	5.47E-05	not est	4.55E-01	4.55E-01
Non-Chlorinated Phenols				
2,4-dimethylphenol	2.50E-05	not est	5.00E-01	5.00E-01
2-nitrophenol	5.88E-05	not est	1.50E+00	1.50E+00
4-nitrophenol	3.92E-05	not est	1.00E+00	1.00E+00
2,4-dinitrophenol	4.41E-08	not est	6.00E+01	6.00E+01
2-methyl-4,6-dinitrophenol	1.63E-07	not est	2.41E+02	2.41E+02
phenol	7.33E-07	not est	1.00E+00	1.00E+00
total phenol		not est		
Inorganic Compounds				
antimony		not est	2.50E-01	2.50E-01
arsenic		not est	2.50E-01	2.50E-01
cadmium		not est	5.00E-02	5.00E-02
lead		not est	2.50E-01	2.50E-01
total cyanide		not est	1.02E+02	1.02E+02
ferro-ferric cyanide (as CN)		not est	9.45E+01	9.45E+01

Scenario 7

Estimated Average Daily Dose over a Life of Exposure -->>

Chemical of Interest	ADD (life) from Inhaled Gases (mg/d)	ADD (life) from Inhaled Fug Dust (mg/d)	ADD (life) from Ingested Dirt (mg/d)	ADD (life) from Adhered Dirt (mg/d)	ADD (life) from Two Inhale Pathways (mg/d)	ADD (life) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	1.02E-11	not est	1.04E-05	7.87E-05	1.02E-11	8.91E-05
benzo(a)anthracene	2.75E-11	not est	9.16E-06	6.92E-05	2.75E-11	7.84E-05
benzo(b)fluoranthene	7.34E-10	not est	9.86E-06	7.46E-05	7.34E-10	8.44E-05
benzo(k)fluoranthene	3.86E-11	not est	1.57E-07	1.18E-06	3.86E-11	1.34E-06
indeno(1,2,3-cd)pyrene	3.14E-13	not est	2.19E-06	1.66E-05	3.14E-13	1.88E-05
chrysene	5.13E-11	not est	2.74E-06	2.07E-05	5.13E-11	2.35E-05
dibenzo(a,h)anthracene	4.17E-13	not est	5.79E-06	4.38E-05	4.17E-13	4.96E-05
benzo(ghi)perylene	1.00E-12	not est	9.00E-06	6.81E-05	1.00E-12	7.71E-05
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	2.56E-05	not est	1.82E-05	1.37E-04	2.56E-05	1.55E-04
fluorene	2.82E-07	not est	7.51E-06	5.68E-05	2.82E-07	6.43E-05
anthracene	2.21E-06	not est	7.51E-06	5.68E-05	2.21E-06	6.43E-05
phenanthrene	7.77E-07	not est	1.70E-05	1.28E-04	7.77E-07	1.45E-04
fluoranthene	1.54E-08	not est	2.36E-05	1.79E-04	1.54E-08	2.02E-04
pyrene	8.15E-09	not est	1.60E-05	1.21E-04	8.15E-09	1.37E-04
acenaphthylene	8.71E-05	not est	3.37E-05	2.55E-04	8.71E-05	2.89E-04
acenaphthene	1.85E-06	not est	2.14E-05	1.62E-04	1.85E-06	1.84E-04
VOC Compounds Considered Carcinogenic						
benzene	1.59E-05	not est	4.15E-08	3.14E-07	1.59E-05	3.55E-07
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	2.06E-06	not est	7.12E-08	5.39E-07	2.06E-06	6.10E-07
Non-Chlorinated Phenols						
2,4-dimethylphenol	9.39E-07	not est	7.83E-08	5.92E-07	9.39E-07	6.70E-07
2-nitrophenol	2.21E-06	not est	2.35E-07	1.78E-06	2.21E-06	2.01E-06
4-nitrophenol	1.47E-06	not est	1.57E-07	1.18E-06	1.47E-06	1.34E-06
2,4-dinitrophenol	1.66E-09	not est	9.39E-06	7.10E-05	1.66E-09	8.04E-05
2-methyl-4,6-dinitrophenol	6.13E-09	not est	3.77E-05	2.85E-04	6.13E-09	3.23E-04
phenol	2.75E-08	not est	1.57E-07	1.18E-06	2.75E-08	1.34E-06
total phenol		not est				
Inorganic Compounds						
antimony		not est	3.91E-08			3.91E-08
arsenic		not est	3.91E-08			3.91E-08
cadmium		not est	7.83E-09			7.83E-09
lead		not est	3.91E-08			3.91E-08
total cyanide		not est	1.60E-05			1.60E-05
ferro-ferric cyanide (as CN)		not est	1.48E-05			1.48E-05

Scenario 7

Estimated Average Daily Dose on a Day of Exposure -->>

Chemical of Interest	ADD (day) from Inhaled Gases (mg/d)	ADD (day) from Inhaled Fug Dust (mg/d)	ADD (day) from Ingested Dirt (mg/d)	ADD (day) from Adhered Dirt (mg/d)	ADD (day) from Two Inhale Pathways (mg/d)	ADD (day) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	3.24E-09	not est	3.33E-03	2.51E-02	3.24E-09	2.85E-02
benzo(a)anthracene	8.78E-09	not est	2.93E-03	2.21E-02	8.78E-09	2.50E-02
benzo(b)fluoranthene	2.34E-07	not est	3.15E-03	2.38E-02	2.34E-07	2.70E-02
benzo(k)fluoranthene	1.23E-08	not est	5.00E-05	3.78E-04	1.23E-08	4.28E-04
indeno(1,2,3-cd)pyrene	1.00E-10	not est	7.00E-04	5.29E-03	1.00E-10	5.99E-03
chrysene	1.64E-08	not est	8.75E-04	6.62E-03	1.64E-08	7.49E-03
dibenzo(a,h)anthracene	1.33E-10	not est	1.85E-03	1.40E-02	1.33E-10	1.58E-02
benzo(ghi)perylene	3.21E-10	not est	2.88E-03	2.17E-02	3.21E-10	2.46E-02
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	8.17E-03	not est	5.80E-03	4.38E-02	8.17E-03	4.96E-02
fluorene	8.99E-05	not est	2.40E-03	1.81E-02	8.99E-05	2.05E-02
anthracene	7.04E-04	not est	2.40E-03	1.81E-02	7.04E-04	2.05E-02
phenanthrene	2.48E-04	not est	5.43E-03	4.10E-02	2.48E-04	4.64E-02
fluoranthene	4.93E-06	not est	7.55E-03	5.71E-02	4.93E-06	6.46E-02
pyrene	2.60E-06	not est	5.10E-03	3.86E-02	2.60E-06	4.37E-02
acenaphthylene	2.78E-02	not est	1.08E-02	8.15E-02	2.78E-02	9.22E-02
acenaphthene	5.90E-04	not est	6.85E-03	5.18E-02	5.90E-04	5.86E-02
VOC Compounds Considered Carcinogenic						
benzene	5.08E-03	not est	1.33E-05	1.00E-04	5.08E-03	1.13E-04
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	6.57E-04	not est	2.28E-05	1.72E-04	6.57E-04	1.95E-04
Non-Chlorinated Phenols						
2,4-dimethylphenol	3.00E-04	not est	2.50E-05	1.89E-04	3.00E-04	2.14E-04
2-nitrophenol	7.06E-04	not est	7.50E-05	5.67E-04	7.06E-04	6.42E-04
4-nitrophenol	4.71E-04	not est	5.00E-05	3.78E-04	4.71E-04	4.28E-04
2,4-dinitrophenol	5.30E-07	not est	3.00E-03	2.27E-02	5.30E-07	2.57E-02
2-methyl-4,6-dinitrophenol	1.96E-06	not est	1.21E-02	9.11E-02	1.96E-06	1.03E-01
phenol	8.79E-06	not est	5.00E-05	3.78E-04	8.79E-06	4.28E-04
total phenol		not est				
Inorganic Compounds						
antimony		not est	1.25E-05			1.25E-05
arsenic		not est	1.25E-05			1.25E-05
cadmium		not est	2.50E-06			2.50E-06
lead		not est	1.25E-05			1.25E-05
total cyanide		not est	5.10E-03			5.10E-03
ferro-ferric cyanide (as CN)		not est	4.73E-03			4.73E-03

Exhibit A-6.7, page 5
Scenario 7

Estimated Health Effects -->>

Chemical of Interest	Ratio via Inhale Non Carcs (--)	Ratio via Ingest Non Carcs (--)	Incremental Lifetime Risk via Inhale Carcs (prob)	Incremental Lifetime Risk via Ingest Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	4.63E-09	4.07E-02	6.58E-14	7.31E-06
benzo(a)anthracene	1.25E-08	3.58E-02	2.58E-14	9.32E-07
benzo(b)fluoranthene	3.35E-07	3.85E-02	6.65E-13	9.69E-07
benzo(k)fluoranthene	1.76E-08	6.11E-04	1.65E-14	7.25E-09
indeno(1,2,3-cd)pyrene	1.43E-10	8.56E-03	4.71E-16	3.57E-07
chrysene	2.34E-08	1.07E-02	1.46E-15	8.46E-09
dibenzo(a,h)anthracene	1.90E-10	2.26E-02	3.00E-15	4.51E-06
benzo(ghi)perylene	4.58E-10	3.52E-02	1.43E-16	1.39E-07
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	2.34E-02	1.42E-01		
fluorene	2.57E-04	5.87E-02		
anthracene	1.81E-02	5.27E-01		
phenanthrene	5.06E-04	9.48E-02		
fluoranthene	3.52E-06	4.62E-02		
pyrene	2.48E-06	4.16E-02		
acenaphthylene	3.97E-02	1.32E-01		
acenaphthene	4.22E-05	4.19E-03		
VOC Compounds Considered Carcinogenic				
benzene			5.91E-09	2.64E-10
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol	2.14E-03	1.53E-03		
2-nitrophenol	5.04E-03	4.59E-03		
4-nitrophenol	3.36E-03	3.06E-03		
2,4-dinitrophenol	3.78E-06	1.83E-01		
2-methyl-4,6-dinitrophenol	1.40E-05	7.37E-01		
phenol	6.28E-06	6.11E-05		
total phenol				
Inorganic Compounds				
antimony		4.46E-04		
arsenic				8.39E-09
cadmium		1.23E-04		
lead		1.28E-04		
total cyanide		3.64E-03		
ferro-ferric cyanide (as CN)		3.38E-03		
Subtotals for Pathways =	9.26E-02	2.18E+00	5.91E-09	1.42E-05
Totals for Pathways =	2.27E+00		1.42E-05	

Soil Concentrations in Test Pits -->>

Chemical of Interest	TP Soil TP-1 (ppm)	TP Soil TP-2 (ppm)	TP Soil TP-3 (ppm)	TP Soil TP-4 (ppm)	TP Soil TP-5 (ppm)	TP Soil TP-6* (ppm)	TP Soil TP-7* (ppm)	TP Soil TP-8* (ppm)
PAH Compounds Considered Potentially Carcinogenic								
benzo(a)pyrene	5.55E+03	6.60E+01	*1.00E+00*	1.50E+01	*1.00E+00*	1.30E+01	1.20E+01	8.00E+00
benzo(a)anthracene	4.60E+03	6.70E+01	4.00E+00	1.00E+01	*1.00E+00*	1.20E+01	1.90E+01	7.00E+00
benzo(b)fluoranthene	6.48E+03	9.10E+01	8.00E+00	1.80E+01	*1.00E+00*	3.20E+01	2.80E+01	8.00E+00
benzo(k)fluoranthene	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*
indeno(1,2,3-cd)pyrene	2.10E+03	3.40E+01	*1.00E+00*	7.00E+00	*1.00E+00*	5.00E+00	7.00E+00	*1.00E+00*
chrysene	1.90E+03	2.80E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*
dibenzo(a,h)anthracene	5.70E+02	1.40E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*
benzo(ghi)perylene	2.10E+03	3.40E+01	*1.00E+00*	1.00E+01	*1.00E+00*	9.00E+00	9.00E+00	*1.00E+00*
PAH Compounds Not Considered Potentially Carcinogenic								
naphthalene	4.74E+04	3.70E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	8.40E+01
fluorene	7.57E+03	4.50E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	5.00E+00	1.90E+01
anthracene	6.01E+03	5.40E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*
phenanthrene	2.34E+04	1.67E+02	*1.00E+00*	1.50E+01	*1.00E+00*	1.50E+01	4.00E+01	3.60E+01
fluoranthene	1.34E+04	1.52E+02	8.00E+00	2.20E+01	*1.00E+00*	2.10E+01	1.90E+01	1.20E+01
pyrene	9.23E+03	1.20E+02	5.00E+00	1.60E+01	*1.00E+00*	1.50E+01	1.50E+01	8.00E+00
acenaphthylene	7.93E+03	3.00E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	8.00E+00
acenaphthene	7.30E+02	7.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.00E+00
VOC Compounds Considered Carcinogenic								
benzene	3.28E+02	6.25E+00	*5.00E-02*	9.10E-01	2.80E+00	*5.00E-02*	1.00E-01	1.15E+01
VOC Compounds Not Considered Carcinogenic								
sum of 8 VOCs	3.41E+02	2.56E+00	*4.00E-01*	2.00E-01	6.50E-01	*4.00E-01*	8.00E-02	3.26E+01
Non-Chlorinated Phenols								
2,4-dimethylphenol	7.60E+02	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*
2-nitrophenol	3.00E+02	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	6.00E+00
4-nitrophenol	9.80E+02	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+01
2,4-dinitrophenol	4.20E+03	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*
2-methyl-4,6-dinitrophenol	2.40E+03	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*
phenol	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	4.00E+00
total phenol								
Inorganic Compounds								
antimony	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*
arsenic	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*
cadmium	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*
lead	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*
total cyanide	9.00E+01	1.60E+02	1.40E+00	4.90E+02	6.90E+01	4.50E+02	1.20E+02	7.00E-01
ferro-ferric cyanide (as CN)	9.00E+00	1.40E+02	*5.00E-02*	4.80E+02	5.40E+01	4.10E+02	1.20E+02	*5.00E-02*

* Test pit is paved.

