ARCADIS GERAGHTY & MILLER

Engineer's Report

Application for Long Island Well Permit (Irrigation)
Towers Country Club
Floral Park, New York

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1. Description of Proposed Action

This Engineer's Report is being submitted as necessary supplemental information required by the New York State Department of Environmental Conservation (NYSDEC) to Towers Country Club's Application for a Long Island Well Permit (Irrigation Well). Towers Country Club is located at 272-40 Grand Central Parkway, Floral Park, New York. The golf course grounds, encompassing approximately 90 acres with approximately 42 acres in need of irrigation, straddle the Queens/Nassau county line (refer to Figure 1, Site Location Map)

The remainder of this section describes the existing Towers County Club golf course irrigation system and the proposed action to install a new irrigation well.

1.1 Irrigation Water Supply System Description

The remainder of this section describes the existing Towers County Club golf course irrigation system, including past pumpage, projected demand, and existing facilities.

1.1.1 Past Pumpage

In accordance with its current Long Island Well Permit (W-933), Towers Country Club has been reporting monthly pumpage to the NYSDEC as required. Based on these records, annual pumpage for the last eight years (i.e., 1992 to 1999) is provided in Appendix A. During May 1999, as planning and calculations for a replacement well design were being considered, readings obtained from the meter for the existing irrigation well (Well N-2576) were reviewed more closely. Towers Country Club compared readings from an electronic meter (installed in 1994) and the older mechanical meter. Based on this comparison, Towers Country Club concluded that the mechanical meter, used to report pumpage data to the NYSDEC, was not functioning properly and had not been for some time. Installation of a new meter was planned as part of the 1999 upgrade project. Towers Country Club estimates that the reported pumpage based on the inaccurate readings have been underestimating the actual pumpage by approximately 62.5 percent. Corrected pumpage figures for the 1992 to 1999 time frame are also provided in Appendix A.

Based on the corrected meter readings, the 1992 to 1999 pumpage summary provided in Appendix A shows variation in annual pumpage from a minimum of approximately 16.52 (1996) to a maximum of 30.21 million gallons (1999). The average annual water usage for this eight-year time frame is approximately 24.5 million gallons. Past pumpage trends for the 1992 to 1999 timeframe indicate a general increase in annual irrigation water usage to approximately 30.21 million gallons for 1999.

1.1.2 Projected Demand

As part of this permit application process, the Towers Country Club retained an irrigation specialist to assess current golf course irrigation needs and provide a basis for projected water demand included in this Engineer's report. The irrigation specialist's report is provided in Appendix B. In summary, the irrigation specialist considered specific elements in the evaluation including size of course, acreage to irrigate, turf to be watered, water requirements of turf (i.e., inches of water), natural precipitation, total irrigation time, and duration of irrigation season. As a result, it is estimated that a maximum of 31 million gallons would need to be pumped annually to properly irrigate the golf course. This is based on applying an appropriate margin of safety against the estimated annual watering requirement of 35.64 million gallons by considering variation in daily evapotranspiration rates and anticipation of a dry season. The recommended maximum annual pumpage requirement is also reasonable considering past pumpage trends. The pump capacity required to properly irrigate the golf course turf is 1,000 gallons per minute (gpm).

1.1.3 Description of Existing Facilities

Existing facilities used to irrigate the Towers Country Club golf course include an operating irrigation well, storage tank, and distribution system. The existing irrigation well (Well N-2576, also referred to as Well #2) was installed in the 1940s with an 18-inch casing and has been relined once, reducing its capacity and diameter. In 1975, a 10-inch casing and screen was placed inside Well N-2576 to a total depth of approximately 200 ft below land surface (bls). Well N-2576 is equipped with an electrically operated deep well turbine pump of 500 gpm capacity. In 1994, Well N-2576 began pumping some sand, clogging the heads. This indicated impending failure of the liner (i.e., well screen). To avoid stressing the liner further during pump starts and to attempt to extend the life of the well, a variable frequency drive for the turbine pump was installed. Due to the present condition of this well (including indications of pumping fine sand), Well N-2576's capacity has dropped to approximately 375 gpm, representing an approximately 25 percent reduction.

Water from Well N-2576 is pumped into a 12,000-gallon pneumatic storage tank and distributed through six inch and smaller pipes for irrigation purposes.

An older irrigation well (N-1332), originally installed in 1932 with 10-inch casing and screen to a depth of 210 feet bls, has been placed out of service and dismantled (pump motor removed) due to past well failures. This well (also referred to as Well #1) was maintained as a standby for Well N-2576 under the existing Long Island Well Permit W-933.

An emergency water feed from New York City (NYC) Water Authority was installed in 1998 as a backup to Well N-2576, specifically to feed up to 300 gpm, if necessary.

1.2 Project Description

This section provides a description of the proposed irrigation well and its integration with existing system facilities.

1.2.1 Description of Proposed Irrigation Well

The proposed irrigation well is planned to be installed on golf course property within Nassau County, at a location approximately 1,000 feet west from existing Well N-2576 (refer to Figure 2, Proposed Well Location Map). The proposed well is planned to be installed with an 18-inch diameter casing and a 12-inch diameter screen. The total well depth will be 265 feet bls with a 20-foot screened interval extending from approximately 243 to 263 feet bls. The proposed well will be equipped with an electrically operated deep well turbine pump of 1,000 gpm capacity required for irrigation purposes. A small out building is planned to be constructed to enclose the well head and associated appurtenances (e.g., piping, meter, etc.).

A 200-foot radius centered on the proposed well location is depicted on Figure 2. Figure 2 also shows the locations of existing Wells N-2576 and N-1332. No surface contaminant sources are known to exist within 200 feet of the proposed well location. However, the proposed well location is within a groundwater horizon impacted by volatile organic compounds (VOCs) associated with the former Unisys facility, which is located approximately 2,000 feet to the east. Further discussions regarding contaminant sources/water quality and related potential impacts are presented in Section 2 and 3 of this report, respectively.

1.2.2 Integration with Existing System Facilities

The proposed irrigation well is intended to replace existing Well N-2576 as the primary water source at the required capacity to accommodate the current irrigation system and to properly irrigate the golf course turf. Water from the proposed irrigation well will be pumped into the 12,000-gallon pneumatic storage tank and distributed through six inch and smaller pipes for irrigation purposes.

1.2.3 Existing Facilities To Be Modified/Removed

As part of the proposed project, existing Well N-2576 will remain as an emergency backup system only.

Well N-1332 has already been removed from service and dismantled. As part of the proposed project, this well will be abandoned in accordance with NYSDEC regulations.

1.3 Establishment of Need

As mentioned previously in Section 1.1.3 of this report, Well N-2576 has dropped off in capacity due to its age and attempts to repair the well in 1975 by relining it. In 1994, Well N-2576 began pumping some sand, clogging the irrigation sprinkler heads. This indicated impending failure of the liner. To avoid stressing the liner further during pump starts and to attempt to extend the life, further maintenance attempts were undertaken by installing a variable frequency drive pump. However, due to the present condition of Well N-2576 (including indications of pumping fine sand), Well N-2576's capacity has dropped to approximately 375 gpm, representing an approximately 25 percent reduction in yield. Therefore, the reliability of Well N-2576 to meet projected demand as a primary source is in question and raises concerns regarding the effect that a sudden failure will have on the golf course property.

Furthermore, the emergency New York City water feed installed in 1998 is not a reliable emergency backup for the irrigation well. This system is not considered a reliable alternate because it is connected to the NYC water system that is routinely restricted for such use during periods of drought. It also restricts the make-up supply to the building air conditioning system cooling tower at a time when it is needed most. Therefore, the reliability of the current emergency backup system to meet irrigation needs is in question and identifies the need for a reliable alternate.

2. Environmental/Hydrogeologic Setting

This section presents a summary of the environmental and hydrogeologic setting in the vicinity of the proposed action.

2.1 Aquifer Identification and Hydrogeologic Characteristics

The proposed screened interval for the new irrigation well is planned for a similar elevation horizon as the existing Well N-2576, accounting for approximate changes in land surface (i.e., estimating a land surface elevation of approximately 215 feet referenced to mean sea level [msl] in the vicinity of the proposed well site). Therefore, the total well depth will be 265 feet bls with a 20-foot screened interval extending from approximately 243 to 263 feet bls, placing it within the upper portion of the Magothy aquifer. Based on existing Well N-2576's original capacity and other supply wells screened in the upper portion of the Magothy aquifer, the proposed well's yield is expected to exceed the pump capacity of 1,000 gpm required for irrigation purposes.

The Magothy aquifer is composed of unconsolidated deposits comprising the Magothy Formation. These unconsolidated deposits are primarily composed of fine to medium sand with silt and clay lenses with a basal coarse sand zone, and are believed to be approximately 250 feet thick. Overlying the Magothy Formation are the Upper Pleistocene glacial deposits which are generally composed of stratified, fine to coarse sands and gravel interbedded with silts and thin clay lenses. Glacial deposits in the vicinity of the former Unisys site are approximately 150 feet thick (ARCADIS Geraghty & Miller, 1999) and comprise the Upper Glacial aquifer. Underlying the Magothy Formation is the upper clay member of the Raritan Formation, which consists of predominantly of light to dark grey clay with some silt and is approximately 200 feet thick. The Lloyd Sand unit underlies the upper clay member of the Raritan Formation.

Generally, the hydraulic conductivity (or permeability) of the Upper Glacial aquifer is greater than that of the underlying Magothy aquifer. Values of hydraulic conductivity for the Upper Glacial and Magothy aquifers have been estimated at 270 feet per day (ft/day) horizontally, 27 ft/day vertically, and 50 ft/day horizontally, 1.4 ft/day vertically, respectively (McClymonds and Franke 1972). The Magothy aquifer is Long Island's principal aquifer and its main source of water for public supply wells. Reported yields during pumping tests of 90 wells completed in the Magothy, in the vicinity of North Hempstead, ranged between 300 gpm to 1,543 gpm, with an average of 1,000 gpm.

At some locations on Long Island, the Magothy aquifer is confined by a clay layer that separates the Upper Glacial aquifer from the Magothy deposits. However, this condition does not exist within western Nassau County area and the contact between the two geologic units is not sharply defined. In western Nassau County, these two aquifer are directly connected and can be thought of as a single unconfined to semiconfined hydrogeologic unit. The Magothy aquifer is underlain by the Raritan Clay which, due to its extremely low vertical and horizontal permeability, is a confining unit. Therefore, interconnection between the Magothy aquifer and the Lloyd Sand (a confined aquifer) is inferred to be minimal.

Regional groundwater flow direction in the subject area within the Upper Glacial and Magothy aquifers is to the west or northwest (Swarzenski 1963). Potentiometric surface maps for the Upper Glacial and Magothy aquifers have been prepared as part of the former Unisys facility remedial investigation to depict groundwater flow patterns at a more local scale. Figure 3 depicts the potentiometric surface configuration of the upper portion of the Magothy aquifer, which was prepared from November 1998 water-level measurements (ARCADIS Geraghty & Miller, 1999). Based on Figure 3, groundwater flow patterns in the vicinity of the Towers Country Club golf course and the former Unisys facility are consistent with regional patterns, except for localized influence of pumping wells and diffusion wells. The horizontal component of groundwater flow is to the northwest with a more westward component near the Queens/Nassau County border. In the northern portion of the Unisys site, pumping extraction/recovery wells has depressed the potentiometric surface and created a capture zone, which suggests that off-site migration of groundwater from the Unisys site is prevented.

The nearest surface water body is a small pond near Lake Success and is located approximately 600 feet north of the proposed well location. Lake Success is located approximately 1,200 feet north of the proposed well location. These ponds are not connected to the water table which is approximately 80 feet below the bottom of Lake Success.

A well completion log for the existing irrigation well (N-2576) with driller's geologic log is provided in Appendix C. A depth-to-water measurement of approximately 133 feet from surface is recorded on the driller's log. The geologic conditions recorded on the driller's log are similar to other geologic logs for nearby supply and monitoring wells reviewed as part of the former Unisys facility remedial investigation. Geologic logs for nearby monitoring wells installed as part of that remedial investigation can be found in the "Interim Draft Remedial Investigation Report, Former Unisys Facility, Operable Unit 2" (ARCADIS Geraghty & Miller, 1999).

2.2 Review of Applicable Proximity Issues

Figure 4 provides the locations of other wells located in the general vicinity, including municipal water supply wells, domestic wells, non-municipal supply wells (including irrigation wells), non-municipal diffusion wells, extraction/recovery wells and monitoring wells. A one-mile radius centered on the proposed well location is also depicted on Figure 4. Table 1 provides a summary of the area wells located within a one-mile radius of the proposed well location. Based on a review of this summary, four municipal water supply wells, 19 non-municipal supply wells (including both Towers Country Club existing irrigation wells), 20 non-municipal diffusion wells, and five extraction/recovery wells (on the former Unisys site) are located within one mile of the proposed well location. In addition, numerous monitoring and observation wells are located within one mile of the proposed well location. Domestic (private) wells have not been identified within one mile of the proposed well location. The nearest municipal supply well (N-1802) is located approximately 3,200 feet east; however, this well is screened within the Lloyd aquifer. Of the four municipal supply wells, two are screened within the upper Magothy; however, these wells are located just over 4,000 feet to the east/northeast. T he nearest non-municipal supply well other than the existing Towers Country Club wells and that is screened within the upper Magothy is approximately 1,600 feet east (N-8803D/11635D, used for diffusion). The nearest extraction/recovery well (EW-1) is located 2,500 feet east on the northern portion of the former Unisys site. EW-1 extracts VOC-impacted groundwater from the upper Magothy to prevent further off-site migration of VOC-impacted groundwater from the former Unisys site.

As mentioned previously in Section 1.2.1 of this report, the proposed well location is within a groundwater horizon impacted by VOCs associated with the former Unisys facility, which is located approximately 2,000 feet to the east. The underlying Upper Glacial and Magothy aquifers (including the upper portion of the Magothy aquifer) have been impacted by VOCs associated with historic operations at the former Unisys facility. This has resulted in a groundwater VOC plume that has migrated downgradient to the north and northwest off-site from the former Unisys site (ARCADIS Geraghty & Miller, 1999). The proposed irrigation well, the existing Well N-2576, and several other nearby area wells are located in a portion of the off-site VOC plume that is characterized by relatively low Total VOC concentrations (i.e., less than 500 micrograms per liter [ug/L]). Figure 5 shows the distribution of Total VOC concentrations in the upper Magothy based upon analytical data from groundwater samples collected during 1999 as part of former Unisys facility remedial investigation efforts. The extent of the VOC plume, as defined by the 5 ug/L contour shown on

Figure 5, encompasses the entire former Unisys site and extends off-site approximately 2,000 feet north of Marcus Avenue, and approximately 3,200 feet west of Lakeville Road.

2.3 Water Quality

Results of water quality testing for existing Well N-2576 are summarized on Table 2 and are considered to be representative of aquifer water quality in the general vicinity of the proposed well. Well N-2576 is located approximately 1,000 feet west of the former Unisys site. The proposed well location is approximately an additional 1,000 feet further west. Well N-2576 was sampled twice in 1999 as part of VOC plume monitoring efforts associated with the former Unisys facility remedial investigation (ARCADIS Geraghty & Miller, 1999). As shown on Table 2, Total VOCs ranged between 75 ug/L in July 1999 to 184 ug/L in August 1999. The primary VOCs detected during both sampling events include 1,2-dichloroethene, trichloroethene, and tetrachloroethene. The concentrations detected for each of these compounds exceeded the Applicable or Relevant and Appropriate Requirements (ARARs) developed for the former Unisys facility as part of the remedial investigation process (ARCADIS Geraghty & Miller, 1999).

Based on the Total VOC distribution and considering the additional 1,000-foot distance the proposed well is from the former Unisys site, relative to Well N-2576, Total VOCs would not be expected to be higher than results summarized for Well N-2576. In addition, Total VOC concentrations in the vicinity of the proposed well would not be expected to significantly increase over time considering current and planned groundwater remediation activities for the former Unisys facility, which include containment and treatment of on-site VOC-impacted groundwater, and considering supporting groundwater flow and transport modeling (see Section 3.1 of this report for detail) efforts performed for the remedial investigation (ARCADIS Geraghty & Miller, 1999) and the feasibility study (in progress). Concentrations of VOCs in on-site (Unisys) groundwater generally is significantly higher than the off-site VOC concentrations detected in Well N-2576 and those that might be expected at the proposed well location.

3. Assessment of Potential Environmental/Hydrogeologic Impacts

This section presents an evaluation of the potential environmental and hydrogeologic impacts associated with the proposed irrigation well. The greatest hydrogeologic impact of the proposed action would be felt within the upper Magothy where the proposed well's screen interval is to be placed. Therefore, within the water bearing zone of interest, potential interference effects on other area supply wells typically would be assessed. However, because the proposed well is a replacement well for existing Well N-2576 and will be screened in a similar horizon, potential interference effects of the proposed well should be negligible. In addition, recent studies for the remedial effort associated with the former Unisys site plume shows that the pumping of a new well at North Shore Towers will not adversely affect the remedial program being designed by Lockheed Martin (see below).

3.1 Assessment of Potential VOC Plume/Related Hydrogeologic Impacts

Groundwater modeling performed as part of the feasibility study process for the former Unisys facility Operable Unit 1, as well as modeling performed as part of the Operable Unit 2 remedial investigation, indicates that operation of existing Well N-2576 does not interfere with the ability to contain and treat on-site (former Unisys facility) impacted groundwater. Groundwater modeling currently in progress as part of the feasibility study evaluations for former Unisys facility Operable Unit 2 indicates that operation of existing Well N-2576 does not interfere with ability of various remedial scenarios to remediate off-site impacted groundwater. The pumpage of Well N-2576 was simulated by specifying an effective continuous pumping rate of 21 gpm. This simulated pumping rate represents an annual pumpage of approximately 11 million gallons. Under these conditions for the various remedial scenarios considered, the maximum width of Well N-2576's capture zone was simulated to be on the order of a few hundred feet.

Based on these groundwater modeling efforts, the potential hydrogeologic impacts of the operation of the proposed well on the ability to achieve remedial objectives associated with the former Unisys facility VOC plume regarding remedial objectives can be reasonably inferred from the operation of Well N-2576. It is reasonable to assume that upper Magothy hydrogeologic characteristics, particularly water transmitting properties, at the location of the proposed well are similar to those at Well N-2576. In addition, the aquifer characteristics represented in the model are essentially the same for both locations. However, to make the inference based on professional understanding of applied groundwater modeling and hydrogeologic principles, the difference in pumping rate used in the model versus projected demand needed to be considered.

It is recognized that simulation of Well N-2576 in the groundwater model underestimates the most recent (1999) actual corrected annual pumpage (approximately 30 million gallons) by a factor of three. Conservatively, it was assumed that the capture zone resulting from a three-fold increase in pumpage would be three times the width simulated for N-2576 (on the order of approximately 900 ft). In reality, applying this proportional increase to the width dimension of the capture zone is not linear because the additional portion of the aquifer contributing water to the well is not one-dimensional. Considering the proposed well's location approximately 1,000 feet west of Well N-2576, the conservatively projected capture zone resulting from the proposed well's operation would not extend beyond Well N-2576's simulated capture towards the east in the direction of the former Unisys facility. Therefore, even if modeling efforts considered a higher pumping rate (accounting for more recent pumpage corrected for meter error, and projected demand) at the proposed well location, the projected effect of the proposed well's operation would not be expected to have any more impact than that simulated for Well N-2576 under the various remedial scenarios considered in the modeling efforts conducted.

Based on this assessment, the conclusion reached regarding potential impacts of the proposed action on the ability to achieve remedial objectives associated with former Unisys facility VOC plume is similar to that resulting from the evaluation for Well N-2576. Specifically, operation of the proposed irrigation well is not expected to interfere with the ability to contain and treat on-site (former Unisys facility) impacted groundwater and or to interfere with ability of various remedial scenarios to treat off-site impacted groundwater and to prevent additional off-site supply wells from being impacted.

3.2 Assessment of Potential VOC Contaminant/Water Quality Impacts

As discussed previously in Section 2.1 of this report (Assessment of Proximity Issues), the proposed well is located within a horizon of VOC-impacted groundwater. Given the proposed well's location within this VOC plume, projected water quality, and water quality results for Well N-2576 indicating VOC concentrations exceeding ARARs, this section assesses potential impacts related to pumping of VOC-impacted groundwater from the upper Magothy aquifer. As part of the former Unisys facility Operable Unit 2 remedial investigation, a baseline human health risk assessment (HHRA) was performed and documented in the Interim Draft Remedial Investigation Report (ARCADIS Geraghty & Miller, 1999). As a baseline risk assessment, the HHRA assumes no remediation is conducted on the groundwater system. A copy of the HHRA is provided in Appendix D. The objective of the HHRA was to characterize potential human health risks associated with past, current, and future off-site migration of Unisys site-related chemicals in groundwater. The HHRA consists of several primary components including data collection/evaluation; exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. While the HHRA focused on Unisys site-related chemicals in off-site groundwater, those chemicals may be transferred to both air and surface soil as the groundwater is used. It was noted that Well N-2576, which supplies the Towers Country Club golf course (referred to as North Shore Towers golf course in the HHRA), is already affected by Unisys site-related chemicals in groundwater. Therefore, considering the use of Well N-2576 (irrigation), the HHRA included an evaluation of potential risks associated with chemicals in:

- Spray irrigation water at the Towers Country Club golf course (Non Municipal Supply Well N-2576), and
- Surface soil wetted by spray irrigation on the Towers Country Club golf course.

In summary, the HHRA concluded that use of Well N-2576 for irrigation of the Towers County Club Golf Course poses no risk to human health. This was based on a conservative analysis carried through the various components of the risk assessment. As a conservative measure, the risk assessment evaluated the highest current or predicted future (based on the groundwater fate and transport model) VOC concentrations. The following is a summary of the risk assessment components presented in the HHRA which are applicable; complete detail is presented in the HHRA provided in Appendix D.

The exposure assessment identified points of exposure as VOCs transferred to the air (via volatilization) and/or surface soil (by watering the grass), and included groundskeepers and golfers as potential receptors (assuming adults). The exposure assessment also included the specific VOCs detected in Well N-2576 in the identification process for constituents of potential concern (COPCs). Exposure point concentrations (EPCs) were calculated for both highly conservative (high-end) and more realistic (central tendency) exposure scenarios. Exposure point concentrations applicable to various combinations of time frames, environmental media and exposure points considered in the HHRA for potential risks identified above were derived from:

1) the groundwater fate and transport model to estimate future concentrations in Well N-2576;

2) a combination of a near-field box model and a vapor emissions model to estimate concentration of COPCs in air as a result of volatilization of VOCs from water during spray irrigation; and

3) an assumption, in the absence of surface soil date, that concentrations of COPCs in the irrigation well water were not diluted upon release to soil, and, therefore that EPCs for soil were equal to EPCS for the spray irrigation well water.

In accordance with numerous USEPA guidance documents, the toxicity assessment qualitatively evaluated health effects based on dose-response relationships and distinguished between cancer and non-cancer effects.

In the final step of risk characterization, the results of the hazard identification, exposure assessment, and toxicity assessment were integrated to yield a quantitative measure of carcinogenic risk and noncarcinogenic hazard. These were evaluated for the complete exposure pathways (refer to the HHRA in Appendix D for a complete summary). The risk characterization showed that the risk associated with the VOC groundwater plume is low and well within the range considered acceptable to the USEPA and NYSDEC. The risk characterization also indicated no potential adverse health effects and showed that predicted cancer risks are also below levels of concern. Therefore, the risk assessment concluded that even if no action is undertaken to remediate the groundwater plume, the risk to human health associated with VOCs in the groundwater system is acceptable. The excess lifetime cancer risk is calculated to be below $1x10^{-5}$ and the Hazard Quotient is expected to 1.0 or less, which are within the ranges generally accepted by the USEPA and NYSDEC for Superfund sites.

Based on the HHRA, which specifically considered existing irrigation Well N-2576, the potential heath impacts associated with the operation of the proposed well within the VOC plume can be reasonably inferred on the basis of the projected water quality. As mentioned in Section 2.3 of this report, since on-site ground water at the former Unisys site is currently being contained and treated, the projected water quality for the proposed irrigation well is not expected to be higher than that for Well N-2576. Therefore, even if the proposed well were included in the HHRA, the conclusion reached regarding potential health impacts associated with operation of the proposed well is expected to be similar to that reached by the risk assessment for Well N-2576.

3.3 Assessment of Other Potential Hydrogeologic Impacts

Considering the projected demand, the projected capture zone, and the replacement nature (for Well N-2576) of the well, the operation of the proposed irrigation well is not expected to adversely impact the available drawdown , and therefore yield, of nearby municipal supply wells, non-municipal supply wells, or extraction/recovery wells identified in Section 2.2 of this report. Given the relative distances of these wells from the proposed well location (greater than 1,000 feet), the operation of the proposed well is not considered to have associated interference effects translating into adverse impact (i.e., yield reduction through significant impact on available drawdown). At these distances, drawdown associated with operation of the proposed well is considered to be negligible based on a similar use to existing Well N-2576, professional judgement, and understanding of the hydrogeologic setting. Even if there was minor additional drawdown realized at nearby wells due to operation of the pumping well, it would still be expected to have a negligible effect on available drawdown considering the saturated thickness of the aquifer system and total depths of the nearby wells.

As mentioned in Section 2.1 of this report, The Raritan aquifer (Lloyd sand) is not interconnected; therefore, there is no impact associated with operation of the proposed irrigation well concerning the underlying water bearing formation. Although the Upper Glacial and Magothy aquifers (particularly the upper portion of the Magothy aquifer) are interconnected, as mentioned in Section 2.1, the potential impact associated with operation of the proposed irrigation well needs to be placed in the context of its capacity, screened interval and the hydrogeologic characteristics. Potential hydrogeologic impacts to the overlying Upper Glacial aquifer are considered to be negligible given the following:

- the significant combined saturated thickness of the Upper Glacial and Magothy aquifers relative to proposed screen length.

- the degree of aquifer anisotropy (ratio of horizontal to vertical permeability) for both the Upper and Magothy aquifers (translating into more horizontal contribution of water to the well as opposed to vertical).

As mentioned previously in Section 2.2, there is no hydraulic interconnection with surface water bodies such as Lake Success.

4. Unavoidable, Negative Environmental/Hydrogeologic Impacts

No unavoidable, negative environmental or hydrogeologic impacts associated with the proposed action are expected.

5. Alternative to Proposed Action

This section evaluates potential alternatives to the proposed action. As mentioned previously in Section 1.1.3 (Description of Existing Facilities) and Section 1.3 (Establishment of Need) of this report, various alternatives to installing a new irrigation well have been attempted unsuccessfully. These include repair of existing Well N-2576, which still continues to show indications of pumping fine sand and a less than reliable well condition of reduced capacity to be adequately used as a primary source of irrigation water. Additional repair efforts to restore Well N-2576 to adequate condition are not considered feasible given the track record of past repairs and age of the well. In addition, redrilling of Well N-2576 presents logistical difficulties because it is located on property not currently owned by Towers Country Club/North Shore Towers Apartments, Inc.. Water importation efforts also have not succeeded in providing a reliable source of water for golf course irrigation, particularly related to the adequacy of emergency backup/standby. The emergency New York City water feed installed in 1998 is not considered a reliable alternate because it is connected to the local water system that is routinely restricted for such during periods of drought. Therefore, a reasonable, feasible, or practical alternative or alternatives to the proposed action have not been identified.

6. Mitigating Measures

Mitigating measures to minimize environmental impacts are not proposed because adverse environmental impacts resulting from the proposed action are not expected.

7. List of Related Information/References

Irrigation Specialist's Report (attached in Appendix B).

ARCADIS Geraghty & Miller, Inc. 1999. Interim Draft Remedial Investigation Report, Former Unisys Facility, Operable Unit 2, prepared by ARCADIS Geraghty & Miller, Inc. for Lockheed Martin Corporation, dated November 4, 1999.

Operable Unit 1 RI/FS (December 1996) and Operable Unit 2 remedial investigation (1999) and feasibility study (in progress) groundwater modeling support conducted by Camp Dresser McKee (CDM).

ARCADIS Geraghty & Miller, Inc. 1999. Baseline Human Health Risk Assessment Report (Draft), Former Unisys Facility, Operable Unit 2, Appendix K of Interim Draft Remedial Investigation Report, Former Unisys Facility, Operable Unit 2, prepared by ARCADIS Geraghty & Miller, Inc. for Lockheed Martin Corporation, dated November 4, 1999 (attached as Appendix D).

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Swarzenski, Wolfgang V. 1963. Hydrogeology of Northwestern Nassau and Northeastern Queens Counties, Long Island, New York. Geological Survey Water-Supply Paper 1657.

Tables

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Table 1. Summary of Wells Within a 1-Mile Radius of the Proposed Irrigation Well.

Well Designation	Date Installed	Total Depth	Well Diameter (inches) top/bottom	Land Surface Elevation (feet relative to msl)	Measuring Point Elevation (feet relative to msl)	Screened Interval (feet bls)	Screened Interval (feet relative to msl)	Installed by	Notes or Well Use as per Well Completion Report	Screened Aquifer
Extraction/Recovery Wells										
EW1	August 42	235	12	142**	--	199 to 229	-57 to -87*	Former Unisys Facility	Recovery	UM
EW2	July 54	260	12	133**	--	225 to 255	-92 to -122*	Former Unisys Facility	Recovery	UM/MM
EW3	March 42	256	12	120**	--	220 to 250	-100 to -130*	Former Unisys Facility	Recovery	UM/MM
RW1	September 91	196	16	139**	144.82	140 to 160	-1 to -21*	Former Unisys Facility	Recovery	UG
						171 to 191	-29 to -49*			UM
RW2	July 91	215	8	133**	128.23	180 to 210	-47 to -77*	Former Unisys Facility	Recovery	UM
Monitoring Wells										
1GU	May 88	115	2	--	143.77	105 to 115	38.77 to 29*	Former Unisys Facility	Monitoring	UG
1GL	May 88	147	4	--	144.41	127 to 147	17.41 to -3*	Former Unisys Facility	Monitoring	UG
1MI	May 88	255	4	--	144.39	235 to 255	-90.61 to -111*	Former Unisys Facility	Monitoring	UM
1MI/L	May 89	342	4	--	144.55	322 to 342	-177.45 to -197*	Former Unisys Facility	Monitoring	MM
1ML	May 91	395	4	--	144.89	390 to 400	-245.11 to -255*	Former Unisys Facility	Monitoring	BM
2GL	May 88	147	4	--	128.35	127 to 147	1 to 19*	Former Unisys Facility	Monitoring	UM
2MU	July 91	185	4	--	125.9	175 to 185	-49.1 to -59*	Former Unisys Facility	Monitoring	UM
2MI	April 89	250	4	--	128.57	230 to 250	-101.43 to -121*	Former Unisys Facility	Monitoring	MM
2ML	August 94	447	4	--	125.69	397 to 407	-271.31 to -281*	Former Unisys Facility	Monitoring	BM
3GL	May 88	149	4	--	139.5	129 to 149	10.5 to -10*	Former Unisys Facility	Monitoring	UG
3ML	July 94	350	4	--	137.02	325 to 335	-187.98 to -198*	Former Unisys Facility	Monitoring	BM
4GL	May 88	150	4	--	144.81	130 to 150	14.81 to -5*	Former Unisys Facility	Monitoring	UG
4MI	March 89	250	4	--	145.1	230 to 250	-84.9 to -105*	Former Unisys Facility	Monitoring	UM
5GU	January 92	95	4	--	131.32	74 to 94	57.32 to 37*	Former Unisys Facility	Monitoring	UG
5GL	February 89	130	4	--	130.32	110 to 130	20.32 to 0*	Former Unisys Facility	Monitoring	UG
5MI	February 89	250	4	--	130.31	239 to 250	-108.69 to -120*	Former Unisys Facility	Monitoring	MM
5ML	July 94	350	4	--	129.17	325 to 335	-195.83 to -206*	Former Unisys Facility	Monitoring	BM
6GL	February 89	125	4	--	128.3	105 to 125	23.3 to 3*	Former Unisys Facility	Monitoring	UG
6MI	July 91	240	4	--	128.8	215 to 235	-86.2 to -106*	Former Unisys Facility	Monitoring	MM
7GL	March 89	150	4	--	149.76	130 to 150	19.76 to 0*	Former Unisys Facility	Monitoring	UG
7ML	June 94	355	4	--	148.98	323 to 333	-174.02 to -184*	Former Unisys Facility	Monitoring	MM

Footnotes on last page.

