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**THIRD AMENDED  
PROPOSED PLAN OF REMEDIAL ACTION**

201 / 205 A Street  
Wilmington, DE

DNREC Project No. DE-1228



August 2004

Delaware Department of Natural Resources and Environmental Control  
Division of Air and Waste Management  
Site Investigation & Restoration Branch  
391 Lukens Drive  
New Castle, Delaware 19720

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### Appendix A: Risk Assessment Summary

## 1.0 INTRODUCTION

The 201/205 A Street site (site) is located on the southern bank of the Christina River in Wilmington, Delaware, which is currently undergoing construction activities associated with the development of the Christina Landing residential townhome community. It is bounded on the south by A Street, on the east by 207 A Street, on the west by 200 S. Market Street, and on the north the Christina River. The site is presently owned by the BPG Residential Partners IV, LLC (BPG), who has entered into a Consent Decree for a Prospective Purchaser Agreement (PPA) and a Voluntary Cleanup Program (VCP) agreement with the Department of Natural Resources and Environmental Control Site Investigation and Restoration Branch (DNREC). BPG entered into these agreements in order to resolve their environmental liability for the site. DNREC's VCP is established under the provisions of the Delaware Hazardous Substance Cleanup Act, 7 Del. C. Chapter 91 (HSCA). Through the PPA and a VCP Agreement, BPG agreed to implement the amended final plan of remedial action, dated August 2003, for the site.

Prior to the purchase of the site by BPG, the Riverfront Development Corporation (RDC) owned the site and had entered into a VCP agreement with DNREC to conduct a Remedial Investigation (RI) of the site. The purpose of the RI was to: 1) collect additional information from the site to refine site knowledge from previous investigations; 2) delineate and determine the extent of contamination, and its possible migration and environmental impacts; and 3) determine the level of risk posed by the contaminants, and based upon this analysis, evaluate remedial alternatives.

The original proposed plan of remedial action (original proposed plan) the 201/205 A Street site was issued for public comment on October 21, 2001. The public comment period ended on November 12, 2001. No comments were received by DNREC. Thus, the proposed plan was adopted as the final plan of remedial action (final plan) on January 31, 2002. Because the owner of the site changed the intended future use of the property after the proposed plan was issued, DNREC determined that it was necessary to issue an amended proposed plan of remedial action (amended proposed plan) to account for this change in the use of the site. The amended proposed plan was issued for public comment on October 21, 2002. The public comment period ended on November 12, 2002, no comments were received by DNREC.

As a result of RDC's request to change the proposed development of the property from commercial/industrial to urban residential (i.e., apartment/condominium) in August 2002, RDC agreed to perform an updated risk assessment of the property to take into account the proposed change in land use. The updated risk assessment concluded that elevated risks to human health are posed by soil contamination at the site. DNREC has determined that the initial proposed remedy, which consisted of "hot spot" excavation and removal and containment of residual petroleum-impacted soils underneath structures and a parking lot, would still be protective of human health and the environment, provided that no areas of contaminated soil would remain exposed, such as for yards or vegetative buffers.

In January 2003, RDC informed DNREC that a possible component of the final construction plans would consist of raising the overall grade of the site from the present elevation (4 to 5 feet above sea level) to the level of the top of the rebuilt bulkhead, approximately 11 feet above sea level. At a minimum, two (2) feet of clean-fill would be added to the existing grade of the site, even if the final construction plans did not require raising the overall grade of the site to 11 feet

above sea level. In this case, the construction-related excavation would be in the clean fill above the contaminated soil and the risk to construction workers would be eliminated since there would be no exposure. Another possible component of the final construction plan might also include performing construction activities in areas that extended below the clean fill. When excavation would be necessary below the clean fill in areas containing elevated concentrations of PAHs, the soils would be over-excavated, removed and properly disposed of. The over-excavated areas would be subsequently filled with clean fill. Therefore, any necessary construction activities would then occur within the clean fill.

Prior to the issuance of an amended final plan, the RDC requested that DNREC revise the final plan to take into account the new construction plans, which required raising the overall grade of the site from the present elevation. As a result, DNREC determined that it was necessary to issue the second amended proposed plan of remedial action (second amended proposed plan). The second amended proposed plan was issued on July 21, 2003, and the comment period expired on August 11, 2003. No comments were received, and DNREC issued the amended final plan on August 2003.