TP Soil TP-11* (ppm)	TP Soil TP-17* (ppm)	TP Soil TP-18* (ppm)	TP Soil TP-23* (ppm)	TP Soil TP-9* (ppm)	TP Soil TP-13 (ppm)	TP Soil TP-14* (ppm)	TP Soil TP-15* (ppm)	TP Soil TP-20 (ppm)	TP Soil TP-21* (ppm)	TP Soil TP-22* (ppm)	TP Soil TP-24 (ppm)
9.00E+00	3.20E+01	1.00E+01	*1.00E+00*	*1.00E+00*	2.30E+01	1.10E+02	3.00E+02	*1.00E+00*	*1.00E+00*	5.30E+01	*1.00E+00*
9.00E+00	2.50E+01	2.40E+01	*1.00E+00*	*1.00E+00*	2.10E+01	9.60E+01	7.90E+02	*1.00E+00*	*1.00E+00*	4.40E+01	*1.00E+00*
2.10E+01	5.70E+01	2.20E+01	2.80E+01	*1.00E+00*	7.00E+01	5.60E+01	4.00E+02	*1.00E+00*	*1.00E+00*	7.10E+01	*1.00E+00*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*
4.00E+00	1.30E+01	7.00E+00	2.80E+01	*1.00E+00*	2.50E+01	3.00E+00	3.00E+02	*1.00E+00*	*1.00E+00*	3.20E+01	*1.00E+00*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	3.40E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	6.00E+00	*1.00E+00*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	5.20E+01	2.20E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*
7.00E+00	1.40E+01	1.00E+01	*1.00E+00*	*1.00E+00*	5.00E+01	6.50E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	3.20E+01	*1.00E+00*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.31E+02	*1.00E+00*	5.54E+03	*1.00E+00*	*1.00E+00*	9.00E+00	*1.00E+00*
1.00E+00	1.60E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	4.40E+01	5.20E+01	1.50E+03	*1.00E+00*	*1.00E+00*	1.70E+01	*1.00E+00*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.30E+01	7.30E+01	5.30E+02	*1.00E+00*	*1.00E+00*	2.60E+01	*1.00E+00*
1.20E+01	3.10E+01	1.30E+01	4.00E+00	*1.00E+00*	2.50E+01	1.92E+02	1.20E+03	*1.00E+00*	*1.00E+00*	9.60E+01	*1.00E+00*
2.20E+01	4.70E+01	2.90E+01	5.00E+00	*1.00E+00*	5.00E+01	2.52E+02	6.90E+02	*1.00E+00*	*1.00E+00*	9.60E+01	*1.00E+00*
1.20E+01	3.20E+01	1.80E+01	4.00E+00	9.00E+00	2.30E+01	1.81E+02	4.70E+02	*1.00E+00*	*1.00E+00*	6.80E+01	*1.00E+00*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	4.12E+02	1.90E+01	5.30E+02	*1.00E+00*	*1.00E+00*	6.00E+00	*1.00E+00*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	2.35E+02	3.90E+01	*1.00E+00*	*1.00E+00*	*1.00E+00*	3.00E+00	*1.00E+00*
5.00E-02	2.00E-01	3.00E-01	5.00E-01	1.60E+00	1.00E-01	4.30E-01	7.81E+00	*5.00E-02*	4.00E-01	2.00E-01	3.90E-01
4.00E-01	8.00E-02	*4.00E-01*	2.00E-01	1.22E+01	8.00E-02	8.30E-01	2.01E+02	*4.00E-01*	9.00E-01	*4.00E-01*	1.00E-01
5.00E-01	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*	*5.00E-01*	5.40E+02	*5.00E-01*	*5.00E-01*	*5.00E-01*	*6.00E+00*
1.50E+00	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.50E+00*	*1.00E+01*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*
6.00E+01	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.00E+01*	*6.50E+01*
2.20E+01	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*	4.60E+02	*2.20E+01*	*2.20E+01*	*2.20E+01*	*2.20E+01*	*4.30E+01*
1.00E+00	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*6.00E+00*
2.50E-01	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*
2.50E-01	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*
5.00E-02	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*
2.50E-01	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*	*2.50E-01*
5.40E+00	1.20E+01	4.86E+01	7.20E+01	1.40E+02	4.40E+01	1.60E+02	7.00E+02	4.10E+00	2.60E+01	3.00E+01	3.60E+01
3.60E+00	1.10E+01	4.00E+01	6.30E+01	1.30E+02	3.90E+01	1.50E+02	6.80E+02	2.90E+00	2.50E+01	2.70E+01	3.60E+01

TP Soil TP-25 (ppm)	TP Soil TP-26 (ppm)	TP Soil TP-29 (ppm)	TP Soil Average (ppm)
1.20E+01	8.80E+01	*1.00E+00*	2.74E+02
2.20E+01	7.80E+01	2.00E+01	2.55E+02
1.20E+01	1.30E+02	2.00E+01	3.29E+02
1.00E+00	*1.00E+00*	*1.00E+00*	1.00E+00
1.00E+00	6.10E+01	*1.00E+00*	1.15E+02
1.00E+00	3.60E+01	*1.00E+00*	8.79E+01
1.00E+00	2.80E+01	*1.00E+00*	3.06E+01
1.00E+00	5.60E+01	*1.00E+00*	1.05E+02
1.00E+00	*1.00E+00*	*1.00E+00*	2.32E+03
1.00E+00	8.00E+00	*1.00E+00*	4.04E+02
1.00E+00	4.60E+01	*1.00E+00*	2.95E+02
1.00E+00	1.20E+01	*1.00E+00*	1.10E+03
1.00E+00	1.50E+02	*1.00E+00*	6.51E+02
1.00E+00	1.00E+02	*1.00E+00*	4.49E+02
1.00E+00	1.10E+01	*1.00E+00*	3.90E+02
1.00E+00	*1.00E+00*	*1.00E+00*	4.49E+01
9.20E-01	*5.00E-02*	8.20E-01	1.58E+01
4.00E-01	*4.00E-01*	7.00E-01	2.59E+01
6.00E+00	*6.00E+00*	*6.00E+00*	5.79E+01
1.00E+01	*1.00E+01*	*1.00E+01*	1.62E+01
1.00E+01	*1.00E+01*	*1.00E+01*	4.51E+01
6.50E+01	*6.50E+01*	*6.50E+01*	2.41E+02
4.30E+01	*4.30E+01*	*4.30E+01*	1.48E+02
6.00E+00	*6.00E+00*	*6.00E+00*	2.00E+00
2.50E-01	*2.50E-01*	*2.50E-01*	2.50E-01
2.50E-01	*2.50E-01*	*2.50E-01*	2.50E-01
5.00E-02	*5.00E-02*	*5.00E-02*	5.00E-02
2.50E-01	*2.50E-01*	*2.50E-01*	2.50E-01
1.00E+04	1.30E+02	1.30E+04	1.12E+03
8.90E+03	1.10E+02	1.30E+04	1.06E+03

Chemical of Interest	Estimated Exposure Point Concentrations -->> Conc in Inhaled Gases (mg Al/m3)	Conc from Inhaled Fug Dust (mg Al/m3)	Conc in Ingested Dirt (mg Al/kg)	Conc in Adhered Dirt (mg Al/kg)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	1.20E-06	7.68E-02	2.74E+02	2.74E+02
benzo(a)anthracene	3.31E-06	7.13E-02	2.55E+02	2.55E+02
benzo(b)fluoranthene	1.10E-04	9.20E-02	3.29E+02	3.29E+02
benzo(k)fluoranthene	1.11E-06	2.80E-04	1.00E+00	1.00E+00
indeno(1,2,3-cd)pyrene	7.61E-08	3.21E-02	1.15E+02	1.15E+02
chrysene	7.15E-06	2.46E-02	8.79E+01	8.79E+01
dibenzo(a,h)anthracene	1.05E-08	8.57E-03	3.06E+01	3.06E+01
benzo(ghi)perylene	5.41E-08	2.93E-02	1.05E+02	1.05E+02
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	1.08E+01	6.49E-01	2.32E+03	2.32E+03
fluorene	5.50E-02	1.13E-01	4.04E+02	4.04E+02
anthracene	3.33E-01	8.25E-02	2.95E+02	2.95E+02
phenanthrene	1.93E-01	3.08E-01	1.10E+03	1.10E+03
fluoranthene	1.72E-03	1.82E-01	6.51E+02	6.51E+02
pyrene	9.23E-04	1.26E-01	4.49E+02	4.49E+02
acenaphthylene	3.57E+00	1.09E-01	3.90E+02	3.90E+02
acenaphthene	1.39E-02	1.26E-02	4.49E+01	4.49E+01
VOC Compounds Considered Carcinogenic				
benzene	1.65E+01	4.42E-03	1.58E+01	1.58E+01
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs	2.32E+00	7.26E-03	2.59E+01	2.59E+01
Non-Chlorinated Phenols				
2,4-dimethylphenol	2.34E+00	1.62E-02	5.79E+01	5.79E+01
2-nitrophenol	4.96E-01	4.52E-03	1.62E+01	1.62E+01
4-nitrophenol	1.38E+00	1.26E-02	4.51E+01	4.51E+01
2,4-dinitrophenol	1.45E-04	6.74E-02	2.41E+02	2.41E+02
2-methyl-4,6-dinitrophenol	8.91E-05	4.15E-02	1.48E+02	1.48E+02
phenol	9.91E-04	5.60E-04	2.00E+00	2.00E+00
total phenol				
Inorganic Compounds				
antimony		7.00E-05	2.50E-01	2.50E-01
arsenic		7.00E-05	2.50E-01	2.50E-01
cadmium		1.40E-05	5.00E-02	5.00E-02
lead		7.00E-05	2.50E-01	2.50E-01
total cyanide		3.14E-01	1.12E+03	1.12E+03
ferro-ferric cyanide (as CN)		2.97E-01	1.06E+03	1.06E+03

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Scenario 8

Estimated Average Daily Dose on a Day of Exposure -->>

Chemical of Interest	ADD (day) from Inhaled Gases (mg/d)	ADD (day) from Inhaled Fug Dust (mg/d)	ADD (day) from Ingested Dirt (mg/d)	ADD (day) from Adhered Dirt (mg/d)	ADD (day) from Two Inhale Pathways (mg/d)	ADD (day) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	1.92E-05	1.23E+00	2.74E-02	1.04E-01	1.23E+00	1.31E-01
benzo(a)anthracene	5.30E-05	1.14E+00	2.55E-02	9.62E-02	1.14E+00	1.22E-01
benzo(b)fluoranthene	1.76E-03	1.47E+00	3.29E-02	1.24E-01	1.47E+00	1.57E-01
benzo(k)fluoranthene	1.78E-05	4.48E-03	1.00E-04	3.78E-04	4.50E-03	4.78E-04
indeno(1,2,3-cd)pyrene	1.22E-06	5.13E-01	1.15E-02	4.33E-02	5.13E-01	5.48E-02
chrysene	1.14E-04	3.94E-01	8.79E-03	3.32E-02	3.94E-01	4.20E-02
dibenzo(a,h)anthracene	1.69E-07	1.37E-01	3.06E-03	1.16E-02	1.37E-01	1.46E-02
benzo(ghi)perylene	8.66E-07	4.69E-01	1.05E-02	3.96E-02	4.69E-01	5.00E-02
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	1.73E+02	1.04E+01	2.32E-01	8.76E-01	1.83E+02	1.11E+00
fluorene	8.80E-01	1.81E+00	4.04E-02	1.53E-01	2.69E+00	1.93E-01
anthracene	5.32E+00	1.32E+00	2.95E-02	1.11E-01	6.64E+00	1.41E-01
phenanthrene	3.09E+00	4.92E+00	1.10E-01	4.15E-01	8.01E+00	5.25E-01
fluoranthene	2.74E-02	2.92E+00	6.51E-02	2.46E-01	2.95E+00	3.11E-01
pyrene	1.48E-02	2.01E+00	4.49E-02	1.70E-01	2.03E+00	2.15E-01
acenaphthylene	5.72E+01	1.75E+00	3.90E-02	1.47E-01	5.89E+01	1.86E-01
acenaphthene	2.23E-01	2.01E-01	4.49E-03	1.70E-02	4.24E-01	2.15E-02
VOC Compounds Considered Carcinogenic						
benzene	2.64E+02	7.08E-02	1.58E-03	5.97E-03	2.64E+02	7.55E-03
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	3.72E+01	1.16E-01	2.59E-03	9.80E-03	3.73E+01	1.24E-02
Non-Chlorinated Phenols						
2,4-dimethylphenol	3.75E+01	2.60E-01	5.79E-03	2.19E-02	3.78E+01	2.77E-02
2-nitrophenol	7.93E+00	7.24E-02	1.62E-03	6.11E-03	8.00E+00	7.72E-03
4-nitrophenol	2.22E+01	2.02E-01	4.51E-03	1.71E-02	2.24E+01	2.16E-02
2,4-dinitrophenol	2.32E-03	1.08E+00	2.41E-02	9.10E-02	1.08E+00	1.15E-01
2-methyl-4,6-dinitrophenol	1.43E-03	6.63E-01	1.48E-02	5.60E-02	6.65E-01	7.08E-02
phenol	1.59E-02	8.96E-03	2.00E-04	7.56E-04	2.48E-02	9.56E-04
total phenol						
Inorganic Compounds						
antimony		1.12E-03	2.50E-05		1.12E-03	2.50E-05
arsenic		1.12E-03	2.50E-05		1.12E-03	2.50E-05
cadmium		2.24E-04	5.00E-06		2.24E-04	5.00E-06
lead		1.12E-03	2.50E-05		1.12E-03	2.50E-05
total cyanide		5.02E+00	1.12E-01		5.02E+00	1.12E-01
ferro-ferric cyanide (as CN)		4.76E+00	1.06E-01		4.76E+00	1.06E-01