ARCADIS GERAGHTY&MILLER

Table 1. Summary of Wells Within a 1-Mile Radius of the Proposed Irrigation Well.

Well Designation	Date Installed	Total Depth	Well Diameter (inches) top/bottom	Land Surface Elevation (feet relative to msl)	Measuring Point Elevation (feet relative to msl)	Screened Interval (feet bls)	Screened Interval (feet relative to msl)	Installed by	Notes or Well Use as per Well Completion Report	Screened Aquifer
Monitoring Wells (continued)										
8GU	April 89	90	4	--	120.42	80 to 90	40.42 to 30*	Former Unisys Facility	Monitoring	UG
8GL	April 89	150	4	--	120.32	130 to 150	-9.68 to -30*	Former Unisys Facility	Monitoring	UM
8ML	June 94	355	4	--	120.50**	328 to 338	-208 to -218*	Former Unisys Facility	Monitoring	BM
9GL	April 89	155	4	--	126.94	135 to 155	-8.06 to -28*	Former Unisys Facility	Monitoring	UM
10GL	April 89	132	4	--	126.03	112 to 132	14.03 to -6*	Former Unisys Facility	Monitoring	UG
11GL	May 89	140	4	--	129.02	120 to 140	9.02 to -11*	Former Unisys Facility	Monitoring	UM
11MI	May 89	250	4	--	129.39	230 to 250	-100.61 to -121*	Former Unisys Facility	Monitoring	MM
12MI	May 91	253	4	--	133.61	243 to 253	-109.39 to -119*	Former Unisys Facility	Monitoring	MM
12ML	May 91	393	4	--	133.85	383 to 393	-249.15 to -259*	Former Unisys Facility	Monitoring	BM
13ML	April 96	275	4	--	158.97	255 to 275	-96.03 to -116*	Former Unisys Facility	Monitoring	MM
14MI	April 96	250	4	--	160.52	220 to 250	-59.48 to -89*	Former Unisys Facility	Monitoring	MM
15GL	August 94	170	4	--	132.57	150 to 160	-17.43 to -27*	Former Unisys Facility	Monitoring	UM
15ML	August 94	340	4	--	132.63	328 to 338	-195.37 to -205*	Former Unisys Facility	Monitoring	BM
16GL	April 96	222	4	--	227.08	202 to 222	25.08 to 5*	Former Unisys Facility	Monitoring	UG
16ML	August 95	326	4	--	227.11	316 to 326	-88.89 to -99*	Former Unisys Facility	Monitoring	UM
17GL	August 94	170	4	--	138.99	155 to 165	-16.01 to -26*	Former Unisys Facility	Monitoring	UM
17ML	August 94	428	4	--	138.64	390 to 400	-251.36 to -261*	Former Unisys Facility	Monitoring	BM
18GL	September 94	170	4	--	150.24	160 to 170	-9.76 to -20*	Former Unisys Facility	Monitoring	UG
18ML	September 94	345	4	--	149.55	324 to 334	-174.45 to -184*	Former Unisys Facility	Monitoring	MM
19GU	January 92	99	2	--	137.2	78 to 98	59.2 to 39*	Former Unisys Facility	Monitoring	UG
19MI	January 92	248	4	--	137.22	229 to 239	-91.78 to -102*	Former Unisys Facility	Monitoring	MM
20GU	June 92	93	--	130**	--	73 to 93	57 to 37*	Former Unisys Facility	Monitoring	UG
21GU	January 92	98	4	--	132.85	78 to 98	54.85 to 35*	Former Unisys Facility	Monitoring	UG
22GL	September 94	168	4	--	135.53	158 to 168	-22.47 to -32*	Former Unisys Facility	Monitoring	UM
22ML	August 94	340	4	--	135.16	315 to 325	-179.84 to -190*	Former Unisys Facility	Monitoring	MM
23GL	August 94	150	2	--	139.82	140 to 150	-0.18 to -10*	Former Unisys Facility	Monitoring	UG
23MI	June 94	215	2	--	138.88	202 to 212	-63.12 to -73*	Former Unisys Facility	Monitoring	UM
24GL	May 94	150	2	--	139.89	139 to 149	0.89 to -9*	Former Unisys Facility	Monitoring	UG
24MI	May 94	220	2	--	139.97	200 to 210	-60.03 to -70*	Former Unisys Facility	Monitoring	UM

Footnotes on last page.

ARCADIS GERAGHTY&MILLER

Table 1. Summary of Wells Within a 1-Mile Radius of the Proposed Irrigation Well.

Well Designation	Date Installed	Total Depth	Well Diameter (inches) top/bottom	Land Surface Elevation (feet relative to msl)	Measuring Point Elevation (feet relative to msl)	Screened Interval (feet bls)	Screened Interval (feet relative to msl)	Installed by	Notes or Well Use as per Well Completion Report	Screened Aquifer
Monitoring Wells (continued)										
25GL	May 94	170	2	--	134.66	159 to 169	-24.34 to -34*	Former Unisys Facility	Monitoring	UM
25MI	May 94	220	2	--	135.75	200 to 210	-64.25 to -74*	Former Unisys Facility	Monitoring	UM
26GL	May 94	184	2	--	130.46	174 to 184	-43.54 to -54*	Former Unisys Facility	Monitoring	UM
26MI	May 94	240	2	--	130.79	220 to 230	-89.21 to -99*	Former Unisys Facility	Monitoring	UM
27GL	June 94	180	2	--	121.75	170 to 180	-48.25 to -58*	Former Unisys Facility	Monitoring	UM
27MI	June 94	230	2	--	122.24	217 to 227	-94.76 to -105*	Former Unisys Facility	Monitoring	UM
28GL	June 94	150	2	--	136.21	140 to 150	-3.79 to -14*	Former Unisys Facility	Monitoring	UG
28MI	June 94	250	2	--	136.57	222 to 232	-85.43 to -95*	Former Unisys Facility	Monitoring	UM
29GL	July 94	170	2	--	143.37	145 to 155	-1.63 to -12*	Former Unisys Facility	Monitoring	UG
29MI	July 94	250	2	--	143.48	207 to 217	-63.52 to -74*	Former Unisys Facility	Monitoring	UM
30GL	September 98	210	4	136.13	138.48	190 to 210	-53.87 to -74	Former Unisys Facility	Monitoring	UM
30MI	August 98	280	4	136.14	138.67	260 to 280	-123.86 to -144	Former Unisys Facility	Monitoring	MM
30ML	August 98	380	4	136.36	138.5	360 to 380	-223.64 to -244	Former Unisys Facility	Monitoring	BM
32GL	September 98	240	4	201.01	200.71	220 to 240	-18.99 to -39	Former Unisys Facility	Monitoring	UG
32MI	September 98	330	4	202.39	202.16	310 to 330	-107.61 to -128	Former Unisys Facility	Monitoring	MM
32ML	September 98	412	4	202.79	202.59	392 to 412	-189.21 to -209	Former Unisys Facility	Monitoring	BM
33GL	August 98	252	4	256.55	256.16	232 to 252	24.55 to 5	Former Unisys Facility	Monitoring	UG
33MI	August 98	310	4	256.65	256.45	290 to 310	-33.35 to -53	Former Unisys Facility	Monitoring	UM
33ML	August 98	425	4	256.66	256.37	405 to 425	-148.34 to -168	Former Unisys Facility	Monitoring	BM
35GL	August 98	135	2	126.70	129.21	115 to 135	11.7 to -8	Former Unisys Facility	Monitoring	UM
36GL	August 98	135	2	132.49	134.41	115 to 135	17.49 to -3	Former Unisys Facility	Monitoring	UG
37MU	July 99	252	4	180.11	179.75	242 to 252	-62 to -72	Former Unisys Facility	Monitoring	UM
37MI	June 99	325	4	180.09	179.72	315 to 325	-135 to -145	Former Unisys Facility	Monitoring	MM
37ML	July 99	428	4	180.21	179.80	418 to 428	-238 to -248	Former Unisys Facility	Monitoring	BM
38MU	August 99	242	4	186.84	186.65	232 to 242	-45 to -55	Former Unisys Facility	Monitoring	UM
38MI	August 99	344	4	188.77	188.45	334 to 344	-145 to -155	Former Unisys Facility	Monitoring	MM
38ML	August 99	444	4	188.87	188.16	430 to 440	-241 to -251	Former Unisys Facility	Monitoring	BM

Footnotes on last page.

Table 1. Summary of Wells Within a 1-Mile Radius of the Proposed Irrigation Well.

Well Designation	Date Installed	Total Depth	Well Diameter (inches) top/bottom	Land Surface Elevation (feet relative to msl)	Measuring Point Elevation (feet relative to msl)	Screened Interval (feet bls)	Screened Interval (feet relative to msl)	Installed by	Notes or Well Use as per Well Completion Report	Screened Aquifer
Monitoring Wells (continued)										
39MU	September 99	206	4	159.0	158.52	196 to 206	-37 to -47	Former Unisys Facility	Monitoring	UM
39MI	September 99	312	4	158.7	158.29	302 to 312	-144 to -154	Former Unisys Facility	Monitoring	MM
39ML	October 99	407	4	158.1	157.92	397 to 407	-239 to -249	Former Unisys Facility	Monitoring	BM
N1102	March 63	166	4	186	184	-- to --	23 to 18	NCDPW	Observation	UG
N10290	May 85	170	4	--	153	160 to 165	-7 to -16*	NCDPW	Observation	UG
N12450	March 94	685	4	--	220	660 to 680	-440 to -460*	NCDPW	Monitoring	L
N12455	March 94	200	2	220**	--	175 to 195	45 to 25*	NCDPW	Monitoring	UG
Municipal Supply Wells										
N1802	September 42	703	20/12	131**	--	641 to 691	-510 to -560*	MLWD	Active	L?
N3905	June 52	259	20/12	150**	--	214 to 254	-64 to -104*	MLWD	Active	UM
N4243	August 53	260	20/12	150**	--	205 to 255	-55 to -105*	MLWD	Active	UM
N5710	January 57	390	20/12	160**	--	325 to 385	-165 to -225*	MLWD	Active	MM/BM
Non-Municipal Diffusion Wells										
DW5	July 42	267	12	128**	--	210 to 260	-82 to -132*	Former Unisys Facility	--	UM/MM
DW6	September 42	259	12	132**	--	209 to 259	-77 to -127*	Former Unisys Facility	--	UM/MM
DW7	June 54	245	12	130**	--	199 to 239	-69 to -109*	Former Unisys Facility	--	UM/MM
DW8	June 42	195	12	128**	--	140 to 190	-12 to -62*	Former Unisys Facility	--	UG/UM
N5157D	March 55	27	4	120**	--	22 to 27	98 to 93*	Lakeville Professional Building, Inc.	Diffusion from N5144/N8267	UG
N7762D	November 64	98	6	150**	--	68 to 98	82 to 52*	Levitt & Son, Inc.	Diffusion from N7560 (replaced by N9714D)	UG
N8372D	October 67	348	8	120**	--	286 to 346	-166 to -266*	L.S.Q. Corp.	Diffusion from N8358	MM/BM
N8373D	May 68	350	8	120**	--	290 to 350	-170 to -230*	L.S.Q. Corp.	Diffusion from N8358	MM/BM
N8787D	May 71	101	6	150**	--	71 to 101	79 to 49*	Levitt & Son, Inc.	Supplemental diffuser (from N7560)	UG
N8803D	May 72	278	10	150**	--	180 to 205	-30 to -55*	A.L.L. Associates	Diffusion from N8801	UM
						252 to 262	-102 to -112*			UM
						272 to 277	-122 to -127*			MM
N8840D	July 72	240	10/6	130**	--	204 to 240	-74 to -110*	Tire Realty Corp.	Diffusion from N8821	UM

Footnotes on last page.

Table 1. Summary of Wells Within a 1-Mile Radius of the Proposed Irrigation Well.

Well Designation	Date Installed	Total Depth	Well Diameter (inches) top/bottom	Land Surface Elevation (feet relative to msl)	Measuring Point Elevation (feet relative to msl)	Screened Interval (feet bls)	Screened Interval (feet relative to msl)	Installed by	Notes or Well Use as per Well Completion Report	Screened Aquifer
Non-Municipal Diffusion Wells (continued)										
N9126D	August 76	240	6	130**	--	199 to 239	-69 to -109*	Michelin Tire Corp.	Diffusion from N8821	UM
N9714D	June 80	99	6	140**	--	59 to 99	81 to 41*	L.I. Jewish Hillside Medical Center	--	UG
N11080D	April 88	318	6	120**	--	252 to 312	-132 to -192*	TRIAD Org.	Diffusion from N10421/N10422	MM
N11635D	March 90	205	10	150**	--	135 to 165	15 to -15*	A.L.L. Associates	--	UG
						185 to 205	-35 to -55*			UM
Q1745D	August 50	89	8/6	115**	110**	69 to 89	46 to 26*	Union Land Corp. (Glen Oaks Shopping Center)	Diffusion from Q1666/Q1667	UG
Q1746D	September 50	89	8/6	115**	110**	69 to 89	46 to 26*	Union Land Corp. (Glen Oaks Shopping Center)	Diffusion from Q1666/Q1667	UG
Q2920D	September 66	96	6	115**	--	76 to 96	39 to 19*	Union Land Corp. (Glen Oaks Shopping Center)	Diffusion from Q1666/Q1667 (replaces Q1745D)	UG
Q3024D	September 71	182	10	130**	--	141 to 181	-11 to -51*	The Home & Hospital for the Daughters of Israel, Inc.	Diffusion from Q3003	UG/UM
Q3025D	September 71	217	10/8	130**	--	171 to 212	-41 to -82*	The Home & Hospital for the Daughters of Israel, Inc.	Diffusion from Q3003	UM
Non-Municipal Supply Wells										
H33-4649***	--	--	--	--	--	-- to --	-- to --	Anthony Marino	--	--
N1332	1932	210	10	160**	--	-- to --	-- to --	North Shore Towers	Irrigation (out of service)	UM
N2576	July 75	200	10	160**	162**	178 to 198	-18 to -38*	North Shore Towers	Irrigation	UM
N2623	August 48	125	8/6	140**	140**	104 to 122	36 to 18*	Fred Schumacher	Irrigation	UG
N5144	January 55	95	6	120**	--	90 to 95	30 to 25*	Lakeville Professional Building, Inc.	Air Conditioning	UG
N7560	August 64	242	8/6	150**	--	221 to 241	-71 to -91*	Long Island Jewish	Cooling	UM
N8038	June 66	295	12	210**	--	272 to 295	-62 to -85*	LS Park Golf Course	Irrigation	UM
N8267	July 67	285	8	120**	--	273 to 285	-153 to -165*	Klein & Teicholz	Air Conditioning	MM
N8358	September 67	397	12/10	120**	--	355 to 397	-235 to -277*	L.S.Q. Corp.	Air Conditioning	BM

Footnotes on last page.

ARCADIS GERAGHTY&MILLER

Table 1. Summary of Wells Within a 1-Mile Radius of the Proposed Irrigation Well.

Well Designation	Date Installed	Total Depth	Well Diameter (inches) top/bottom	Land Surface Elevation (feet relative to msl)	Measuring Point Elevation (feet relative to msl)	Screened Interval (feet bls)	Screened Interval (feet relative to msl)	Installed by	Notes or Well Use as per Well Completion Report	Screened Aquifer
Non-Municipal Supply Wells (continued)										
N8801	July 72	280	12/10	150**	--	240 to 270	-90 to -120*	A.L.L. Associates	Air Conditioning	MM
N9817	September 81	383	12/10	120**	--	340 to 380	-220 to -260*	Success Const. Corp.	Air Conditioning	BM
N11047	September 88	330	10	120**	--	305 to 325	-185 to -205*	TRIAD Org.	Cooling	MM
N11048	September 88	330	10	120**	--	287 to 327	-167 to -207*	TRIAD Org.	Cooling	MM
Q1666	August 50	106	10	115**	--	86 to 106	29 to 9*	Union Land Corp. (Glen Oaks Shopping Center)	Air Conditioning	UG
Q1667	August 50	109	8	115**	108**	89 to 109	26 to 6*	Union Land Corp. (Glen Oaks Shopping Center)	Air Conditioning	UG
Q1909	October 52	245	12	132**	122**	205 to 245	-73 to -113*	Long Island Jewish	Air Conditioning	UM
Q1908	October 52	180	12	130**	116**	140 to 180	-10 to -50*	Long Island Jewish	Cooling	UG/UM
Q3003	June 72	320	16/12	130**	--	279 to 319	-144 to -189*	The Home & Hospital for the Daughters of Israel, Inc.	Air Conditioning	MM
Q3247	June 89	110	4	125**	122**	105 to 110	20 to 12*	Mr. Liberto	Irrigation	UG
Use Unknown										
N6406	January 58	171	4	170**	--	166 to 171	4 to -1*	J. Lapender	--	UG
N11460	May 1989	106	4	105**	102**	101 to 106	4 to -1*	Joseph Bianco	--	UG
Q3190	April 86	108	4	110**	--	104 to 108	6 to 2*	Garrett Dalton	--	UG

Footnotes on last page.

msl	Mean sea level.
--	Information not available.
*	Elevation of screen interval based on measuring point elevation and depth to screen interval below land surface or an estimated land surface elevation. Therefore the screen interval elevation is only approximate.
**	Estimated.
***	Well designation based on Permit-Code No. per New York City Department of Health - Public Health Engineering listing.
GCPWD	Garden City Park Water District.
JWSC	Jamaica Water Supply Company.
MLWD	Manhasset-Lakeville Water District.
WAGNN	Water Authority of Great Neck North.
WAWN	Water Authority of Western Nassau County.
NCDOH	Nassau County Department of Health.
NCDPW	Nassau County Department of Public Works.
USEPA	United States Environmental Protection Agency.
VEW	Vacuum Extraction Well.
LS	Lake Success.
UG	Upper Glacial. Screen interval located from approximately landsurface to -24 feet relative to msl.
UM	Upper portion of the Magothy. Screen interval located from approximately landsurface to -24 to -113 feet relative to msl.
MM	Middle portion of the Magothy. Screen interval located from approximately landsurface to -113 to -204 feet relative to msl.
BM	Basal portion of the Magothy. Screen interval located from approximately landsurface to -204 to -270 feet relative to msl.
L	Lloyd aquifer. Screen interval located approximately deeper than -270 ft bls and below the Raritan.

NOTE: Summary taken from Table 2-1 (wells within a 1.5-Mile Radius of the Former Unisys Facility, Great Neck, New York) as provided in the Interim Draft Remedial Investigation Report, Former Unisys Facility, Operable Unit 2, dated 11/4/99.

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Table 2. Existing Irrigation Well Water Quality Summary.

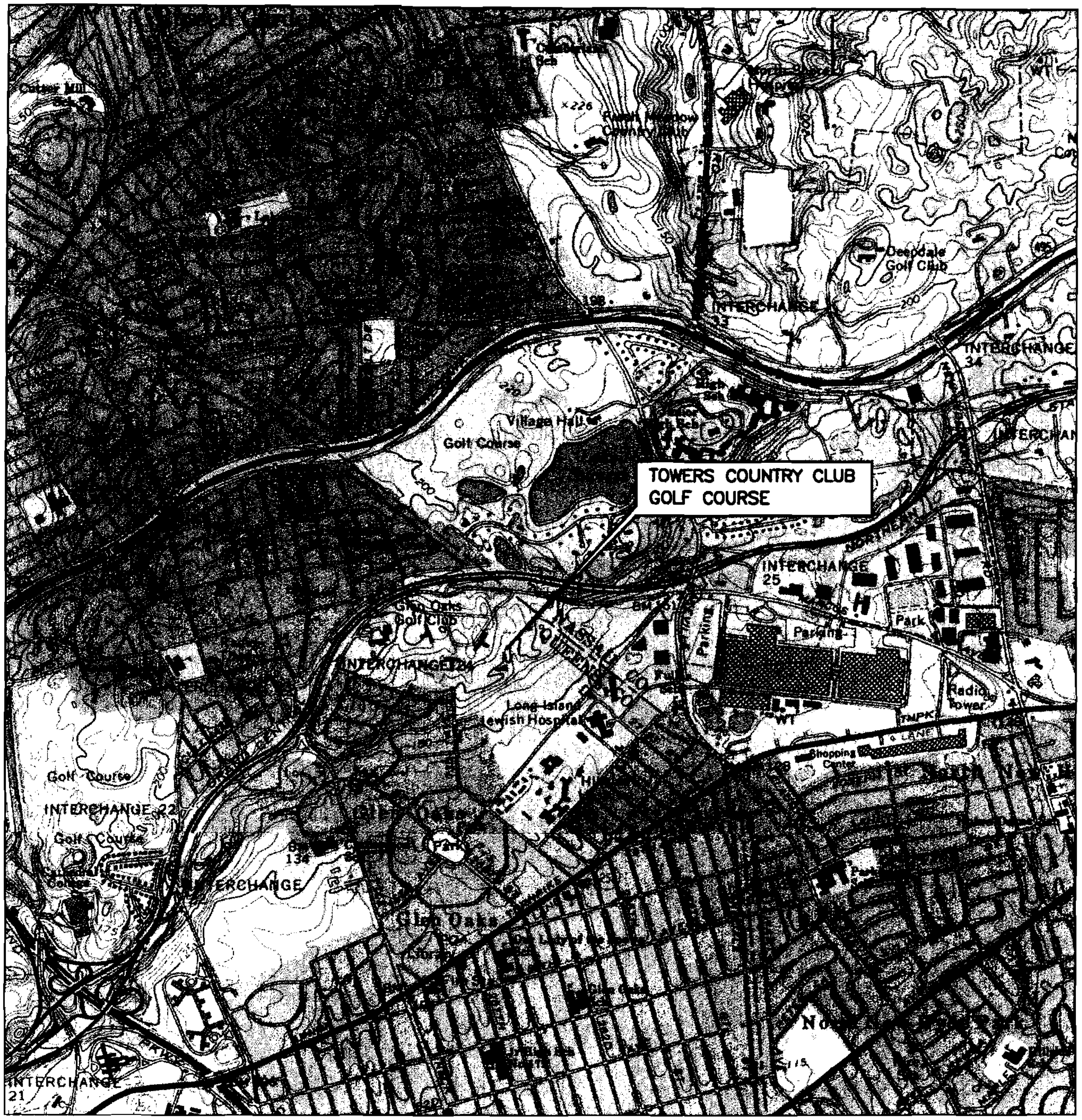
Parameter Units in ug/L	Site Specific ARARs	Well Designation: Date Collected: Well Use:	N2576 7/8/99 Irrigation	N2576 8/10/99 Irrigation
Chloromethane	5		< 10	< 10
Bromomethane	5		< 10	< 10
Vinyl chloride	2		< 10	< 10
Chloroethane	5		< 10	< 10
Methylene chloride	5		< 10	< 10
Acetone	50		< 10	< 10
Carbon disulfide	--		< 10	< 10
1,1-Dichloroethene	5		< 10	0.6 J
1,1-Dichloroethane	5		< 10	< 10
1,2-Dichloroethene (total)	5(a)		54	130
2-Butanone	50		< 10	< 10
Chloroform	7 or 100(d)***		< 10	0.4 J
1,2-Dichloroethane	0.6		< 10	< 10
1,1,1-Trichloroethane	5		< 10	< 10
Carbon tetrachloride	5		< 10 J	< 10
Bromodichloromethane	50 or 100(d)***		< 10	< 10
1,2-Dichloropropane	1		< 10	< 10
cis-1,3-Dichloropropene	0.4(b)		< 10	< 10
Trichloroethene	5		11	30
Benzene	1		< 10	< 10
Dibromochloromethane	50 or 100(d)***		< 10	< 10
trans-1,3-Dichloropropene	0.4(b)		< 10	< 10
1,1,2-Trichloroethane	1		< 10	< 10
Bromoform	50 or 100(d)***		< 10	< 10
4-Methyl-2-pentanone	--		< 10	< 10
2-Hexanone	50		< 10	< 10
Tetrachloroethene	5		10	23
1,1,2,2-Tetrachloroethane	5		< 10	< 10
Toluene	5		< 10	< 10
Chlorobenzene	5		< 10	< 10
Ethylbenzene	5		< 10	< 10
Styrene	5		< 10	< 10
Xylene (total)	5(c)		< 10	< 10
Freon 113	5		< 10	< 10
Total VOCs			75	184

ug/L	Micrograms per liter.
VOCs	Volatile organic compounds.
J	Estimated value.
--	No standard available.
(a)	Represents standard for cis- or trans-1-2-Dichloroethene.
(b)	Applies to sum of cis- and trans-1,3-Dichloropropene.
(c)	Represents standard for each of the three isomers.
(d)	Sum of trihalomethanes (four parameters listed above).
*	Lowest concentration of Applicable or Relevant and Appropriate Requirements.
***	Use standard that is lowest if sum (d) isomer 100.
Freon 113	1,1,2-Trichlorotrifloroethane.

NOTE: Summary taken from Table 2-2 (Results of Volatile Organic Compound Analysis of Groundwater Samples Collected Fall 1998 and Summer 1999 at and in the Vicinity of the Former Unisys Facility, Great Neck, New York) as provided in the Interim Draft Remedial Investigation Report, Former Unisys Facility, Operable Unit 2, dated 11/4/99.

1 Site-Specific ARARs refers to the Applicable or Relevant and Appropriate Requirements developed for the former Unisys facility, as part of the remedial investigation process.

Figures



SOURCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE, LYNBROOK, N.Y. AND
SEA CLIFF, N.Y., REVISED 1979.

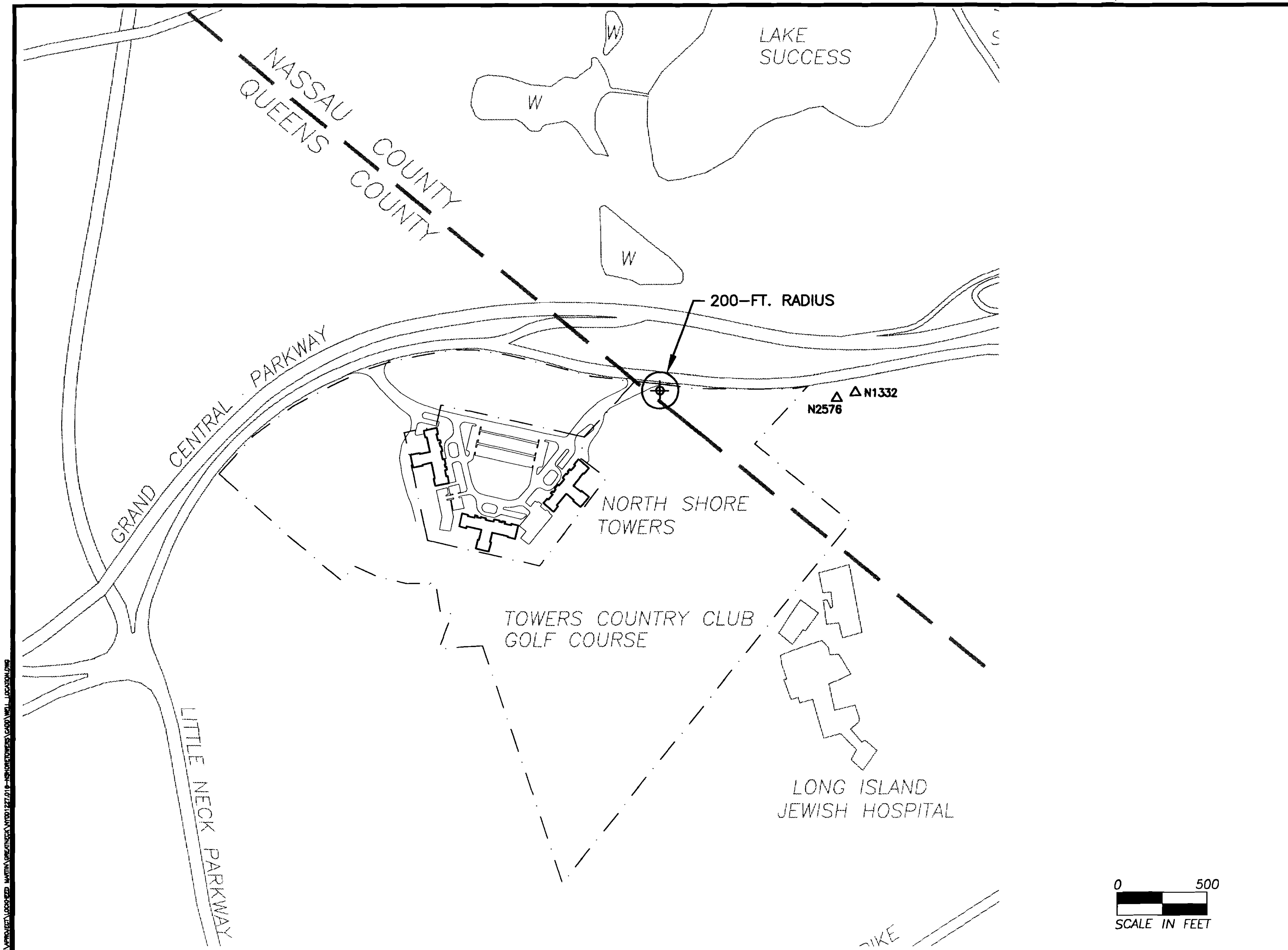
SCALE: 1"=2000'-0"

CLIENT:
LOCKHEED MARTIN CORPORATION
NORTH SHORE TOWERS APTS., INC.

NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS
GERAGHTY & MILLER

DRAWN A.G.	DATE 5/4/00	PROJECT MANAGER C. SAN GIOVANNI 5/00	DEPARTMENT MANAGER
SITE LOCATION MAP		LEAD DESIGN PROF.	CHECKED A.Z. 5/00
TOWERS COUNTRY CLUB FLORAL PARK, NEW YORK		PROJECT NUMBER NY001227.0016	FIGURE 1



N

LEGEND

- LOCATION OF PROPOSED IRRIGATION WELL
- N2576 LOCATION AND DESIGNATION OF EXISTING TOWERS COUNTRY CLUB IRRIGATION WELL
- W BODY OF WATER
- PROPERTY BOUNDARY

NO.	DATE	REVISION DESCRIPTION	BY / CKD

CLIENT:
LOCKHEED MARTIN CORPORATION
NORTH SHORE TOWERS APTS., INC.

PROPOSED WELL LOCATION MAP

TOWERS COUNTRY CLUB
FLORAL PARK, NEW YORK

ARCADIS
GERAGHTY & MILLER

88 Duryea Road
Melville, New York 11747
Tel: 516/249-7600 Fax: 516/249-7610

PROJECT MANAGER C. SAN GIOVANNI	DEPARTMENT MANAGER
LEAD DESIGN PROF.	CHECKED A.Z.
DRAWN A.G.	DATE 5/4/00
PROJECT NUMBER NY001227.0016	DRAWING NUMBER 2

For oversized Drawings 3-5, see Project Manager.

ARCADIS GERAGHTY & MILLER

Appendix A

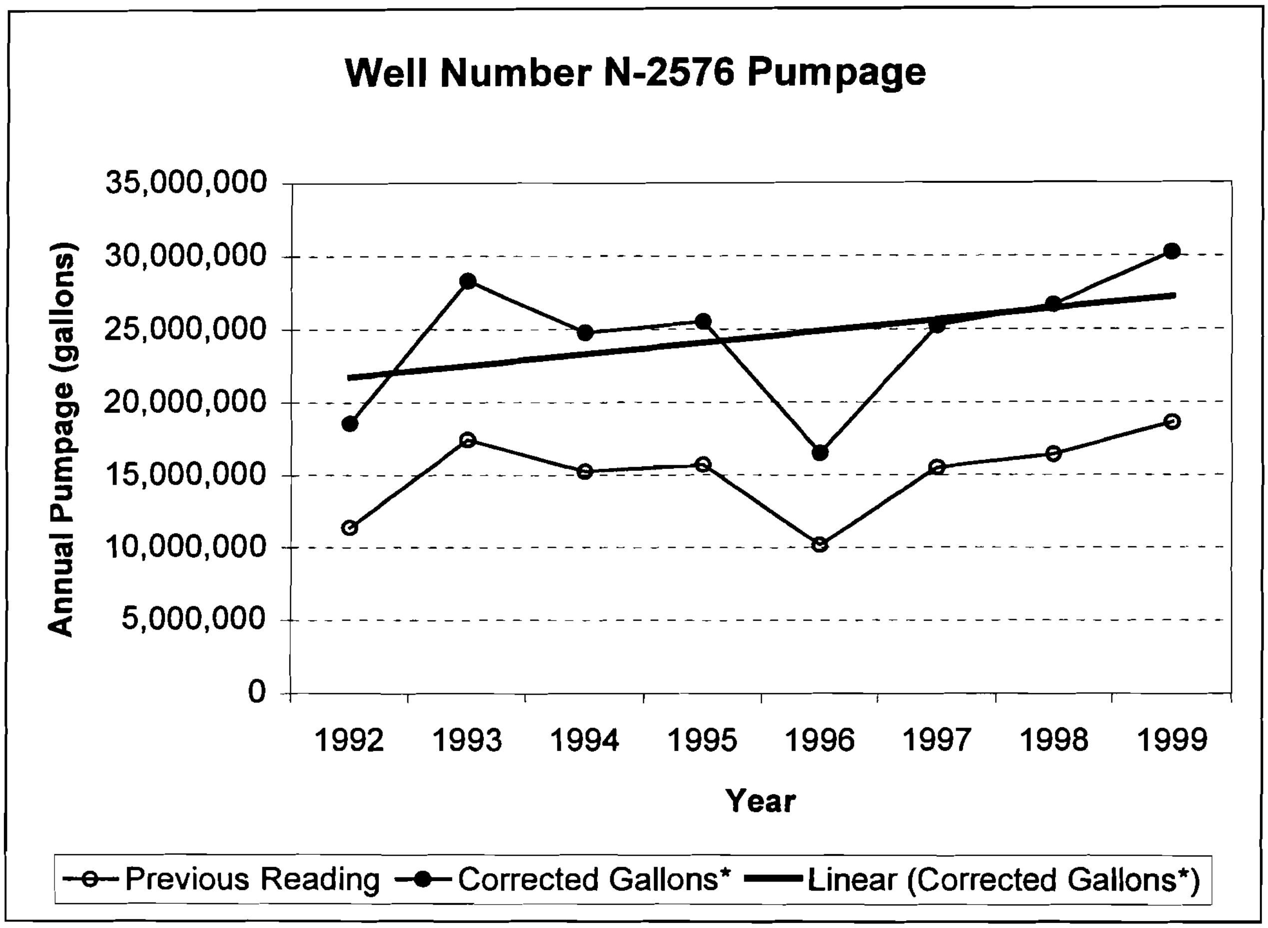
Past Pumpage Information

ARCADIS GERAGHTY&MILLER

WELL NUMBER N-2576
PUMPAGE

Year	Previous Reading	Corrected Gallons*
1992	11,414,900	18,549,213
1993	17,424,500	28,314,813
1994	15,244,000	24,771,500
1995	15,709,700	25,528,263
1996	10,163,500	16,515,688
1997	15,519,000	25,218,375
1998	16,403,900	26,656,338
1999	18,591,300	30,210,862

* adding 62.5% error



NORTH SHORE TOWERS
TOWERS COUNTRY CLUB
IRRIGATION WELL PUMP

DATE	MECHANICAL METER READING	GALLONS METERED	ELECTRONIC METER READING	GALLONS METERED
5/12/1999	603239		770	
5/13/1999	604680	144100	772	200000
5/17/1999	608162	348200	778	600000
TOTALS		492300		800000

DIFFERENCE BETWEEN METERS = 307700
MECHANICAL METER ERROR = ADD 62.502539 %

ARCADIS GERAGHTY & MILLER

Appendix B

Irrigation Specialist's Report

AUTOMATIC IRRIGATION DESIGN

333 Baldwin Rd. Hempstead, NY 11550 ▫ Div. of Stewart Senter Inc. ▫ Sales (516) 486-7500 ▫ Service (516) 486-7515 ▫ Fax (516) 486-8800

5/23/00
Att: Carlo
Arcadis, Geraghty & Miller

RE: North Shore Towers

Gentlemen,

The Towers Country Club at North Shore Towers operates an **18** hole golf course on **90** acres of which **42** acres is currently irrigated. The required weekly precipitation rate is **1.25** inches. To apply this amount to one acre requires **33,942** gallons since it takes **27,154** gallons to cover one acre with one inch of water. So knowing **42** acres (approx) will need a total of **1,425,564** gallons per week and having approx **25** weeks that the course will need irrigation per year the yearly total will be **35,639,100** gallons for existing irrigated areas only. If in the future additional areas are to be irrigated, each acre will need **848,550** gallons per year. Please note that in periods of heavy natural precipitation these numbers would be lower. The course currently receives its water from a well drilled in the **1940's** that had been relined once in the **1970's** and currently with this reduced capacity is pulling up sand and is causing damage to the irrigation system components. There is also an emergency feed from the domestic supply of **300** gallons per minute that also feeds the **HVAC** unit. I do not recommend using this feed due to the **A/C's** heavy demand at the same time irrigation would be used the most.

With the current water window of **6** hours per day and having **42** acres to cover I would recommend that a new well with a capacity of **1000** gallons per minute and a **Variable Frequency Drive** motor be installed. This along with a computer controlled satellite and weather station that can calculate evapotranspiration rates on a daily basis and automatically update the zone run times. This would keep any waste to an absolute minimum.

This system is currently having its flow monitored by **2** water meters; one being a new electronic on the **VFD** which is a highly accurate device and the other, a bronze propeller type from 1940. Having compared the readings it is my belief that the old meter is off by **60** to **70** percent and should no longer be used to calculate the wells usage. I also believe this meter has not functioned properly for a long time. Any readings recently taken from this meter should be disregarded.

AUTOMATIC IRRIGATION DESIGN

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Also note we have to back out these calculations for natural rainfall the following are the average precipitation rates

APRIL	**=4.17 IN**
MAY	**=4.22 IN**
JUNE	**=3 67 IN**
JULY	**=4.36 IN**
AUGUST	**=4.14 IN**
SEPT	**=3.99 IN**
AVERAGE TOTAL PERCIPITATION DURING WATERING SEASON	**=24.55 IN**

Understand that these are the combined history of **100 years** of record and that although it would seem that you would receive **60** to **70** percent of your total irrigation need (ie, **65** percent of **35,639,100** gallons, or approximately **23,165,415** gallons) from natural precipitation, leaving a remainder of approximately **12,473,685** gallons of required pump age, in reality you don't. The recommended maximum pump age requirements must be based on more conservative calculations to allow for a safe margin for the existing system and most importantly considering variations from average precipitation (i.e.: drought periods) and evapotranspiration.

The contribution from natural precipitation needs to be adjusted conservatively to reflect anticipated dry spells. Based on the combined history of 100 years of record, a typical dry season averages approximately **17** inches of total precipitation during the watering season considered above.

AUTOMATIC IRRIGATION DESIGN

333 Baldwin Rd. Hempstead, NY 11550 ▫ Div. of Stewart Senter Inc. ▫ Sales (516) 486-7500 ▫ Service (516) 486-7515 ▫ Fax (516) 486-8800

This represents an approximately **30** percent reduction in the contribution from natural precipitation (or approximately **6,949,624** gallons) Therefore, because make up of irrigation water during a typical dry season can only be accomplished by irrigation well pump age at this site, an additional **6,949,624** gallons needs to be factored into the maximum pump age capacity requirement. Furthermore, an additional amount needs to be factored into the maximum pump age requirement because, in reality the needed evapotranspiration rate on a day-to-day basis is not reached. Based on my **23** years of experience, an appropriate safety margin is estimated to be between **30** and **35** percent of the total irrigation need of **35,639,100** gallons (or approximately **11,582,700** gallons of additional water) With these adjustments in mind , the total required pump age would be approximately **31,000,000** gallons .

My recommendation is to apply for a not to exceed cap of **31,000,000** gallons this would allow for some but not all of the remaining property to receive some irrigation in the future and allow a safe margin for the existing system. From the perspective of a weekly water usage requirement in inches, this recommended maximum required pump age translates into **1.09** inches with natural precipitation making up the remainder of **0.16** inches to meet the total irrigation need of **1.25** inches per week.
If you would like to discuss this or any irrigation matter I can be reached at the above phone numbers.

Sincerely,
Robert Cerchia **C.I.C., C.L.I.A.**

Certified Irrigation Contractor
Certified Landscape Irrigation Auditor
General Manager Commercial Division
Automatic Irrigation Design

ARCADIS GERAGHTY & MILLER

Appendix C

Driller's Log for Existing Irrigation Well (N-2576)

Nassau
County

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

N-2576
Well No.

COMPLETION REPORT – LONG ISLAND WELL

OWNER: NO. SHORE TOWERS (S. Sommer)

ADDRESS: 280 Park Ave., New York, N.Y.

LOCATION OF WELL: NO. SHORE TOWERS (Marcus Ave. G.C.) Little Neck (formerly Glen Oaks)

DEPTH OF WELL BELOW SURFACE: 200' ft.

DEPTH TO GROUND WATER FROM SURFACE: 132'-6" 7/2/75 ft.

CASINGS

DIAMETER in. | in. | in. | in.

LENGTH ft. | ft. | ft. | ft.

SEALING

CASINGS REMOVED

SCREENS

MAKE

OPENINGS

DIAMETER in. | in. | in. | in.

LENGTH ft. | ft. | ft. | ft.

DEPTH TO TOP FROM TOP OF CASING

PUMPING TEST

DATE

TEST OR PERMANENT PUMP?

DURATION OF TEST days | hours

MAXIMUM DISCHARGE gallons per min.

STATIC LEVEL PRIOR TO TEST ft. | in. below top of casing

LEVEL DURING MAXIMUM PUMPING ft. | in. below top of casing

MAXIMUM DRAWDOWN ft.

Approximate time of return to normal level after cessation of pumping hrs. | min.

PUMP INSTALLED

TYPE

MAKE

MODEL NO.

MOTIVE POWER

MAKE

H.P.

CAPACITY g.p.m. against | ft. of discharge head

NUMBER BOWLS OR STAGES | ft. of total head

DROP LINE

DIAMETER in.

LENGTH ft.

SUCTION LINE

DIAMETER in.

LENGTH ft.

METHOD OF DRILLING: ☐ rotary ☒ cable tool ☐ other

USE OF WATER: Irrigation

WORK STARTED: 5/15/75

COMPLETED: 7/75

DATE: 12/10/76

DRILLER: Layne-New York Co., Inc.

LICENSE NO.: 5

*NOTE: Show log of well - materials encountered, with depth below ground surface, water bearing beds and water levels in each, casings, screens, pump, additional pumping tests and other matters of interest. Describe repair job.
See Instructions as to Well Drillers' Licenses and Reports. Pages 5 - 7.

* LOG

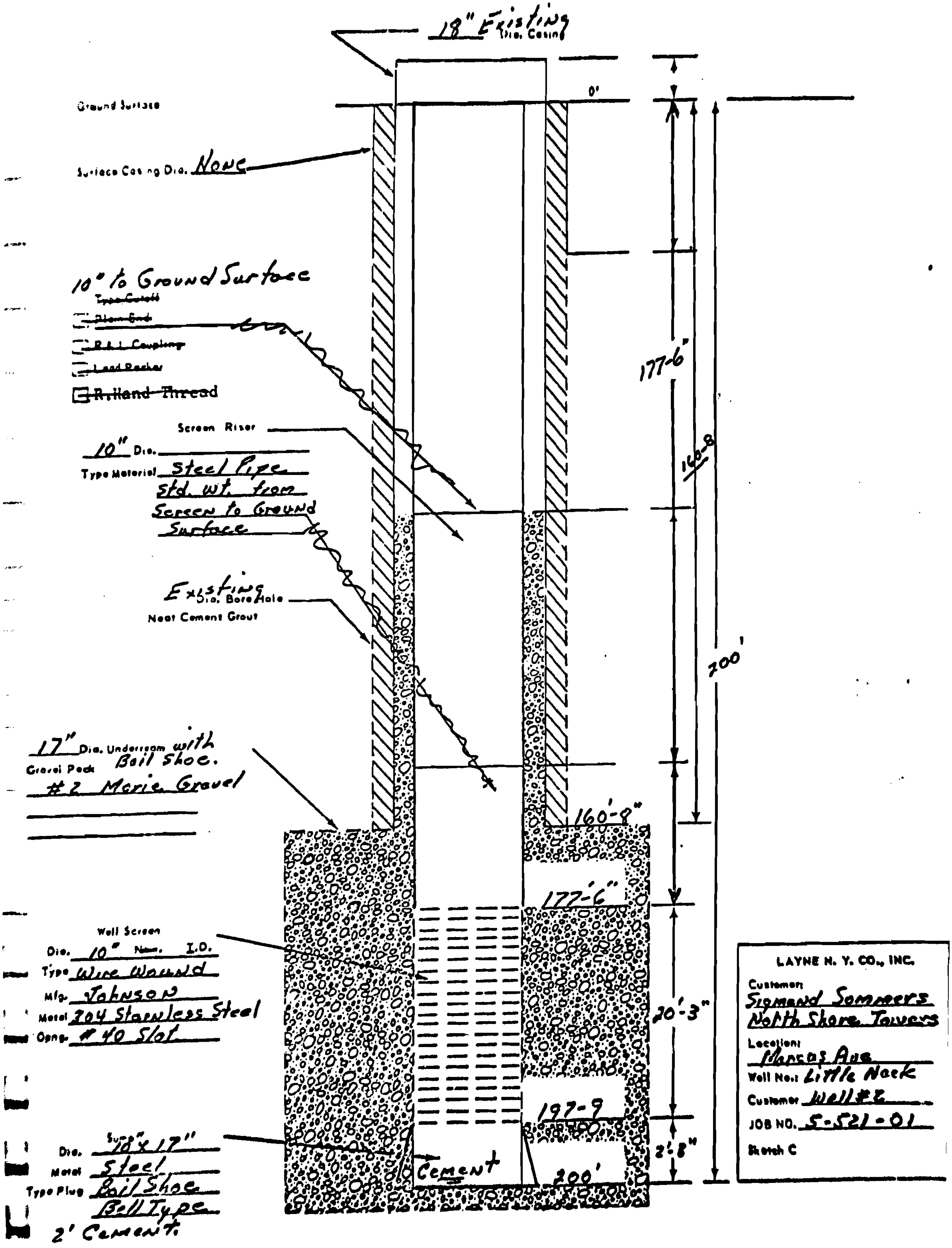
Ground Surface

El. ft. above sea

ft.

TOP OF WELL

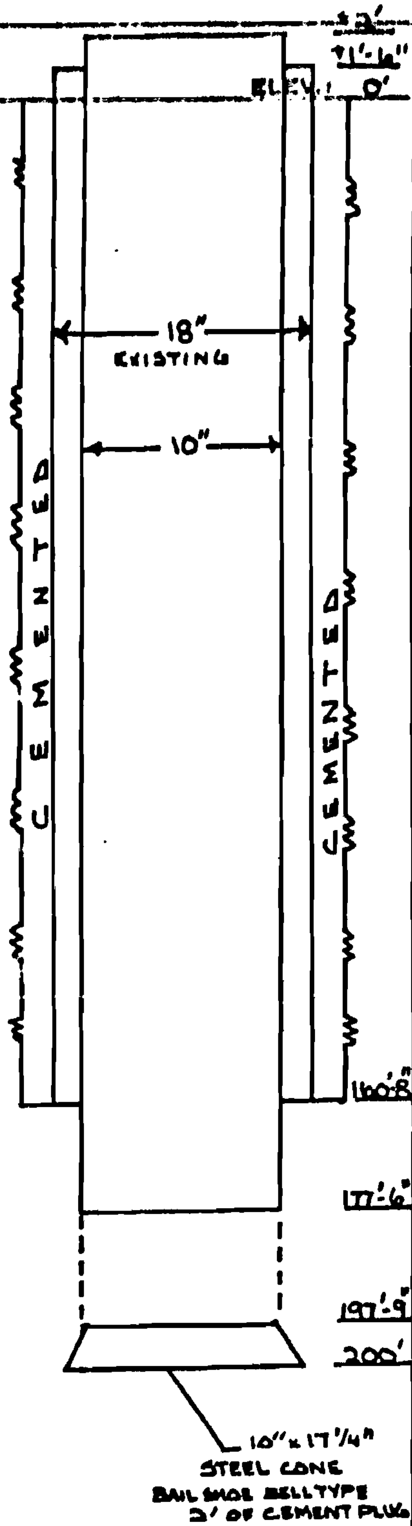
Note: Pulled out old brass shutter screen and riser pipe. Installed 20' of stainless steel #40 slot Johnson wire-wound screen with a 10" x 17" bail shoe on it, plus a new 10" riser pipe to grade with #2 morie gravel around it.



18" Existing Dia. Casing
Ground Surface
0'
Surface Casing Dia. None
10" to Ground Surface
~~Type Cutoff~~
~~Plain End~~
~~R & L Coupling~~
~~Lead Packer~~
~~R. Hand Thread~~
Screen Riser
10" Dia.
Type Material Steel Pipe std. wt. from Screen to Ground Surface
Existing Dia. Bore Hole
Neat Cement Grout
177-6"
160-8
200'
17" Dia. Underream with Bail Shoe.
Gravel Pack #2 Morie Gravel
160'-8"
177'-6"
Well Screen
Dia. 10" Nom. I.D.
Type Wire Wound
Mfg. Johnson
Metal 304 Stainless Steel
Opng. #40 Slot
20'-3"
197-9
2'-8"
Sump Dia. 18" x 17"
Metal Steel
Type Plug Bail Shoe Bell Type
2' Cement.
Cement
200'
LAYNE N. Y. CO., INC.
Customer: Sigmund Sommers North Shore Towers
Location: Marcus Ave
Well No.: Little Neck
Customer Well #2
JOB NO. 5-521-01
Sketch C

ORIGINAL GROUND LEVEL 0'

SANDY CLAY AND BOULDERS	80'
SANDY CLAY AND GRAVEL	113'
HARDPAN	117'
RED AND WHITE CLAY	136'
SANDY CLAY	156'
MEDIUM LIGHT BROWN SAND	199'
SANDY CLAY AND HARD STREAKS	



MATERIAL N-2576

PIPE: 162'-2" OF 18" DIAM. BLACK STEEL PIPE WELDED
181' OF 10" DIAM. .365" WALL BLACK STEEL PIPE WELDED

SCREEN: 20' OF 10" DIAM. JOHNSON W.W. - 304 STAINLESS STEEL SCREEN - NO. 40 SLOT

PLUG: CEMENT CONE - 2'-2" OF 10" DIAM. TOP TO 17 1/4" DIAM STEEL PIPE

GRAVEL: 150 BAGS OF MORIE #2

SEAL:

PUMP

SIZE	10"	NUMBER	16064
STAGES	11	TYPE	RKHC
SETTING	179'-8" TO S.F.	COLUMN	7" x 5' x 10' CPLD.
TUBING	2 1/2"	SHAFTING	1 1/2" CRS
BOWLS	CAST IRON ENAM.	IMPELLERS	BRONZE
IMP. SHAFT	410 STAINLESS STEEL	SUCTION	10' OF 6"
STRAINER	NONE	PRESS. B.P.	
HEAD	TF818	AIR LINE	170' - B.P.

MOTOR

MAKE	US	TYPE	CFU
VOLTS	220/440	CYCLE	60
PHASE	3	AMP.	180 - 90
H. P.	75	RPM	1800
FRAME	445-9	NON REV.	YES
MODEL	HOLLOWSHAFT	SERIAL NO.	661906
UPPER BRG.		LOWER BRG.	

GEAR DRIVE

MFG.		MODEL	
RATIO		SERIAL NO.	
HVY. THRUST		NON-REV.	

ENGINE

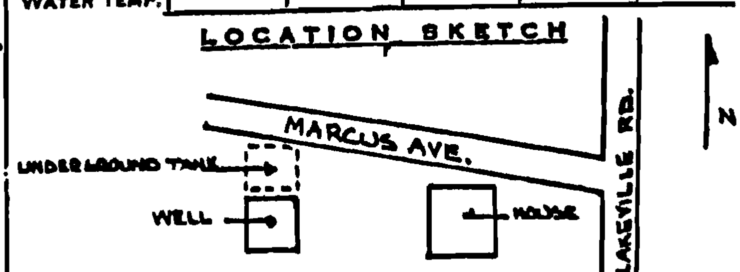
MFG.		MODEL	
RPM		CONTINUOUS H. P.	
FUEL		SERIAL NO.	

WELL

STARTED	5-13-75	CLEAR DEPTH	200' B.P.
FIRST TEST	7-2-75 REDRILL	METHOD	CABLE TOOL
FINAL TEST		GUAR. CAP.	
ACCEPTED		GUAR. PRESS.	
B. P. ELEV.		FORMATION	
DIST. TO G.W.		DRILLER	D. CICONNA

DATE	7-2-75			
STATIC LEV.	132'-6"			
PRODUCTION	321 GPM			
PUMP. LEVEL	141'-6"			
WATER TEMP.				

LOCATION SKETCH



LAYNE-NEW YORK CO., INC. - LINDEN, N. J.
WATER SUPPLY CONTRACTORS
NORTH SHORE TOWERS (FORMERLY GLEN OAKS CLUB INC)
MARCUS AVE. LITTLE NECK N.Y.

DRAWN BY K.C.
STATE # N-2576
LAYNE WELL #
CUSTOMER WELL # 2

ARCADIS GERAGHTY & MILLER

Appendix D

Risk Assessment Report

ARCADIS GERAGHTY & MILLER

APPENDIX K

Baseline Human Health Risk Assessment Report

Former Unisys Facility
Operable Unit 2

PREPARED FOR

Lockheed Martin Corporation

ARCADIS GERAGHTY & MILLER

APPENDIX K

Baseline Human Health Risk Assessment Report

Former Unisys Facility
Operable Unit 2

Miranda Henning
Principal Scientist

Carlo San Giovanni
Project Manager

Nicholas Valkenburg
Project Director

Prepared for:
Lockheed Martin Corporation

Prepared by:
ARCADIS Geraghty & Miller, Inc.
24 Preble Street
Suite 100
Portland
Maine 04101
Tel 207 828 0046
Fax 207 828 0062

Our Ref.:
NY001227.0005.ME004

Date:
November 4, 1999 DRAFT

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Tables

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1. Introduction

ARCADIS Geraghty & Miller performed a baseline human health risk assessment (HHRA) as part of the Remedial Investigation (RI) for Operable Unit 2 (OU-2) of the former Unisys facility (the Site) in Great Neck, New York. OU-2 consists of the off-site areas immediately surrounding the Site. The primary purpose of the OU-2 RI was to evaluate the nature and extent of site-related chemicals in off-site groundwater. A baseline risk assessment was previously conducted for the 94 acre on-site project area (Operable Unit 1 or OU-1). The results of that risk assessment suggested that off-site migration of groundwater might pose human health risks (H2M 1997). The objective of the OU-2 HHRA is to characterize potential health risks associated with off-site migration of site-related chemicals in groundwater assuming no remediation is undertaken on the groundwater system.

The OU-2 HHRA was performed in accordance with the numerous guidance documents that have been issued by the U.S. Environmental Protection Agency (EPA). The most important of these guidance documents are:

- *Risk Assessment Guidance for Superfund (RAGS)-Parts A and D (EPA 1989, 1998);*
- *RAGS Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (EPA, 1991);*
- *Supplemental Guidance to RAGS: Calculating the Concentration Term (EPA, 1992a);*
- *Guidelines for Exposure Assessment (EPA, 1992b);*
- *Exposure Factors Handbook (EPA, 1997a); and*
- *Policy for Risk Characterization (EPA, 1995a).*

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The primary components of the HHRA are:

1. Data Collection and Evaluation - collection and analysis of relevant site data and identification of chemicals of potential concern (COPCs).

2. Exposure Assessment - evaluation of chemical releases, identification of exposed populations and potential exposure pathways, estimation of exposure point concentrations and chemical intakes for each pathway.

3. Toxicity Assessment - compilation of quantitative and qualitative toxicity information and identification of toxicity values descriptive of the dose-response relationship for each COPC.

4. Risk Characterization - estimation and summary of cancer and noncancer risks.

5. Uncertainty Analysis - description of the uncertainty associated with each component of the risk assessment.

The risk assessment components outlined above are presented in Sections 3 through 8 of this report for the OU-2 HHRA.

2. Site Background and History

The former Unisys facility, located at 365 Lakeville Road, in Great Neck, New York, is currently vacant, except for operation and maintenance of various remedial systems. The facility was previously used for the manufacture of products related to national defense. Processes included a foundry, etching, degreasing, plating, painting, machining, and assembly. Halogenated and nonhalogenated organic solvents, cutting oil, paint, and fuel oil were used as part of manufacturing activities at the Site. Groundwater was previously used as non-contact cooling water at the facility. Since 1993, an Interim Remedial Measure (IRM) for the removal, treatment, and re-injection of groundwater has been in operation at the Site. In addition, a soil-vapor extraction (SVE) system was installed in 1994 for remediation of volatile organic compound (VOC) contamination in the former dry well area.

The New York Department of Environmental Conservation (NYSDEC) has classified the former Unisys facility as Class 2 Site, due to chemicals in soil and groundwater (Site No. 130045, NYSDEC Registry of Inactive Hazardous Waste Disposal sites in New York State). On March 31, 1997, a Record of Decision (ROD) was signed,

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detailing the selected remedial actions for the 94 acre on-site project area (OU-1). In January 1998, a work plan was proposed for the RI for off-site areas immediately surrounding the site (OU-2) (ARCADIS Geraghty & Miller, 1999).

This HHRA for OU-2 is intended to characterize the nature and extent of potential past, current, and future risks to human health associated with site-related chemicals in off-site groundwater[1]. For all current and future exposure pathways, it was assumed that neither the public water supply wells nor the irrigation wells are treated. The future exposure scenarios also evaluated risks assuming that no remedial actions are taken to reduce chemical concentrations in groundwater.

Some municipal drinking water wells and wells supplying nearby golf courses' spray irrigation systems are already affected and/or could be affected by site-related chemicals in groundwater in the future. However, wells with concentrations greater than maximum contaminant levels (MCLs) being used to provide potable water are currently being treated to prevent exposure above the MCL. While this HHRA focuses on off-site groundwater as the source of site-related chemicals, those chemicals may be transferred to both air and surface soil as the groundwater is used. This HHRA evaluates potential risks associated with chemicals in wells that have already been affected or could potentially be affected, as determined by groundwater modeling:

- Municipal drinking water from wells in the Manhasset-Lakeville Water District and Great Neck North District that have already been affected or are predicted to be affected (Wells N5710, N3905, N4243, N5099, N0022, N12999, and N13000);
- Spray irrigation water for the North Shore Towers Golf Course, Village of Lake Success Golf Course, and Deepdale Golf Course (Well N2576, N8038, and N5535);
- Air; and
- Surface soil wetted by spray irrigation at the North Shore Towers and Village of Lake Success golf courses.

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[1] Baseline risk assessment do not generally consider risks associated with past exposures. However, NYSDEC has specifically requested that risks be evaluated for past residents that may have watered their vegetable gardens with impacted groundwater.

Table 2-1 summarizes potential exposures associated with these four media.

3. Data Collection and Evaluation

In October and November 1998, 74 groundwater samples were collected from on-site and off-site monitoring wells and analyzed for Target Compound List (TCL) VOCs and Freon 113 using NYSDEC ASP Method 95-1. A detailed description of the groundwater well sampling technique is provided in Section 2.2 of the RI Report. H2M Labs of Melville, New York performed all chemical analyses. Quality Assurance/Quality Control (QA/QC) of laboratory results was conducted according to NYSDEC ASP Method 95-1. All data results from H2M Labs were reviewed by Data Validation Services (DVS), North Creek, New York and performed in accordance with the NYSDEC RI/FS Validation Scope of Work, with guidance from the most current editions of the USEPA Contract Laboratory Program (CLP),"National Functional Guidelines for Organics Data Review" and the EPA Validation SOPs HW-6. With the exception of sample MW-33GL, the validated sample results met the data quality objectives (DQOs) stated in the OU-2 RI Work Plan (H2M 1998a) and are usable for the project. Since Well MW-33GL was analyzed outside of the required holding times, the possibility exists for false negative results.