BPG agreed to implement the amended final plan during the development of the site. During the initial site excavation activities, a registered previously abandoned 1,000 gallon underground storage tank (UST) was discovered, as well as, subsurface petroleum impacts that were greater (in area and concentration) than previously identified within the RI. An interim remedial action (IRA) was conducted consisting of removing the UST in accordance with DNREC-Tanks Management Branch (TMB) regulations, over-excavating petroleum-impacted soils and performing an additional risk assessment to address possible vapor intrusion. Based upon these findings, DNREC has determined that it is necessary to issue this third amended proposed plan of remedial action (third amended proposed plan).

This document is DNREC's third amended proposed plan for the site. It is based on the results of the previous investigations performed at the site and the IRA. This third amended proposed plan is issued under the provisions of the HSCA and the Regulations Governing Hazardous Substance Cleanup (Regulations). It presents the Department's assessment of the potential health and environmental risks posed by the site.

As described in Section 12 of the Regulations, DNREC will provide notice to the public and an opportunity for the public to comment on the third amended proposed plan. After the comment period concludes, DNREC will review and consider all of the comments received and issue a second amended final plan of remedial action (second amended final plan). The second amended final plan will designate the selected remedy for the site. The RI, the original proposed plan, the amended proposed plan, the second amended proposed plan, the third amended proposed plan, the comments received from the public, DNREC's responses to those comments, the final plan, the amended final plan, and the second amended final plan will constitute the remedial decision record for the site.

Section 2.0 presents a summary of the site description, history and previous investigations of the site. Section 3.0 provides a description of the RI results. Section 4.0 presents a summary of the IRA. Section 5.0 presents a discussion of the remedial action objectives. Section 6.0 presents the third amended proposed plan of remedial action. Section 7.0 discusses public participation requirements.

## **2.0 SITE DESCRIPTION AND HISTORY**

### *2.1 Site Setting*

The site is located along the southern bank of the Christina River in Wilmington, Delaware (Figures 1 & 2). The site is bordered on the north by the Christina River, on the west by a parking lot (200 S. Market Street), on the east by 207 A Street, and on the south by A Street. The site is part of a larger property, which consists of three parcels: 201 A Street, 205 A Street, and 207 A Street, which in total encompass 3.58 acres. However, 207 A Street, which consists of 1.76 acres, was assessed as part of a separate investigation and is not part of the site. The remaining two parcels (combined as tax parcel number 26-050.00.005) constitute the 201/205 A Street site, which is approximately 1.82 acres in size. The site is part of the Christina Landing residential development, which consists of several parcels, encompassing approximately nine (9) acres. The site is currently under redevelopment which will consist of two high rise apartment towers, 63 residential townhomes, open space, sidewalks, roads, parking and related infrastructure. The surrounding land use is generally light industrial and commercial.

### *2.2 Site and Project History*

EA, through a review of historical aerial photographs, United States Geologic Survey topographic maps, historical Sanborn fire insurance maps and city directories, investigated the historical use of the site. The 1887 and 1893 Sanborn maps indicated that the site was used as a planing mill, coal and lumberyard, and was owned by the Cold Spring Ice and Coal Company. By the 1920s, the site was occupied by the American Oil Company, and contained an aboveground storage tank farm, several small buildings and railroad sidings. The American Oil Company continued to operate at the property until the 1980s. Until the property was transacted in January 2004, the site was operated as the Christina River Club, a restaurant.

The RDC entered into a VCP Agreement in 2001 with DNREC to perform a RI. The objectives of the RI were to evaluate potential risks to human health, welfare and the environment posed by the site.

## **3.0 PREVIOUS INVESTIGATION RESULTS**

EA conducted a Phase II investigation at the site in October 1999, which consisted of direct push soil and groundwater sampling. Subsurface soil samples were collected from five direct push soil borings at the site. Groundwater samples were collected from temporary wells constructed in three of the soil boring locations.

Subsequent to the Phase II investigation, a RI was conducted in April and May 2001 by EA, in which soil samples were collected from a total of seven soil borings, with groundwater samples collected from permanent monitoring wells constructed in three of the soil boring locations.

The samples were analyzed for contaminants listed on the Target Analyte List (TAL) and the Target Compound List (TCL). The analytical results were first compared to the DNREC-SIRB Uniform Risk Based Remediation Standards (URS) in a non-critical water resource area, using the unrestricted use risk scenario as a screen in order to determine potential contaminants of concern (COCs). Those chemicals whose concentrations exceeded the unrestricted use URS were selected as COCs and included in a human health risk assessment and ecological risk assessment screening.