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Scenario 8

Estimated Average Daily Dose over a Life of Exposure -->>

Chemical of Interest	ADD (life) from Inhaled Gases (mg/d)	ADD (life) from Inhaled Fug Dust (mg/d)	ADD (life) from Ingested Dirt (mg/d)	ADD (life) from Adhered Dirt (mg/d)	ADD (life) from Two Inhale Pathways (mg/d)	ADD (life) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	6.00E-09	3.85E-04	8.59E-06	3.25E-05	3.85E-04	4.11E-05
benzo(a)anthracene	1.66E-08	3.57E-04	7.97E-06	3.01E-05	3.57E-04	3.81E-05
benzo(b)fluoranthene	5.52E-07	4.61E-04	1.03E-05	3.89E-05	4.61E-04	4.92E-05
benzo(k)fluoranthene	5.56E-09	1.40E-06	3.13E-08	1.18E-07	1.41E-06	1.50E-07
indeno(1,2,3-cd)pyrene	3.81E-10	1.61E-04	3.59E-06	1.36E-05	1.61E-04	1.71E-05
chrysene	3.58E-08	1.23E-04	2.75E-06	1.04E-05	1.23E-04	1.32E-05
dibenzo(a,h)anthracene	5.28E-11	4.29E-05	9.58E-07	3.62E-06	4.29E-05	4.58E-06
benzo(ghi)perylene	2.71E-10	1.47E-04	3.28E-06	1.24E-05	1.47E-04	1.57E-05
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	5.40E-02	3.25E-03	7.26E-05	2.74E-04	5.73E-02	3.47E-04
fluorene	2.76E-04	5.67E-04	1.26E-05	4.78E-05	8.42E-04	6.04E-05
anthracene	1.67E-03	4.13E-04	9.23E-06	3.49E-05	2.08E-03	4.41E-05
phenanthrene	9.68E-04	1.54E-03	3.44E-05	1.30E-04	2.51E-03	1.64E-04
fluoranthene	8.59E-06	9.14E-04	2.04E-05	7.71E-05	9.22E-04	9.75E-05
pyrene	4.62E-06	6.30E-04	1.41E-05	5.32E-05	6.35E-04	6.72E-05
acenaphthylene	1.79E-02	5.47E-04	1.22E-05	4.61E-05	1.84E-02	5.83E-05
acenaphthene	6.97E-05	6.30E-05	1.41E-06	5.32E-06	1.33E-04	6.72E-06
VOC Compounds Considered Carcinogenic						
benzene	8.26E-02	2.22E-05	4.95E-07	1.87E-06	8.26E-02	2.37E-06
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	1.16E-02	3.64E-05	8.12E-07	3.07E-06	1.17E-02	3.88E-06
Non-Chlorinated Phenols						
2,4-dimethylphenol	1.17E-02	8.13E-05	1.81E-06	6.86E-06	1.18E-02	8.67E-06
2-nitrophenol	2.48E-03	2.27E-05	5.06E-07	1.91E-06	2.51E-03	2.42E-06
4-nitrophenol	6.94E-03	6.33E-05	1.41E-06	5.34E-06	7.00E-03	6.75E-06
2,4-dinitrophenol	7.26E-07	3.38E-04	7.54E-06	2.85E-05	3.39E-04	3.61E-05
2-methyl-4,6-dinitrophenol	4.47E-07	2.08E-04	4.64E-06	1.75E-05	2.08E-04	2.22E-05
phenol	4.96E-06	2.81E-06	6.26E-08	2.37E-07	7.77E-06	2.99E-07
total phenol						
Inorganic Compounds						
antimony		3.51E-07	7.83E-09		3.51E-07	7.83E-09
arsenic		3.51E-07	7.83E-09		3.51E-07	7.83E-09
cadmium		7.01E-08	1.57E-09		7.01E-08	1.57E-09
lead		3.51E-07	7.83E-09		3.51E-07	7.83E-09
total cyanide		1.57E-03	3.51E-05		1.57E-03	3.51E-05
ferro-ferric cyanide (as CN)		1.49E-03	3.33E-05		1.49E-03	3.33E-05

Exhibit A-6.8, page 7
Scenario 8

Estimated Health Effects -->>

Chemical of Interest	Ratio via Inhale Non Carcs (--)	Ratio via Ingest Non Carcs (--)	Incremental Lifetime Risk via Inhale Carcs (prob)	Incremental Lifetime Risk via Ingest Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	1.76E+00	1.87E-01	2.49E-06	3.37E-06
benzo(a)anthracene	1.63E+00	1.74E-01	3.35E-07	4.53E-07
benzo(b)fluoranthene	2.11E+00	2.24E-01	4.18E-07	5.65E-07
benzo(k)fluoranthene	6.43E-03	6.83E-04	6.02E-10	8.10E-10
indeno(1,2,3-cd)pyrene	7.33E-01	7.82E-02	2.41E-07	3.26E-07
chrysene	5.63E-01	6.00E-02	3.51E-09	4.75E-09
dibenzo(a,h)anthracene	1.96E-01	2.09E-02	3.09E-07	4.17E-07
benzo(ghi)perylene	6.70E-01	7.15E-02	2.09E-08	2.83E-08
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	5.23E+02	3.17E+00		
fluorene	7.69E+00	5.52E-01		
anthracene	1.70E+02	3.61E+00		
phenanthrene	1.64E+01	1.07E+00		
fluoranthene	2.10E+00	2.22E-01		
pyrene	1.93E+00	2.05E-01		
acenaphthylene	8.42E+01	2.66E-01		
acenaphthene	3.03E-02	1.53E-03		
VOC Compounds Considered Carcinogenic				
benzene			3.07E-05	1.76E-09
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol	2.70E+02	1.98E-01		
2-nitrophenol	5.72E+01	5.51E-02		
4-nitrophenol	1.60E+02	1.54E-01		
2,4-dinitrophenol	7.72E+00	8.22E-01		
2-methyl-4,6-dinitrophenol	4.75E+00	5.06E-01		
phenol	1.77E-02	1.37E-04		
total phenol				
Inorganic Compounds				
antimony	4.00E-02	8.93E-04		
arsenic			2.50E-07	1.68E-09
cadmium	1.10E-02	2.46E-04	6.11E-09	
lead	3.72E-02	2.55E-04		
total cyanide	3.59E+00	8.01E-02		
ferro-ferric cyanide (as CN)	3.40E+00	7.59E-02		
Subtotals for Pathways =	1.32E+03	1.18E+01	3.48E-05	5.16E-06
Totals for Pathways =	1.33E+03		3.99E-05	

Exhibit A-6.9, page 1
Scenario 9

Chemical of Interest	Soil Concentrations in Test Pits: TP Soil TP-1 (ppm)	TP Soil Average (ppm)
PAH Compounds Considered Potentially Carcinogenic		
benzo(a)pyrene	5.55E+03	5.55E+03
benzo(a)anthracene	4.60E+03	4.60E+03
benzo(b)fluoranthene	6.48E+03	6.48E+03
benzo(k)fluoranthene	*1.00E+00*	1.00E+00
indeno(1,2,3-cd)pyrene	2.10E+03	2.10E+03
chrysene	1.90E+03	1.90E+03
dibenzo(a,h)anthracene	5.70E+02	5.70E+02
benzo(ghi)perylene	2.10E+03	2.10E+03
PAH Compounds Not Considered Potentially Carcinogenic		
naphthalene	4.74E+04	4.74E+04
fluorene	7.57E+03	7.57E+03
anthracene	6.01E+03	6.01E+03
phenanthrene	2.34E+04	2.34E+04
fluoranthene	1.34E+04	1.34E+04
pyrene	9.23E+03	9.23E+03
acenaphthylene	7.93E+03	7.93E+03
acenaphthene	7.30E+02	7.30E+02
VOC Compounds Considered Carcinogenic		
benzene	3.28E+02	3.28E+02
VOC Compounds Not Considered Carcinogenic		
sum of 8 VOCs	3.41E+02	3.41E+02
Non-Chlorinated Phenols		
2,4-dimethylphenol	7.60E+02	7.60E+02
2-nitrophenol	3.00E+02	3.00E+02
4-nitrophenol	9.80E+02	9.80E+02
2,4-dinitrophenol	4.20E+03	4.20E+03
2-methyl-4,6-dinitrophenol	2.40E+03	2.40E+03
phenol	*1.00E+00*	1.00E+00
total phenol		
Inorganic Compounds		
antimony	*2.50E-01*	2.50E-01
arsenic	*2.50E-01*	2.50E-01
cadmium	*5.00E-02*	5.00E-02
lead	*2.50E-01*	2.50E-01
total cyanide	9.00E+01	9.00E+01
ferro-ferric cyanide (as CN)	9.00E+00	9.00E+00

* Test pit is paved.

Chemical of Interest	Estimated Exposure Point Concentrations -->> Conc in Inhaled Gases (mg Al/m3)	Conc from Inhaled Fug Dust (mg Al/m3)	Conc in Ingested Dirt (mg Al/kg)	Conc in Adhered Dirt (mg Al/kg)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	2.32E-05	1.55E+00	5.55E+03	5.55E+03
benzo(a)anthracene	5.74E-05	1.29E+00	4.60E+03	4.60E+03
benzo(b)fluoranthene	2.08E-03	1.81E+00	6.48E+03	6.48E+03
benzo(k)fluoranthene	1.06E-06	2.80E-04	1.00E+00	1.00E+00
indeno(1,2,3-cd)pyrene	1.34E-06	5.88E-01	2.10E+03	2.10E+03
chrysene	1.48E-04	5.32E-01	1.90E+03	1.90E+03
dibenzo(a,h)anthracene	1.88E-07	1.60E-01	5.70E+02	5.70E+02
benzo(ghi)perylene	1.04E-06	5.88E-01	2.10E+03	2.10E+03
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	2.11E+02	1.33E+01	4.74E+04	4.74E+04
fluorene	9.88E-01	2.12E+00	7.57E+03	7.57E+03
anthracene	6.50E+00	1.68E+00	6.01E+03	6.01E+03
phenanthrene	3.94E+00	6.55E+00	2.34E+04	2.34E+04
fluoranthene	3.38E-02	3.75E+00	1.34E+04	1.34E+04
pyrene	1.82E-02	2.58E+00	9.23E+03	9.23E+03
acenaphthylene	6.97E+01	2.22E+00	7.93E+03	7.93E+03
acenaphthene	2.17E-01	2.04E-01	7.30E+02	7.30E+02
VOC Compounds Considered Carcinogenic				
benzene	3.28E+02	9.18E-02	3.28E+02	3.28E+02
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs	2.93E+01	9.56E-02	3.41E+02	3.41E+02
Non-Chlorinated Phenols				
2,4-dimethylphenol	2.95E+01	2.13E-01	7.60E+02	7.60E+02
2-nitrophenol	8.82E+00	8.40E-02	3.00E+02	3.00E+02
4-nitrophenol	2.88E+01	2.74E-01	9.80E+02	9.80E+02
2,4-dinitrophenol	2.42E-03	1.18E+00	4.20E+03	4.20E+03
2-methyl-4,6-dinitrophenol	1.38E-03	6.72E-01	2.40E+03	2.40E+03
phenol	4.75E-04	2.80E-04	1.00E+00	1.00E+00
total phenol				
Inorganic Compounds				
antimony		7.00E-05	2.50E-01	2.50E-01
arsenic		7.00E-05	2.50E-01	2.50E-01
cadmium		1.40E-05	5.00E-02	5.00E-02
lead		7.00E-05	2.50E-01	2.50E-01
total cyanide		2.52E-02	9.00E+01	9.00E+01
ferro-ferric cyanide (as CN)		2.52E-03	9.00E+00	9.00E+00

Estimated Average Daily Dose on a Day of Exposure -->>

Chemical of Interest	ADD (day) from Inhaled Gases (mg/d)	ADD (day) from Inhaled Fug Dust (mg/d)	ADD (day) from Ingested Dirt (mg/d)	ADD (day) from Adhered Dirt (mg/d)	ADD (day) from Two Inhale Pathways (mg/d)	ADD (day) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	3.71E-04	2.49E+01	5.55E-01	2.10E+00	2.49E+01	2.65E+00
benzo(a)anthracene	9.18E-04	2.06E+01	4.60E-01	1.74E+00	2.06E+01	2.20E+00
benzo(b)fluoranthene	3.33E-02	2.90E+01	6.48E-01	2.45E+00	2.91E+01	3.10E+00
benzo(k)fluoranthene	1.70E-05	4.48E-03	1.00E-04	3.78E-04	4.50E-03	4.78E-04
indeno(1,2,3-cd)pyrene	2.14E-05	9.41E+00	2.10E-01	7.94E-01	9.41E+00	1.00E+00
chrysene	2.37E-03	8.51E+00	1.90E-01	7.18E-01	8.51E+00	9.08E-01
dibenzo(a,h)anthracene	3.01E-06	2.55E+00	5.70E-02	2.15E-01	2.55E+00	2.72E-01
benzo(ghi)perylene	1.66E-05	9.41E+00	2.10E-01	7.94E-01	9.41E+00	1.00E+00
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	3.38E+03	2.12E+02	4.74E+00	1.79E+01	3.59E+03	2.27E+01
fluorene	1.58E+01	3.39E+01	7.57E-01	2.86E+00	4.97E+01	3.62E+00
anthracene	1.04E+02	2.69E+01	6.01E-01	2.27E+00	1.31E+02	2.87E+00
phenanthrene	6.31E+01	1.05E+02	2.34E+00	8.85E+00	1.68E+02	1.12E+01
fluoranthene	5.41E-01	6.00E+01	1.34E+00	5.07E+00	6.06E+01	6.41E+00
pyrene	2.91E-01	4.14E+01	9.23E-01	3.49E+00	4.16E+01	4.41E+00
acenaphthylene	1.11E+03	3.55E+01	7.93E-01	3.00E+00	1.15E+03	3.79E+00
acenaphthene	3.47E+00	3.27E+00	7.30E-02	2.76E-01	6.74E+00	3.49E-01
VOC Compounds Considered Carcinogenic						
benzene	5.25E+03	1.47E+00	3.28E-02	1.24E-01	5.25E+03	1.57E-01
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	4.69E+02	1.53E+00	3.41E-02	1.29E-01	4.71E+02	1.63E-01
Non-Chlorinated Phenols						
2,4-dimethylphenol	4.71E+02	3.40E+00	7.60E-02	2.87E-01	4.75E+02	3.63E-01
2-nitrophenol	1.41E+02	1.34E+00	3.00E-02	1.13E-01	1.42E+02	1.43E-01
4-nitrophenol	4.61E+02	4.39E+00	9.80E-02	3.70E-01	4.65E+02	4.68E-01
2,4-dinitrophenol	3.88E-02	1.88E+01	4.20E-01	1.59E+00	1.89E+01	2.01E+00
2-methyl-4,6-dinitrophenol	2.21E-02	1.08E+01	2.40E-01	9.07E-01	1.08E+01	1.15E+00
phenol	7.59E-03	4.48E-03	1.00E-04	3.78E-04	1.21E-02	4.78E-04
total phenol						
Inorganic Compounds						
antimony		1.12E-03	2.50E-05		1.12E-03	2.50E-05
arsenic		1.12E-03	2.50E-05		1.12E-03	2.50E-05
cadmium		2.24E-04	5.00E-06		2.24E-04	5.00E-06
lead		1.12E-03	2.50E-05		1.12E-03	2.50E-05
total cyanide		4.03E-01	9.00E-03		4.03E-01	9.00E-03
ferro-ferric cyanide (as CN)		4.03E-02	9.00E-04		4.03E-02	9.00E-04