In May, June, and July 1999, 76 groundwater samples were collected from on-site and off-site wells. The newly installed monitoring wells (37MU, 37MI, 37ML, 38MU, 38MI, 38ML, 39MU, 39MI, and 39ML) were sampled in September and October of 1999. Non-municipal Supply Well N2576 was sampled in July and August 1999 and Non-municipal Supply Wells N5535 and N8038 were sampled in October 1999. All wells were analyzed for TCL VOCs and Freon 113 using NYSDEC ASP Method 95-1. A detailed description of the groundwater well sampling technique is provided in Section 2.2 of the RI Report. Severn Trent Laboratories in Monroe, Connecticut performed all chemical analyses. QA/QC of laboratory results was conducted according to NYSDEC ASP Method 95-1. All data results from Severn Trent Laboratories were reviewed by ARCADIS Geraghty & Miller and performed in accordance with the NYSDEC RI/FS Validation Scope of Work, with guidance from the most current editions of the USEPA CLP," National Functional Guidelines for Organics Data Review" and the EPA Validation SOPs HW-6.

Tables 3-1 through 3-2 describe the occurrence and distribution of chemicals detected in groundwater at all monitoring wells and groundwater at the spray irrigation supply well, respectively. Because chemicals in air were not monitored, tables are not included that describe the occurrence and distribution of chemicals in air. Rather, the results of the models used to predict concentrations in air that could result from volatilization from groundwater are presented as part of the exposure assessment (Section 5.3.2).

4. Identification of COPCs

COPCs for this HHRA were selected based on the frequency of detection. Compounds were designated COPCs if the detection frequency exceeded five percent. Comparisons of detected concentrations to background were not used to select COPCs because VOCs do not generally occur naturally in groundwater, air, or soil. Likewise, because none of the detected chemicals are essential nutrients, status as nutrients was not used as a basis to screen out potential COPCs. New York State Standards, Criteria, and Guidance Values (SCGs) were considered potential applicable or relevant and appropriate requirements (ARARs) for the purpose of the HHRA; however, these criteria were not used to screen chemicals from consideration as COPCs.

Tables 3-1 and 3-2 present the selection or exclusion of detected chemicals as COPCs in groundwater at both the municipal wells and the spray irrigation well. Because COPCs in air and soil are assumed to be derived from groundwater, the same COPCs designated for groundwater are designated for air and soil.

5. Exposure Assessment

Exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of human exposure to substances present in the environment. The exposure assessment includes the identification of potentially exposed populations, development of exposure scenarios, analysis of exposure pathways, definition of exposure points, and estimation of exposure point concentrations (EPCs) to estimate potential intake under past, current and reasonably foreseeable uses of off-site groundwater. Intake estimates are subsequently combined with the toxicity values identified in Section 6 to estimate the risks of current and foreseeable future exposures, as part of the risk characterization discussed in Section 7. The exposure assessment is a critical component of the risk assessment process, as it qualitatively and quantitatively describes potential contact between COPCs and the people that may be affected by them.

5.1 Exposure Setting

The former Unisys facility is located at the intersection of Marcus Avenue and Lakeville Road within both the Village of Lake Success and the Town of North Hempstead in Nassau County, New York. The area surrounding the facility is comprised of industrial and commercial facilities to the east, northeast and northwest, and residential properties bordering the site to the southeast, south, and southwest. Lake Success is located approximately 1,600 feet north of the site. Data from the 1990 U.S. Census indicate a population of approximately 20,000 people living within two miles of the site. Six schools and one hospital are also located within two miles of the site. A well survey conducted as part of the OU-1 risk assessment revealed that all properties within one and a half miles of the site are on the public water supply system (H2M 1997).

Exposure to the affected aquifer is influenced by the regional and local hydrogeology, which is described in detail in Section 3.3 of the OU-2 RI report. The public water supply system in the Great Neck Area of Long Island, New York is described in the report, *Great Neck Area Public Water Supply Study* (H2M 1998b). As described in the Public Water Supply Study, there are at least 14 public wells within the vicinity of the site. However, the only wells evaluated in the risk assessment are those wells already affected or predicted by groundwater modeling to be affected in the future. Three golf courses draw water from the affected aquifer for use in irrigation.

The HHRA for OU-1 provided data on the climatological and meteorological setting for the former Unisys facility (H2M 1997). The mean air temperature is 1.3 °C during the winter months and 21.7°C during the summer months. The maximum monthly precipitation during the spring and late summer is typically 9 to 10 cm. The predominant wind direction is out of the south, with west-northwesterly winds also present at a relatively high frequency. Average wind speeds of approximately 13 miles per hour are routinely encountered.

5.2 Conceptual Site Model

The conceptual site model for the HHRA describes the chemical sources, receiving media, retention and/or transport of chemicals, and potential exposure profiles for current and foreseeable uses. During the OU-1 RI, the dry well area of the former Unisys facility was identified as the source of elevated chemical concentrations detected in on-site groundwater; this source area resulted from wastewater disposal practices associated with previous manufacturing operations. The migration of chemicals in groundwater to off-site locations is discussed in detail in Section 6 of the OU-2 RI report.

On February 21, 1997, an investigation was conducted to determine potential migration of groundwater into Lake Success (H2M 1998b). The investigation focused on determining the depth of the lake bottom in comparison to the depth to groundwater. Depth soundings were recorded along three transect lines and confirmed that the depth of the lake ranged from 4 to 71 feet. Data collected from monitoring wells determined that groundwater occurs at approximately 160 feet below grade in the vicinity of Lake Success. Hence, because there is at least 80 to 90 feet vertical distance between the lake bottom and the groundwater table, Lake Success does not intercept the groundwater plume and cannot become contaminated.

Overall, the available analytical data indicate that chemicals in groundwater have migrated from the former Unisys facility to the residential areas north of the site. Within this area, the COPCs (i.e., chemicals detected in more than 5 percent of samples) are chloroform, 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethene (1,2-DCE), Freon 113, trichloroethene (TCE), tetrachloroethene (PCE), and toluene. Residential properties within this area utilize the public drinking water supply. Although some residential properties overlie the groundwater plume, the depth of the groundwater contamination (>80 feet below grade) suggests that vapor intrusion into residential buildings is implausible.

A groundwater fate and transport model was used to evaluate the potential for site-derived chemicals in groundwater to affect public water supply wells in the future assuming no remedial action. The results of this model indicate that, during the next 30 years, VOCs may be detected in downgradient water supply wells. At that time, residents in the Great Neck area could potentially be exposed to site-derived chemicals in drinking water. If however, chemicals were to be detected in any public water supply wells above the MCL, treatment would be provided. The groundwater fate and transport model is further described in Section 6 of the OU-2 RI report.

Groundwater modeling was conducted for wells in two water supply districts: Manhasset-Lakeville and Great Neck North. The modeling results indicated that the Manhasset-Lakeville Water District will likely be affected by the plume to a greater extent than the Water Authority of Great Neck North. The 30-year average concentration for the Manhasset-Lakeville wells is 0.076 mg/L compared to 0.014 mg/L for the Great Neck North wells. Therefore, only the modeling data for the

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Manhasset-Lakeville water district were used in this HHRA, as this district represents worst case conditions.

Three golf courses also use irrigation wells that draw groundwater from the impacted aquifer. These include the North Shore Towers golf course (Well N2576), the Village of Lake Success Golf Course (Well N3038), and the Deepdale Golf Club (Well N5535). Of these wells, the one servicing the North Shore Towers golf course is located closest to the most impacted portion of the plume. As such, it represents worst case conditions for potential exposure to VOCs in irrigation water and, therefore, analytical data from Well N2576 were used to evaluate all exposures to irrigation water.

Exposure profiles were developed for potential receptors in the off-site areas surrounding the former Unisys facility, as summarized in Table 2-1. For this HHRA, the sources of exposure to groundwater (assuming no remedial action and no treatment) may occur at the impacted municipal supply wells for the Manhasset-Lakeville Water District (Wells N5710, N3905, N4243, and N5099) and at the irrigation well for North Shore Towers golf course (Well N2576). (In reality, Wells N3905, N4243 and 5710 are already equipped with treatment Plant). From these points of exposure, VOCs may be transferred to air (through volatilization) and/or surface soil (by watering the grass or a garden). Receptors include residents, who may be grouped as either living at the North Shore Towers condominiums or in single family houses (hereafter referred to as either North Shore Towers residents or Residents), as well as groundskeepers and golfers at the North Shore Towers golf course. All potential exposure scenarios were evaluated using both conservative (high end) and more realistic (central tendency) exposure assumptions. Both children and adults were evaluated for the residential scenarios, while it was assumed that groundskeepers and golfers are adults.

Although the groundwater plume has migrated to the residential area near the site, residents in the Manhasset-Lakeville Water District (i.e., Residents) are not currently exposed to chemicals in the groundwater because they rely on the public water supply (which is either not currently impacted or is receiving treatment) and the groundwater plume is more than 80 feet below ground surface. In the future, however, if site-related chemicals in groundwater are detected in the public water supply wells that are not now receiving treatment, adult and child Residents would be potentially exposed to COPCs. These receptors could potentially ingest COPCs in tap water, inhale vapors while showering, and absorb COPCs through the skin following dermal contact with tap water.

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Because North Shore Towers residents are not served by the Manhasset-Lakeville water district, but by water from New York City, they cannot be exposed to COPCs in tap water. However, they may have been exposed to COPCs in the past 18 months during gardening activities. North Shore Towers residents can maintain garden plots on the condominium property. The garden plots have only been available for use since the spring of 1998. Each plot is approximately 8 feet by 10 feet in size. On average, about 40% of the plots are ornamental, while 60% of the plots are planted with vegetables. In 1998 and for part of the 1999-growing season, water was supplied to the garden plots from the Well N2576, which is also the well that supplies the golf course's irrigation system. During the summer of 1999, the water supplying the garden plots was switched to the municipal water supply which is provided by New York City. Consequently, between the spring of 1998 and the summer of 1999, Residents may have been exposed to COPCs in groundwater at the irrigation well through dermal contact with water, incidental ingestion of water, inhalation of VOCs that volatilized from the spray irrigation water to the air, dermal contact with surface soil that had been wetted with spray irrigation water, incidental ingestion of surface soil that had been wetted with spray irrigation water, and consumption of homegrown produce that had been watered using water from Well N2576.

As noted above, the source of water supplied to the garden plots was changed from the spray irrigation well to the municipal water supply wells during the summer of 1999. Hence, current North Shore Towers residents no longer face potential exposures to site-related chemicals in groundwater as a result of gardening activities. However, the golf course continues to be irrigated by water from the spray irrigation wells. As a result, there is the remote possibility that current and future North Shore Towers residents could be exposed to volatilized chemicals derived from the irrigation water that may accumulate in their apartments. For such exposures to occur, volatilized COPCs would have to be transported to the intake of the building's air-conditioning system, without being diluted, degraded or transformed.

As noted above, the golf course continues to be spray irrigated with water containing COPCs. The groundskeeper typically begins work on the golf course early in the morning, after some spray irrigation has ceased, but while the grass may still be damp. The current and future groundskeeper may contact COPCs in spray irrigation water through inhalation of chemicals that volatilized during irrigation activities (both at night and during the day), dermal contact with spray irrigation water as he or she walks through the damp grass, dermal contact with surface soil wetted by the spray irrigation water, and incidental ingestion of surface soil wetted by the spray irrigation water if any digging or hoeing is necessary.

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Given the timing of the spray irrigation and the objective of minimizing disturbance to golfers by spray irrigation, there is very limited potential for golfers to contact COPCs in the spray irrigation water. By the time the golf course opens in the morning, VOCs in air that volatilized during the night's spray irrigation are expected to have dispersed and/or photooxidized, and the grass is expected to have dried. However, because soil wetted by spray irrigation may still be damp when the golf course opens, it is conservatively assumed that golfers may be exposed to COPCs through dermal contact with and incidental ingestion of surface soil that has been wetted by spray irrigation water.

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5.3 Determination of Exposure Point Concentrations

Exposure point concentrations (EPCs) are derived in Tables 5-1 through 5-9 for the various combinations of time frames, environmental media and exposure points considered in this HHRA. EPCs were derived in six different ways: (1) to estimate future concentrations of COPCs at the municipal drinking water wells and spray irrigation wells, a groundwater fate and transport model was employed; (2) a volatilization factor was used to estimate concentrations of COPCs in air as a result of volatilization of VOCs in tap water during showering; (3) a combination of a near-field box model and a vapor emissions model was used to estimate concentrations of COPCs in air as a result of volatilization of VOCs in spray irrigation water during irrigation; (4) groundwater monitoring data were used to estimate all other groundwater EPCs; (5) in the absence of surface soil data, it was assumed that concentrations of COPCs in the irrigation well water were not diluted upon release to soil and, therefore, that EPCs for soil were equal to EPCs for the spray irrigation well water; and (6) except for concentrations of COPCs, EPCs in vegetables were estimated by modeling uptake of COPCs by vegetables. Each of these methods is detailed below.

In accordance with EPA exposure assessment and risk characterization guidance (EPA 1992b, 1995a), EPCs were calculated for both high-end and central tendency exposure scenarios. The high-end scenario describes individuals at the upper end of the population distribution (greater than 90th percentile, but not above the distribution), while the central tendency estimates characterize individuals in the middle of the population distribution (approximately 50th percentile).

5.3.1 EPCs for Future Groundwater

As detailed in Section 6 of the RI report, a groundwater fate and transport model was employed to estimate total VOC (TVOC) concentrations at each water supply potentially affected in the future by the OU-2 groundwater plume, based on the monitoring data collected in 1998. The model was not re-run using 1999 monitoring data for a number of reasons. First, NYSDEC agreed that use of the 1998 data was appropriate (Personal communication, Girish Desai, September 28, 1999). Second, the mass of TVOC measured in 1998 and 1999 appears to be comparable. Third, assuming that the model is accurate, use of the 1999 data would generate very similar results for a time period that starts and ends one year later in time.

As an initial step in developing EPCs for groundwater for future scenarios, both the 1998 and 1999 monitoring well data were evaluated to determine whether the TVOC concentration is comprised of a consistent contribution of individual COPCs. This was done to determine whether percentage values could be applied to convert the modeled TVOC concentrations to estimate future COPC concentrations at the water supply well exposure point. Table 5-10 presents the percentage of each VOC as compared to the TVOC concentration and each monitoring well. On average, the majority of TVOC in groundwater is 1,2-DCE (65%), while TCE (24%), PCE (14%) and toluene (13%) were also present at elevated concentrations and at high frequencies of detection. The other four COPCs (1,1-DCE, 1,1-DCA, chloroform, and Freon 113) comprised considerably lower fractions of TVOC (0.43% to 4.5%), on average.

As previously indicated, the groundwater wells modeled currently service three different water supply districts. Although all wells were modeled, only those wells expected to be impacted were evaluated in the risk assessment. The modeling results therefore, are conservative (i.e., health-protective) surrogates for the actual expected concentrations that may be present in the water supply system (given that some wells are not predicted to be affected), in the absence of remediation. That is, mixing impacted water with unimpacted water in the supply system will results in lower concentrations at the tap than would be observed at the impacted wells. As previously discussed, only modeling results for the affected wells within the Manhasset-Lakeville water district were included in this HHRA, because the modeling predicts that these wells will be affected to a greater extent than wells in other water districts.

As presented in Table 3-2, the central tendency EPC was selected as the arithmetic mean of the 30-year mean concentrations for the four impacted wells located within the Manhasset-Lakeville water district. The high end EPC was selected as the maximum of the 30-year mean concentrations for the four impacted wells in this water district. The maximum of the 30-year mean was viewed as a more appropriate high end EPC than the peak concentration, because the peak concentration is an instantaneous value, in contrast with a long-term concentration. The maximum 30-year mean was selected instead of the 95% upper confidence limit (UCL) on the mean because the relatively small sample size would cause the 95% UCL on the mean to exceed the maximum modeled concentration.

Although individual COPCs were not modeled, EPCs were calculated separately for carcinogenic and noncarcinogenic COPCs. All compounds identified as COPCs have been determined to cause noncancer health effects. As a result, the maximum 30-year average TVOC concentration was used in the high-end analysis, while the mean of the 30-year mean concentrations was used in the central tendency analysis (Table 5-2). In contrast, only three COPCs (chloroform, 1,1-DCE and 1,1-DCA) are possible human carcinogens (see Section 6.0). The maximum concentration of TVOC was measured in monitoring well 17GL. Carcinogens comprised only 0.22% of the TVOC in this well in 1998 and 0% in 1999. The EPCs used to evaluate cancer risks conservatively assumed that 0.22% of the TVOC concentration was comprised of carcinogenic compounds. The mean and maximum concentrations used in the central tendency and high end analyses were adjusted accordingly (Table 5-2). The carcinogenic compounds 1,1-DCE and 1,1-DCA are not consistently detected in monitoring wells with lower TVOC concentrations, suggesting that these chemicals may not actually reach the public drinking water supply wells (Table 5-1). Tap water concentrations used in the ingestion and dermal contact pathways were assumed to be equivalent to either the maximum or mean modeled TVOC concentrations at the water supply wells.

For future exposures to COPCs in spray irrigation water, EPCs were derived using modeling results specific to the spray irrigation well (Table 5-3).

5.3.2 EPCs for Air

Because data are not available on the (future) concentrations of TVOCs in indoor air in the homes of Residents, the EPC in the shower was estimated using a volatilization factor (K) of 0.0005 x 1000 L/m^3. Table 5-4 presents the calculation of concentrations of COPCs in indoor air based on concentrations of COPCs in tap water used for showering.

To estimate air concentrations resulting from VOCs in spray irrigation water during irrigating, the near-field box model approach (Pasquill 1975; Horst 1979) and the

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vapor emission model approach (Andelman 1984; 1985a,b) were employed (Tables 5-5 and 5-6). The air release model was initially developed using radon as a standard (Andelman 1984; 1985b), but is also applicable to VOCs. The air release model calculates the concentration of VOCs in ambient air on-site using the following equation:

$$C_a = \frac{C_{gw} x Q_{gw} x E}{H_b x W_b x U_m} \qquad \text{Equation 1}$$

where:

C_a = concentration of VOC in ambient air on-site (mg/m^3).

C_{gw} = concentration of VOC in groundwater (mg/L);

E = efficiency of release of VOC from spray water to air (unitless);

Q_{gw} = pumping rate for non-potable well (L/s);

H_b = downwind height of box in meters (m);

W_b = width of box, crosswind dimension of the affected area (m); and

U_m = average wind speed through the box (m/s).

The average wind speed through the box (Um) is calculated by the following equation:

$$Um = 0.22 \times U10 \times \ln(2.5 \times Hb) \qquad \text{Equation 2}$$

where:

U10 = mean wind speed at 10 m above ground surface.

The efficiency of release of VOCs from spray water to air was calculated using Equation 3 (Andelman 1984; 1985a,b). The efficiency of air release is adjusted for

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VOCs detected at the site by assuming the efficiency of release from water to air is proportional to the Henry's Law Constant. A maximum efficiency of 1.0 is imposed so that for very volatile constituents no more chemical can be lost than is present in the groundwater.

$$E = \frac{E_{STD} \times H}{H_{STD}} \qquad \text{Equation 3}$$

where:

E	= efficiency of release for a VOC (unitless);
ESTD	= efficiency of release of standard (radon) from water to air (unitless);
H	= Henry's Law Constant for a VOC (atm-m^3/mol); and
HSTD	= Henry's Law Constant for standard (radon).

Parameters used in Equations 1, 2, and 3 are presented in Tables 5-5 and 5-6. For high end exposures, the maximum groundwater concentration detected in Well N2576 in 1999 was used to estimate volatilization of COPCs. The central tendency EPC was based on mean concentrations detected in Well N2576 during the two 1999 sampling rounds. An estimated pumping rate (Q_{gw}) of 500 gallons/minute (32 L/s) was obtained from Kevin McManus, the North Shore Towers golf superintendent. Although the annual average pumping rate is estimated to be substantially lower (i.e., 21 gallons/minute), the higher pumping rate that occurs *during irrigation* was conservatively applied to this model. A default value of 10 m was applied for the width of the box. Distances to the receptor greater than 10 m will result in lower ambient air concentrations and lower exposure rates. Using wind speed data collected from LaGuardia and Kennedy Airports, wind speed was estimated to be 11.5 miles per hour or approximately 5 m/s. Based on this approach, the TVOC concentrations summarized in Table 5-5 (past and current exposures) and Table 5-6 (future exposure) were used to calculate past/current and future air EPCs for the spray irrigation pathway.

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5.3.3 EPCs for Past and Current Groundwater

Monitoring data were used to calculate EPCs for past and current exposures to spray irrigation water. Because only monitoring data from 1999 are available for the spray irrigation well, both past and current exposures to spray irrigation water used data from this data set (Table 5-7).

5.3.4 EPCs for Soil

In the absence of surface soil data for the golf course and garden plots, it was conservatively assumed that concentrations of COPCs in the irrigation well water do not change upon release to soil. Clearly, this assumption results in an overestimate of assumed soil concentrations because a substantial fraction of the TVOCs in groundwater likely volatilize upon release from the irrigation system, or shortly thereafter. As illustrated in Table 5-8, until analytical results from actual soil samples become available, the HHRA will assume that EPCs for soil are equal to the EPCs for spray irrigation well water. A proposal to sample soil at the North Towers golf course has been submitted to the NYSDEC for approval.

5.3.5 EPCs for Vegetables

EPA (1998) guidance was followed in calculating EPCs for vegetables that grow both above-ground and below-ground and may uptake VOCs in soil through their roots (Table 5-9). Equation 4 presents the equation for calculating concentrations of chemicals in above-ground vegetables using the "soil to above-ground plant transfer approach" developed by Travis and Arms (1988).

$$Cav = Cs \times Br \qquad \text{Equation 4}$$

where:

Cav = concentration in above ground vegetables (mg/kg)

Cs = concentration in soil (mg/kg)

Br = plant-soil bioconcentration factor for produce (unitless)

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Based on Travis and Arms' (1988) data, Br (on a dry weight basis) can be calculated using Equation 5. To convert from dry weight to wet weight, the moisture content of tomatoes (94 percent) was used (EPA 1997a).

$$\log Br = 1.588 - 0.578 \times \log Kow \qquad \text{Equation 5}$$

EPCs for below-ground vegetables were calculated using Equation 6, as described in EPA (1994a) and EPA (1995b).

$$Cbv = Cs \times RCF \times VG / Kd \times 1 \text{ kg/L} \qquad \text{Equation 6}$$

where:

Cbv = concentration in below ground vegetables (mg/kg)

RCF = root concentration factor (unitless)

VG = empirical correction factor for below ground produce (unitless)

Kd = soil-water partition coefficient (L/kg)

Values for VG and RCF were calculated based on the lipophilicity of the individual COPCs. A value of 1.0 was used for all COPCs, because all have logarithms of the octanol-water partitioning coefficient (log Kow) less than 4.0. The RCF (in dry weight) was calculated using Equation 7, as developed by Briggs et al. (1982). The RCF describes the ratio of the COPC concentration in the edible root to the concentration of COPCs in the soil water and was converted to a wet weight basis assuming a moisture content of 87 percent in root vegetables (EPA 1997a).

$$\text{Log}(RCF - 0.82) = 0.77 \times \log Kow - 1.52 \qquad \text{Equation 7}$$

The resultant EPCs are presented in Table 5-9.

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5.4 Description of Exposure Assumptions and Calculation of Chemical Intake

Tables 5-10 through 5-20 present the exposure equations and exposure parameter values used to estimate potential intake of COPCs for all of the various and applicable combinations of land uses, age groups, time frames, exposure points and exposure pathways. When calculating exposure for ingestion and dermal contact, intake is modeled as a dose in units of mg/kg-day, whereas for inhalation of vapors, intake is expressed as a concentration in mg/m^3.

In all cases, intake is evaluated for both high end and central tendency exposures. High end exposure has been defined by EPA (1992b) as the "plausible estimate of the individual risk for those persons at the upper end of the risk distribution. The intent of this descriptor is to convey an estimate of risk in the upper range of the distribution, but to avoid estimates which are beyond the true distribution." High end risk estimates may be calculated by "identifying the most sensitive parameters and using maximum or near-maximum values for one or a few of these variables, leaving others at their mean values" (EPA 1992b). Depending on the receptor, high end variables for the ingestion pathway were selected for two or more of the following parameters: the concentration in water, soil or vegetables, ingestion rate, exposure duration, exposure frequency, exposure time, and fraction of soil ingested from the site. For the dermal contact pathway, high end variables were selected for two or more of the following parameters (again, depending on the receptor): concentration in water, soil or vegetables, surface area, exposure frequency, and exposure time. For the inhalation pathway, high end parameters were selected for two or more of the following parameters (again, depending on the receptor): concentration in air, exposure duration, exposure frequency, and exposure time. In contrast to the high end exposure, central tendency evaluates potential intake for the average exposure. As such, central tendency exposure parameters are generally set at the 50^{th} percentile values.

Chronic and subchronic exposures were evaluated in the risk assessment. Subchronic exposure is defined as occurring over seven years or less and is often an important scenario when evaluating noncarcinogenic risks. Exposures to children were evaluated, because they would be expected to receive higher exposures due to their lower body weights. Chronic toxicity values were used to estimate subchronic risks to children to account for any unique susceptibility in this subpopulation.

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6. Toxicity Assessment

Human health risk is a function of both exposure to chemicals in the environment and the toxicity of those chemicals. Quantitative toxicity values are used to evaluate health risks based on the relationship between the dose of chemical received and the incidence or magnitude of the toxic response observed (i.e., the dose-response relationship). Laboratory animal studies are generally used to characterize the dose-response relationship for a chemical, unless adequate human epidemiological data are available.

In the risk assessment process, a distinction is made between cancer and noncancer health effects. For noncancer effects, the dose-response assessment yields a reference dose (RfD) or reference concentration (RfC), which correspond to an estimate of the daily exposure likely to be without appreciable risk of adverse noncarcinogenic effects during a lifetime, with uncertainty spanning perhaps an order of magnitude (Dourson and Stara 1983). The RfD is generally calculated by determining the highest dose rate at which there are no observable health effects (NOAEL) and by adjusting this dose using a series of uncertainty factors (UFs) and modifying factors (MFs). UFs are intended to account for the variation in sensitivity within the human population, uncertainty in extrapolating from animals to man, uncertainty in extrapolating from short term animal studies to chronic exposures in humans, and/or the inability of the toxicological database to address all possible adverse outcomes in humans. MFs may be applied to address specific scientific uncertainties or overall database quality. For studies in which a NOAEL cannot be identified, the lowest dose rate associated with an observable adverse effect (LOAEL) is used and an additional UF is applied to account for the uncertainty of using LOAEL data rather than NOAEL data. RfC values are calculated from inhalation toxicity studies and include parameters to address the structure and function of the respiratory system, applicable species differences, and the physiochemical properties of COPCs (EPA 1994b).

Tables 6-1 and 6-2 summarize the noncancer toxicity data for the oral/dermal and inhalation pathways, respectively, for the COPCs identified in this risk assessment. For each COPC, the target organ for the critical effect is noted and the magnitude of the total UF is indicated. Table 6-1 also contains information on the adjustment of oral RfD values for the dermal exposure pathway, using absorption efficiency values specific to the exposure route.

The assessment of cancer health effects generally follows a two-step process consisting of assignment of a qualitative weight of evidence classification and derivation of a quantitative toxicity value when appropriate. The weight of evidence classification scheme includes: known human carcinogens (Group A), probable human carcinogens (Groups B1 and B2), possible human carcinogens (Groups C), chemicals not classified (Group D), and compounds for which there is no evidence of carcinogenicity (Group E). The weight of evidence classification is based on the strength of the data demonstrating carcinogenesis in both laboratory animal studies and human epidemiology studies. Quantitative toxicity values, including cancer slope factors (CSFs) and/or inhalation unit risk (UR) values, are generally derived for Group A and B1/B2 carcinogens. Because EPA generally favors use of a linear dose-response model, many available CSFs and UR values were derived using the linearized multistage model (LMS). These CSFs and UR values usually represent the 95% UCL on the probability of a response per unit intake of a chemical, and are expressed as either $(mg/kg\text{-}day)^{-1}$ or $(ug/m^3)^{-1}$, respectively.

A more recent approach to cancer risk assessment is presented in EPA's (1996) *Proposed Guidelines for Carcinogen Risk Assessment.* Standard cancer risk descriptors are used instead of the traditional classification scheme and several alternative methods are available for dose-response modeling and low dose extrapolation. It is anticipated that new dose-response assessments will utilize the recently proposed methodology and that some older assessments may undergo re-evaluation to make them consistent with the new guidance. Tables 6-3 and 6-4 summarize the toxicity data for carcinogens identified as COPCs in this risk assessment. For each COPC, the weight of evidence classification and the target organ for cancer is presented.

Sources of toxicity information used in this HHRA include: EPA's Integrated Risk Information System (IRIS) database, EPA's Health Effects Assessment Summary Tables (HEAST) (EPA 1997b), and Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles (e.g., ATSDR 1994). The reference for each toxicity value is indicated in Tables 6-1, 6-2, 6-3, and 6-4.

As described in Section 5, the EPCs for tap water used in this risk assessment represent the future TVOC concentrations (without treatment) at water supply wells, determined by groundwater fate and transport modeling. EPCs are not available for the individual chemicals identified as COPCs in the groundwater plume. To estimate the future risks associated with groundwater exposure to TVOCs, the most conservative toxicity values for each exposure pathway were used. For noncancer effects associated with oral or dermal exposure, the chronic and subchronic oral RfD for 1,1-DCE was used. The chronic RfC for toluene and the subchronic RfC for 1,1-DCA were used to

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evaluate noncancer effects from inhalation. The oral CSF and inhalation UR values for 1,1-DCE were used to assess cancer risks from TVOC exposure in groundwater. To allow comparisons across scenarios and pathways, the same approach of evaluating TVOC intake relative to the most conservative toxicity values was also used to assess risks and hazards from exposures to COPCs in air, soil, and vegetables.

Oral toxicity values were used to evaluate dermal exposure to groundwater without adjustment to account for differential absorption by distinct exposure routes (relative absorption factor of 1 or 100%; see Table 6-1 and 6-3). The calculations used to assess dermal exposure to groundwater result in calculation of an internal dose of the COPC because skin permeability is taken into account (EPA 1989). The detected chlorinated solvents are nearly completely absorbed from the gastrointestinal tract (ATSDR 1994); therefore, the applied dose that represents the toxicity value is equivalent to an absorbed dose and no adjustment is necessary for the dermal exposure pathway.