Exhibit A-6.9, page 4
Scenario 9

Estimated Average Daily Dose over a Life of Exposure -->>

Chemical of Interest	ADD (life) from Inhaled Gases (mg/d)	ADD (life) from Inhaled Fug Dust (mg/d)	ADD (life) from Ingested Dirt (mg/d)	ADD (life) from Adhered Dirt (mg/d)	ADD (life) from Two Inhale Pathways (mg/d)	ADD (life) from Two Ingest Pathways (mg/d)
PAH Compounds Considered Potentially Carcinogenic						
benzo(a)pyrene	1.16E-07	7.79E-03	1.74E-04	6.57E-04	7.79E-03	8.31E-04
benzo(a)anthracene	2.88E-07	6.45E-03	1.44E-04	5.44E-04	6.45E-03	6.88E-04
benzo(b)fluoranthene	1.04E-05	9.09E-03	2.03E-04	7.67E-04	9.10E-03	9.70E-04
benzo(k)fluoranthene	5.33E-09	1.40E-06	3.13E-08	1.18E-07	1.41E-06	1.50E-07
indeno(1,2,3-cd)pyrene	6.70E-09	2.95E-03	6.58E-05	2.49E-04	2.95E-03	3.14E-04
chrysene	7.42E-07	2.67E-03	5.95E-05	2.25E-04	2.67E-03	2.84E-04
dibenzo(a,h)anthracene	9.42E-10	8.00E-04	1.78E-05	6.75E-05	8.00E-04	8.53E-05
benzo(ghi)perylene	5.21E-09	2.95E-03	6.58E-05	2.49E-04	2.95E-03	3.14E-04
PAH Compounds Not Considered Potentially Carcinogenic						
naphthalene	1.06E+00	6.65E-02	1.48E-03	5.61E-03	1.13E+00	7.09E-03
fluorene	4.95E-03	1.06E-02	2.37E-04	8.96E-04	1.56E-02	1.13E-03
anthracene	3.26E-02	8.43E-03	1.88E-04	7.11E-04	4.10E-02	9.00E-04
phenanthrene	1.98E-02	3.28E-02	7.33E-04	2.77E-03	5.26E-02	3.50E-03
fluoranthene	1.69E-04	1.88E-02	4.20E-04	1.59E-03	1.90E-02	2.01E-03
pyrene	9.10E-05	1.29E-02	2.89E-04	1.09E-03	1.30E-02	1.38E-03
acenaphthylene	3.49E-01	1.11E-02	2.48E-04	9.39E-04	3.60E-01	1.19E-03
acenaphthene	1.09E-03	1.02E-03	2.29E-05	8.64E-05	2.11E-03	1.09E-04
VOC Compounds Considered Carcinogenic						
benzene	1.64E+00	4.60E-04	1.03E-05	3.88E-05	1.64E+00	4.91E-05
VOC Compounds Not Considered Carcinogenic						
sum of 8 VOCs	1.47E-01	4.79E-04	1.07E-05	4.04E-05	1.47E-01	5.11E-05
Non-Chlorinated Phenols						
2,4-dimethylphenol	1.48E-01	1.07E-03	2.38E-05	9.00E-05	1.49E-01	1.14E-04
2-nitrophenol	4.42E-02	4.21E-04	9.39E-06	3.55E-05	4.46E-02	4.49E-05
4-nitrophenol	1.44E-01	1.37E-03	3.07E-05	1.16E-04	1.46E-01	1.47E-04
2,4-dinitrophenol	1.21E-05	5.89E-03	1.32E-04	4.97E-04	5.90E-03	6.29E-04
2-methyl-4,6-dinitrophenol	6.93E-06	3.37E-03	7.51E-05	2.84E-04	3.37E-03	3.59E-04
phenol	2.38E-06	1.40E-06	3.13E-08	1.18E-07	3.78E-06	1.50E-07
total phenol						
Inorganic Compounds						
antimony		3.51E-07	7.83E-09		3.51E-07	7.83E-09
arsenic		3.51E-07	7.83E-09		3.51E-07	7.83E-09
cadmium		7.01E-08	1.57E-09		7.01E-08	1.57E-09
lead		3.51E-07	7.83E-09		3.51E-07	7.83E-09
total cyanide		1.26E-04	2.82E-06		1.26E-04	2.82E-06
ferro-ferric cyanide (as CN)		1.26E-05	2.82E-07		1.26E-05	2.82E-07

Estimated Health Effects -->>

Chemical of Interest	Ratio via Inhale Non Carcs (--)	Ratio via Ingest Non Carcs (--)	Incremental Lifetime Risk via Inhale Carcs (prob)	Incremental Lifetime Risk via Ingest Carcs (prob)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	3.55E+01	3.79E+00	5.04E-05	6.81E-05
benzo(a)anthracene	2.94E+01	3.14E+00	6.06E-06	8.19E-06
benzo(b)fluoranthene	4.15E+01	4.42E+00	8.25E-06	1.11E-05
benzo(k)fluoranthene	6.42E-03	6.83E-04	6.02E-10	8.10E-10
indeno(1,2,3-cd)pyrene	1.34E+01	1.43E+00	4.43E-06	5.98E-06
chrysene	1.22E+01	1.30E+00	7.60E-08	1.03E-07
dibenzo(a,h)anthracene	3.65E+00	3.89E-01	5.75E-06	7.76E-06
benzo(ghi)perylene	1.34E+01	1.43E+00	4.20E-07	5.67E-07
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	1.03E+04	6.47E+01		
fluorene	1.42E+02	1.03E+01		
anthracene	3.36E+03	7.37E+01		
phenanthrene	3.43E+02	2.28E+01		
fluoranthene	4.33E+01	4.58E+00		
pyrene	3.97E+01	4.20E+00		
acenaphthylene	1.64E+03	5.42E+00		
acenaphthene	4.81E-01	2.49E-02		
VOC Compounds Considered Carcinogenic				
benzene			6.10E-04	3.65E-08
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol	3.39E+03	2.59E+00		
2-nitrophenol	1.02E+03	1.02E+00		
4-nitrophenol	3.32E+03	3.35E+00		
2,4-dinitrophenol	1.35E+02	1.43E+01		
2-methyl-4,6-dinitrophenol	7.70E+01	8.19E+00		
phenol	8.62E-03	6.83E-05		
total phenol				
Inorganic Compounds				
antimony	4.00E-02	8.93E-04		
arsenic			2.50E-07	1.68E-09
cadmium	1.10E-02	2.46E-04	6.11E-09	
lead	3.72E-02	2.55E-04		
total cyanide	2.88E-01	6.43E-03		
ferro-ferric cyanide (as CN)	2.88E-02	6.43E-04		
Subtotals for Pathways =	2.39E+04	2.31E+02	6.86E-04	1.02E-04
Totals for Pathways =	2.42E+04		7.88E-04	

Exhibit A-7

Summary of Estimated Health Effects

	Ratio Ingestion	Ratio Inhalation	Lifetime Risk Ingestion	Lifetime Risk Inhalation
Scenario 1		1.87E-01		4.59E-05
Scenario 2		2.98E+00		5.74E-05
Scenario 3		7.16E-01		5.74E-05
Scenario 4		1.19E+00		2.01E-05
Scenario 5		5.74E-01		5.10E-06

	Ratio Ingestion	Ratio Inhalation	Lifetime Risk Ingestion	Lifetime Risk Inhalation
Scenario 6	6.07E-05	9.35E-03	5.82E-11	3.67E-07
Scenario 7	2.18E+00	9.26E-02	1.42E-05	5.91E-09
Scenario 8	1.18E+01	1.32E+03	5.16E-06	3.48E-05
Scenario 9	2.31E+02	2.39E+04	1.02E-04	6.86E-04

APPENDIX B

OFF-SITE EXPOSURE SCENARIOS

APPENDIX B

OFF-SITE RECEPTORS

The major assumptions, models used, and calculations related to estimating risks to off-site receptors are presented in this appendix. Supporting calculations are presented in Appendix C.

Scenario: 10 Children Visiting Site Stream on NYSEG Property

Case/Timing:	Base Case
Employees?	No
Adults or Children	Children
Activity:	Play
Number of People:	few (but not otherwise specified)
Frequency:	rare event - five times per lifetime

Pathways and Compounds Modeled

Incidental Ingestion

Compounds: All chemicals of interest

Models: Soil Ingestion Model Assumption - intake of 100 mg/day of soil; matrix effect of 50%

Primary Data Set: Suirface soils and sediments on-site in the vicinity of the easterly site stream

Average Body Weight: 40 kg (child)

Direct Skin Contact

Compounds: All chemicals of interest

Models: Skin Contact Model Assumptions - 1200 cm2 of skin surface; soil adherence of 1.6 mg/cm2 of soil; 0.1 fraction of chemical absorbed from soil through the skin

Average Body Weight: 40 kg (typical of 10 to 11 year old)

Special Notes

Inhalation of dusts or vapors not considered significant due to wet nature of the environment.

Scenario: 11 Children Visiting Site Stream in Seneca Lake Park Area

Case/Timing:	Base Case
Employees?	No
Adults or Children	Children (most sensitive/likely receptors)
Activity:	Play
Number of People:	visitor population (but not otherwise specified)
Frequency:	more frequent event - hundred times per lifetime considered to be a conservative (upper) estimate

Pathways and Compounds Modeled

Incidental Ingestion

Compounds: All chemicals of interest

Models: Soil Ingestion Model Assumption - intake of 100 mg/day of soil; matrix effect of 50%

Primary Data Set: sediments in the stream sediments in the park; note values were specified for non-detected PAH compounds;

Average Body Weight: 40 kg (child - 10-11 year old)

Direct Skin Contact

Compounds: All chemicals of interest

Models: Skin Contact Model Assumptions - 1200 cm2 of skin surface; soil adherence of 1.6 mg/cm2 of soil; 0.1 fraction of chemical absorbed from soil through the skin

Average Body Weight: 40 kg (typical of 10 to 11 year old)

Special Notes

Inhalation of dusts or vapors not considered significant due to wet nature of the environment.

Scenario: 12 Lake Seneca Receptors

Case/Timing: **Base Case**

Employees? **No**

Adults or Children: **Adults over lifetime of 70 years**

Activity: **Drinking Water and Eating Fish**

Number of People: **visitor population and residents (but not otherwise specified)**

Frequency: **assumed daily exposure over a 70 year lifetime**

Pathways and Compounds Modeled

Ingestion

Compounds: All organic chemicals of interest

Models: Fish Ingestion Model Assumption - intake of 6.5 g/day of fish (EPA estimate as an average intake level); intake of drinking water assumed to be 2 liters per day (EPA estimate as an average intake level); a fugacity model was used to partition the chemicals of interest among various environmental media (water, biota, sediments); the model was run for steady state (non-equilibrium) conditions and assumed that all chemicals of interest in coke quench wastewater and streams would enter the lake.

Primary Data Set: sediments in the stream sediments in the park; note values were specified for non-detected PAH compounds;

Average Body Weight: 70 kg (average lifetime body weight)

The estimated risk calculations for scenarios 10, 11, and 12 are presented in Exhibits B.1, B.2, and B.3. Supporting calculations are presented in Appendix C.

Exhibit B.1: Scenario 10
Children Visiting Stream Area

Chemical of Interest	Concentrations in Soils or Stream Sediments (mg/kg)						Estimated Exposure Point Concentration	
	STREAM DREDGE PILE			EAST OF STREAM	STREAM SEDIMENT		Conc. in Ingested Dirt (mg/kg)	Conc. in Adhered Dirt (mg/kg)
	SS-7	SS-13	SS-15	SS-14	SD-1	SD-2		
PAH Compounds Considered Potentially Carcinogenic								
benzo(a)pyrene	6.80E+0	2.20E-1	2.10E-1	2.20E-1	1.50E+1	4.60E+1	11.41	11.41
benzo(a)anthracene	5.06E+0	4.00E-1	4.00E-1	4.00E-1	9.60E+0	4.80E+1	10.64	10.64
benzo(b)fluoranthene	5.00E+0	1.00E+0	1.00E+0	1.00E+0	3.00E+0	2.20E+1	5.50	5.50
benzo(k)fluoranthene	7.44E+0	1.40E-1	1.30E-1	1.40E-1	1.60E+1	4.30E+1	11.14	11.14
indeno(1,2,3-cd)pyrene	4.40E+0	2.10E-1	2.10E-1	2.10E-1	4.00E+0	5.30E+1	10.34	10.34
chrysene	6.58E+0	2.90E-1	1.47E+0	8.40E-1	2.90E-1	2.90E-1	1.63	1.63
dibenzo(a,h)anthracene	2.20E-1	2.20E-1	2.20E-1	2.20E-1	7.00E+0	1.16E+2	20.65	20.65
benzo(ghi)perylene	5.13E+0	2.20E-1	2.20E-1	2.20E-1	5.00E+0	4.60E+1	9.47	9.47
PAH Compounds Not Considered Potentially Carcinogenic								
naphthalene	8.30E-1	2.30E-1	2.20E-1	5.00E-1	9.00E-1	2.20E-1	.48	.48
fluorene	2.10E-1	2.30E-1	2.10E-1	2.10E-1	2.10E-1	5.00E+0	1.01	1.01
anthracene	8.60E-1	2.60E-1	2.50E-1	2.60E-1	2.60E-1	2.00E+1	3.65	3.65
phenanthrene	2.50E+0	2.30E-1	2.20E-1	2.30E-1	2.30E-1	1.10E+2	18.90	18.90
fluoranthene	1.06E+1	2.10E-1	2.00E-1	2.10E-1	1.50E+1	1.10E+2	22.70	22.70
pyrene	9.14E+0	2.00E-1	2.86E+0	2.00E-1	1.10E+1	7.10E+1	15.73	15.73
acenaphthylene	8.70E-1	2.20E-1	2.10E-1	2.20E-1	9.00E-1	5.00E+0	1.24	1.24
acenaphthene	2.00E-1	2.00E-1	2.00E-1	2.00E-1	2.00E-1	8.00E+0	1.50	1.50
VOC Compounds Considered Carcinogenic								
benzene	<0.06	<0.07	<0.04	<0.04	0.00E+0		0	0
VOC Compounds Not Considered Carcinogenic								
sum of 8 VOCs								
Non-Chlorinated Phenols								
2,4-dimethylphenol	1.25E+0	1.30E+0	1.27E+0	1.34E+0	1.25E+0	1.10E+2	19.40	19.40
2-nitrophenol	<3.16	<3.22	<3.19	<3.30		0.00E+0	0	0
4-nitrophenol	2.50E+0	2.50E+0	2.50E+0	2.50E+0	2.50E+0	2.80E+1	6.75	6.75
2,4-dinitrophenol	<25.20	<25.70	<25.50	<26.40	0.00E+0		0	0
2-methyl-4,6-dinitroph	<7.57	<7.72	<7.65	<7.91	0.00E+0		0	0
phenol	<2.52	<2.57	<2.55	<2.64	0.00E+0		0	0
Inorganic Compounds								
antimony								
arsenic	1.69E+1	9.90E+0	1.41E+1	1.32E+1			13.53	13.53
cadmium	<1.84	<1.84	<1.85	<1.84	0.00E+0		0	0
lead	1.17E+2	1.70E+1	3.44E+1	1.70E+1			46.35	46.35
total cyanide	1.10E+2	2.27E+2	4.31E+1	1.19E+2	1.20E+2	7.20E+1	115.18	115.18
ferro-ferric cyanide (	7.20E+1	2.22E+2	4.31E+1	1.18E+2	1.00E+2	5.10E+1	101.02	101.02

Exhibit 8.1: Scenario 10
Children Visiting Stream Area

Chemical of Interest	Estimated Average Daily Dose on a day of exposure: ADD (day) from Ingested Dirt (mg/day)	Estimated Average Daily Dose on a day of exposure: ADD (day) from Soil Contact (mg/day)	Estimated Average Daily Dose over a lifetime of Exposure: ADD (life) from Ingested Dirt (mg/day)	Estimated Average Daily Dose over a lifetime of Exposure: ADD (life) from Soil Contact (mg/day)
PAH Compounds Considered				
benzo(a)pyrene	1.14E-3	2.19E-3	2.23E-7	4.29E-7
benzo(a)anthracene	1.06E-3	2.04E-3	2.08E-7	4.00E-7
benzo(b)fluoranthene	5.50E-4	1.06E-3	1.08E-7	2.07E-7
benzo(k)fluoranthene	1.11E-3	2.14E-3	2.18E-7	4.19E-7
indeno(1,2,3-cd)pyrene	1.03E-3	1.98E-3	2.02E-7	3.88E-7
chrysene	1.63E-4	3.12E-4	3.18E-8	6.11E-8
dibenzo(a,h)anthracene	2.06E-3	3.96E-3	4.04E-7	7.76E-7
benzo(ghi)perylene	9.47E-4	1.82E-3	1.85E-7	3.56E-7
PAH Compounds Not Conside				
naphthalene	4.83E-5	9.28E-5	9.46E-9	1.82E-8
fluorene	1.01E-4	1.94E-4	1.98E-8	3.80E-8
anthracene	3.65E-4	7.00E-4	7.14E-8	1.37E-7
phenanthrene	1.89E-3	3.63E-3	3.70E-7	7.10E-7
fluoranthene	2.27E-3	4.36E-3	4.44E-7	8.53E-7
pyrene	1.57E-3	3.02E-3	3.08E-7	5.91E-7
acenaphthylene	1.24E-4	2.37E-4	2.42E-8	4.65E-8
acenaphthene	1.50E-4	2.88E-4	2.94E-8	5.64E-8
VOC Compounds Considered				
benzene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
VOC Compounds Not Conside				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol	1.94E-3	3.73E-3	3.80E-7	7.29E-7
2-nitrophenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
4-nitrophenol	6.75E-4	1.30E-3	1.32E-7	2.54E-7
2,4-dinitrophenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
2-methyl-4,6-dinitroph	0.00E+0	0.00E+0	0.00E+0	0.00E+0
phenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Inorganic Compounds				
antimony				
arsenic	1.35E-3	2.60E-3	2.65E-7	5.08E-7
cadmium	0.00E+0	0.00E+0	0.00E+0	0.00E+0
lead	4.64E-3	8.90E-3	9.07E-7	1.74E-6
total cyanide	1.15E-2	2.21E-2	2.25E-6	4.33E-6
ferro-ferric cyanide (	1.01E-2	1.94E-2	1.98E-6	3.80E-6

Exhibit B.1: Scenario 10
Children Visiting Stream Area

Chemical of Interest	Hazard Index Ratio via Ingestion/ Dermal Contact	Incremental Lifetime Risk via Ingestion/Dermal Contact with Potential Carcinogens (probablility)
PAH Compounds Considered Potentially Carcinogenic		
benzo(a)pyrene	.008	4.68E-8
benzo(a)anthracene	.008	6.33E-9
benzo(b)fluoranthene	.004	3.16E-9
benzo(k)fluoranthene	.008	3.01E-9
indeno(1,2,3-cd)pyrene	.008	9.83E-9
chrysene	.001	2.93E-11
dibenzo(a,h)anthracene	.015	9.40E-8
benzo(ghi)perylene	.007	8.54E-10
PAH Compounds Not Considered Potentially Carcinogenic		
naphthalene	.001	
fluorene	.001	
anthracene	.048	
phenanthrene	.020	
fluoranthene	.008	
pyrene	.008	
acenaphthylene	.001	
acenaphthene	.000	
VOC Compounds Considered Potentially Carcinogenic		
benzene		0.00E+0
VOC Compounds Not Considered Potentially carcinogenic		
sum of 8 VOCs		
Non-Chlorinated Phenols		
2,4-dimethylphenol	.071	
2-nitrophenol	0	
4-nitrophenol	.025	
2,4-dinitrophenol	0	
2-methyl-4,6-dinitroph	0	
phenol	0	
Inorganic Compounds		
antimony		
arsenic		1.45E-7
cadmium	0	
lead	.242	
total cyanide	.042	
ferro-ferric cyanide (	.037	
	.562	3.09E-7

Exhibit B.2: Scenario 11
Visitors to Seneca Lake Park

Chemical of Interest	Eastern Site Stream Location SS-10	Estimated Exposure Point Concentration: Conc. in Ingested (mg/kg)	Estimated Exposure Point Concentration: Conc. in Adhered Dirt (mg/kg)
PAH Compounds Considered Potentially Carcinogenic			
benzo(a)pyrene	2.20E-1	2.20E-1	2.20E-1
benzo(a)anthracene	4.00E-1	4.00E-1	4.00E-1
benzo(b)fluoranthene	1.00E+0	1.00E+0	1.00E+0
benzo(k)fluoranthene	8.20E-1	8.20E-1	8.20E-1
indeno(1,2,3-cd)pyrene	2.10E-1	2.10E-1	2.10E-1
chrysene	2.20E-1	2.20E-1	2.20E-1
dibenzo(a,h)anthracene	2.20E-1	2.20E-1	2.20E-1
benzo(ghi)perylene	2.20E-1	2.20E-1	2.20E-1
PAH Compounds Not Considered Potentially Carcinogeni			
naphthalene	2.10E-1	2.10E-1	2.10E-1
fluorene	2.10E-1	2.10E-1	2.10E-1
anthracene	2.60E-1	2.60E-1	2.60E-1
phenanthrene	2.30E-1	2.30E-1	2.30E-1
fluoranthene	2.10E-1	2.10E-1	2.10E-1
pyrene	2.00E-1	2.00E-1	2.00E-1
acenaphthylene	2.20E-1	2.20E-1	2.20E-1
acenaphthene	2.00E-1	2.00E-1	2.00E-1
VOC Compounds Considered Carcinogenic			
benzene	0.00E+0	0.00E+0	0.00E+0
VOC Compounds Not Considered Carcinogenic			
sum of 8 VOCs			
Non-Chlorinated Phenols			
2,4-dimethylphenol	0.00E+0	0.00E+0	0.00E+0
2-nitrophenol	0.00E+0	0.00E+0	0.00E+0
4-nitrophenol	0.00E+0	0.00E+0	0.00E+0
2,4-dinitrophenol	0.00E+0	0.00E+0	0.00E+0
2-methyl-4,6-dinitrophenol	0.00E+0	0.00E+0	0.00E+0
phenol	0.00E+0	0.00E+0	0.00E+0
total phenol	0.00E+0	0.00E+0	0.00E+0
Inorganic Compounds			
antimony			
arsenic	2.07E+1	2.07E+1	2.07E+1
cadmium	5.39E+0	5.39E+0	5.39E+0
lead	4.50E+1	4.50E+1	4.50E+1
total cyanide	6.94E+0	6.94E+0	6.94E+0
ferro-ferric cyanide (as CN)			
Totals			

Exhbit B.2: Scenario 11
Visitors to Seneca Lake Park

Chemical of Interest	Estimated Average Daily Dose on a day of exposur ADD (day) from Ingested Dirt (mg/day)	ADD (day) from Soil Contact (mg/day)	Estimated Average Daily Dose over a lifetime of Exposure ADD (life) from Ingested Dirt (mg/day)	ADD (life) from Soil Contact (mg/day)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	2.20E-5	4.22E-5	8.61E-8	1.65E-7
benzo(a)anthracene	4.00E-5	7.68E-5	1.57E-7	3.01E-7
benzo(b)fluoranthene	1.00E-4	1.92E-4	3.91E-7	7.51E-7
benzo(k)fluoranthene	8.20E-5	1.57E-4	3.21E-7	6.16E-7
indeno(1,2,3-cd)pyrene	2.10E-5	4.03E-5	8.22E-8	1.58E-7
chrysene	2.20E-5	4.22E-5	8.61E-8	1.65E-7
dibenzo(a,h)anthracene	2.20E-5	4.22E-5	8.61E-8	1.65E-7
benzo(ghi)perylene	2.20E-5	4.22E-5	8.61E-8	1.65E-7
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	2.10E-5	4.03E-5	8.22E-8	1.58E-7
fluorene	2.10E-5	4.03E-5	8.22E-8	1.58E-7
anthracene	2.60E-5	4.99E-5	1.02E-7	1.95E-7
phenanthrene	2.30E-5	4.42E-5	9.00E-8	1.73E-7
fluoranthene	2.10E-5	4.03E-5	8.22E-8	1.58E-7
pyrene	2.00E-5	3.84E-5	7.83E-8	1.50E-7
acenaphthylene	2.20E-5	4.22E-5	8.61E-8	1.65E-7
acenaphthene	2.00E-5	3.84E-5	7.83E-8	1.50E-7
VOC Compounds Considered Carcinogenic				
benzene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
2-nitrophenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
4-nitrophenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
2,4-dinitrophenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
2-methyl-4,6-dinitrophenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
phenol	0.00E+0	0.00E+0	0.00E+0	0.00E+0
total phenol				
Inorganic Compounds				
antimony				
arsenic	2.07E-3	3.97E-3	8.10E-6	1.56E-5
cadmium	5.39E-4	1.03E-3	2.11E-6	4.05E-6
lead	4.50E-3	8.64E-3	1.76E-5	3.38E-5
total cyanide	6.94E-4	1.33E-3	2.72E-6	5.22E-6
ferro-ferric cyanide (as CN)				
Totals				

Exhbit B.2: Scenario 11
Visitors to Seneca Lake Park

Risk Estimates

Chemical of Interest	Hazard Index Ratio via Ingestion/ Dermal Contact	Incremental Lifetime Risk via Ingestion/Dermal Contact with Potential Carcinogens (probablility)
PAH Compounds Considered Potentiatially Carcinogenic		
benzo(a)pyrene	.000	1.80E-8
benzo(a)anthracene	.000	4.76E-9
benzo(b)fluoranthene	.001	1.15E-8
benzo(k)fluoranthene	.001	4.44E-9
indeno(1,2,3-cd)pyrene	.000	4.00E-9
chrysene	.000	7.94E-11
dibenzo(a,h)anthracene	.000	2.00E-8
benzo(ghi)perylene	.000	3.97E-10
PAH Compounds Not Considered Poteotentially Carcinogenic		
naphthalene	.000	
fluorene	.000	
anthracene	.003	
phenanthrene	.000	
fluoranthene	.000	
pyrene	.000	
acenaphthylene	.000	
acenaphthene	.000	
VOC Compounds Considered Carcinognogenic		
benzene		0.00E+0
VOC Compounds Not Considered Carcarconigenic		
sum of 8 VOCs		
Non-Chlorinated Phenols		
2,4-dimethylphenol	0	
2-nitrophenol	0	
4-nitrophenol	0	
2,4-dinitrophenol	0	
2-methyl-4,6-dinitrophenol	0	
phenol	0	
total phenol		
Inorganic Compounds		
antimony		
arsenic		4.44E-6
cadmium	.136	
lead	.235	
total cyanide	.003	
ferro-ferric cyanide (as CN)		
Totals	.380	4.50E-6