A dermal absorption factor was used to reflect the desorption of a chemical from soil and the absorption of the chemical across the skin and into the bloodstream. The dermal absorption factor was assumed to be 0.05% (EPA 1995c), based on studies by Skowronski et al. (1988) and Franz (1984) that evaluated benzene absorption from soil. EPA Region 3 recommends this value for use with chlorinated solvents, such as the COPCs in this risk assessment (EPA 1995c). It is important to note that major uncertainties exist in estimating percutaneous absorption from soil and that the soil matrix may play a role in this process (EPA 1992c).

7. Risk Characterization

Risk characterization is the final step in the risk assessment process. In this step, the results of the hazard identification, exposure assessment, and toxicity assessment are integrated to yield a quantitative measure of carcinogenic risk and noncarcinogenic hazard. Potential carcinogenic risks and noncarcinogenic hazards were evaluated for the complete exposure pathways identified in Table 2-1.

Hazard Quotients (HQs) were calculated by dividing estimated intake of COPCs by the appropriate noncarcinogenic toxicity criteria (RfD or RfC):

$$\text{Hazard Quotient} = \text{Intake} \div \text{RfD or RfC}$$

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Consistent with EPA policy, the HQ was evaluated in comparison to a benchmark value of 1.0. Cumulative risks or hazards for adults and children were then calculated by summing the individual pathway values calculated for ingestion, dermal contact, and inhalation. Both central tendency and high end noncancer hazards for all pathways associated with the various exposure scenarios are presented in Tables 7-1 through 7-13.

Carcinogenic risk estimates were calculated by multiplying the estimated intake of COPCs by the appropriate carcinogenic value (CSF or UR):

Cancer Risk = Intake x CSF or UR

When evaluating potential carcinogenic risks, EPA has established an acceptable risk range of 1 x 10^{-4} to 1 x 10^{-6} (EPA 1990). In establishing this range, EPA accepted the policy that a risk range, rather than a single risk value, adequately protects public health and the environment (55 FR 8716). For the purposes of this risk assessment, the midpoint of EPA's risk range (1 x 10^{-5}) has been applied as the benchmark for judging the significance of risk to human health. Both central tendency and high end cancer risks for all pathways associated with the various exposure scenarios are presented in Tables 7-14 through 7-23.

Risks and hazards associated with different exposure points and exposure pathways are summed and presented in Tables 7-24 through 7-35. None of the noncancer hazard indices (i.e., risk of health effects other than cancer) are predicted to exceed 1.0, indicating that even under very conservative estimates of exposure, there are no adverse chronic or subchronic health effects. Moreover, the hazards for each pathway (i.e., ingestion, dermal contact) were summed for each receptor and were still below regulatory benchmarks. Predicted cancer risks are also below levels of concern (i.e., 10^{-5}), indicating that even very conservative estimates of exposure are unlikely to elevate an individual's risk of developing cancer by more than one chance in one-hundred thousand.

The groundwater fate and transport modeling results were also evaluated to determine whether peak concentrations of VOCs that may occur at any time during the next 30 years are likely to exceed standards, criteria or guidance values (SCGs) or MCLs defined by the Safe Drinking Water Act. Table 7-36 identifies the maximum predicted concentration of TVOCs for each of the wells that have the potential to be used as a drinking water source and are not currently undergoing treatment. The maximum TVOC concentration is then compared to the MCLs and SCGs of each COPC. Wells where TVOCs may exceed MCLs or the SCG in the future may require treatment. Based on this analysis, Wells N0022 and N5535 are not likely to require treatment at any time in the next 30 years to meet these criteria, while Wells N5099, N12999, and N13000 may to require treatment in the future. Groundwater monitoring will determine if treatment may be necessary

8. Uncertainty Analysis

An important component of the HHRA involves recognition of the uncertainties and limitations inherent in the risk assessment process. The primary goal of the uncertainty assessment is to determine the extent to which the risk results may be over or underestimated, and to identify the specific uncertainties associated with the risk estimates. Uncertainties arise primarily from the data quality and quantity, toxicity values, and exposure parameter values, as summarized in Table 8-1 and described below.

8.1 Data Quality and Quantity

Limitations in the quality and quantity of the analytical data contributed to uncertainty in the risk assessment by affecting the selection of COPCs and determination of EPCs. The groundwater analytical data were collected for the purpose of plume delineation and were subsequently adapted for risk assessment purposes. As a result, the selection of COPCs and the determination of EPCs may be biased if the number and locations of samples are not directly representative of potential exposure frequencies. For the OU-2 HHRA, analytical data from both on-site and off-site monitoring wells were used to select COPCs. This was done to ensure that all chemicals that could potentially migrate off-site would be evaluated in the baseline risk assessment.

The TVOC results of the groundwater fate and transport model were used to estimate EPCs for future drinking water, in the absence of chemical-specific modeling data. It was conservatively assumed that any of the COPCs selected for groundwater could be present at the water supply wells and contribute to the TVOC concentration. Uncertainties associated with the results and assumptions of the groundwater fate and transport model are described in Section 6 of the OU-2 RI report.

Modeling was also necessary to generate estimates of concentrations of COPCs in air that result from volatilization during showering or irrigation, as well as concentrations of COPCs in vegetables as a result of uptake from soil. In all cases, because models are simplified representations of reality, uncertainty is inevitable. To the greatest extent possible, the most simple yet plausible model was applied using conservative (i.e., health protective) input values. As such, estimated concentrations of COPCs in air and vegetables are expected to be overestimated, which in turn results in overestimates of risk and hazard.

8.2 Exposure Assumptions

There is considerable uncertainty regarding the likelihood of exposure to a given medium of concern. It is unknown whether all of the exposure pathways modeled are actually complete or whether the individuals evaluated (North Shore Towers residents, Residents, groundskeepers, golfers) will actually be exposed to COPCs. For example, for the current and future North Shore Towers residents' inhalation pathway to be complete, VOCs present in the spray irrigation water must volatilize upon release during irrigation and then be transported to the inlet of the air conditioning system, through the air conditioning ducts to the residents' apartments. It was conservatively assumed that North Shore Towers residents are exposed to the same air concentrations as the groundskeeper working directly on the golf course. That is, any dilution in concentration associated with transport from the golf course into the apartments and with the air conditioning system was not accounted for. Once the VOCs have reached the apartment air, it is assumed that windows are kept closed so that the concentrations are not diluted. Even under these circumstances, risk estimates were less than 1×10^{-6} for cancer and less than 1 for noncancer hazard. A more refined modeling effort would reduce all risks even further below benchmarks of acceptable hazard and risk.

For the golfer's soil contact pathways to be complete, the golfer must regularly golf early in the morning while the soil is still damp from the night's irrigation activities, and the golfer must touch and incidentally ingest soil that has been dampened by the irrigation water. In reality, exposure pathways such as these are unlikely to be complete under most circumstances, but were included in the HHRA for the sake of conservatism (i.e. to be health protective).

For high end exposures to the future Resident, it was assumed that the sole source of residential drinking water was the water supply well predicted to have the highest 30-year mean concentration of TVOCs, as estimated from the groundwater modeling. However, water supply districts pump from multiple supply wells at any given time, preferentially drawing from the least impacted wells. This is better described by the central tendency exposure, which uses the average of the 30-year mean TVOC concentration for the water supply wells potentially impacted by the plume. In either the high end or central tendency case, however, the influence of nonimpacted wells within the water district was not considered and only the most impacted water district (Manhasset-Lakeville) was evaluated. In reality, drinking water within the Manhasset-Lakeville water district should have considerably lower concentrations of TVOCs due to the contributions of nonimpacted wells within that district, treatment on currently-impacted wells, and volatilization that occurs upon release of water at the tap. Furthermore, all other water districts are expected to have even lower concentrations of TVOCs in their water supply. For these reasons, risks posed to future NonTowers residents may be significantly overstated.

D

Many of the exposure parameter values presented in Section 5 are default values determined by EPA (1989; 1991;, 1997a), rather than site specific values. As such, risk estimates based on these exposure parameters will generally represent conservative estimates. This uncertainty is addressed somewhat, by presentation of both central tendency and high end risk descriptors.

R

8.3 Toxicity Values

Significant uncertainty is associated with derivation of RfDs, RfCs, CSFs and UR values. Toxicity values based on human epidemiological studies are not available for most chemicals, and those human studies that are available generally lack exposure data and are confounded by exposure to multiple chemicals, recall bias, and lifestyle issues. Laboratory animal studies are used to derive most toxicity values and the practice of extrapolating from effects in animals to predict human toxic response is a major source of uncertainty in risk assessment.

A

RfD development is a highly conservative process, which uses a no observable adverse effect level (NOAEL) or a lowest observed adverse effect level (LOAEL) from an animal study, divided by a series of 10-fold uncertainty factors (UFs). The UFs are intended to account for differences between humans and laboratory animals, variation in sensitivity within the human population, differences between subchronic and chronic exposures, use of a LOAEL versus a NOAEL, and the strength of the toxicology database for a particular chemical. The combination of several UFs results in RfDs that are several orders of magnitude lower than the doses that produce minimal or no effects in animals. Conservative assumptions are also employed when deriving RfC values from inhalation toxicity studies, in order to account for species differences in the structure and function of the respiratory system (EPA 1994b).

F

T

CSFs and UR values contain multiple sources of uncertainty, including the methods of extrapolation from high doses to low doses and from animals to humans. In addition, human susceptibility to cancer is influenced by genetic constitution, diet, occupational and home environments, activity patterns, and other cultural factors. To compensate for this uncertainty, CSFs and UR values generally represent the 95% UCL on the probability of a carcinogenic response at a certain dose rate over a lifetime.

The most conservative toxicity values were used to assess risks associated with exposures to TVOCs. This approach results in an overestimation of future health risk, because it was assumed that all VOCs present were as toxic as the most toxic component. In addition, although TCE was considered a COPC for groundwater, no toxicity values are currently available for this compound. Therefore, TCE was not included in selection of the toxicity values for evaluation of TVOC exposure. The results of the risk assessment would not change significantly if the noncancer toxicity and carcinogenic potency of TCE is similar to the other chlorinated solvents selected as COPCs.

8.4 Risk Characterization

The risk characterization for the OU-2 HHRA combines overly conservative assessments of both exposure and toxicity resulting in a general overestimation of cancer and noncancer risks. The high end exposure scenarios utilize the maximum concentrations as the EPCs. In addition, for noncancer effects it was assumed that the TVOC concentration was representative of the most toxic COPC identified (1,1-DCE for oral and dermal exposure and PCE for inhalation exposure).

9. Conclusions

The OU-2HHRA conducted for the Site indicates that there are no significant risks to individuals who have been exposed to constituents in groundwater in the past or who may be exposed currently or in the future. For all scenarios evaluated at the Site, neither cancer risks nor noncancer hazards exceeded the acceptable regulatory standards (HI=1, cancer risk $=1\times10^{-5}$). The scenarios evaluated in the HHRA are very conservative in that they assume no groundwater remediation and worst-case exposures. In reality, individuals are expected to be exposed to concentrations much lower then those estimated and for shorter durations. Modifying exposure assumptions to be more realistic will further reduce estimated cancer risks and noncancer hazards.

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TABLE 2-1
SELECTION OF EXPOSURE PATHWAYS
Former Unisys Facility

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Past	Groundwater	Spray irrigation	Spray irrigation water	North Shore Tower resident	Child	Dermal	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
						Ingestion	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
						Inhalation	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
					Adult	Dermal	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
						Ingestion	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
						Inhalation	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
			Surface soil	Resident	Child	Dermal	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
						Ingestion	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
					Adult	Dermal	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
						Ingestion	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
			Produce grown in soil	Resident	Child	Ingestion	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
					Adult	Ingestion	Off-site	Quant	Pathway complete; NYSDEC requested evaluation of past exposures.
Current	Groundwater	Groundwater	Tap water	North Shore Tower resident	Child	Dermal	Off-site	None	Groundwater plume has not reached public water supply wells or well is receiving treatment.
						Ingestion	Off-site	None	Groundwater plume has not reached public water supply wells or well is receiving treatment.
					Adult	Dermal	Off-site	None	Groundwater plume has not reached public water supply wells or well is receiving treatment.
						Ingestion	Off-site	None	Groundwater plume has not reached public water supply wells or well is receiving treatment.
	Groundwater	Groundwater	Water vapors at showerhead	Resident	Child	Inhalation	Off-site	None	Groundwater plume has not reached public water supply wells or well is receiving treatment.
					Adult	Inhalation	Off-site	None	Groundwater plume has not reached public water supply wells or well is receiving treatment.
	Groundwater	Groundwater	Vapor intrusion into basements	North Shore Tower resident	Child	Inhalation	Off-site	None	Exposure unlikely due to 80 ft depth to groundwater.
					Adult	Inhalation	Off-site	None	Exposure unlikely due to 80 ft depth to groundwater.
	Groundwater	Spray irrigation	Spray irrigation water	Resident	Child	Dermal	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
						Ingestion	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
						Inhalation	Off-site	Quant	Volatilized compounds may accumulate in apartments.
					Adult	Dermal	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
						Ingestion	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
						Inhalation	Off-site	Quant	Volatilized compounds may accumulate in apartments.
				Groundskeeper	Adult	Dermal	Off-site	Quant	Contact with spray irrigation water possible during maintenance activities.
						Ingestion	Off-site	Quant	Contact with spray irrigation water possible during maintenance activities.
						Inhalation	Off-site	Quant	Contact with spray irrigation water possible during maintenance activities.
	Soil	Soil	Surface soil affected by spray irrigation	Resident	Child	Dermal	Off-site	None	Exposures expected to be less than or equal to golfer's and groundskeeper's.
						Ingestion	Off-site	None	Exposures expected to be less than or equal to golfer's and groundskeeper's.
					Adult	Dermal	Off-site	None	Exposures expected to be less than or equal to golfer's and groundskeeper's.
						Ingestion	Off-site	None	Exposures expected to be less than or equal to golfer's and groundskeeper's.

TABLE 2-1
SELECTION OF EXPOSURE PATHWAYS
Former Unisys Facility

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil	Soil	Surface soil affected by spray irrigation	Groundskeeper	Adult	Dermal	Off-site	Quant	Contact with damp soil possible after irrigation.
						Ingestion	Off-site	Quant	Contact with damp soil possible after irrigation.
				Golfer	Adult	Dermal	Off-site	Quant	Contact with damp soil possible after irrigation.
						Ingestion	Off-site	Quant	Contact with damp soil possible after irrigation.
			Produce grown in soil	Resident	Child	Dermal	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
						Ingestion	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
					Adult	Dermal	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
						Ingestion	Off-site	None	Source of water supply to garden plots changed to municipal water supply.
Future	Groundwater	Groundwater	Tap water	North Shore Tower resident	Child	Dermal	Off-site	Quant	Chemicals in groundwater may migrate to off-site public water supply wells.
						Ingestion	Off-site	Quant	Chemicals in groundwater may migrate to off-site public water supply wells.
					Adult	Dermal	Off-site	Quant	Chemicals in groundwater may migrate to off-site public water supply wells.
						Ingestion	Off-site	Quant	Chemicals in groundwater may migrate to off-site public water supply wells.
	Groundwater	Groundwater	Water vapors at showerhead	Resident	Child	Inhalation	Off-site	Quant	Chemicals in groundwater may migrate to off-site public water supply wells.
					Adult	Inhalation	Off-site	Quant	Chemicals in groundwater may migrate to off-site public water supply wells.
	Groundwater	Groundwater	Vapor intrusion into basements	North Shore Tower resident	Child	Inhalation	Off-site	None	Exposure unlikely due to 80 ft depth to groundwater.
					Adult	Inhalation	Off-site	None	Exposure unlikely due to 80 ft depth to groundwater.
		Spray irrigation	Spray irrigation water	Resident	Child	Inhalation	Off-site	Quant	Chemicals that volatilize during irrigation may accumulate in apartments through air conditioning system.
					Adult	Inhalation	Off-site	Quant	Chemicals that volatilize during irrigation may accumulate in apartments through air conditioning system.
				Groundskeeper	Adult	Dermal	Off-site	Quant	Contact with spray irrigation water possible during maintenance activities.
						Ingestion	Off-site	Quant	Contact with spray irrigation water possible during maintenance activities.
						Inhalation	Off-site	Quant	Contact with spray irrigation water possible during maintenance activities.
	Surface water	Surface water	Lake Success	Recreational	Child	Dermal	Off-site	None	Affected aquifer does not discharge into Lake Success.
						Ingestion	Off-site	None	Affected aquifer does not discharge into Lake Success.
						Inhalation	Off-site	None	Affected aquifer does not discharge into Lake Success.
					Adult	Dermal	Off-site	None	Affected aquifer does not discharge into Lake Success.
						Ingestion	Off-site	None	Affected aquifer does not discharge into Lake Success.
						Inhalation	Off-site	None	Affected aquifer does not discharge into Lake Success.
	Soil	Soil	Surface soil affected by spray irrigation	Groundskeeper	Adult	Dermal	Off-site	Quant	Contact with damp soil possible after irrigation.
						Ingestion	Off-site	Quant	Contact with damp soil possible after irrigation.
				Golfer	Adult	Dermal	Off-site	Quant	Contact with damp soil possible after irrigation.
						Ingestion	Off-site	Quant	Contact with damp soil possible after irrigation.

Notes : "Quant" indicates pathway evaluated quantitatively in this HHRA.
Resident = Non North Shore Tower Resident

TABLE 3-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (TAP WATER)
Former Unisys Facility

Scenario Timeframe: Current
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water

CAS Number	Chemical	Minimum Concentration Detected	Minimum Qualifier	Maximum Concentration Detected	Maximum Qualifier	Units	Location of Maximum Concentration	Year of Max. Conc.	Detection Frequency	Detection Limit	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Chemical Deletion or Selection[1]
71-43-2	Benzene	0.3	J	2	J	ug/L	28MI	1999	4/157	10	1	SCG	No	IFD
78-93-3	2-Butanone	2	J	2	J	ug/L	17MJ, 30MI	1999	2/157	10	50	SCG	No	IFD
75-15-0	Carbon disulfide	0.3	J	79	J	ug/L	28GL	1999	2/157	10	none	SCG	No	IFD
56-23-5	Carbon tetrachloride	0.3	J	0.4	J	ug/L	33ML	1999	2/157	10	5	SCG	No	IFD
67-66-3	Chloroform	0.1	J	20	J	ug/L	28GL	1999	28/157	10	7	SCG	Yes	FD
75-34-3	1,1-Dichloroethane	0.3	J	7	J	ug/L	17GL, 22ML	1998, 1999	18/157	10	5	SCG	Yes	FD
107-06-2	1,2-Dichloroethane	0.4	J	1	J	ug/L	5ML, 37ML	1999	5/157	10	0.6	SCG	No	IFD
75-35-4	1,1-Dichloroethene	0.4	J	15	J	ug/L	25MI	1999	36/157	10	5	SCG	Yes	FD
540-59-0	1,2-Dichloroethene	0.2	J	7200	EJ	ug/L	17GL	1998	133/157	10	5	SCG	Yes	FD
100-41-4	Ethylbenzene	1	J	1	J	ug/L	1GL	1999	1/157	10	5	SCG	No	IFD
76-13-1	Freon 113	0.4	J	180	DJ	ug/L	17GL	1998	81/157	10	5	SCG	No	IFD
75-09-2	Methylene chloride	0.8	J	43	J	ug/L	17GLB	1999	5/157	10	5	SCG	Yes	FD
100-42-5	Styrene	0.3	J	0.3	J	ug/L	1GL	1999	1/157	10	5	SCG	No	IFD
127-18-4	Tetrachloroethene	0.3	J	660	DJ	ug/L	17GL	1998	122/157	10	5	SCG	Yes	FD
108-88-3	Toluene	0.2	J	2	J	ug/L	17ML, 22ML	1999	14/157	10	5	SCG	Yes	FD
71-55-6	1,1,1-Trichloroethane	0.4	J	2	J	ug/L	30MI	1999	6/157	10	5	SCG	Yes	FD
79-00-5	1,1,2-Trichloroethane	2	J	2	J	ug/L	17GL	1998	1/157	10	1	SCG	No	IFD
79-01-6	Trichloroethene	0.4	J	540	DJ	ug/L	17GL	1998	129/157	10	5	SCG	Yes	FD
75-01-4	Vinyl chloride	3	J	300	J	ug/L	28GL	1999	6/157	10	2	SCG	No	IFD
1330-20-7	Xylenes (total)	0.3	J	4	J	ug/L	RW2	1998	3/157	10	5	SCG	No	IFD

Notes:
(1) Rationale Codes Selection Reason: Frequent Detection (FD)
Deletion Reason: Infrequent Detection (IFD)

Definitions: N/A = Not Applicable
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement
J = Estimated Value
D = Detected at a secondary dilution
E = Detected above calibration range
SCG = State Standards, Criteria, and Guidance Values

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TABLE 3-2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (SPRAY IRRIGATION WELL)
Former Unisys Facility

Scenario Timeframe: Current
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Spray Irrigation Well

CAS Number	Chemical	Minimum Concentration Detected	Minimum Qualifier	Maximum Concentration Detected	Maximum Qualifier	Units	Detection Frequency	Detection Limit	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Chemical Deletion or Selection(1)
75-35-4	1,1-Dichloroethene	0.6	J	0.6	J	ug/L	1/2	10	5	SCG	Yes	FD
540-59-0	1,2-Dichloroethene (total)	54		130		ug/L	2/2	10	5	SCG	Yes	FD
67-66-3	Chloroform	0.4	J	0.4	J	ug/L	1/2	10	7	SCG	Yes	FD
79-01-6	Trichloroethene	11		30		ug/L	2/2	10	5	SCG	Yes	FD
127-18-4	Tetrachloroethene	10		23		ug/L	2/2	10	5	SCG	Yes	FD

Notes:
(1) Rationale Codes Selection Reason: Frequent Detection (FD)
Deletion Reason: Infrequent Detection (IFD)

Definitions: COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant end Appropriate Requirement/
J = Estimated Value
SCG = State Standards, Criteria, and Guidance Values

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Table 5-1
The Percantage of Each Compound Detected as Compared to the Total Volatile Organic Compounds
Former Unisys Facility

SITE	DATE	Total VOCs (ug/L)	Benzene	2-Butanone	Carbon disulfide	Carbon tetrachloride	Chloroform	1,1-Dichloro ethane	1,2-Dichloro ethane	1,1-Dichloro ethene	1,2-Dichloro ethene (total)	Ethyl benzene	Freon 113	Methylene chloride	Styrene	Tetrachloro ethene	Toluene	1,1,1-Tri chloroethane	1,1,2-Tri chloroethane	Trichloro ethene	Vinyl Choride	Xylene (total)
			Percentage of the Total Volatile Organic Compounds Detected																			
1GL	10/22/98	196	0	0	0	0	0	0	0	0	75.78	0	3.03	0	0	8.08	0	0	0	13.13	0	0
1GU	10/22/96	6	0	0	0	0	0	0	0	0	33.33	0	0	0	0	0	0	0	0	66.67	0	0
1MI	10/22/98	558	0	0	0	0	0	0	0	0	71.68	0	2.87	0	0	11.65	0	0	0	13.80	0	0
1MI/L	10/22/98	566	0	0	0	0	0	0	0	0.53	56.54	0	4.59	0	0	11.84	0	0	0	26.50	0	0
1ML	10/26/96	155	0	0	0	0	0	0	0	0	61.29	0	3.23	0	0	14.19	0	0	0	21.29	0	0
2GL	10/20/98	37	0	0	0	0	0	0	0	0	72.97	0	0	0	0	13.51	0	0	0	13.51	0	0
2MI	10/20/98	308	0	0	0	0	0	0	0	0	84.42	0	0.97	0	0	4.55	0	0	0	10.06	0	0
2ML	10/20/98	2	0	0	0	0	0	0	0	0	100.00	0	0	0	0	0	0	0	0	0	0	0
2MU	10/20/98	41	0	0	0	0	0	0	0	0	82.93	0	0	0	0	7.32	0	0	0	9.76	0	0
3GL	10/19/98	568	0	0	0	0	0	0	0	0	72.16	0	2.82	0	0	11.27	0	0	0	13.73	0	0
3ML	10/19/98	129	0	0	0	0	0	0	0	0	53.49	0	2.33	0	0	11.63	0	0	0	32.56	0	0
4GL	10/15/98	530	0	0	0	0	0	0	0	0	69.81	0	1.13	0	0	14.91	0	0	0	14.15	0	0
4MI	10/15/98	619	0	0	0	0	0	0	0	0.18	67.85	0	2.91	0	0	17.77	0	0	0	11.31	0	0
5GL	10/20/98	13	0	0	0	0	0	0	0	0	46.15	0	15.38	0	0	23.08	0	0	0	15.38	0	0
5GU	10/19/98	10	0	0	0	0	0	0	0	0	0	0	20.00	0	0	40.00	0	0	0	40.00	0	0
5MI	10/20/98	877	0	0	0	0	0	0	0	0	78.40	0	1.48	0	0	7.30	0	0	0	14.82	0	0
5ML	10/20/98	1078	0	0	0	0	0	0	0	0	71.43	0	2.60	0	0	12.06	0	0	0	13.91	0	0
6GL	10/20/98	4	0	0	0	0	0	0	0	0	50.00	0	50.00	0	0	0	0	0	0	0	0	0
6MI	10/20/98	5	0	0	0	0	0	0	0	0	100.00	0	0	0	0	0	0	0	0	0	0	0
7GL	10/15/98	601	0	0	0	0	0	0	0	0	66.56	0	2.33	0	0	18.64	0	0	0	14.48	0	0
7ML	10/15/98	1356	0	0	0	0	0	0.15	0	0.29	70.06	0	3.69	0	0	11.80	0	0	0	14.01	0	0
8GL	10/14/98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8GU	10/14/98	200	0	0	0	0	0	0	0	1.50	46.00	0	8.00	0	0	16.50	0	0	0	28.00	0	0
8ML	10/14/98	26	0	0	0	0	0	0	0	0	42.31	0	3.85	0	0	23.08	0	0	0	30.77	0	0
9GL	10/15/98	88	0	0	0	0	0	0	0	4.55	30.68	0	6.82	0	0	23.86	0	1.14	0	32.95	0	0
10GL	10/20/98	28	0	0	0	0	0	0	0	0	28.57	0	10.71	0	0	28.57	0	0	0	32.14	0	0
11GL	10/20/96	477	0	0	0	0	0	0	0	0	64.99	0	8.08	0	0	13.84	0	0	0	15.09	0	0
11MI	10/20/98	136	0	0	0	0	0	0	0	0	73.53	0	2.21	0	0	11.76	0	0	0	12.50	0	0
12MI	10/14/98	213	0	0	0	0	0	0	0	0	75.12	0	2.35	0	0	10.80	0	0	0	11.74	0	0
12ML	10/15/98	35	0	0	0	0	0	0	0	0	85.71	0	0	0	0	11.43	0	0	0	22.86	0	0
13ML	11/3/98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14MI	11/3/98	9	0	0	0	0	0	0	0	0	66.67	0	0	0	0	0	0	0	0	33.33	0	0
15GL	10/29/98	37	0	0	0	0	0	0	0	0	67.57	0	0	0	0	18.92	0	0	0	13.51	0	0
15ML	10/29/98	12	0	0	0	0	0	0	0	0	66.67	0	0	0	0	16.67	0	0	0	16.67	0	0
16GL	11/3/98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16ML	11/3/98	188	0	0	0	0	0	0	0	0	51.60	0	4.26	0	0	13.30	0	0	0	30.85	0	0
17GL	11/6/98	8601	0	0	0	0	0	0.08	0	0.14	83.71	0	2.09	0	0	7.67	0	0	0	6.28	0	0
17ML	11/6/98	242	0	0	0	0	0	0	0	0	74.38	0	2.07	0	0	8.26	0	0	0	15.29	0	0
18GL	10/30/98	769	0	0	0	0	0	0	0	0	83.22	0	2.47	0	0	14.30	0	0	0.02	0	0	0
18ML	10/30/98	683	0	0	0	0	0	0	0	0	60.03	0	4.54	0	0	13.47	0	0	0	21.96	0	0
19GU	10/19/98	11	0	0	0	0	0	0	0	0	38.38	0	0	0	0	36.36	0	0	0	27.27	0	0
19MI	10/19/98	932	0	0	0	0	0	0	0	0	70.82	0	2.79	0	0	10.30	0	0	0	16.09	0	0
21GU	10/26/98	5	0	0	0	0	0	0	0	0	40.00	0	20.00	0	0	0	0	0	0	40.00	0	0
22GL	10/30/98	9	0	0	0	0	0	0	0	0	33.33	0	0	0	0	0	0	0	0	66.67	0	0
22ML	10/30/98	736	0	0	0	0	0	0	0	0	42.12	0	5.84	0	0	8.56	0	0	0	43.48	0	0
23GL	10/19/98	24	0	0	0	0	0	0	0	0	0	0	0	0	0	25.00	0	0	0	75.00	0	0
23MI	10/19/98	272	0	0	0	0	0	0	0	0	69.85	0	3.68	0	0	12.13	0	0	0	14.34	0	0
24GL	10/19/98	167	0	0	0	0	0	0	0	0	71.86	0	2.40	0	0	8.38	0	0	0	17.37	0	0
24MI	10/19/98	386	0	0	0	0	0	0	0	0	72.54	0	2.59	0	0	8.81	0	0	0	16.06	0	0
25GL	10/14/98	15	0	0	0	0	0	0	0	0	40.00	0	0	0	0	20.00	0	0	0	40.00	0	0
25MI	10/14/98	2050	0	0	0	0	0	0.10	0	0.29	78.05	0	2.54	0	0	11.71	0	0	0	7.32	0	0
26GL	10/14/98	49	0	0	0	0	0	0	0	2.04	51.02	0	4.08	0	0	12.24	0	0	0	30.61	0	0
26MI	10/14/98	90	0	0	0	0	0	0	0	0	70.00	0	0	0	0	12.22	0	0	0	17.78	0	0
27GL	10/14/98	36	0	0	0	0	0	0	0	0	52.78	0	0	0	0	13.89	0	0	0	33.33	0	0
27MI	10/14/98	27	0	0	0	0	0	0	0	0	55.56	0	0	0	0	14.81	0	0	0	29.63	0	0
28GL	10/14/98	2861	0.03	0	0	0	0	0.10	0	0.35	90.25	0	4.17	0	0	3.47	0	0	0	1.63	0	0
28MI	10/14/98	721	0	0	0	0	0	0	0	0.28	81.83	0	1.94	0	0	9.43	0	0	0	6.52	0	0

DRAFT

Table 5-1
The Percentage of Each Compound Detected as Compared to the Total Volatile Organic Compounds
Former Unisys Facility