Exhbit B.3: Scenario 12
Lake Seneca Receptors

Chemical of Interest	Fish Conc (ug/g) Source: Stream	Fish (ug/g) Source: Deep Well	Drinking Water (mg/l) Source: Stream	Drinking Water (mg/l) Source: Deep Well
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	2.41E-3	1.20E-2	4.61E-8	2.17E-7
benzo(a)anthracene	2.30E-3	1.14E-2	4.40E-8	2.07E-7
benzo(b)fluoranthene	4.49E-3	2.23E-2	8.59E-8	4.04E-7
benzo(k)fluoranthene	4.16E-3	2.07E-2	7.96E-8	3.75E-7
indeno(1,2,3-cd)pyrene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
chrysene	2.30E-3	1.14E-2	4.40E-8	2.07E-7
dibenzo(a,h)anthracene	3.29E-4	1.63E-3	6.29E-9	2.96E-8
benzo(ghi)perylene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	7.86E-5	7.96E-2	8.21E-7	8.31E-7
fluorene	4.73E-5	8.97E-3	3.43E-8	6.48E-6
anthracene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
phenanthrene	1.26E-4	2.39E-2	9.14E-8	1.73E-5
fluoranthene	2.53E-4	4.78E-2	1.83E-7	3.45E-5
pyrene	3.00E-4	5.68E-2	2.17E-7	4.10E-5
acenaphthylene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
acenaphthene	3.95E-5	7.48E-3	2.86E-8	5.40E-6
VOC Compounds Considered Carcinogenic				
benzene	3.07E-4	7.12E-3	4.85E-5	1.12E-3
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol		4.63E-7		2.09E-7
2-nitrophenol		1.55E-8		7.01E-9
4-nitrophenol				
2,4-dinitrophenol				
2-methyl-4,6-dinitrophenol				
phenol	7.55E-9	4.83E-6	3.44E-9	2.18E-6

Totals

Exhbit B.3: Scenario 12
Lake Seneca Receptors

Chemical of Interest	Estimated Exposure Point Concentration: Conc. in Ingested Fish (ug/gm)	Estimated Exposure Point Concentration: Conc. in Drinking Water (mg/l)	Estimated Average Daily Dose on a day of exposure: ADD (day) from Ingested Fish (mg/day)	Estimated Average Daily Dose on a day of exposure: ADD (day) from Drinking Water (mg/day)
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	1.44E-2	2.63E-7	9.35E-5	5.26E-7
benzo(a)anthracene	1.37E-2	2.51E-7	8.93E-5	5.02E-7
benzo(b)fluoranthene	2.68E-2	4.90E-7	1.74E-4	9.81E-7
benzo(k)fluoranthene	2.49E-2	4.54E-7	1.62E-4	9.09E-7
indeno(1,2,3-cd)pyrene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
chrysene	1.37E-2	2.51E-7	8.93E-5	5.02E-7
dibenzo(a,h)anthracene	1.96E-3	3.59E-8	1.28E-5	7.18E-8
benzo(ghi)perylene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	7.97E-2	1.65E-6	5.18E-4	3.30E-6
fluorene	9.02E-3	6.51E-6	5.86E-5	1.30E-5
anthracene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
phenanthrene	2.40E-2	1.74E-5	1.56E-4	3.47E-5
fluoranthene	4.81E-2	3.47E-5	3.13E-4	6.94E-5
pyrene	5.71E-2	4.12E-5	3.71E-4	8.25E-5
acenaphthylene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
acenaphthene	7.51E-3	5.42E-6	4.88E-5	1.08E-5
VOC Compounds Considered Carcinoginogenic				
benzene	7.43E-3	1.17E-3	7.43E-7	2.34E-3
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs				
Non-Chlorinated Phenols				
2,4-dimethylphenol	4.63E-7	2.09E-7	4.63E-11	4.19E-7
2-nitrophenol	1.55E-8	7.01E-9	1.55E-12	1.40E-8
4-nitrophenol				
2,4-dinitrophenol				
2-methyl-4,6-dinitrophenol				
phenol	4.84E-6	2.19E-6	4.84E-10	4.37E-6
Totals				

Exhbit B.3: Scenario 12
Lake Seneca Receptors

Chemical of Interest	Estimated Average Daily Dose over a lifetime of Exposure: ADD (life) from Ingested Fish (mg/day)	ADD (life) from Ingested Water (mg/day)	Hazard Index Ratio via Ingestion of Fish	Hazard Index Ratio via Ingestion Drinking W	Incremental Lifetime Risk via Ingestion of Fish (probability)
PAH Compounds Considered Potentially Carcinogenic					
benzo(a)pyrene	9.35E-5	5.26E-7	1.34E-4	7.517E-7	7.67E-6
benzo(a)anthracene	8.93E-5	5.02E-7	1.28E-4	7.175E-7	1.06E-6
benzo(b)fluoranthene	1.74E-4	9.81E-7	2.49E-4	1.401E-6	2.00E-6
benzo(k)fluoranthene	1.62E-4	9.09E-7	2.31E-4	1.298E-6	8.74E-7
indeno(1,2,3-cd)pyrene	0.00E+0	0.00E+0	0.00E+0	0.000E+0	0.00E+0
chrysene	8.93E-5	5.02E-7	1.28E-4	7.175E-7	3.22E-8
dibenzo(a,h)anthracene	1.28E-5	7.18E-8	1.82E-5	1.025E-7	1.16E-6
benzo(ghi)perylene	0.00E+0	0.00E+0	0.00E+0	0.000E+0	0.00E+0
PAH Compounds Not Considered Potentially carcinogenic					
naphthalene	5.18E-4	3.30E-6	1.48E-3	9.440E-6	
fluorene	5.86E-5	1.30E-5	1.67E-4	3.720E-5	
anthracene	0.00E+0	0.00E+0	0.00E+0	0.000E+0	
phenanthrene	1.56E-4	3.47E-5	3.19E-4	7.085E-5	
fluoranthene	3.13E-4	6.94E-5	2.23E-4	4.960E-5	
pyrene	3.71E-4	8.25E-5	3.54E-4	7.853E-5	
acenaphthylene	0.00E+0	0.00E+0	0.00E+0	0.000E+0	
acenaphthene	4.88E-5	1.08E-5	3.49E-6	7.749E-7	
VOC Compounds Considered Carcinogenic					
benzene	7.43E-7	2.34E-3	#VALUE!		5.52E-10
VOC Compounds Not Considered Carcinogenic					
sum of 8 VOCs					
Non-Chlorinated Phenols					
2,4-dimethylphenol	4.63E-11	4.19E-7	3.31E-10	2.990E-6	
2-nitrophenol	1.55E-12	1.40E-8	1.11E-11	1.002E-7	
4-nitrophenol					
2,4-dinitrophenol					
2-methyl-4,6-dinitrophenol					
phenol	4.84E-10	4.37E-6	6.91E-11	6.249E-7	
Totals			3.43E-3	2.55E-4	1.28E-5

Exhbit B.3: Scenario 12
Lake Seneca Receptors

Chemical of Interest	Incremental Lifetime Risk Via Ingestion of Drinking Water (probability)
PAH Compounds Considered Potentially Carcinogenic	
benzo(a)pyrene	4.31E-8
benzo(a)anthracene	5.97E-9
benzo(b)fluoranthene	1.13E-8
benzo(k)fluoranthene	4.92E-9
indeno(1,2,3-cd)pyrene	0.00E+0
chrysene	1.81E-10
dibenzo(a,h)anthracene	6.53E-9
benzo(ghi)perylene	0.00E+0
PAH Compounds Not Considered Potentially Carcinog	
naphthalene	
fluorene	
anthracene	
phenanthrene	
fluoranthene	
pyrene	
acenaphthylene	
acenaphthene	
VOC Compounds Considered Carcinogenic	
benzene	1.74E-6
VOC Compounds Not Considered Carcinogenic	
sum of 8 VOCs	
Non-Chlorinated Phenols	
2,4-dimethylphenol	
2-nitrophenol	
4-nitrophenol	
2,4-dinitrophenol	
2-methyl-4,6-dinitrophenol	
phenol	
Totals	1.81E-6

APPENDIX C

ANALYSES OF FATE OF CHEMICALS INTRODUCED TO SENECA LAKE

CONTRIBUTORS TO AND FATE OF CHEMICALS WITHIN SENECA LAKE

C.1 Estimate of Streamflows and Contaminant Loading Associated with the Intermittent East and West Site Streams

There have been no direct measurements of flows in either the East or West site streams at the NYSEG Geneva Site. Such information is of interest in order to evaluate the potential transport of chemicals via these streams from the site to lower stream reaches and eventually to Seneca Lake.

In order to develop estimates of stream flow, the following approach was taken. The characteristics of the streams were determined from a brief site visit and conversations with TRC site investigators who visited and sampled the streams at various times of the year.

The streams were described as small, intermittent-flow, drainage streams. The easterly stream starts in the wetlands in the northern part of the site and enters a well-defined channel at the employees' parking lot, flows south to the NYSEG property boundary, and then enters a culvert which extends from the railroad embankment to the south side of Routes 5 and 20. At that point it becomes an open stream. As it flows south and passes the Seneca Lake State Park entrance road, it enters an open, lined ditch. It flows through this ditch to the lake. The water depth in the stream ranged from 3-10" and averaged about 6". The bottom was mostly soft, tan clayey muck.

The culvert through which the east stream passed into the park was described as being approximately 3-4 feet wide and 1.5 ft deep. The stream has an estimated velocity of about one meter per minute. Based upon these observations, an estimate of stream flow of approximately 0.29 cfs (0.0083 m sec-1 velocity) was made. It is anticipated that both higher and lower streamflows would occur.

The western site stream was also described as small. Where the stream exits the site property it is about 2 ft across and approximately 8 inches

deep. Flow in this stream is judged to be less than that in the eastern stream.

Because the streams were small and intermittent in flow, the New York State DEC was contacted to determine if they had a stream classification system based on flow. Richard Draper was contacted and the problem of estimating stream flow described. Mr. Draper indicated that a low value for an intermittent stream, one that could not support fish populations, would probably be about 0.1 cfs.

Based on discussions with NYS DEC personnel and the limited observations made at the site, the flows for the easterly and westerly streams were estimated to be between 0.1 and 1 cfs (0.003 and 0.03 m sec-1 velocity).

Estimates of Loading

Estimates of loading of Chemicals of Interest into Seneca Lake via the site streams were made by multiplying the concentrations of compounds in surface water samples (3-4 sampling dates) by the estimated surface water flow. It must be noted that this will provide an estimate of contaminant flux at the monitoring point but may not be reflective of actual loading to the lake. In particular the following factors may be important with regard to actual loading:

1. There may be high scouring periods which could mobilize sediments and transport them to the lake; the existing data base includes data from February, May, August, and December and is therefore somewhat representative of "seasonal" conditions.

2. There may be subsequent deposition or loss of the chemicals from the stream below the monitoring points. Such losses would result in reduced loadings to the lake than those calculated here; in particular, data indicate that the highest concentrations of Chemicals of Interest tend to occur in surface water sampling point No. 1 (upstream from sampling point No. 2). The reduced concentrations between these two sampling points indicates that PAH losses are likely to occur from the water column with distance downstream.

Based upon the analysis undertaken here, the following results were obtained.

Loading of PAH Compounds Via the Site Streams

Results of the analyses for PAH compounds are provided in Tables C-1 and C-2. At a stream flow of 0.1 cfs, the yearly loading of potentially carcinogenic PAH compounds to Seneca Lake was estimated to be between 0.25 and 1.46 kg/yr for the easterly site stream and 0.05 kg/yr for the westerly site stream. Other PAH compounds (those not considered to be potentially carcinogenic) ranged between 0.75 and 1.01 kg/yr for the easterly site stream and 0.37 kg/yr for the westerly site stream. At a flow of 1.0 cfs, the loadings would be ten times higher by simple extrapolation.

Loading of Volatile Organic Compounds

At a stream flow of 0.1 cfs, the loading of the compound benzene ranged between non-detectable to 2.75 kg/yr for the easterly site stream. Benzene was not detected in the westerly site stream. Other volatile organics (sum of eight compounds) ranged between non-detected and 3 kg/yr in the easterly site stream and was estimated to be 1.54 kg/yr in the westerly site stream.

Because volatiles will tend to be lost from the stream water via volatilization, the method used here probably overestimates the likely loading to the lake by a large margin. Most of the volatiles would be expected to be lost from the stream before the stream actually enters Seneca Lake.

Loading of Phenols

Total phenol loadings at a stream flow rate of 0.1 cfs were estimated to be approximately 0.75 kg/yr for the easterly site stream and 0.43 kg/yr for

Table C-1. Possible loading of Chemicals of Interest to Lake Seneca (kg/yr) via the Eastern Site Stream based on an analysis of surface water concentrations and a stream flow of 0.1 cfs (3 liters/sec). Loadings would be 10 times higher at an estimated stream flow rate of 1.0 cfs.

	EASTERN SITE STREAM			
	SW-1 Mean(1)	Range	SW-2 Mean(1)	Range
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	0.22	ND-0.76	ND	ND
benzo(a)anthracene	0.21	ND-0.66	0.07	ND-0.21
benzo(b)fluoranthene	0.41	ND-1.42	0.07	ND-0.25
benzo(k)fluoranthene	0.38	ND-1.42	ND	ND
indeno(1,2,3-cd)pyrene	ND	ND	ND	ND
chrysene	0.21	ND-0.76	ND	ND
dibenzo(a,h)anthracene	0.03	ND-0.05	0.11	ND-0.38
benzo(ghi)perylene	ND	ND	ND	ND
TOTAL	1.46	0.02-5.0	0.25	ND-0.47
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	0.03	ND-0.06	0.05	ND-0.15
fluorene	0.06	ND-0.20	0.23	ND-0.61
anthracene	ND			
phenanthrene	0.16	ND-0.56	ND	
fluoranthene	0.32	ND-1.04	ND	
pyrene	0.38	ND-0.95	0.44	ND-1.32
acenaphthylene	ND		ND	
acenaphthene	0.05	ND-0.15	ND	
TOTAL	1.01	0.11-2.61	0.75	ND-1.02
VOC Compounds Considered Carcinogenic				
benzene	2.75	ND-5.87	ND	
VOC Compounds Not Considered Carcinogenic				
sum of 8 VOCs	3.00	0.75-7.76	ND	
Non-Chlorinated Phenols				
total phenol	0.73	ND-1.42	0.75	ND-1.42

Table C-2. Possible loading of Chemicals of Interest to Lake Seneca (kg/yr) via the Western Site Stream based on an analysis of surface water concentrations and a stream flow of 0.1 cfs (3 liters/sec). Loadings at a flow rate of 1.0 cfs would be 10 times higher.

	WESTERN SITE STREAM	
	Mean(1)	Range
<u>PAH Compounds Considered Potentially Carcinogenic</u>		
benzo(a)pyrene	ND	
benzo(a)anthracene	ND	
benzo(b)fluoranthene	0.05	ND-1.30
benzo(k)fluoranthene	ND	
indeno(1,2,3-cd)pyrene	ND	
chrysene	ND	
dibenzo(a,h)anthracene	ND	
benzo(ghi)perylene	ND	
TOTAL	0.05	ND-1.30
<u>PAH Compounds Not Considered Potentially Carcinogenic</u>		
naphthalene	ND	
fluorene	0.11	ND-0.37
anthracene	ND	
phenanthrene	ND	
fluoranthene	0.09	ND-0.30
pyrene	0.17	ND-0.62
acenaphthylene	ND	
acenaphthene	ND	
TOTAL	0.37	ND-1.02
<u>VOC Compounds Considered Carcinogenic</u>		
benzene	ND	
<u>VOC Compounds Not Considered Carcinogenic</u>		
sum of 8 VOCs	1.54	ND-3.88
<u>Non-Chlorinated Phenols</u>		
total phenol	0.43	ND-0.95

the westerly site stream. Again, estimated loadings would be higher at higher stream flows.

C.2 Estimating the Loading Associated with Injection of Coke Quench Waters and Assessment of Their Fate

Quantity of Coké Quench Wastewater

As part of the risk assessment effort an attempt was made to determine the fate of coke quenching waste water in the environment. These wastes were disposed of in the site stream until about 1923 when an injection well was installed for waste disposal. The exact date of installation of the injection well is uncertain (see Task 1 report), but the earliest date of 1923 is used here for estimation purposes. At that time, a concrete sludge basin was constructed at the site. Quenching waste water was pumped to this basin and allowed to separate. The cleaner top layer was discharged to the nearby stream while the lower layer was pumped into the injection well.

A rough estimate of the volume of waste water generated between the years of 1923 and 1934 (when the plant closed) was calculated. The actual amount that was disposed of through the injection well would be less than the amount generated since some would evaporate from the sludge basins and because only the lower layer of liquid in the sludge basins was disposed of in the well (the upper layer was disposed of in the site stream).

Several assumptions were made in calculating the volume of wastewater generated. These include:

1. All the gas produced at the plant was a by-product of the coking process. The production values include gas used to fuel the coke ovens. Gas production values for the years of 1923-1934 were taken from Public Service commission Reports (2nd District, abstracts of Reports of Corporation - Electric, Gas, Telegraph, Telephone, Steam).

2. A conversion factor of 10,500 cubic feet of gas per ton of coal was used (ERT, 1984).

3. A conversion factor of 0.7 tons (1400 lbs) coke per 1 ton coal was used (Adams et al, 1975).

4. A conversion factor of 50-200 gallons of waste water per 1 ton of coke was used.

The total gas production at the Geneva plant from 1924-1934 (no production during 1923) was 11,868,631,000 cubic feet. The amount of coal required to produce that amount of gas is 1,130,345 tons. This amount of coal will produce 791,242 tons of coke yielding 39,562,100 to 158,248,400 gallons of waste water.

Fate of Coke Quench Wastewater

Coke quench wastewater was disposed of, in part, by injection of the wastewater into a deep well at the site. According to Crain (1974) the injection well at the Geneva Site was 336' deep and open or screened in the Camillus Shale. Geophysical investigations (TRC, 1986) indicate that bedrock at the site is 200' below surface. The uppermost bedrock formation in that area is the Camillus Shale, a fractured unit of shale and thin limestone, gypsum and salt beds.

Little is known about the exact hydraulic nature of the unit at the site. In Seneca County the average yield from the Camillus is 45 gpm (Crain, 1974) with yields of up to 1000 gpm reported. This high permeability is normally attributed to the solution of interbedded salt and gypsum. The well yields may actually increase with time and pumpage in the vicinity of the pumping wells (TRC, 1986).

The hydraulic character of the Camillus is apparently not uniform over long distances. Data reported in an application to the NYS DEC by the Morton Salt Company to operate an injection well at Penn Yan, New York indicates that

in that area the Camillus Shale is dolomitic and has a very low permeability and transmissibility (Subsurface, Inc., 1976). The formation in that area is cited as being able to act as a confining layer below the proposed disposal zone.

The regional ground water sink in the Geneva area is Seneca Lake and any wastes deposited in the Camillus Shale would most likely move toward the Lake.

The precise fate of the coke quench wastes in the environment cannot be determined without testing the hydraulic properties of the Camillus Shale at the site. However, it is TRC's professional opinion that the Camillus Shale in the Geneva area is sufficiently permeable to have allowed these wastes to move towards Seneca Lake at such a rate that all wastes would have reached the Lake within the more than 50 years since the plant closed. Thus, for the purposes of analysis, it has been assumed that all the coke quench wastewater that was pumped into the injection well has reached Seneca Lake.

Chemicals of Interest in Coke Quench Wastewater

Coke quench wastewater is expected to contain a number of the Chemicals of Interest at the Geneva Site. Data on the chemical characteristics of coke quench wastewater were taken from the U.S. Environmental Protection Agency as summarized in Table C-3. Total loading of individual PAH compounds considered to be potentially carcinogenic ranged between 10s and 100s of kg depending on the volume of wastewater. Individual PAH compounds not considered to be potentially carcinogenic ranged between 100s and 1,000s of kg. Total PAH loading ranged between 5,400 and 21,600 kg (5.4 to 21.6 metric tons). Naphthalene was the most predominant PAH compound.

Benzene loadings were estimated to range between 4,300 and 17,400 kg. Loadings of selected phenolic compounds are also estimated to be in the 1000s of kg with phenol having a high estimate of about 144,000 kg (144 metric tons).

Table C-3. Estimated loadings of chemicals of interest to the associated with coke quench wastewater injected into the deep well at the Geneva Site.

Chemical of Interest	Concentration in Wastewater (mg/l)	Total Loading (kg) Lower (1)	Higher
PAH Compounds Considered Potentially Carcinogenic			
benzo(a)pyrene	.48	72	288
benzo(a)anthracene	.49	74	294
benzo(b)fluoranthene	No Data		
benzo(k)fluoranthene	No Data		
indeno(1,2,3-cd)pyrene	No Data		
chrysene	.55	83	330
dibenzo(a,h)anthracene	No Data		
benzo(ghi)perylene	No Data		
PAH Compounds Not Considered Potentially Carcinogenic			
naphthalene	25	3752	14989
fluorene	.70	105	420
anthracene (2)	.56	84	336
phenanthrene (2)	1.78	267	1067
fluoranthene	1.20	180	719
pyrene	.91	137	546
acenaphthylene (2)	1.32	198	791
acenaphthene	3	450	1799
VOC Compounds Considered Carcinogenic			
benzene	29	4352	17388
VOC Compounds Not Considered Carcinogenic			
sum of 8 VOCs	7	1051	4197
Non-Chlorinated Phenols			
2,4-dimethylphenol	23	3452	13790
2-nitrophenol	.77	116	462
4-nitrophenol	No Data		
2,4-dinitrophenol	No Data		
2-methyl-4,6-dinitrophenol	No Data		
phenol	240	36020	143899
Inorganic Compounds			
antimony	.12	18	72
arsenic	57	8555	34176
cadmium (2)	.02	3	12
lead (2)	.09	14	54
total cyanide	No Data		

(1) Lower and higher loadings were developed for wastewater volume of 39.6 and 158.2 million gallons.
(2) Data are for Gasification Quench Water (USEPA, 1986).

Among the inorganics, arsenic was found to have a loading of between 8,500 and 34,200 kg.

Many of the chemicals listed in Table C-3 will be attenuated in the subsurface and, thus, the estimated loadings overestimate the actual loading to Seneca Lake. However, in the absence of information on the extent of attenuation, the potential effects of this wastewater reaching the lake was estimated assuming no attenuation in deep bedrock.

C.3 Estimates of Loadings to Seneca Lake from Other Sources

To provide information that can help place results in perspective, estimates were developed for loadings associated with other sources of the chemicals of interest to Seneca Lake.

Atmospheric Sources

Estimates of loading for six PAH compounds were developed using the study conducted by Eisenreich et al. (1981) for the Great Lakes. The six compounds included in the Eisenreich analysis included anthracene, phenanthrene, pyrene, benz(a)anthracene, perylene, and benzo(a)pyrene. Estimates for atmospheric loadings of these chemicals to Lakes Erie and Ontario were used to calculate loadings on a per square mile basis. This per unit area loading rate (1.12 kg/sq.mile/yr) was then applied to Seneca Lake by multiplying it by the surface area of the lake. The resultant annual atmospheric loading of the six PAH compounds to Seneca Lake was 98 kg.

Non-Point Sources

There are probably a variety of non-point contributors of PAH compounds to Seneca Lake. As has been discussed in numerous reports on PAH compounds in the environment, these chemicals are generated as part of a wide variety of

activities. A predominant source is combustion. The highways and roadways along the lake are probably a major source of the chemicals. Highways and roadways have been shown to yield relatively high levels of PAH and other chemicals in stormwater runoff (Ammon, 1980; Zawlocki, 1981). In addition, boating operations and marinas would also result in contributions of these chemicals to the lake. The contributions of these sources have not been estimated in this report. However, estimates are provided for one of the many non-point sources, urban runoff.

Estimates of loadings to the lake via urban runoff were developed for the northern area of the lake and specifically for the city of Geneva and surrounding developed areas. Data used to develop these estimates were taken from the results of the nationwide urban runoff program (NURP) and applied to the Geneva area. Estimates should be considered very approximate since no specific data were reviewed for the Geneva area itself.

The volume of runoff was estimated for a 1.86 square mile area, estimated to be the areal extent of the Geneva and other northern urban areas. Annual rainfall for the Geneva area was estimated to be approximately 40 inches. In order to estimate the volume of runoff, a runoff coefficient must be selected. The value of 0.35 was selected as a typical mean runoff coefficient. It is the median of the NURP mean runoff coefficient database for the twenty projects discussed in that report (USEPA, 1983).

The NURP report also provided data on the range in detected concentrations of priority pollutants in urban runoff. For the purpose of the present analysis, the midpoints of these ranges were selected to represent urban runoff from the greater Geneva area. The resultant chemical loadings to Seneca Lake associated with urban runoff from the Geneva area are presented in Table C-4. As is suggested by the table, urban runoff will contain a variety of the same chemicals of interest being evaluated at the Geneva Site.

Table C-4. Estimate of pollutant loading associated with urban runoff at the northern end of Lake Seneca.

Chemical of Interest	Mid Point of Detected Values From NURP (1) (ug/l)	Loading to Lake (kg/yr) (2)
PAH Compounds Considered Potentially Carcinogenic		
benzo(a)pyrene	5.50	9.42
benzo(a)anthracene	5.50	9.42
benzo(b)fluoranthene	3	5.14
benzo(k)fluoranthene	8	13.69
indeno(1,2,3-cd)pyrene	4	6.85
chrysene	5	8.56
dibenzo(a,h)anthracene	1	1.71
benzo(ghi)perylene	5	8.56
PAH Compounds Not Considered Potentially Carcinogenic		
naphthalene	1.50	2.57
fluorene	1	1.71
anthracene	5.50	9.42
phenanthrene	5.10	8.73
fluoranthene	10	17.12
pyrene	8	13.69
acenaphthylene	ND	
acenaphthene	ND	
VOC Compounds Considered Carcinogenic		
benzene	7	11.98
VOC Compounds Not Considered Carcinogenic		
sum of 8 VOCs	10	17.12
Non-Chlorinated Phenols		
2,4-dimethylphenol	5.50	9.42
2-nitrophenol	1	1.71
4-nitrophenol	19	32.53
2,4-dinitrophenol	ND	
2-methyl-4,6-dinitrophenol		
phenol	7	11.98
Inorganic Compounds		
antimony	12.50	21.40
arsenic	25	42.80
cadmium	7	11.98
lead	230	393.73
total cyanide	150	256.78

(1) Values taken from National Urban Runoff Program (USEPA, 1983)
(2) Loadings are estimated by multiplying concentrations in urban the estimated runoff of the urban areas at northern end Lake Runoff was estimated for a 1.86 sq mile area, 40 inch/year ra and a runoff coefficient of 0.35 (median from NURP Program).

C.4 Estimate of Fate of Contaminants in Seneca Lake Using the Fugacity Model of Mackay and Paterson (1986)

The potential fate and transport of chemicals in Seneca Lake associated with stream discharge and deep ground water discharge (i.e., coke quench water) from the site was examined using the fugacity model developed by Mackay and Paterson (1986). The model is a steady state rather than an equilibrium model which calculates interphase transport rates from the physical properties of the chemicals. It assumes conservative molecular and water diffusivities. This evaluative model can generate information of value for exposure assessment by integrating data on partitioning, reaction, advection, and interphase transport.

The model calculates transport of contaminants between model compartments by comparing fugacities of contaminants in each compartment. Fugacity, which has units of pressure, is a thermodynamic quantity related to chemical potential or activity characterizing the escaping tendency of a chemical substance from a phase. The model uses the physical properties, partition coefficients, and bioconcentration factors for a given chemical to determine how the chemical is partitioned among the various phases.

The model assumes:

- the system is under steady state;
- phases capable of receiving pollutant emissions include air, water, sediment, biota, and suspended sediment;
- an estimated exchange rate for Seneca Lake (once every thirty years based on discussions with Dr. William Ahrnsback of the Geosciences Department of Hobart and William Smith College, Geneva, New York.

Lake morphometry was estimated from charts or taken from the literature on Seneca Lake. Data for the lake are summarized below:

Maximum Depth = 188.4 meters
Average Depth = 88.6 meters
Area = 175.4 km2
Volume = 1.55E+10 m3
Residence time = 30 years

Values on the physical and chemical properties of the chemicals of interest are presented in Appendix A. A biodegradation rate with a half-life of five years was applied to PAH compounds in the sediments. This rate should be conservative based on a review of the literature. A conservative number was used because of the lack of information on actual biodegradation rates in the field. A faster biodegradation rate (half life of two weeks) was applied to fish populations. This rate is consistent and perhaps conservative when compared to reported rates in the literature. The Fish and Wildlife Service in its recent review of PAH compounds has noted that one of the reasons high levels of PAH are not seen in fish flesh is because of the relatively high metabolism of these compounds by the fish.