			Percentage of the Total Volatile Organic Compounds Detected																			
SITE	DATE	Total VOCs (ug/L)	Benzene	2-Butanone	Carbon disulfide	Carbon tetrachloride	Chloroform	1,1-Dichloro ethane	1,2-Dichloro ethane	1,1-Dichloro ethene	1,2-Dichloro ethene (total)	Ethyl benzene	Freon 113	Methylene chloride	Styrene	Tetrachloro ethene	Toluene	1,1,1-Tri chloroethane	1,1,2-Tri chloroethane	Trichloro ethene	Vinyl Choride	Xylene (total)
29GL	10/19/98	1670	0	0	0	0	0	0.11	0	0.18	85.56	0	1.71	0	0	4.78	0	0	0	6.95	0.75	0
29MI	10/19/98	1258	0	0	0	0	0	0	0	0.18	87.57	0	2.86	0	0	15.10	0	0	0	14.31	0	0
30GL	11/7/98	5	0	0	0	0	0	0	0	0	0	0	0	0	0	60.00	0	0	0	40.00	0	0
30MI	11/7/98	13	0	0	0	0	0	0	0	30.77	23.08	0	0	0	0	7.69	0	0	0	38.46	0	0
30ML	11/7/98	3	0	0	0	0	0	0	0	0	100.00	0	0	0	0	0	0	0	0	0	0	0
31GL	11/4/98	3	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0
31MI	11/4/98	2	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0
31ML	11/4/98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32GL	11/2/98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32MI	11/2/98	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00	0	0
32ML	11/6/98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33GL	11/20/98	2	0	0	0	0	0	0	0	0	100.00	0	0	0	0	0	0	0	0	0	0	0
33MI	11/12/98	13	0	0	0	0	0	0	0	0	38.46	0	0	0	0	15.38	0	0	0	46.15	0	0
33ML	11/12/98	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00	0	0
35GL	11/5/98	2828	0	0	0	0	0	0	0	0.18	95.47	0	1.70	0	0	0.92	0	0	0	0.99	0.74	0
36GL	11/16/98	13	0	0	0	0	0	0	0	0	69.23	0	0	0	0	15.38	0	0	0	15.38	0	0
BAKER	11/20/98	8	0	0	0	0	0	0	0	0	87.50	0	0	12.5	0	0	0	0	0	0	0	0
RW2	10/21/98	63	0	0	0	0	0	0	0	0	66.67	0	0	0	0	23.81	0	0	0	3.17	0	6.35
1GL	6/1/99	220	0	0	0	0	0.14	0.23	0	0.59	77.36	0.46	2.28	0	0.14	5.92	0	0.23	0	10.92	1.37	0.36
1GU	6/1/99	6.8	0	0	0	0	0	0	0	0	29.41	0	0	0	0	11.76	0	0	0	58.62	0	0
1MI	6/1/99	935	0	0	0	0	0.11	0	0	0	71.66	0	2.57	0	0	10.70	0	0	0	14.97	0	0
1MI/L	6/9/99	763	0	0	0	0	0.27	0	0	0	76.09	0	1.09	0	0	3.53	0	0	0	19.02	0	0
1ML	6/15/99	109	0	0	0	0	0	0	0	0.37	77.70	0	1.83	0	0	3.68	0	0	0	16.45	0	0
2GL	6/3/99	62	0	0	0	0	0	0	0	0	79.03	0	0	0	0	9.68	0	0	0	11.29	0	0
2MI	6/7/99	411	0	0	0	0	0.15	0	0	0	77.93	0	0	0	0	9.25	0	0	0	12.66	0	0
2ML	6/16/99	1.4	0	0	0	0	0	0	0	0	71.43	0	0	0	0	0	0	0	0	28.57	0	0
2MU	6/7/99	128	0	0	0	0	0.16	0	0	0	78.00	0	0	0	0	10.14	0	0	0	11.70	0	0
3GL	6/4/99	439	0	0	0	0	0.14	0.14	0.11	0	79.76	0	0	0	0	8.66	0	0	0	11.17	0	0
3ML	6/10/99	79.6	0	0	0	0	0.75	0	0	0	59.05	0	1.26	0	0	5.03	0	0	0	33.92	0	0
4GL	6/4/99	369	0	0	0	0	0.18	0.16	0	0.22	73.17	0	0	0	0	12.20	0	0	0	14.09	0	0
4MI	6/9/99	187	0	0	0	0	0	0	0	0	80.21	0	1.60	0	0	8.56	0	0	0	9.63	0	0
5GL	6/2/99	5	0	0	0	0	0	0	0	0	60.00	0	0	0	0	20.00	0	0	0	20.00	0	0
5GU	6/2/99	9	0	0	0	0	0	0	0	0	55.56	0	0	0	0	22.22	0	0	0	22.22	0	0
5MI	6/2/99	910	0	0	0	0	0.11	0	0	0	72.53	0	2.42	0	0	9.56	0	0	0	15.38	0	0
5ML	6/18/99	531	0	0	0	0	0.19	0	0.19	0.19	79.10	0	1.51	0	0	3.58	0	0	0	15.25	0	0
6GL*	6/4/99	0.4	0	0	0	0	0	0	0	0	100.00	0	0	0	0	0	0	0	0	0	0	0
6MI	6/16/99	1.9	0	0	0	0	0	0	0	0	52.63	0	0	0	0	0	47.37	0	0	0	0	0
7GL	6/3/99	376	0.16	0	0	0	0	0	0	0.21	74.47	0	1.60	0	0	9.57	0.16	0	0	13.83	0	0
7ML	6/11/99	801	0	0	0	0	0.12	0	0	0.12	82.40	0	2.00	0	0	4.37	0.12	0	0	10.88	0	0
8GL	5/27/99	114.6	0.26	0	0	0	0.26	0.61	0	1.75	47.12	0	6.98	0	0	14.83	0.26	0	0	27.92	0	0
8GU	5/27/99	2.5	0	0	0	0	0	0	0	0	0	0	28.00	0	0	20.00	0	0	0	40.00	0	12.00
8ML	6/10/99	3.4	0	0	0	0	0	0	0	0	58.82	0	0	0	0	11.76	0	0	0	29.41	0	0
9GL	6/3/99	20	0	0	0	0	0	0	0	5.00	40.00	0	0	0	0	20.00	0	0	0	35.00	0	0
10GL	6/2/99	12	0	0	0	0	0	0	0	4.17	33.33	0	0	0	0	25.00	4.17	0	0	33.33	0	0
11GL	6/2/99	492	0	0	0	0	0	0	0	0	71.14	0	5.28	0	0	10.16	0	0	0	13.41	0	0
11MI	6/2/99	38	0	0	0	0	0	0	0	0	81.58	0	0	0	0	7.89	0	0	0	10.53	0	0
12MI	6/3/99	16	0	0	0	0	0	0	0	0	68.75	0	0	0	0	12.50	0	0	0	18.75	0	0
12ML	6/17/99	11	0	0	0	0	0	0	0	0	72.73	0	0	0	0	0	0	0	0	27.27	0	0
13ML	6/3/99	0.6	0	0	100.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14MI	6/17/99	2.8	0	0	0	0	0	0	0	0	10.71	0	0	0	0	0	0	17.86	0	71.43	0	0
15GL	6/4/99	120	0	0	0	0	0	0	0	0	81.67	0	2.50	0	0	7.50	0	0	0	8.33	0	0
15ML	6/11/99	4	0	0	0	0	0	0	0	0	75	0	0	0	0	25.00	0	0	0	0	0	0
16GL	6/8/99	0.8	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0
16ML	6/17/99	138	0	0	0	0	0.72	0	0	0	58.70	0	0	0	0	7.97	0	0	0	32.61	0	0
17GLMP	6/23/99	6260	0	0	0	0	0	0	0	0	89.48	0	0	0.32	0	5.27	0	0	0	4.95	0	0
17ML	7/1/99	229	0	0.87	0	0	0.22	0.13	0.17	0.17	74.37	0	2.19	0	0	4.37	0.87	0	0	16.62	0	0
18GL	6/8/99	467	0	0	0	0	0.17	0.15	0	0.13	72.79	0	1.07	0.43	0	10.49	0	0	0	14.77	0	0

Table 5-1
The Percentage of Each Compound Detected as Compared to the Total Volatile Organic Compounds
Former Unisys Facility

SITE	DATE	Total VOCs (ug/L)	Benzene	2-Butanone	Carbon disulfide	Carbon tetrachloride	Chloroform	1,1-Dichloro ethane	1,2-Dichloro ethane	1,1-Dichloro ethene	1,2-Dichloro ethene (total)	Ethyl benzene	Freon 113	Methylene chloride	Styrene	Tetrachloro ethene	Toluene	1,1,1-Tri chloroethane	1,1,2-Tri chloroethane	Trichloro ethene	Vinyl Choride	Xylene (total)
			Percentage of the Total Volatile Organic Compounds Detected																			
18ML	6/10/99	863	0	0	0	0	0	0	0	0	84.59	0	1.04	0	0	2.76	0	0	0	11.59	0	0
19GU	6/7/99	5	0	0	0	0	0	0	0	0	40.00	0	0	0	0	40.00	0	0	0	20.00	0	0
19MI	6/8/99	607	0	0	0	0	0.16	0	0	0	77.43	0	0.62	0	0	7.25	0	0	0	14.33	0	0
21GU	6/7/99	1.7	0	0	0	0	0	0	0	0	41.18	0	0	0	0	0	11.76	0	0	47.06	0	0
22GL	6/1/99	12.7	0	0	0	0	0	0	0	0	39.37	0	0	0	0	5.51	0	0	0	55.12	0	0
22ML	7/1/99	277	0	0	0	0	0.29	0.14	0.18	0.33	50.61	0	3.62	0	0	4.34	0.72	0	0	39.77	0	0
23GL	6/8/99	89	0	0	0	0	0	0	0	0	68.54	0	1.12	0	0	6.74	0	0	0	23.60	0	0
23MI	6/14/99	1032	0	0	0	0	0	0	0	0	75.58	0	2.13	0	0	10.66	0	0	0	11.63	0	0
24GL	6/7/99	97.4	0	0	0.31	0	0.10	0	0	0	57.49	0	6.16	0	0	10.27	0	0	0	25.67	0	0
24MI	6/15/99	832	0	0	0	0	0	0	0	0.24	74.52	0	2.64	0	0	9.38	0	0	0	13.22	0	0
25GL	6/3/99	29.6	0	0	0	0	0	0	0	6.76	33.78	0	0	0	0	27.03	0	2.03	0	30.41	0	0
25MI	6/15/99	5133	0	0	0	0	0	0	0	0.29	65.72	0	2.34	0	0	7.01	0.16	0	0	4.48	0	0
26GL	6/3/99	70.4	0	0	0	0	0	0.71	0	2.84	49.72	0	0	0	0	17.05	0.71	0.57	0	28.41	0	0
26MI	6/10/99	425	0	0	0	0	0	0.18	0	0.24	84.77	0	0.94	0	0	7.77	0	0	0	6.12	0	0
27GL	6/4/99	74.1	0	0	0	0	0.27	0.67	0	2.70	47.23	0	5.40	0	0	16.19	0.54	0	0	26.99	0	0
27MI	6/14/99	75.5	0	0	0	0	0	0.73	0	3.97	45.00	0	5.29	0	0	16.53	0	0	0	26.48	0	0
28GL*	6/10/99	6030	0	0	0	0	0.33	0	0	0	92.67	0	0	0	0	1.82	0	0	0	1.66	3.32	0
28MI	6/14/99	744	0.27	0	0	0	0.12	0	0	0.40	79.31	0	1.75	0	0	7.93	0.27	0	0	9.95	0	0
29GL	6/8/99	2970	0	0	0	0	0	0	0	0	80.81	0	0.84	0.51	0	8.75	0	0	0	9.09	0	0
29MI	6/15/99	846	0	0	0	0	0.11	0	0	0	75.66	0	2.96	0	0	9.58	0	0	0	11.70	0	0
30GL	6/1/99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30MI	6/1/99	9.1	0	21.98	0	0	0	5.49	0	21.98	0	0	6.59	0	0	0	0	21.98	0	21.98	0	0
30ML	7/2/99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31GL	5/26/99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31MI	5/26/99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31ML	6/15/99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32GL	5/26/99	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00	0	0	0	0	0
32MI	6/16/99	8.4	0	0	0	0	0	0	0	0	23.81	0	0	0	0	4.76	0	0	0	71.43	0	0
32ML	6/17/99	95.8	0	0	0	0	0.84	0	0	0	57.41	0	0	0	0	6.26	0	0	0	35.49	0	0
33GL	6/23/99	7.6	0	0	0	0	0	0	0	0	65.71	0	0	0	0	0	14.29	0	0	0	0	0
33MI	6/22/99	11.1	0	0	0	2.70	2.70	0	0	0	1.80	0	0	0	0	2.70	0	0	0	90.09	0	0
33ML	6/22/99	22.8	0	0	0	1.75	1.75	0	0	0	8.77	0	4.39	0	0	4.39	0	0	0	78.95	0	0
35GL	6/16/99	6274	0	0	0	0	0	0	0	0	95.63	0	0.69	0	0	0.59	0	0	0	0.49	2.39	0
36GL	6/9/99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37MU	9/9/99	450	0	0	0	0	0	0	0	0	71.66	0	2.09	0	0	8.60	0	0	0	17.65	0	0
37MI	9/9/99	650	0	0	0	0	0	0	0	0	72.94	0	2.47	0	0	6.94	0	0	0	17.65	0	0
37ML	9/9/99	239	0	0	0	0	0.42	0	0.42	0	62.76	0	3.35	0	0	5.44	0	0	0	27.62	0	0
38MU	9/10/99	21	0	0	0	0	0	0	0	0	66.67	0	0	0	0	4.76	0	0	0	28.57	0	0
38MI	9/10/99	540	0	0	0	0	0	0	0	0	61.11	0	3.69	0	0	7.22	0	0	0	27.78	0	0
38ML	9/10/99	174.9	0	0	0	0	0.51	0	0	0	57.18	0	4.00	0	0	7.43	0	0	0	30.87	0	0
EW1	7/8/99	880.7	0	0	0	0	0.08	0	0	0	77.21	0	2.73	0	0	11.13	0	0	0	8.86	0	0
RW1	7/2/99	233.6	0	0	0	0	0	0.13	0	0.21	65.62	0	0	0	0	5.99	0	0	0	3.90	4.15	0
RW2	7/7/99	18.4	0	0	0	0	0	0	0	0	76.09	0	2.17	0	0	10.67	0	0	0	10.87	0	0
N2576	7/8/99	75	0	0	0	0	0	0	0	0	72.00	0	0	0	0	13.33	0	0	0	14.67	0	0
N2576	8/10/99	184	0	0	0	0	0.22	0	0	0.33	70.65	0	0	0	0	12.50	0	0	0	16.30	0	0
Maximum Percent:			0.27	21.98	100.00	2.70	2.70	5.49	0.42	30.77	100.00	0.46	50.00	100.00	0.14	100.00	100.00	21.98	0.02	100.00	4.15	12.00
Minimum Percent:			0.03	0.67	0.31	1.75	0.10	0.08	0.11	0.12	1.80	0.46	0.82	0.32	0.14	0.59	0.12	0.23	0.02	0.49	0.74	0.36
Average Percent:			0.16	11.43	50.15	2.23	0.43	0.59	0.16	2.76	65.36	0.46	4.49	22.75	0.14	13.74	12.96	7.30	0.02	23.92	2.12	6.24
Frequency of Detection			4/159	2/159	2/159	2/159	29/159	18/159	5/159	37/159	135/159	1/159	81/159	5/159	1/159	124/159	14/159	6/159	1/159	131/159	6/159	3/159
Detection Percent			2.52	1.26	1.26	1.26	18.24	11.32	3.14	23.27	84.91	0.63	50.94	3.14	0.63	77.99	8.81	3.77	0.63	82.39	3.77	1.89

Notes:
ug/L Micrograms per liter
VOCs Volatile Organic Compounds
Duplicate analyses averaged prior to calculating summary statistics.

TABLE 5-2
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY (FUTURE TAP WATER)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water

Well Location	Modeled Future 30 Year Mean TVOC Concentration	Units	Public Water Supply Yes / No		Summary EPC Values	High-End Exposure		Central Tendency	
						Medium TVOC EPC Value (mg/L)	Medium TVOC EPC Statistic	Medium TVOC EPC Value (mg/L)	Medium TVOC EPC Statistic
N3905	0.0271	mg/L	Yes						
N4243	0.1292	mg/L	Yes						
N5099	0.0215	mg/L	Yes						
N5710	0.1259	mg/L	Yes						
					noncancer	0.13	Max	0.076	30 Year Mean
					cancer	2.8E-04	0.22% of Max	1.7E-04	0.22% of Mean

Notes:

Only wells from most impacted water district (Manhassett-Lakeville) included.

Statistics: Max = Maximum modeled value; Mean = modeled 30 year mean concentration.

EPCs for cancer risks assumed to be 0.22% of TVOC concentrations because 0.22% of TVOCs are comprised of carcinogenic chemicals.

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TABLE 5-3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY (FUTURE SPRAY IRRIGATION WELL)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Spray Irrigation Well

Well Location	Modeled Future TVOC Concentration	Units	Public Water Supply Yes / No		Summary EPC Values	High-End Exposure		Central Tendency	
						Medium TVOC EPC Value (mg/L)	Medium TVOC EPC Statistic	Medium TVOC EPC Value (mg/L)	Medium TVOC EPC Statistic
N2576	0.1435	mg/L	No		noncancer	0.194	95% UCL	0.144	30 year Mean
					cancer	4.3E-04	0.22% of 95% UCL	3.2E-04	0.22% of Mean

Notes:
Only the most impacted irrigation well evaluated.
Statistics: 95% UCL = 95% upper confidence limit of modeled 30 year mean concentration; Mean = modeled 30 year mean concentration.
EPCs for cancer risks assumed to be 0.22% of TVOC concentrations because 0.22% of TVOCs are comprised of carcinogenic chemicals.

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TABLE 5-4
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY (FUTURE SHOWER AIR)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Shower

	Modeled Future TVOC Concentration in Tap Water (mg/L)	Volitilization Factor (L/m^3)	Estimated Future TVOC Concentration in Air at Showerhead (mg/m^3)
High End Exposure			
NonCancer	0.13	0.5	0.065
Cancer	2.8E-04	0.5	1.4E-04
Central Tendency			
NonCancer	0.076	0.5	0.038
Cancer	1.7E-04	0.5	8.4E-05

Notes:

Modeled future TVOC concentration in tap water derived from Table 3-2.

Volatilization factor derived from EPA, 1991.

Estimated future TVOC concentration in air at showerhead equals the product of the concentration in tap water and the volatilization factor.

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TABLE 5-5

DERIVATION OF EXPOSURE POINT CONCENTRATION FOR AIR RESULTING FROM VOLATILIZATION OF COPCs IN SPRAY IRRIGATION WELL WATER

Former Unisys Facility

Scenario Timeframe: Past and Current
Medium: Air
Exposure Medium: Air
Exposure Point: Apartment

COPC	High Exposure EPC in Groundwater Cgw mg/L	Central Tendency Exposure EPC in Groundwater Cgw mg/L	Pumping rate Qgw L/s	Efficiency of Release of Standard from Water to Air[a] Estd unitless	Henry's Law Constant H Pa-m3/mol	Henry's Law Constant[b] H atm-m^3/mol	Henry's Law Constant for standard[a] Hstd atm-m^3/mol	Efficiency of release E unitless	Downwind height of box[c] Hb m	Width of box, crosswind dimension of the Affected Area Wb m	Average wind speed 10m above ground surface U10 m/s	Average wind speed through box Um m/s	High End Exposure EPC in Air Ca mg/m^3	Central Tendency EPC in Air Ca mg/m^3
Chloroform	0.0004	0.0002	32	0.52	339	3.35E-03	1.90E-02	0.0916	1.4	10	5	1.3780	6.08E-05	3.04E-05
1,1-Dichloroethene	0.0006	0.0003	32	0.52	6920	6.83E-02	1.90E-02	1.8691	1.4	10	5	1.3780	1.86E-03	9.30E-04
1,2-Dichloroethene	0.1300	0.0920	32	0.52	1110	1.10E-02	1.90E-02	0.2999	1.4	10	5	1.3780	6.47E-02	4.58E-02
Tetrachloroethene	0.0230	0.0170	32	0.52	1737	1.71E-02	1.90E-02	0.4692	1.4	10	5	1.3780	1.79E-02	1.32E-02
Trichloroethene	0.0300	0.0210	32	0.52	931	9.19E-03	1.90E-02	0.2515	1.4	10	5	1.3780	1.25E-02	8.76E-03
TVOC	0.184	0.131											9.70E-02	6.87E-02
Carcinogenic fraction	0.54%	0.38%											5.24E-04	2.61E-04

Notes:

Ca = Cgw x Qgw x E x 1/Hb x 1/Wb x 1/Um

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TABLE 5-6

DERIVATION OF EXPOSURE POINT CONCENTRATION FOR AIR RESULTING FROM VOLATILIZATION OF COPCs IN SPRAY IRRIGATION WELL WATER

Former Unisys Facility

Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Apartment

	Modeled Future TVOC Concentration in Irrigation Water (mg/L)	Pumping rate Qgw L/s	Efficiency of release of standard from water to air [a] Estd unitless	Henry's Law Constant H Pa-m3/mol	Henry's Law Constant [b] H atm-m^3/mol	Henry's Law Constant for standard [a] Hstd atm-m^3/mol	Efficiency of release E unitless	Downwind height of box [c] Hb m	Width of box, crosswind dimension of the affected area [c] Wb m	Average wind speed 10 m above ground surface U10 m/s	Average wind speed through box Um m/s	Concentration in ambient air Ca mg/m^3
High End Exposure												
NonCancer	0.194	32	0.52	339	3.35E-03	1.90E-02	0.2999	1.4	10	5	1.3780	9.63E-02
Cancer	4.3E-04	32	0.52	339	3.35E-03	1.90E-02	0.2999	1.4	10	5	1.3780	2.12E-04
Central Tendency												
NonCancer	0.144	32	0.52	339	3.35E-03	1.90E-02	0.2999	1.4	10	5	1.3780	7.14E-02
Cancer	3.2E-04	32	0.52	339	3.35E-03	1.90E-02	0.2999	1.4	10	5	1.3780	1.57E-04

Notes:

Ca = Cgw x Qgw x E x 1/Hb x 1/Wb x 1/Um

TVOC concentration in irrigation water derived from Table 3-3.

a: Andelman, 1984, 1985a,b

b: Mackay, 1993

c: Estimated

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TABLE 5-7

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

(PAST AND CURRENT SPRAY IRRIGATION WELL)

Former Unisys Facility

Scenario Timeframe: Past and Current
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Spray Irrigation Well

	High End Exposure EPC(1) (mg/L)	Central Tendency Exposure EPC (mg/L)
Chloroform	0.0004	0.0002
1,1-Dichloroethene	0.0006	0.0003
1,2-Dichloroethene	0.130	0.092
Tetrachloroethene	0.023	0.017
Trichloroethene	0.030	0.021
TVOC	0.184	0.131
Carcinogenic Fraction	0.0010	0.0005

Notes:

EPC = Exposure Point Concentration

COPC = Chemical of Potential Concern

(1) High End Exposure EPC is maximum measured concentration

(2) Central Tendency EPC is mean measured concentration

TABLE 5-8
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY (SOIL)
Former Unisys Facility

Scenario Timeframe: Past, Current, Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Garden and Near Irrigation Points

Location	TVOC Concentration in Water	Units	Assumed TVOC Concentration in Soil	Units		Summary EPC Values	High-End Exposure		Central Tendency	
							Medium TVOC EPC Value (mg/kg)	Medium TVOC EPC Statistic	Medium TVOC EPC Value (mg/kg)	Medium TVOC EPC Statistic
N2576	0.1435	mg/L	0.1435	mg/kg		noncancer	0.194	95% UCL	0.144	30 year Mean
						cancer	4.3E-04	0.22% of 95% UCL	3.2E-04	0.22% of Mean

Notes:
Only the most impacted irrigation well evaluated.
Statistics: 95% UCL = 95% upper confidence limit of modeled 30 year mean concentration; Mean = modeled 30 year mean concentration.
EPCs for cancer risks assumed to be 0.22% of TVOC concentrations because 0.22% of TVOCs are comprised of carcinogenic chemicals.

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TABLE 5-9

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY (VEGETABLES)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Soil
Exposure Medium: Soil
Exposure Point: Vegetables

Chemical	High End Exposure Soil EPC **Cs** (mg/kg)	Central Tendency Exposure Soil EPC **Cs** (mg/kg)	Plant-Soil Bioconcentration Factor **Br** (unitless)	Root Concentration Factor **RCF** (unitless)	Correction Factor for Below-Ground Produce[a] **VG** (unitless)	Soil-Water Partition Coefficient **Kd** (L/kg)	High End Exposure Above Ground Vegetable Concentration **Cav** (mg/kg)	High End Exposure Below Ground Vegetable Concentration **Cbv** (mg/kg)	Central Tendency Above Ground Vegetable Concentration **Cav** (mg/kg)	Central Tendency Below Ground Vegetable Concentration **Cbv** (mg/kg)	Total High End Exposure Vegetable Concentration **Cv** (mg/kg)	Total Central Tendency Vegetable Concentration **Cv** (mg/kg)
TVOC - NonCancer	0.194	0.144	2.77	14.1	1.0	4.98	0.54	0.55	0.40	0.41	1.08	0.80
TVOC - Cancer	4.26E-04	3.16E-04	2.77	14.1	1.0	4.98	1.18E-03	1.21E-03	8.74E-04	8.94E-04	2.39E-03	1.77E-03

Notes:

a. VG = 0.01 for chemicals with a log Kow greater than four; VG = 1.0 for chemicals with a log Kow less than four

Cav = Cs x Br

Cbv = Cs x RCF x VG/(Kd x 1 kg/L)

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TABLE 5-10
VALUES USED FOR DOSE CALCULATIONS (RESIDENT - CHILDREN)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater and Air
Exposure Point: Tap Water
Receptor Population: Resident
Receptor Age: Child (1-8 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-2	chemical-specific	Table 3-2	Intake (mg/kg-day) =
	IR	Ingestion Rate	L/day	1.29	EPA, 1997	0.74	EPA, 1997	Cw x IR x Ao x EF x ED x 1/BW x 1/AT
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	
	EF	Exposure Frequency	days/year	350	EPA, 1997	350	EPA, 1997	
	ED	Exposure Duration	years	7	EPA, 1997	7	EPA, 1997	
	BW	Body Weight	kg	18	EPA, 1997	18	EPA, 1997	
	ATc	Averaging Time (cancer) (2)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	2555	EPA, 1997	2555	EPA, 1997	
Dermal	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-2	chemical-specific	Table 3-2	Intake (mg/kg-day) =
	SA	Surface Area	cm^2	8556	EPA, 1997	7555	EPA, 1997	Cw x SA x PC x EF x ED x ET x CF x
	PC	Dermal Permeability Constant (1)	cm/hr	1.60E-02	EPA, 1992c	1.60E-02	EPA, 1992c	1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1997	350	EPA, 1997	
	ED	Exposure Duration	years	7	EPA, 1997	7	EPA, 1997	
	ET	Exposure Time	hrs/day	0.5	EPA, 1997	0.21	EPA, 1997	
	CF	Conversion Factor	L/cm^3	0.001	N/A	0.001	N/A	
	BW	Body Weight	kg	18	EPA, 1997	18	EPA, 1997	
	ATc	Averaging Time (cancer) (2)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	2555	EPA, 1997	2555	EPA, 1997	
Inhalation	Ca	Concentration in Water	mg/m^3	chemical-specific	Table 3-4	chemical-specific	Table 3-4	Intake (mg/m^3) =
	ET	Exposure Time	hrs/day	0.5	EPA, 1997	0.21	EPA, 1997	Ca x ET x EF x ED x CF x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1997	350	EPA, 1997	
	ED	Exposure Duration	years	7	EPA, 1997	7	EPA, 1997	
	CF	Conversion Factor	day/hr	0.042	N/A	0.042	N/A	
	ATc	Averaging Time (cancer) (2)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	2555	EPA, 1997	2555	EPA, 1997	

Notes:
(1) PC for 1,1-Dichloroethene was used as a surrogate for TVOC, consistent with the toxicity value used in the risk calculation.
(2) Parameters related to cancer risks are not relevant for the child scenario, because only subchronic noncancer hazards were evaluated.
N/A: Not applicable

TABLE 5-11

VALUES USED FOR DOSE CALCULATIONS (RESIDENT - ADULTS)

Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater and Air
Exposure Point: Tap Water
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-2	chemical-specific	Table 3-2	Intake (mg/kg-day) =
	IR	Ingestion Rate	L/day	2.35	EPA, 1997	1.41	EPA, 1997	Cw x IR x Ao x EF x ED x 1/BW x 1/AT
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	
	EF	Exposure Frequency	days/year	350	EPA, 1997	350	EPA, 1997	
	ED	Exposure Duration	years	30	EPA, 1997	9	EPA, 1997	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	10950	EPA, 1997	3285	EPA, 1997	
Dermal	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-2	chemical-specific	Table 3-2	Intake (mg/kg-day) =
	SA	Surface Area	cm^2	20900	EPA, 1997	18150	EPA, 1997	Cw x SA x PC x EF x ED x ET x CF x
	PC	Dermal Permeability Constant (1)	cm/hr	1.60E-02	EPA, 1992c	1.60E-02	EPA, 1992c	1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1997	350	EPA, 1997	
	ED	Exposure Duration	years	30	EPA, 1997	9	EPA, 1997	
	ET	Exposure Time	hrs/day	0.5	EPA, 1997	0.25	EPA, 1997	
	CF	Conversion Factor	L/cm^3	0.001	N/A	0.001	N/A	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	10950	EPA, 1997	3285	EPA, 1997	
Inhalation	Ca	Concentration in Air	mg/m^3	chemical-specific	Table 3-4	chemical-specific	Table 3-4	Intake (mg/m^3) =
	ET	Exposure Time	hrs/day	0.5	EPA, 1997	0.25	EPA, 1997	Ca x ET x EF x ED x CF x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1997	350	EPA, 1997	
	ED	Exposure Duration	years	30	EPA, 1997	9	EPA, 1997	
	CF	Conversion Factor	day/hr	0.042	N/A	0.042	N/A	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	10950	EPA, 1997	3285	EPA, 1997	

Notes:

(1) PC for 1,1-Dichloroethene was used as a surrogate for TVOC, consistent with the toxicity value used in the risk calculation.

N/A: Not applicable

TABLE 5-11

VALUES USED FOR DOSE CALCULATIONS (RESIDENT - ADULTS)

Former Unisys Facility

	Cancer		NonCancer	
	HEE	CT	HEE	CT
"Dose" Ing	1.38E-02	2.48E-03	3.22E-02	1.93E-02
"Dose" Dermal	9.82E-04	1.28E-04	2.29E-03	9.95E-04
"Dose" Inh	8.56E-03	1.28E-03	2.00E-02	9.99E-03

Note: "Dose" excludes EPC value.

Table 5-12

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - CHILDREN GROUNDWATER)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Groundwater
Exposure Medium: Groundwater and Air
Exposure Point: Garden and Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Child (1-8 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-7	chemical-specific	Table 3-7	Intake (mg/kg-day) = Cw x IR x Ao x EF x ED x 1/BW x 1/AT
	IR	Ingestion Rate	L/day	0.43	EPA, 1997	0.201	EPA, 1997	
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	
	EF	Exposure Frequency	days/year	60	2 day/wk, 30 wks	30	1 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	BW	Body Weight	kg	18	EPA, 1997	18	EPA, 1997	
	ATc	Averaging Time (cancer) (2)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Dermal	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-7	chemical-specific	Table 3-7	Intake (mg/kg-day) = Cw x SA x PC x EF x ED x ET x CF x 1/BW x 1/AT
	Sa	Surface Area	cm^2	3881	EPA, 1997	1919	EPA, 1997	
	PC	Dermal Permeability Constant (1)	cm/hr	1.60E-02	EPA, 1992c	1.60E-02	EPA, 1992c	
	EF	Exposure Frequency	days/year	60	2 day/wk, 30 wks	30	1 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	
	CF	Conversion Factor	L/cm^3	0.001	N/A	0.001	N/A	
	BW	Body Weight	kg	18	EPA, 1997	18	EPA, 1997	
	ATc	Averaging Time (cancer) (2)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Inhalation	Ca	Concentration in Air	mg/m^3	chemical-specific	Table 3-5	chemical-specific	Table 3-5	Intake (mg/m^3) = Ca x ET x EF x ED x CF x 1/AT
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	
	EF	Exposure Frequency	days/year	60	2 day/wk, 30 wks	30	1 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	CF	Conversion Factor	day/hr	0.042	N/A	0.042	N/A	
	ATc	Averaging Time (cancer)(2)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	

Notes:

(1) PC for 1,1-Dichloroethene was used as a surrogate for TVOC, consistent with the toxicity value used in the risk calculation.

(2) Parameters related to cancer risks are not relevant for the child scenario, because only subchronic noncancer hazards were evaluated.

N/A: not applicable

Table 5-12

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - CHILDREN GROUNDWATER)

Former Unisys Facility

	Cancer		NonCancer	
	HEE	CT	HEE	CT
"Dose" Ing	N/A	N/A	3.93E-03	9.18E-04
"Dose" Dermal	N/A	N/A	1.13E-03	1.40E-04
"Dose" Inh	N/A	N/A	1.37E-02	3.42E-03

Note: "Dose" excludes EPC value.

Table 5-13

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - CHILDREN SOIL)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Soil
Exposure Medium: Soil and Vegetables
Exposure Point: Garden
Receptor Population: North Shore Tower Resident
Receptor Age: Child (1-8 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-8	chemical-specific	Table 3-8	Intake (mg/kg-day) =
	IR	Ingestion Rate	mg/day	50	EPA, 1997	50	EPA, 1997	Cs x IR x Ao x EF x ED x CF x FI
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	60	2 day/wk, 30 wks	30	1 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	FI	Fraction Ingested from Source	unitless	1.0	assumption	0.5	assumption	
	BW	Body Weight	kg	18	EPA, 1997	18	EPA, 1997	
	ATc	Averaging Time (cancer)(1)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Dermal	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-8	chemical-specific	Table 3-8	Intake (mg/kg-day) =
	SA	Surface Area	cm^2	3881	EPA, 1997	1919	EPA, 1997	Cs x SA x AF x EF x ED x ABS x CF x
	AF	Adherence Factor	mg/cm^2-day	0.1	EPA, 1997	0.1	EPA, 1997	1/BW x 1/AT
	EF	Exposure Frequency	days/year	60	2 day/wk, 30 wks	30	1 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	ABS	Absorption Factor	unitless	0.0005	EPA, 1995c	0.0005	EPA, 1995c	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	BW	Body Weight	kg	18	EPA, 1997	18	EPA, 1997	
	ATc	Averaging Time (cancer)(1)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Ingestion of Vegetables	Cv	Concentration in Vegetables	mg/kg	chemical-specific	Table 3-9	chemical-specific	Table 3-9	Intake (mg/kg-day) =
	IR	Ingestion Rate	g/kg-day	6.03	EPA, 1997	0.747	EPA, 1997	Cv x IR x FI x EF x ED x CF x 1/AT
	FI	Fraction Ingested from Source	unitless	1.0	EPA, 1997	1.0	EPA, 1997	
	EF	Exposure Frequency	days/year	365	EPA, 1997	365	EPA, 1997	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	CF	Conversion Factor	kg/g	1.00E-03	N/A	1.00E-03	N/A	
	ATc	Averaging Time (cancer)(1)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	

Notes:

(1) Parameters related to cancer risks are not relevant for the child scenario, because only subchronic noncancer hazards were evaluated.

N/A: not applicable

Table 5-13

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - CHILDREN SOIL)

Former Unisys Facility

	Cancer		NonCancer	
	HEE	CT	HEE	CT
"Dose" Ing	N/A	N/A	4.57E-07	1.14E-07
"Dose" Dermal	N/A	N/A	1.77E-09	4.38E-10
"Dose" Inh	N/A	N/A	6.03E-03	7.47E-04

Note: "Dose" excludes EPC value.

Table 5-14

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - ADULTS GROUNDWATER)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Groundwater
Exposure Medium: Groundwater and Air
Exposure Point: Garden and Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-7	chemical-specific	Table 3-7	Intake (mg/kg-day) =
	IR	Ingestion Rate	L/day	0.49	EPA, 1997	0.201	EPA, 1997	Cw x IR x Ao x EF x ED x 1/BW x 1/AT
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	
	EF	Exposure Frequency	days/year	150	5 day/wk, 30 wks	60	2 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer) (2)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Dermal	Cw	Concentration in Water	mg/L	chemical-specific	Table 3-7	chemical-specific	Table 3-7	Intake (mg/kg-day) =
	Sa	Surface Area	cm^2	5276	EPA, 1997	3271	EPA, 1997	Cw x SA x PC x EF x ED x ET x CF x 1/BW x 1/AT
	PC	Dermal Permeability Constant (1)	cm/hr	1.60E-02	EPA, 1992c	1.60E-02	EPA, 1992c	
	EF	Exposure Frequency	days/year	150	5 day/wk, 30 wks	60	2 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	
	CF	Conversion Factor	L/cm^3	0.001	N/A	0.001	N/A	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer) (2)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Inhalation	Ca	Concentration in Air	mg/m^3	chemical-specific	Table 3-5	chemical-specific	Table 3-5	Intake (mg/m^3) =
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	Ca x ET x EF x ED x CF x 1/AT
	EF	Exposure Frequency	days/year	112	7 day/wk, 16 wks	112	7 day/wk, 16 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	CF	Conversion Factor	day/hr	0.042	N/A	0.042	N/A	
	ATc	Averaging Time (cancer)(2)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	

Notes:

(1) PC for 1,1-Dichloroethene was used as a surrogate for TVOC, consistent with the toxicity value used in the risk calculation.

(2) Parameters related to cancer risks are not relevant for the child scenario, because only subchronic noncancer hazards were evaluated.

N/A: not applicable

Table 5-14

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - ADULTS GROUNDWATER)

Former Unisys Facility

	Cancer		NonCancer	
	HEE	CT	HEE	CT
"Dose" Ing	5.75E-05	9.44E-06	2.88E-03	4.72E-04
"Dose" Dermal	1.98E-05	2.46E-06	9.91E-04	1.23E-04
"Dose" Inh	5.11E-04	2.56E-04	2.56E-02	1.28E-02

Note: "Dose" excludes EPC value.

Table 5-15

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - ADULTS SOIL)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Soil
Exposure Medium: Soil and Vegetables
Exposure Point: Graden
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-12	chemical-specific	Table 3-12	Intake (mg/kg-day) =
	IR	Ingestion Rate	mg/day	50	EPA, 1997	50	EPA, 1997	Cs x IR x Ao x EF x ED x CF x FI
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	150	5 day/wk, 30 wks	60	2 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	FI	Fraction Ingested from Source	unitless	1.0	assumption	0.5	assumption	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer) (1)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Dermal	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-12	chemical-specific	Table 3-12	Intake (mg/kg-day) =
	SA	Surface Area	cm^2	5276	EPA, 1997	3271	EPA, 1997	Cs x SA x AF x EF x ED x ABS x CF x
	AF	Adherence Factor	mg/cm^2-day	1.00E-01	EPA, 1997	1.00E-01	EPA, 1997	1/BW x 1/AT
	EF	Exposure Frequency	days/year	150	5 day/wk, 30 wks	60	2 day/wk, 30 wks	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	ABS	Absorption Factor	unitless	0.0005	EPA, 1995c	0.0005	EPA, 1995c	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer) (1)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	
Ingestion of Vegetables	Cv	Concentration in Vegetables	mg/kg	chemical-specific	Table 3-13	chemical-specific	Table 3-13	Intake (mg/kg-day) =
	IR	Ingestion Rate	g/kg-day	6.03	EPA, 1997	0.747	EPA, 1997	Cv x IR x FI x EF x ED x CF x 1/AT
	FI	Fraction Ingested from Source	unitless	1.0	EPA, 1997	1.0	EPA, 1997	
	EF	Exposure Frequency	days/year	350	EPA, 1997	350	EPA, 1997	
	ED	Exposure Duration	years	1.4	EPA, 1997	1.4	EPA, 1997	
	CF	Conversion Factor	kg/g	1.00E-03	N/A	1.00E-03	N/A	
	ATc	Averaging Time (cancer)(1)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	

Notes:

(1) Parameters related to cancer risks are not relevant for the child scenario, because only subchronic noncancer hazards were evaluated.

N/A: not applicable

Table 5-15

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - ADULTS SOIL)

Former Unisys Facility

	Cancer		NonCancer	
	HEE	CT	HEE	CT
"Dose" Ing	5.87E-09	1.17E-09	2.94E-07	5.87E-08
"Dose" Dermal	3.10E-11	7.68E-12	1.55E-09	3.84E-10
"Dose" Inh	1.16E-04	1.43E-05	5.78E-03	7.16E-04

Note: "Dose" excludes EPC value.

Table 5-16

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - CHILDREN AIR)

Former Unisys Facility

Scenario Timeframe: Current and Future
Medium: Air
Exposure Medium: Air
Exposure Point: Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Child (1-8 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cac	Concentration in Air (Current)	mg/m^3	chemical-specific	Table 3-5	chemical-specific	Table 3-5	Intake (mg/m^3) =
	Caf	Concentration in Air (Future)	mg/m^3	chemical-specific	Table 3-6	chemical-specific	Table 3-6	Ca x ET x EF x ED x CF x 1/AT
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	
	EF	Exposure Frequency	days/year	112	7 days/wk, 16 wks	112	7 days/wk, 16 wks	
	ED	Exposure Duration	years	7	EPA, 1997	7	EPA, 1997	
	CF	Conversion Factor	day/hr	0.042	N/A	0.042	N/A	
	ATc	Averaging Time (cancer)(1)	days	N/A	N/A	N/A	N/A	
	ATnc	Averaging Time (noncancer)	days	2555	EPA, 1997	2555	EPA, 1997	

Notes:

(1) Parameters related to cancer risks are not relevant for the child scenario, because only subchronic noncancer hazards were evaluated.

N/A: not applicable

Table 5-17

VALUES USED FOR DOSE CALCULATIONS (NORTH SHORE TOWERS RESIDENT - ADULTS AIR)

Former Unisys Facility

Scenario Timeframe: Current and Future
Medium: Air
Exposure Medium: Air
Exposure Point: Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cac	Concentration in Air (Current)	mg/m^3	chemical-specific	Table 3-5	chemical-specific	Table 3-5	Intake (mg/m^3) =
	Caf	Concentration in Air (Future)	mg/m^3	chemical-specific	Table 3-6	chemical-specific	Table 3-6	Ca x ET x EF x ED x CF x 1/AT
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	
	EF	Exposure Frequency	days/year	112	7 days/wk, 16 wks	112	7 days/wk, 16 wks	
	ED	Exposure Duration	years	30	EPA, 1997	9	EPA, 1997	
	CF	Conversion Factor	day/hr	0.042	N/A	0.042	N/A	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	511	EPA, 1997	511	EPA, 1997	

Notes:

N/A: not applicable

TABLE 5-18

VALUES USED FOR DOSE CALCULATIONS (GROUNDSKEEPER - GROUNDWATER/AIR)

Former Unisys Facility

Scenario Timeframe: Current and Future
Medium: Groundwater
Exposure Medium: Groundwater and Air
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw (C)	Concentration in Water (Current)	mg/L	chemical-specific	Table 3-7	chemical-specific	Table 3-7	Intake (mg/kg-day) =
	Cw (F)	Concentration in Water (Future)	mg/L	chemical-specific	Table 3-3	chemical-specific	Table 3-3	Cw x IR x Ao x EF x ED x 1/BW x 1/AT
	IR	Ingestion Rate	L/day	0.49	EPA, 1997	0.201	EPA, 1997	
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	
	EF	Exposure Frequency	days/year	80	5 days/wk, 16 wks	80	5 days/wk, 16 wks	
	ED	Exposure Duration	years	6.6	EPA, 1997	6.6	EPA, 1997	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	2409	EPA, 1997	2409	EPA, 1997	
Dermal	Cw (C)	Concentration in Water (Current)	mg/L	chemical-specific	Table 3-7	chemical-specific	Table 3-7	Intake (mg/kg-day) =
	Cw (F)	Concentration in Water (Future)	mg/L	chemical-specific	Table 3-3	chemical-specific	Table 3-3	Cw x SA x PC x EF x ED x ET x CF x 1/BW x 1/AT
	SA	Surface Area	cm^2	5276	EPA, 1997	3271	EPA, 1997	
	PC	Dermal Permeability Constant[1]	cm/hr	1.80E-02	EPA, 1992c	1.80E-02	EPA, 1992c	
	EF	Exposure Frequency	days/year	80	5 days/wk, 16 wks	80	5 days/wk, 16 wks	
	ED	Exposure Duration	years	6.6	EPA, 1997	6.6	EPA, 1997	
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	
	CF	Conversion Factor	L/cm^3	0.001	N/A	0.001	N/A	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	2409	EPA, 1997	2409	EPA, 1997	
Inhalation	Ca (C)	Concentration in Air (Current)	mg/m^3	chemical-specific	Table 3-5	chemical-specific	Table 3-5	Intake (mg/m^3) =
	Ca (F)	Concentration in Air (Future)	mg/m^3	chemical-specific	Table 3-6	chemical-specific	Table 3-6	Ca x ET x EF x ED x CF x 1/AT
	ET	Exposure Time	hrs/day	2	assumption	1	assumption	
	EF	Exposure Frequency	days/year	80	5 days/wk, 16 wks	80	5 days/wk, 16 wks	
	ED	Exposure Duration	years	6.6	EPA, 1997	6.6	EPA, 1997	
	CF	Conversion Factor	days/hr	0.042	N/A	0.042	N/A	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	2409	EPA, 1997	2409	EPA, 1997	

Notes:

(1) PC for 1,1-Dichloroethene was used as a surrogate for TVOC, consistent with the toxicity value used in the risk calculation.

N/A: not applicable

(C) = current

(F) = future

TABLE 5-18

VALUES USED FOR DOSE CALCULATIONS (GROUNDSKEEPER - GROUNDWATER/AIR)

Former Unisys Facility

	Cancer		NonCancer	
	HEE	CT	HEE	CT
"Dose" Ing	1.45E-04	5.93E-05	1.53E-03	6.29E-04
"Dose" Dermal	4.98E-05	1.55E-05	5.29E-04	1.64E-04
"Dose" Inh	1.72E-03	8.61E-04	1.83E-02	9.13E-03

Note: "Dose" excludes EPC value.

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TABLE 5-19

VALUES USED FOR DOSE CALCULATIONS (GROUNDSKEEPER - SOIL)

Former Unisys Facility

Scenario Timeframe: Current and Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-8	chemical-specific	Table 3-8	Intake (mg/kg-day) =
	IR	Ingestion Rate	mg/day	50	EPA, 1997	50	EPA, 1997	Cs x IR x Ao x EF x ED x CF x FI
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	80	5 days/wk, 16 wks	80	5 days/wk, 16 wks	
	ED	Exposure Duration	years	6.6	EPA, 1997	6.6	EPA, 1997	
	FI	Fraction Ingested from Source	unitless	1.0	assumption	0.5	assumption	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	2409	EPA, 1997	2409	EPA, 1997	
Dermal	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-8	chemical-specific	Table 3-8	Intake (mg/kg-day) =
	SA	Surface Area	cm^2	5276	EPA, 1997	3271	EPA, 1997	Cs x SA x AF x EF x ED x ABS x CF x
	AF	Adherence Factor	mg/cm^2-day	0.1	EPA, 1997	0.1	EPA, 1997	1/BW x 1/AT
	EF	Exposure Frequency	days/year	80	5 days/wk, 16 wks	80	5 days/wk, 16 wks	
	ED	Exposure Duration	years	6.6	EPA, 1997	6.6	EPA, 1997	
	ABS	Absorption Factor	unitless	0.0005	EPA, 1995c	0.0005	EPA, 1995c	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	2409	EPA, 1997	2409	EPA, 1997	

Notes:

N/A: not applicable

TABLE 5-20

VALUES USED FOR DOSE CALCULATIONS (GOLFER)

Former Unisys Facility

Scenario Timeframe: Current and Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Golfer
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	High-End Value	High-End Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-8	chemical-specific	Table 3-8	Intake (mg/kg-day) =
	IR	Ingestion Rate	mg/day	50	EPA, 1997	50	EPA, 1997	Cs x IR x Ao x EF x ED x CF x FI
	Ao	Oral Absorption	unitless	1.0	EPA, 1997	1.0	EPA, 1997	x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	48	3 days/wk, 16 wks	16	1 day/wk, 16 wks	
	ED	Exposure Duration	years	30	EPA, 1997	9	EPA, 1997	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	FI	Fraction Ingested from Source	unitless	1.0	assumption	0.5	assumption	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	10950	EPA, 1997	10950	EPA, 1997	
Dermal	Cs	Concentration in Soil	mg/kg	chemical-specific	Table 3-8	chemical-specific	Table 3-8	Intake (mg/kg-day) =
	SA	Surface Area	cm^2	5276	EPA, 1997	3271	EPA, 1997	Cw x SA x PC x EF x ED x ET x CF x
	AF	Adherence Factor	mg/cm^2-day	1.00E-01	EPA, 1997	1.00E-01	EPA, 1997	1/BW x 1/AT
	EF	Exposure Frequency	days/year	48	3 days/wk, 16 wks	16	1 day/wk, 16 wks	
	ED	Exposure Duration	years	30	EPA, 1997	9	EPA, 1997	
	ABS	Absorption Factor	unitless	0.0005	EPA, 1995c	0.0005	EPA, 1995c	
	CF	Conversion Factor	kg/mg	1.E-06	N/A	1.E-06	N/A	
	BW	Body Weight	kg	70	EPA, 1997	70	EPA, 1997	
	ATc	Averaging Time (cancer)	days	25550	EPA, 1997	25550	EPA, 1997	
	ATnc	Averaging Time (noncancer)	days	10950	EPA, 1997	10950	EPA, 1997	

Notes:

N/A: not applicable

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TABLE 6-1

NON-CANCER TOXICITY DATA - ORAL/DERMAL

Former Unisys Facility

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor	Adjusted Dermal RfD	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD	Dates of RfD
Chloroform	chronic	1.0E-02	mg/kg-d	100%	1.0E-02	mg/kg-d	Liver	1,000	IRIS	10/5/99
	subchronic	1.0E-02	mg/kg-d	100%	1.0E-02	mg/kg-d	Liver	1,000	HEAST	07/01/97
1,1-Dichloroethane	chronic	1.0E-01	mg/kg-d	100%	1.00E-01	mg/kg-d	no effects	1,000	HEAST	07/01/97
	subchronic	1.0E+00	mg/kg-d	100%	1.00E+00	mg/kg-d	no effects	100	HEAST	07/01/97
1,1-Dichloroethene	chronic	**9.0E-03**	mg/kg-d	100%	**9.00E-03**	mg/kg-d	Liver	1,000	IRIS	10/5/99
	subchronic	**9.0E-03**	mg/kg-d	100%	**9.00E-03**	mg/kg-d	Liver	1,000	HEAST	07/01/97
1,2-Dichloroethene (total)(1)	chronic	2.0E-02	mg/kg-d	100%	2.00E-02	mg/kg-d	Liver	1,000	IRIS	10/5/99
	subchronic	2.0E-01	mg/kg-d	100%	2.00E-02	mg/kg-d	Liver	100	HEAST	10/5/99
Freon 113	chronic	3.0E+01	mg/kg-d	100%	3.00E+01	mg/kg-d	Nervous system	10	IRIS	10/5/99
	subchronic	3.0E+00	mg/kg-d	100%	3.00E+00	mg/kg-d	Weight	100	HEAST	07/01/97
Tetrachloroethene	chronic	1.0E-02	mg/kg-d	100%	1.00E-02	mg/kg-d	Liver	1,000	IRIS	10/5/99
	subchronic	1.0E-01	mg/kg-d	100%	1.00E-01	mg/kg-d	Liver	100	HEAST	07/01/97
Toluene	chronic	2.0E-01	mg/kg-d	100%	2.0E-01	mg/kg-d	Liver/Kidney	1,000	IRIS	10/5/99
	subchronic	2.0E+00	mg/kg-d	100%	2.00E+00	mg/kg-d	Liver/Kidney	100	HEAST	07/01/97
Trichloroethene	chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

N/A = Not Applicable

(1) Based on trans-1,2-dichloroethene

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

Bold values reflect toxicity criteria applied to TVOC.

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TABLE 6-2
NON-CANCER TOXICITY DATA - INHALATION
Former Unisys Facility

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC/RfD	Dates of RfC/RfD
Chloroform	chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,1-Dichloroethane	chronic	5.00E-01	mg/m^3	N/A	N/A	Kidney	1000	HEAST	07/01/97
	subchronic	**5.00E+00**	mg/m^3	N/A	N/A	Kidney	100	HEAST	07/01/97
1,1-Dichloroethene	chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dichloroethene (total)(1)	chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Freon 113	chronic	3.00E+01	mg/m^3	N/A	N/A	Weight	100	HEAST	07/01/97
	subchronic	3.00E+01	mg/m^3	N/A	N/A	Weight	100	HEAST	07/01/97
Tetrachloroethene	chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Toluene	chronic	**4E-01**	mg/m^3	N/A	N/A	Nervous System	300	IRIS	10/05/99
	subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trichloroethene	chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

N/A = Not Applicable

(1) Based on trans-1,2-dichloroethene

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

Bold values reflect toxicity criteria applied to TVOC.

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TABLE 6-3
CANCER TOXICITY DATA - ORAL/DERMAL
Former Unisys Facility

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (2) (MM/DD/YY)
Chloroform	6.1E-03	100%	6.1E-03	$(mg/kg\text{-}d)^{-1}$	B2	IRIS	10/5/99
1,1-Dichloroethane	N/A	N/A	N/A	N/A	C	IRIS	10/5/99
1,1-Dichloroethene	**6.0E-01**	100%	**6.0E-01**	$(mg/kg\text{-}d)^{-1}$	C	IRIS	10/5/99
1,2-Dichloroethene	N/A	N/A	N/A	N/A	D (cis isomer)	IRIS	10/5/99
Freon 113	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tetrachloroethene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Toluene	N/A	N/A	N/A	N/A	D	N/A	10/5/99
Trichloroethene	withdrawn	N/A	N/A	N/A	withdrawn	IRIS	10/5/99

Notes:
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
Bold values reflect toxicity criteria applied to TVOC.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

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TABLE 6-4
CANCER TOXICITY DATA - INHALATION
Former Unisys Facility

Chemical of Potential Concern	Unit Risk	Units	Adjustment	Inhalation Cancer Slope Factor (HEAST, 7/1/97)	Units	Weight of Evidence/ Cancer Guideline Description	Source for Unit Risk	Date
Chloroform	2.3E-02	$(mg/m^3)^{-1}$	N/A	8.1E-02	$(mg/kg\text{-}d)^{-1}$	B2	IRIS	10/5/99
1,1-Dichloroethane	N/A	N/A	N/A	N/A	N/A	C	IRIS	10/5/99
1,1-Dichloroethene	**5.0E-02**	$(mg/m^3)^{-1}$	N/A	1.2E+00	$(mg/kg\text{-}d)^{-1}$	C	IRIS	10/5/99
1,2-Dichloroethene	N/A	N/A	N/A	N/A	N/A	D (cis isomer)	IRIS	10/5/99
Freon 113	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tetrachloroethene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Toluene	N/A	N/A	N/A	N/A	N/A	D	IRIS	10/5/99
Trichloroethene	withdrawn	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
Bold values reflect toxicity criteria applied to TVOC.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

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TABLE 7-1
CALCULATION OF NON-CANCER HAZARDS (RESIDENT - CHILDREN)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater and Shower Air
Exposure Point: Tap and Shower
Receptor Population: Resident
Receptor Age: Child (1-8 years old)

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.13	mg/L	8.9E-03	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.987
Dermal	TVOCs	0.13	mg/L	4.7E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.052
Inhalation	TVOCs	0.065	mg/m^3	1.3E-03	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.003
Total Hazard Index Across All Exposure Routes/Pathways										1.0
Central Tendency										
Ingestion	TVOCs	0.076	mg/L	3.0E-03	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.333
Dermal	TVOCs	0.076	mg/L	1.0E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.011
Inhalation	TVOCs	0.038	mg/m^3	3.2E-04	mg/m^3	N/A	N/A	4.00E-01	mg/m^3	0.001
Total Hazard Index Across All Exposure Routes/Pathways										0.3

TABLE 7-2
CALCULATION OF NON-CANCER HAZARDS (RESIDENT - ADULTS)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater and Shower Air
Exposure Point: Tap and Shower
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.13	mg/L	4.2E-03	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.462
Dermal	TVOCs	0.13	mg/L	3.0E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.033
Inhalation	TVOCs	0.065	mg/m^3	1.3E-03	mg/m^3	N/A	N/A	4.00E-01	mg/m^3	0.003
Total Hazard Index Across All Exposure Routes/Pathways										0.50
Central Tendency										
Ingestion	TVOCs	0.076	mg/L	1.5E-03	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.163
Dermal	TVOCs	0.076	mg/L	7.6E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.008
Inhalation	TVOCs	0.038	mg/m^3	3.8E-04	mg/m^3	N/A	N/A	4.00E-01	mg/m^3	0.001
Total Hazard Index Across All Exposure Routes/Pathways										0.17

TABLE 7-3

CALCULATION OF NON-CANCER HAZARDS (NORTH SHORE TOWERS RESIDENT - CHILDREN PAST SPRAY IRRIGATION)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Groundwater
Exposure Medium: Spray Irrigation Water and Air
Exposure Point: Garden and Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Child (1-8 years old)

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.184	mg/L	7.2E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0803
Dermal	TVOCs	0.184	mg/L	2.1E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0232
Inhalation	TVOCs	0.097	mg/m^3	1.3E-03	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.0033
Total Hazard Index Across All Exposure Routes/Pathways										0.11
Central Tendency										
Ingestion	TVOCs	0.131	mg/L	1.2E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0133
Dermal	TVOCs	0.131	mg/L	1.8E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0020
Inhalation	TVOCs	0.069	mg/m^3	2.4E-04	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.0006
Total Hazard Index Across All Exposure Routes/Pathways										0.02

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TABLE 7-4
CALCULATION OF NON-CANCER HAZARDS (NORTH SHORE TOWERS RESIDENT - CHILDREN PAST SOIL/VEGETABLES)
Former Unisys Facility

Scenario Timeframe: Past
Medium: Soil
Exposure Medium: Soil and Vegetables
Exposure Point: Garden
Receptor Population: North Shore Tower Resident
Receptor Age: Child (1-8 years old)

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion - Soil	TVOCs	0.194	mg/kg	8.8E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	9.8E-06
Dermal - Soil	TVOCs	0.194	mg/kg	3.4E-10	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	3.8E-08
Ingestion - Vegetables	TVOCs	1.085	mg/kg	6.5E-03	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	7.3E-01
Total Hazard Index Across All Exposure Routes/Pathways										0.73
Central Tendency										
Ingestion - Soil	TVOCs	0.144	mg/kg	1.6E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.8E-06
Dermal - Soil	TVOCs	0.144	mg/kg	6.3E-11	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	7.0E-09
Ingestion - Vegetables	TVOCs	0.804	mg/kg	6.0E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	6.7E-02
Total Hazard Index Across All Exposure Routes/Pathways										0.07

TABLE 7-5

CALCULATION OF NON-CANCER HAZARDS (NORTH SHORE TOWERS RESIDENT - ADULTS PAST SPRAY IRRIGATION WATER/AIR)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Groundwater
Exposure Medium: Spray Irrigation Water and Air
Exposure Point: Garden and Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.184	mg/L	5.3E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0588
Dermal	TVOCs	0.184	mg/L	1.8E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0203
Inhalation	TVOCs	0.097	mg/m^3	2.5E-03	mg/m^3	N/A	N/A	5.00E+00	mg/m^3	0.0005
Total Hazard Index Across All Exposure Routes/Pathways										0.08
Central Tendency										
Ingestion	TVOCs	0.131	mg/L	6.2E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0068
Dermal	TVOCs	0.131	mg/L	1.6E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	0.0018
Inhalation	TVOCs	0.069	mg/m^3	8.8E-04	mg/m^3	N/A	N/A	5.00E+00	mg/m^3	0.0002
Total Hazard Index Across All Exposure Routes/Pathways										0.01

Notes:
Subchronic toxicity values were used. Exposure duration=1.4 years)

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TABLE 7-6
CALCULATION OF NON-CANCER HAZARDS (NORTH SHORE TOWERS RESIDENT - ADULTS PAST SOIL/VEGETABLES)
Former Unisys Facility

Scenario Timeframe: Past
Medium: Soil
Exposure Medium: Soil
Exposure Point: Garden and Vegetables
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion - Soil	TVOCs	0.194	mg/kg	5.7E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	6.3E-06
Dermal - Soil	TVOCs	0.194	mg/kg	3.0E-10	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	3.3E-08
Ingestion - Vegetables	TVOCs	1.085	mg/kg	6.3E-03	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	7.0E-01
Total Hazard Index Across All Exposure Routes/Pathways										0.70
Central Tendency										
Ingestion - Soil	TVOCs	0.144	mg/kg	8.4E-09	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	9.4E-07
Dermal - Soil	TVOCs	0.144	mg/kg	5.5E-11	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	6.1E-09
Ingestion - Vegetables	TVOCs	0.804	mg/kg	5.8E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	6.4E-02
Total Hazard Index Across All Exposure Routes/Pathways										0.06