The fugacity model was run for several classes of chemicals. Potentially carcinogenic PAHs were modeled using the chemical properties of benzo(a)pyrene. Napthalenes were modeled using the properties of naphthalene; and, non-carcinogenic PAHs were modeled using the properties of phenanthrene; benzene was modeled using its properties; phenolic compounds were modeled using the properties of phenol.

Several worst case assumptions were made concerning the loading of organic compounds to the lake via site streams or via deep ground water discharge. These are stated below:

Input Via Site Streams

1. It was assumed that the stream input would be characterized by the more contaminated of the two monitoring stations on the site itself. The conservatism of this assumption has already been discussed; in particular, it assumes no attenuation with distance downstream.

2. It was assumed that the stream flow rate would be 1.0 cfs on a mean annual basis; this was the high end of the range that was estimated.

Input Via Deep Ground Water Discharge

1. It was assumed that the higher of the two estimates of quenchwater PAH loadings to the deep well would be reaching the lake;

2. Since data from the literature was not available on all of the potentially carcinogenic PAH compounds in coke quench wastewater, it was estimated from data at the Geneva Site that the compounds for which there were literature values represented about 47% of the total amount (loadings were adjusted accordingly);

3. It was assumed that there was no attenuation or biodegradation of the compounds in the deep bedrock aquifer;

4. It was assumed that all of the chemicals discharged down the deep well would reach the lake over a thirty year period.

Results of the fugacity model runs are presented in Table C-5. This table provides the model output with regard to concentrations of chemicals in fish (biota) and water.

Table C-5. Estimates of concentrations of chemicals of interest in fish and water of Lake Seneca based on conservative assumptions regarding loading of these chemicals from the site. Estimates were obtained by applying the Fugacity Model to the lake.

	Concentrations in Environmental Media			
	Fish (ug/g)		Water (mg/l)	
Chemical of Interest	Due to Site Stream	Due to Deep Well	Due to Site Stream	Due to Deep Well
PAH Compounds Considered Potentially Carcinogenic				
benzo(a)pyrene	2.41E-3	1.20E-2	4.61E-8	2.17E-7
benzo(a)anthracene	2.30E-3	1.14E-2	4.40E-8	2.07E-7
benzo(b)fluoranthene	4.49E-3	2.23E-2	8.59E-8	4.04E-7
benzo(k)fluoranthene	4.16E-3	2.07E-2	7.96E-8	3.75E-7
indeno(1,2,3-cd)pyrene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
chrysene	2.30E-3	1.14E-2	4.40E-8	2.07E-7
dibenzo(a,h)anthracene	3.29E-4	1.63E-3	6.29E-9	2.96E-8
benzo(ghi)perylene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PAH Compounds Not Considered Potentially Carcinogenic				
naphthalene	7.86E-5	7.96E-2	8.21E-7	8.31E-7
fluorene	4.73E-5	8.97E-3	3.43E-8	6.48E-6
anthracene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
phenanthrene	1.26E-4	2.39E-2	9.14E-8	1.73E-5
fluoranthene	2.53E-4	4.78E-2	1.83E-7	3.45E-5
pyrene	3.00E-4	5.68E-2	2.17E-7	4.10E-5
acenaphthylene	0.00E+0	0.00E+0	0.00E+0	0.00E+0
acenaphthene	3.95E-5	7.48E-3	2.86E-8	5.40E-6
VOC Compounds Considered Carcinogenic				
benzene	3.07E-4	7.12E-3	4.85E-5	1.12E-3
VOC Compounds Not Considered Concidered Carcinogenic				
sum of 8 VOCs	Not Estimated			
Non-Chlorinated Phenols				
2,4-dimethylphenol		4.63E-7		2.09E-7
2-nitrophenol		1.55E-8		7.01E-9
4-nitrophenol				
2,4-dinitrophenol				
2-methyl-4,6-dinitrophenol				
phenol	7.55E-9	4.83E-6	3.44E-9	2.18E-6

APPENDIX D

INDOOR AIR QUALITY SAMPLING - GENEVA SITE

1.0 INTRODUCTION

Analytical data collected during Task 2 and Task 3 of the Geneva site investigation indicated the presence of several volatile organic constituents in the soil near some of the site buildings. During the development of exposure scenarios for the Risk Assessment (Task 4), the possibility that soil gas containing these constituents could become entrapped in the buildings, exposing workers to elevated concentrations, was considered. Although data on total volatile organic compounds were available from measurements with a flame ionization detector (FID), no direct measurements of individual constituents in the buildings were made. Therefore, in order to evaluate these scenarios it was necessary to gather additional, constituent specific, air quality data directly from these buildings. This appendix describes the rationale and methods used in this study and summarizes the analytical data. These data are evaluated and discussed from a risk assessment perspective in the text of the Task 4 Report (Section 7.3).

2.0 SAMPLING PROGRAM

The sampling program detailed below was conducted by TRC during April 10-13 and 23, 1988.

2.1 Selection of Constituents

Three volatile or semi-volatile constituents were selected as analytes. Each is from a separate chemical class of the Chemicals of Interest presented in Section 4.3. The criteria for selection of Chemicals of Interest are discussed in that section. The selected compounds include:

Benzene -	a potentially carcinogenic volatile compound
Naphthalene -	the most volatile of the polynuclear aromatic hydrocarbons
Phenol -	selected from the group of Chemicals of Interest evaluated with respect to systemic health effects.

2.2 Sampling Locations

Two buildings at the Geneva site are located close to the areas where the above referenced constituents were detected in the subsurface soil. The Service Building/Garage facility is considered in Exposure Scenarios 1 and 2 and the Corporate Meter Building (former purifier building) in Scenario 3. In order to provide background data, a similar NYSEG Service Building/Garage facility located in Auburn, NY was also sampled. The Auburn facility is not located at a former coal gasification site.

Within each building, samplers were placed in one "high potential area" and one "typical work area". High potential areas are those where the highest concentrations of volatiles would be expected to be present. The typical work areas selected are frequented by workers, and are generally away from the points where volatiles would be expected to be entering the building from the subsurface soil.

At the Geneva site, the garage attached to the main office building was chosen as having the highest potential for volatiles in the air. The "typical work" location was an office on the second floor of the building. In the meter lab, the high potential sampling location was in the meter storage area, across from the meter wash room. The typical work area was an office near the east doorway in that building (across from the "coffee room").

At the Auburn facility, only the office/garage building was sampled. A location inside the loading area, where utility equipment is loaded onto trucks, was selected as having the highest potential for the presence of organic volatiles. The typical work area selected was in a copying cubicle of the upstairs offices.

2.2 Sampling and Analytical Methods

Modified NIOSH Methods 1500, 5515, and 3502 were used to sample for benzene, naphthalene and phenol respectively. Method 1500 requires the use of 100 milligram/50 milligram (100 mg/50 mg) charcoal tubes at a known sampling rate between 0.01 and 0.2 liters per minute (l/min) for a total volume of 30 liters. Breakthrough volume for this method is 45 liters. To obtain a lower detection limit, a larger sampling medium (400 mg/200 mg) and greater total volume (72 liters) were used. The sample was collected for 24 hours at a sampling rate of 0.05 l/min for a total volume of 72 liters.

Method 5515 uses a 2 microgram, 37-millimeter teflon filter and a 100 mg/50 mg XAD-2 collection tube. The pump sampled for 24 hrs at 0.5 l/min for a total volume of 720 liters. Method 3502 uses a "midget bubbler" with a 0.1 N sodium hydroxide (NaOH) sampling medium. The sample was drawn for 24 hours at a 0.1 l/min flow rate, for a total volume of 144 liters.

3.0 ANALYTICAL RESULTS

The samples were analyzed by Galson Technical Services, Inc. of East Syracuse, New York. An explanation of the sample numbers is given in Table 1.

The analytical results, summarized in Tables 2 through 4, indicate that none of the analytes were found above the detection limits. None of the constituents were detected in the field blanks.

TABLE 1

EXPLANATION OF SAMPLE NUMBERS

SAMPLE(*) NUMBER	LOCATION (SITE, BUILDING, AREA)
AUBHI11	AUBURN, SERVICE/GARAGE, HIGH POTENTIAL
AUBLO11	AUBURN, SERVICE/GARAGE, TYPICAL WORK AREA
AUBFB2(**)	AUBURN, FIELD BALNK
GENOH11	GENEVA, SERVICE/GARAGE, HIGH POTENTIAL
GENOL11	GENEVA, SERVICE/GARAGE, TYPICAL WORK AREA
GENFB2	GENEVA, FIELD BLANK
GENMH11	GENEVA, METER BUILDING, HIGH POTENTIAL
GENML11	GENEVA, METER BUILDING, TYPICAL WORK AREA

(*) Number in sample ID indicates date of sampling (e.g, 11 = 4/11/88)

(**) number in field blank sample ID indicates day of sampling program (e.g., 2 = 2'nd day of sampling)

TABLE 2

ANALYTICAL DATA - AUBURN SERVICE BUILDING/GARAGE

DATE	SAMPLE NUMBER	BENZENE VOLUME (LITERS)	BENZENE TOTAL UG	BENZENE MG/CUBIC M	BENZENE PPM	NAPHTHALENE VOLUME (LITERS)	NAPHTHALENE TOTAL UG	NAPHTHALENE MG/CUBIC	NAPHTHALENE PPM
4/11/87	AUBHI11	71.75	<6	<0.08	<0.03	717.5	<20	<0.03	<0.005
	AUBLO11	71.70	<6	<0.08	<0.03	717.0	<20	<0.03	<0.005
	AUBFB2	NA	<6	NA	NA	NA	<20	NA	NA
4/12/87	AUBHI12	66.15	<6	<0.09	<0.03	661.5	<20	<0.03	<0.006
	AUBLO12	65.8	<6	<0.09	<0.03	658.0	<20	<0.03	<0.006
	AUBFB3	NA	<6	NA	NA	NA	<20	NA	NA
4/23/87	AUBHI23	73.75	<6	<0.08	<0.02	737.5	<20	<0.03	<0.005
	AUBLO23	73.60	<6	<0.08	<0.02	736.0	<20	<0.03	<0.006
	AUBFB4	NA	<6	NA	NA	NA	<20	NA	NA

NA = Not Applicable
NC = Blank for this constituent not collected at this site on the indicated date.

TABLE 3

ANALYTICAL DATA - GENEVA SERVICE BUILDING/GARAGE

DATE	SAMPLE NUMBER	BENZENE VOLUME (LITERS)	BENZENE TOTAL UG	BENZENE MG/CUBIC	BENZENE PPM	NAPHTHALENE VOLUME (LITERS)	NAPHTHALENE TOTAL UG	NAPHTHALENE MG/CUBIC	NAPHTHALENE PPM	PHENOL VOLUME (LITERS)	PHENOL TOTAL UG	PHENOL MG/CUBIC	PHENOL PPM
4/10/87	GENOL10	75.25	<6	<0.08	<0.03	752.5	<20	<0.03	<0.005	150.5	<130	<0.9	<0.2
4/11/87	GENOH11	72.90	<6	<0.08	<0.03	729.0	<20	<0.03	<0.005	145.8	<130	<0.9	<0.2
	GENOL11	62.25	<6	<0.10	<0.03	622.5	<20	<0.03	<0.006	124.5	<130	<1.0	<0.3
	GENFB2	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA
4/12/87	GENOH12	65.95	<6	<0.09	<0.03	659.5	<20	<0.03	<0.006	131.9	<130	<1.0	<0.3
	GENOL12	65.85	<6	<0.09	<0.03	658.5	<20	<0.03	<0.006	131.7	<130	<1.0	<0.3
	GENFB3	NA	<6	NA	NA	NA	<20	NA	NA	NC			
4/23/87	GENOH23	66.15	<6	<0.09	<0.03	661.5	<20	<0.03	<0.006	132.3	<130	<1.0	<0.3
	GENOL23	66.0	<6	<0.09	<0.03	660.0	<20	<0.03	<0.006	132.0	<130	<1.0	<0.3
	GENFB4	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA

NA = Not Applicable

NC = Blank for this constituent not collected at this site on the indicated date.

TABLE 4

ANALYTICAL DATA - GENEVA METER BUILDING

DATE	SAMPLE NUMBER	BENZENE VOLUME (LITERS)	BENZENE TOTAL UG	BENZENE MG/CUBIC	BENZENE PPM	NAPHTHALENE VOLUME (LITERS)	NAPHTHALENE TOTAL UG	NAPHTHALENE MG/CUBIC	NAPHTHALENE PPM	PHENOL VOLUME (LITERS)	PHENOL TOTAL UG	PHENOL MG/CUBIC	PHENOL PPM
4/11/87	GENMH11	73.3	<6	<0.08	<0.03	733.0	<20	<0.03	<0.005	146.6	<130	<0.9	<0.2
	GENML11	73.85	<6	<0.08	<0.03	738.5	<20	<0.03	<0.005	147.7	<130	<0.9	<0.2
	GENFB2	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA
4/12/87	GENMH12	67.85	<6	<0.09	<0.03	678.5	<20	<0.03	<0.006	135.7	<130	<1.0	<0.3
	GENML12	68.25	<6	<0.09	<0.03	682.5	<20	<0.03	<0.006	136.5	<130	<1.0	<0.3
	GENFB3	NA	<6	NA	NA	NA	<20	NA	NA	NC			
4/23/87	GENMH23	66.35	<6	<0.09	<0.03	663.5	<20	<0.03	<0.006	132.7	<130	<1.0	<0.3
	GENML23	65.9	<6	<0.09	<0.03	664.0	<20	<0.03	<0.006	131.8	<130	<1.0	<0.3
	GENFB4	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA

NA = Not Applicable

NC = Blank for this constituent not collected at this site on the indicated date.

4.0 SUMMARY

The data gathered during this investigation has allowed a more accurate evaluation of the risks from inhalation exposure associated with working in the buildings at the Geneva site. The results of risk calculations conducted with these data are presented in the text of the Geneva Risk Assessment (Task 4) Report.