TABLE 7-6
CALCULATION OF NON-CANCER HAZARDS (NORTH SHORE TOWERS RESIDENT - ADULTS PAST SOIL/VEGETABLES)
Former Unisys Facility

Scenario Timeframe: Past
Medium: Soil
Exposure Medium: Soil
Exposure Point: Garden and Vegetables
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion - Soil	TVOCs	0.194	mg/kg	5.7E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	6.3E-06
Dermal - Soil	TVOCs	0.194	mg/kg	3.0E-10	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	3.3E-08
Ingestion - Vegetables	TVOCs	1.085	mg/kg	6.3E-03	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	7.0E-01
Total Hazard Index Across All Exposure Routes/Pathways										0.70
Central Tendency										
Ingestion - Soil	TVOCs	0.144	mg/kg	8.4E-09	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	9.4E-07
Dermal - Soil	TVOCs	0.144	mg/kg	5.5E-11	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	6.1E-09
Ingestion - Vegetables	TVOCs	0.804	mg/kg	5.8E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	6.4E-02
Total Hazard Index Across All Exposure Routes/Pathways										0.06

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TABLE 7-7

CALCULATION OF NON-CANCER HAZARDS (NORTH SHORE TOWERS RESIDENT - ADULTS AND CHILDREN - CURRENT AND FUTURE AIR)

Former Unisys Facility

Scenario Timeframe: Current and Future
Medium: Air
Exposure Medium: Air
Exposure Point: Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Child (1-8 years old) and Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Inhalation - Current Child	TVOCs	0.097	mg/m^3	2.5E-03	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.01
Inhalation - Current Adult	TVOCs	0.097	mg/m^3	5.3E-02	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.13
Inhalation - Future Child	TVOCs	0.096	mg/m^3	2.5E-03	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.01
Inhalation - Future Adult	TVOCs	0.096	mg/m^3	5.3E-02	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.13
Central Tendency										
Inhalation - Current Child	TVOCs	0.069	mg/m^3	8.8E-04	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.002
Inhalation - Current Adult	TVOCs	0.069	mg/m^3	5.6E-03	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.01
Inhalation - Future Child	TVOCs	0.071	mg/m^3	9.1E-04	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.002
Inhalation - Future Adult	TVOCs	0.071	mg/m^3	5.9E-03	mg/m^3	N/A	N/A	4.0E-01	mg/m^3	0.01

TABLE 7-8

CALCULATION OF NON-CANCER HAZARDS (GROUNDSKEEPER - CURRENT SPRAY IRRIGATION WATER/AIR)

Former Unisys Facility

Scenario Timeframe: Current
Medium: Groundwater
Exposure Medium: Spray Irrigation Water and Air
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.184	mg/L	2.8E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	3.1E-02
Dermal	TVOCs	0.184	mg/L	9.7E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.1E-02
Inhalation	TVOCs	0.097	mg/m^3	1.8E-03	mg/m^3	N/A	N/A	5.0E+00	mg/m^3	3.5E-04
Total Hazard Index Across All Exposure Routes/Pathways										0.04
Central Tendency										
Ingestion	TVOCs	0.131	mg/L	8.2E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	9.1E-03
Dermal	TVOCs	0.131	mg/L	2.1E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	2.4E-03
Inhalation	TVOCs	0.069	mg/m^3	6.3E-04	mg/m^3	N/A	N/A	5.00E+00	mg/m^3	1.3E-04
Total Hazard Index Across All Exposure Routes/Pathways										0.01

Notes:
Subchronic toxicity values were used. (Exposure duration = 6.6 years)

TABLE 7-9
CALCULATION OF NON-CANCER HAZARDS (GROUNDSKEEPER - CURRENT SOIL)
Former Unisys Facility

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.194	mg/kg	3.0E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	3.4E-06
Dermal	TVOCs	0.194	mg/kg	1.6E-10	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.8E-08
Total Hazard Index Across All Exposure Routes/Pathways										3.4E-06
Central Tendency										
Ingestion	TVOCs	0.144	mg/kg	1.1E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.2E-06
Dermal	TVOCs	0.144	mg/kg	7.3E-11	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	8.2E-09
Total Hazard Index Across All Exposure Routes/Pathways										1.3E-06

TABLE 7-10
CALCULATION OF NON-CANCER HAZARDS (GROUNDSKEEPER - FUTURE SPRAY IRRIGATION WATER/AIR)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Spray Irrigation Water and Air
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.194	mg/L	3.0E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	3.3E-02
Dermal	TVOCs	0.194	mg/L	1.0E-04	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.1E-02
Inhalation	TVOCs	0.096	mg/m^3	1.8E-03	mg/m^3	N/A	N/A	5.00E+00	mg/m^3	3.5E-04
Total Hazard Index Across All Exposure Routes/Pathways										0.04
Central Tendency										
Ingestion	TVOCs	0.144	mg/L	9.0E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.0E-02
Dermal	TVOCs	0.144	mg/L	2.4E-05	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	2.6E-03
Inhalation	TVOCs	0.071	mg/m^3	6.5E-04	mg/m^3	N/A	N/A	5.00E+00	mg/m^3	1.3E-04
Total Hazard Index Across All Exposure Routes/Pathways										0.01

Notes:
Subchronic toxicity values were used. (Exposure duration = 6.6 years)

TABLE 7-11
CALCULATION OF NON-CANCER HAZARDS (GROUNDSKEEPER - FUTURE SOIL)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.194	mg/kg	3.0E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	3.4E-06
Dermal	TVOCs	0.194	mg/kg	1.6E-10	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.8E-08
Total Hazard Index Across All Exposure Routes/Pathways										3.4E-06
Central Tendency										
Ingestion	TVOCs	0.144	mg/kg	1.1E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.2E-06
Dermal	TVOCs	0.144	mg/kg	7.3E-11	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	8.2E-09
Total Hazard Index Across All Exposure Routes/Pathways										1.3E-06

TABLE 7-12
CALCULATION OF NON-CANCER HAZARDS (GOLFER - CURRENT SOIL)
Former Unisys Facility

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Golfer
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.194	mg/kg	1.8E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	2.0E-06
Dermal	TVOCs	0.194	mg/kg	9.6E-11	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.1E-08
Total Hazard Index Across All Exposure Routes/Pathways										2.0E-06
Central Tendency										
Ingestion	TVOCs	0.144	mg/kg	6.7E-10	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	7.5E-08
Dermal	TVOCs	0.144	mg/kg	4.4E-12	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	4.9E-10
Total Hazard Index Across All Exposure Routes/Pathways										7.5E-08

TABLE 7-13
CALCULATION OF NON-CANCER HAZARDS (GOLFER - FUTURE SOIL)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Golfer
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration (1)	Reference Concentration Units	Hazard Quotient
High End										
Ingestion	TVOCs	0.194	mg/kg	1.8E-08	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	2.0E-06
Dermal	TVOCs	0.194	mg/kg	9.6E-11	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	1.1E-08
						Total Hazard Index Across All Exposure Routes/Pathways				2.0E-06
Central Tendency										
Ingestion	TVOCs	0.144	mg/kg	6.7E-10	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	7.5E-08
Dermal	TVOCs	0.144	mg/kg	4.4E-12	mg/kg-d	9.0E-03	mg/kg-d	N/A	N/A	4.9E-10
						Total Hazard Index Across All Exposure Routes/Pathways				7.5E-08

(1) Subchronic toxicity values used to estimate hazard quotient.

TABLE 7-14
CALCULATION OF CANCER RISKS (RESIDENT)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater and Shower Air
Exposure Point: Tap and Shower
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High-End								
Ingestion	TVOCs	2.8E-04	mg/L	3.9E-06	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.4E-06
Dermal	TVOCs	2.8E-04	mg/L	2.8E-07	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.7E-07
Inhalation	TVOCs	1.4E-04	mg/m^3	1.2E-06	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	6.1E-08
						Total Risk Across All Exposure Routes/Pathways		2.6E-06
Central Tendency								
Ingestion	TVOCs	1.7E-04	mg/L	4.1E-07	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.5E-07
Dermal	TVOCs	1.7E-04	mg/L	2.1E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.3E-08
Inhalation	TVOCs	8.4E-05	mg/m^3	1.1E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	5.4E-09
						Total Risk Across All Exposure Routes/Pathways		2.7E-07

TABLE 7-15

CALCULATION OF CANCER RISKS (NORTH SHORE TOWER RESIDENT - PAST SPRAY IRRIGATION WATER/AIR)

Former Unisys Facility

Scenario Timeframe: Past
Medium: Groundwater
Exposure Medium: Spray Irrigation Water and Air
Exposure Point: Garden and Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion	TVOCs	1.0E-03	mg/L	5.8E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	3.5E-08
Dermal	TVOCs	1.0E-03	mg/L	2.0E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.2E-08
Inhalation	TVOCs	5.2E-04	mg/m^3	2.7E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	1.3E-08
Total Risk Across All Exposure Routes/Pathways								6.0E-08
Central Tendency								
Ingestion	TVOCs	5.0E-04	mg/L	4.7E-09	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.8E-09
Dermal	TVOCs	5.0E-04	mg/L	1.2E-09	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	7.4E-10
Inhalation	TVOCs	2.6E-04	mg/m^3	6.7E-08	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	3.3E-09
Total Risk Across All Exposure Routes/Pathways								6.9E-09

TABLE 7-16
CALCULATION OF CANCER RISKS (NORTH SHORE TOWERS RESIDENT - PAST SOIL/VEGETABLES)
Former Unisys Facility

Scenario Timeframe: Past
Medium: Soil
Exposure Medium: Soil and Vegetables
Exposure Point: Garden
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion - Soil	TVOCs	4.3E-04	mg/kg	2.5E-12	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.5E-12
Dermal - Soil	TVOCs	4.3E-04	mg/kg	1.3E-14	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	7.9E-15
Ingestion - Vegetables	TVOCs	2.4E-03	mg/kg	2.8E-07	mg/kg-d	5.00E-02	$(mg/m^3)^{-1}$	1.4E-08
Total Risk Across All Exposure Routes/Pathways								1.4E-08
Central Tendency								
Ingestion - Soil	TVOCs	3.2E-04	mg/kg	3.7E-13	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.2E-13
Dermal - Soil	TVOCs	3.2E-04	mg/kg	2.4E-15	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.5E-15
Ingestion - Vegetables	TVOCs	1.8E-03	mg/kg	2.5E-08	mg/kg-d	5.00E-02	$(mg/m^3)^{-1}$	1.3E-09
Total Risk Across All Exposure Routes/Pathways								1.3E-09

TABLE 7-17

CALCULATION OF CANCER RISKS (NORTH SHORE TOWERS RESIDENT - CURRENT AND FUTURE AIR)

Former Unisys Facility

Scenario Timeframe: Current and Future
Medium: Air
Exposure Medium: Air
Exposure Point: Apartment
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Inhalation - Current	TVOCs	5.2E-04	mg/m^3	5.7E-06	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	2.9E-07
Inhalation - Future	TVOCs	2.1E-04	mg/m^3	2.3E-06	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	1.2E-07
Central Tendency								
Inhalation - Current	TVOCs	2.6E-04	mg/m^3	4.3E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	2.1E-08
Inhalation - Future	TVOCs	1.6E-04	mg/m^3	2.6E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	1.3E-08

TABLE 7-18

CALCULATION OF CANCER RISKS (GROUNDSKEEPER - CURRENT SPRAY IRRIGATION WATER/AIR)

Former Unisys Facility

Scenario Timeframe: Current
Medium: Groundwater
Exposure Medium: Spray Irrigation Water and Air
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion	TVOCs	1.0E-03	mg/L	1.4E-07	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	8.7E-08
Dermal	TVOCs	1.0E-03	mg/L	5.0E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	3.0E-08
Inhalation	TVOCs	5.2E-04	mg/m^3	9.0E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	4.5E-08
							Total Risk Across All Exposure Routes/Pathways	1.6E-07
Central Tendency								
Ingestion	TVOCs	5.0E-04	mg/L	3.0E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.8E-08
Dermal	TVOCs	5.0E-04	mg/L	7.7E-09	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	4.6E-09
Inhalation	TVOCs	2.6E-04	mg/m^3	2.2E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	1.1E-08
							Total Risk Across All Exposure Routes/Pathways	3.4E-08

TABLE 7-19
CALCULATION OF CANCER RISKS (GROUNDSKEEPER - CURRENT SOIL)
Former Unisys Facility

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion	TVOCs	4.3E-04	mg/kg	6.3E-12	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	3.8E-12
Dermal	TVOCs	4.3E-04	mg/kg	3.3E-14	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.0E-14
Total Risk Across All Exposure Routes/Pathways								3.8E-12
Central Tendency								
Ingestion	TVOCs	3.2E-04	mg/kg	2.3E-12	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.4E-12
Dermal	TVOCs	3.2E-04	mg/kg	1.5E-14	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	9.1E-15
Total Risk Across All Exposure Routes/Pathways								1.4E-12

TABLE 7-20
CALCULATION OF CANCER RISKS (GROUNDSKEEPER - FUTURE SPRAY IRRIGATION WATER/AIR)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Spray Irrigation Water and Air
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion	TVOCs	4.3E-04	mg/L	6.2E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	3.7E-08
Dermal	TVOCs	4.3E-04	mg/L	2.1E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.3E-08
Inhalation	TVOCs	2.1E-04	mg/m^3	3.6E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	1.8E-08
						Total Risk Across All Exposure Routes/Pathways		6.8E-08
Central Tendency								
Ingestion	TVOCs	3.2E-04	mg/L	1.9E-08	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.1E-08
Dermal	TVOCs	3.2E-04	mg/L	4.9E-09	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.9E-09
Inhalation	TVOCs	1.6E-04	mg/m^3	1.4E-07	mg/m^3	5.00E-02	$(mg/m^3)^{-1}$	6.8E-09
						Total Risk Across All Exposure Routes/Pathways		2.1E-08

TABLE 7-21
CALCULATION OF CANCER RISKS (GROUNDSKEEPER - FUTURE SOIL)
Former Unisys Facility

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Groundskeeper
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion	TVOCs	4.3E-04	mg/kg	6.3E-12	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	3.8E-12
Dermal	TVOCs	4.3E-04	mg/kg	3.3E-14	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.0E-14
Total Risk Across All Exposure Routes/Pathways								3.8E-12
Central Tendency								
Ingestion	TVOCs	3.2E-04	mg/kg	2.3E-12	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.4E-12
Dermal	TVOCs	3.2E-04	mg/kg	1.5E-14	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	9.1E-15
Total Risk Across All Exposure Routes/Pathways								1.4E-12

TABLE 7-22
CALCULATION OF CANCER RISKS (GOLFER - CURRENT SOIL)
Former Unisys Facility

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Golfer
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion	TVOCs	4.3E-04	mg/kg	1.7E-11	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.0E-11
Dermal	TVOCs	4.3E-04	mg/kg	9.0E-14	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	5.4E-14
Total Risk Across All Exposure Routes/Pathways								1.0E-11
Central Tendency								
Ingestion	TVOCs	3.2E-04	mg/kg	6.4E-13	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	3.8E-13
Dermal	TVOCs	3.2E-04	mg/kg	4.2E-15	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.5E-15
Total Risk Across All Exposure Routes/Pathways								3.8E-13

TABLE 7-23

CALCULATION OF CANCER RISKS (GOLFER - FUTURE SOIL)

Former Unisys Facility

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Near Irrigation System
Receptor Population: Golfer
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
High End								
Ingestion	TVOCs	4.3E-04	mg/kg	1.7E-11	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	1.0E-11
Dermal	TVOCs	4.3E-04	mg/kg	9.0E-14	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	5.4E-14
				Total Risk Across All Exposure Routes/Pathways				1.0E-11
Central Tendency								
Ingestion	TVOCs	3.2E-04	mg/kg	6.4E-13	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	3.8E-13
Dermal	TVOCs	3.2E-04	mg/kg	4.2E-15	mg/kg-d	6.00E-01	$(mg/kg\text{-}d)^{-1}$	2.5E-15
				Total Risk Across All Exposure Routes/Pathways				3.8E-13

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Table 7-24
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (RESIDENT - CHILDREN FUTURE)
Former Unisys Facility

Scenerio Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Child (1-8 years old)

	Medium	Exposure Point	Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Groundwater	Tap Water	9.9E-01	5.2E-02	--	1.0E+00
		Shower	--	--	3.2E-03	3.2E-03
					Total =	1.0
Central Tendency	Groundwater	Tap Water	3.3E-01	1.1E-02	--	3.4E-01
		Shower	--	--	8.0E-04	8.0E-04
					Total =	0.34

Notes:
(1) Only subchronic noncancer hazards were evaluated for child scenerio.

Table 7-25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (RESIDENT - ADULTS FUTURE)
Former Unisys Facility

Scenerio Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Groundwater	Tap Water	2.4E-06	1.7E-07	--	2.5E-06	4.6E-01	3.3E-02	--	5.0E-01
		Shower	--	--	6.1E-08	6.1E-08	--	--	3.2E-03	3.2E-03
					Total =	**3.E-06**			**Total =**	**0.50**
Central Tendency	Groundwater	Tap Water	2.5E-07	1.3E-08	--	2.6E-07	1.6E-01	8.4E-03	--	1.7E-01
		Shower	--	--	5.4E-09	5.4E-09	--	--	9.5E-04	9.5E-04
					Total =	**3.E-07**			**Total =**	**0.17**

Notes:
(1) Only subchronic noncancer hazards were evaluated for child scenerio.

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Table 7-26

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (NORTH SHORE TOWERS RESIDENT - CHILDREN PAST)

Former Unisys Facility

Scenerio Timeframe:	Past
Receptor Population:	North Shore Tower Resident
Receptor Age:	Child (1-8 years old)

	Medium	Exposure Point	Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Groundwater	Garden	8.0E-02	2.3E-02	--	1.0E-01
	Air	Apartment	--	--	3.3E-03	3.3E-03
	Soil	Garden	9.8E-06	3.8E-08	--	9.9E-06
		Vegetables	7.3E-01	--	--	7.3E-01
					Total =	**0.83**
Central Tendency	Groundwater	Garden	1.3E-02	2.0E-03	--	1.5E-02
	Air	Apartment	--	--	5.9E-04	5.9E-04
	Soil	Garden	1.8E-06	7.0E-09	--	1.8E-06
		Vegetables	6.7E-02	--	--	6.7E-02
					Total =	**0.08**

Notes:

(1) Only subchronic noncancer hazards were evaluated for child scenario.

Table 7-27

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (NORTH SHORE TOWERS RESIDENT - ADULTS PAST)

Former Unisys Facility

Scenerio Timeframe: Past
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Groundwater	Garden	3.5E-08	1.2E-08	--	5.E-08	5.9E-02	2.0E-02	--	7.9E-02
	Air	Apartment	--	--	1.3E-08	1.E-08	--	--	5.0E-04	5.0E-04
	Soil	Garden	1.5E-12	7.9E-15	--	2.E-12	6.3E-06	3.3E-08	--	6.4E-06
		Vegetables	1.4E-08	--	--	1.E-08	7.0E-01	--	--	7.0E-01
					Total =	**7.E-08**			**Total =**	**0.78**
Central Tendency	Groundwater	Garden	2.8E-09	7.4E-10	--	4.E-09	6.8E-03	1.8E-03	--	8.6E-03
	Air	Apartment	--	--	3.3E-09	3.E-09	--	--	1.8E-04	1.8E-04
	Soil	Garden	2.2E-13	1.5E-15	--	2.E-13	9.4E-07	6.1E-09	6.4E-02	6.4E-02
		Vegetables	1.3E-09	--	--	1.E-09	6.4E-02	--	--	6.4E-02
					Total =	**8.E-09**			**Total =**	**0.14**

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Table 7-28

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (NORTH SHORE TOWERS RESIDENT - CHILDREN CURRENT)

Former Unisys Facility

Scenerio Timeframe:	Current
Receptor Population:	North Shore Tower Resident
Receptor Age: Child	(1-8 years old)

	Medium	Exposure Point	Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Air	Apartment	--	--	6.2E-03	6.2E-03
					Total =	**0.006**
Central Tendency	Air	Apartment	--	--	2.2E-03	2.2E-03
					Total =	**0.002**

Notes:

(1) Only subchronic noncancer hazards were evaluated for child scenario.

Table 7-29

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (NORTH SHORE TOWERS RESIDENT - ADULTS CURRENT)

Former Unisys Facility

Scenerio Timeframe: Current
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Air	Apartment	--	--	2.9E-07	3.E-07	--	--	1.3E-01	1.3E-01
					Total =	**3.E-07**			**Total =**	**0.13**
Central Tendency	Air	Apartment	--	--	1.3E-08	1.E-08	--	--	1.4E-02	1.4E-02
					Total =	**1.E-08**			**Total =**	**0.01**

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Table 7-30

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (NORTH SHORE TOWERS RESIDENT - CHILDREN FUTURE)

Former Unisys Facility

Scenerio Timeframe: Future
Receptor Population: North Shore Tower Resident
Receptor Age: Child (1-8 years old)

	Medium	Exposure Point	Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Air	Apartment	--	--	6.2E-03	6.2E-03
					Total =	**0.006**
Central Tendency	Air	Apartment	--	--	2.3E-03	2.3E-03
					Total =	**0.002**

Notes:

(1) Only subchronic noncancer hazards were evaluated for child scenario.

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Table 7-31

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (NORTH SHORE TOWERS RESIDENT - ADULTS FUTURE)

Former Unisys Facility

Scenerio Timeframe: Future
Receptor Population: North Shore Tower Resident
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Air	Apartment	--	--	1.2E-07	1.E-07	--	--	1.3E-01	1.3E-01
					Total =	**1.E-07**			**Total =**	**0.13**
Central Tendency	Air	Apartment	--	--	1.3E-08	1.E-08	--	--	1.5E-02	1.5E-02
					Total =	**1.E-08**			**Total =**	**0.01**

Table 7-32
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (GROUNDSKEEPER - ADULTS CURRENT)
Former Unisys Facility

Scenerio Timeframe: Current
Receptor Population: Groundskeeper
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Groundwater	Near Irrigation System	8.7E-08	3.0E-08	--	1.E-07	3.1E-02	1.1E-02	--	4.2E-02
	Air	Near Irrigation System	--	--	4.5E-08	5.E-08	--	--	3.5E-04	3.5E-04
	Soil	Near Irrigation System	3.8E-12	2.0E-14	--	4.E-12	3.4E-06	1.8E-08	--	3.4E-06
					Total =	**2.E-07**			**Total =**	**0.04**
Central Tendency	Groundwater	Near Irrigation System	1.8E-08	4.6E-09	--	2.E-08	9.1E-03	2.4E-03	--	1.2E-02
	Air	Near Irrigation System	--	--	1.1E-08	1.E-08	--	--	1.3E-04	1.3E-04
	Soil	Near Irrigation System	1.4E-12	9.1E-15	--	1.E-12	1.2E-06	8.2E-09	--	1.3E-06
					Total =	**3.E-08**			**Total =**	**0.01**

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Table 7-33
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (GROUNDSKEEPER - ADULTS FUTURE)
Former Unisys Facility

Scenerio Timeframe: Future
Receptor Population: Groundskeeper
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Groundwater	Near Irrigation System	3.7E-08	1.3E-08	--	5.E-08	3.3E-02	1.1E-02	--	4.4E-02
	Air	Near Irrigation System	--	--	1.8E-08	2.E-08	--	--	3.5E-04	3.5E-04
	Soil	Near Irrigation System	3.8E-12	2.0E-14	--	4.E-12	3.4E-06	1.8E-08	--	3.4E-06
					Total =	**7.E-08**			**Total =**	**0.04**
Central Tendency	Groundwater	Near Irrigation System	1.1E-08	2.9E-09	--	1.E-08	1.0E-02	2.6E-03	--	1.3E-02
	Air	Near Irrigation System	--	--	6.8E-09	7.E-09	--	--	1.3E-04	1.3E-04
	Soil	Near Irrigation System	1.4E-12	9.1E-15	--	1.E-12	1.2E-06	8.2E-09	--	1.3E-06
					Total =	**2.E-08**			**Total =**	**0.01**

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Table 7-34

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (GOLFER - ADULTS CURRENT)

Former Unisys Facility

Scenerio Timeframe: Current
Receptor Population: Golfer
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Soil	Near Irrigation System	1.0E-11	5.4E-14	--	1.E-11	2.0E-06	1.1E-08	--	2.0E-06
					Total =	**1.E-11**			**Total =**	**2.0E-06**
Central Tendency	Soil	Near Irrigation System	3.8E-13	2.5E-15	--	4.E-13	7.5E-08	4.9E-10	--	7.5E-08
					Total =	**4.E-13**			**Total =**	**7.5E-08**

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Table 7-35
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs (GOLFER - ADULTS FUTURE)
Former Unisys Facility

Scenerio Timeframe: Future
Receptor Population: Golfer
Receptor Age: Adult

	Medium	Exposure Point	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
			Ingestion	Dermal	Inhalation	Exposure Routes Total	Ingestion	Dermal	Inhalation	Exposure Routes Total
High End	Soil	Near Irrigation System	1.0E-11	5.4E-14	--	1.E-11	2.0E-06	1.1E-08	--	2.0E-06
					Total =	**1.E-11**			**Total =**	**2.0E-06**
Central Tendency	Soil	Near Irrigation System	3.8E-13	2.5E-15	--	4.E-13	7.5E-08	4.9E-10	--	7.5E-08
					Total =	**4.E-13**			**Total =**	**7.5E-08**

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Table 7-36

Comparison of Predicted Future Groundwater Concentrations to Drinking Water Criteria

Former Unisys Facility

Well Modeled	Max. Predicted TVOC Conc. (ug/L)	Year Max. Predicted to Occur	Exceeded
N0022	1.1	2021	no criteria exceeded
N3003	0.08	2012	no criteria exceeded
N5099	72.95	2023	SCG, MCL
N5535	1.18	2023	no criteria exceeded
N12999	33.22	2023	SCG, MCL
N13000	122.75	2023	SCG, MCL

Notes: 1,1-DCA = 1,1-Dichloroethane
1,1-DCE = 1,1-Dichloroethene
1,2-DCE = 1,2-Dichloroethene
TCE = Trichloroethene
PCE = Tetrachloroethene
SCG = State Standards, Criteria, and Guidance Values
MCL = Maximum Contaminant Level
Only wells potentially providing drinking water and not currently treated are listed

	SCG (μg/L)	MCL (μg/L)
1,1-DCA	5	--
1,1-DCE	5	7
1,2-DCE*	5	70
Chloroform	7	--
TCE	5	5
Toluene	5	1000
PCE	5	5
Freon 113	5	--

*Value for the cis isomer is used since it is the most conservative.

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Table 8-1
Summary of Uncertainty Analysis
Lockheed Martin - OU-2

POTENTIAL SOURCE OF UNCERTAINTY	DIRECTION OF EFFECT	JUSTIFICATION
Selection of COPCs based on both on-site and off-site groundwater data.	Overestimate	Some VOCs identified in on-site groundwater may not migrate as far as the water supply wells (exposure point).
Analytical procedures used by laboratories	Overestimate or underestimate	Numerous QA/QC checks were conducted by laboratories; however, one or more chemicals or concentrations may have been misidentified or misread.
Use of modeled TVOC data as EPCs in tap water	Overestimate	Modeling data was not available for individual chemicals. The model assumed the most rapid migration for COPCs.
Unimpacted wells not modeled or included in estimates of future concentrations, even though these unimpacted wells will contribute to the water supply	Overestimate	Lack of data on unimpacted wells prevented their inclusion in the data set. Concentrations to which people will be exposed will reflect both impacted and unimpacted wells.
The maximum of the 30-year average TVOC concentrations obtained from the fate and transport model was used as the EPC for the high-end scenario	Overestimate	Residents receive their drinking water from more than one water supply well, reducing the TVOC concentration at the tap. Volatilization at the tap was not accounted for.
Risks were calculated for the water district most highly impacted by the groundwater plume.	Overestimate	Residents may receive drinking water from other water districts with lower concentrations of COPCs
Cancer EPCs assume 0.2% of TVOC is comprised of carcinogenic compounds	Overestimate	Monitoring well data suggests that carcinogenic chemicals may not reach the water supply wells.
Exposure assumptions (frequency, duration, and intensity)	Unknown; probably overestimate	Parameters selected are conservative estimates of exposure; however, in the absence of site-specific data the actual exposure may be greater than evaluated.
Models were used to estimate EPCs for air and vegetables	Overestimate	Conservative model inputs may result in overestimation of EPCs
Extrapolation of animal toxicity data to humans	Unknown; probably overestimate	Animals and humans differ with respect to absorption, metabolism, distribution, and excretion leading to variations in chemical effects. Animal studies typically involve high-dose exposures, whereas humans are generally exposed to low doses in the environment.
Use of uncertainty factors in the derivation of reference doses	Overestimate or underestimate	Ten-fold uncertainty factors are incorporated to account for various sources of uncertainty (animal to human extrapolation, protection of sensitive human populations, extrapolation from subchronic to chronic data, and use of LOAELs rather than NOAELs). Although some data seem to support the ten-fold factor, its selection is somewhat arbitrary.
Use of a linearized, multi-stage model to derive the cancer slope factor for 1,1-dichloroethene	Overestimate	Model assumes a non-threshold, linear low dose response for carcinogens. Many compounds induce cancer by non-genotoxic mechanisms. Model results in a 95% UCL of the cancer risk. The true risk is unlikely to be higher and may be as low as zero.

Table 8-1
Summary of Uncertainty Analysis
Lockheed Martin - OU-2

The cancer slope factor and unit risk values for chloroform are highly uncertain Note: the chloroform values are presented in the tox. tables, but are not used in the calculations.	No effect	The carcinogenicity assessment for chloroform is undergoing review by EPA's Science Advisory Board. Consideration of a nonlinear mode of action will likely reduce the toxicity values resulting in lower cancer risks.
Application of the most conservative toxicity values to TVOC exposure	Overestimate	The modeled TVOC concentration consists of multiple VOC constituents with differing degrees of toxic potency.
Summation of effects (cancer risks and hazard indices) from multiple substances	Overestimate or underestimate	The assumption that effects are additive ignores potential synergistic and/or antagonistic effects and assumes similarity in mechanism of action, which is not the case for many substances. Compounds may induce tumors or other toxic effects in different systems.
Toxicity values are not available for trichloroethene	No change or underestimate	If the toxic potency of trichloroethene is similar to the other chlorinated solvents selected as COPCs, no significant change in the risk assessment would be anticipated.
The risk characterization combines overestimates of both exposure and toxicity	Overestimate	The use of modeled TVOC data results in overestimation of both exposure and toxicity.

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