The only volatile organic compound (VOC) detected above the unrestricted use URS values was benzene in two (2) Phase II soil boring locations. Benzene was detected at concentrations of 3.4 milligrams per kilogram (mg/kg) from the soil sample collected from soil boring location B-4, and 1.2 mg/kg from the soil sample collected from location B-9 (URS value of 0.8 mg/kg). However, concentrations of benzene did not exceed the unrestricted URS value in 83% of the soil samples collected. In accordance with the 75%/10X rule outlined in the *Remediation Standards Guidance*, attainment of guidance criteria can be obtained if sample concentrations from at least 75% of the samples (from the same media) fall below the respective URS for the contaminant in question, with no single result exceeding the URS value by a factor of 10.

Subsurface soil samples from eleven (11) Phase II and RI soil boring locations contained one or more polynuclear aromatic hydrocarbons (PAHs) at concentrations exceeding the respective unrestricted use URS values. Benzo(a)pyrene exceeded the unrestricted use URS value of 0.09 mg/kg in eleven locations, with concentrations ranging up to 7.1 mg/kg. Other PAHs detected in subsurface soils at concentrations in exceedence of the respective unrestricted URS values include benzo(a)anthracene (up to 6.9 mg/kg; URS of 0.9 mg/kg), benzo(b)fluoranthene (up to 7.7 mg/kg; URS of 0.9 mg/kg), dibenz(a,h)anthracene (up to 1.3 mg/kg; URS value of 0.09 mg/kg), and indeno(1,2,3-cd)pyrene (up to 3.3 mg/kg; URS of 0.9 mg/kg). The highest concentrations of each of the above compounds were detected in samples collected from soil boring B-4, located along the 205/207 A Street parcel boundary. However, all of the contaminant concentrations were below the respective restricted use URS values.

Arsenic and iron exceeded their unrestricted use URS value of 0.4 mg/kg and 2,300 mg/kg, respectively, in every soil sample, at concentrations ranging up to 30.7 mg/kg and 58,000 mg/kg, respectively. However, all of the contaminant concentrations were below the respective restricted use URS values.

The results of the Phase II investigation identified several metals and PAH compounds at concentrations exceeding the respective groundwater URS values. However, due to the sampling method utilized, these groundwater samples contained a high level of suspended fine sediment, and were not considered to be representative of groundwater quality. The RI, which utilized permanent monitoring wells, did not detect any PAH compounds.

Each of the three RI groundwater samples contained arsenic (up to 63 micrograms per liter ["µg/L"], MW-2), iron (up to 28,000 µg/L, MW-3) and manganese (up to 819 µg/L, MW-3) above their respective groundwater URS values. Both the iron and manganese values are based upon drinking water Secondary Maximum Contaminant Levels of 300 µg/L and 50 µg/L, respectively, and represent non-enforceable aesthetic standards. Further, public water is available in this area, and a Groundwater Management Zone (GMZ) restricting use of

groundwater in Wilmington is presently in place, both of which prevent human exposure to site groundwater.

Contaminants identified as COCs and retained for inclusion in the human health risk assessment include: benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, benzo(a)anthracene, iron, manganese and arsenic. The calculations were conducted using the DNREC Site-Specific Calculator for Multiple Analytes (DNREC May 2000 version). The initial risk assessment that was performed assumed a restricted use risk setting, and development of the site into a multi-story office building. It was performed in order to evaluate the cumulative risk associated with the exposure to soil and ingestion of groundwater on the site. The initial risk assessment calculated a soil cumulative risk to be  $4 \times 10^{-6}$ , which is below the HSCA action level of  $1 \times 10^{-5}$ , and a hazard quotient (HQ) below 1.0. Therefore, it was concluded that the soil did not pose an unacceptable risk to human health, given a commercial/industrial risk setting.

Based upon the request to change the proposed development at the site from commercial/industrial to urban residential, a second risk assessment was performed, at DNREC's request, to take into account the proposed change in land use. The exposure pathway evaluation determined that the only potential completed pathway is exposure to contaminated soil by future construction workers. At that time there were no completed pathways as the majority of the site was covered by asphalt. After development of the site, exposure pathways would then be eliminated as the site will be covered by buildings, landscape, and paving. In that case, the only possible exposure pathway would be that of construction workers exposed to direct contact with subsurface soil or to fugitive dust emissions during construction, future utility maintenance, and similar activities.

The results of the risk calculations showed that noncancer risk (HQ) to the construction worker was 0.83, which is below the 1.0 threshold. The ingestion route of exposure accounted for 97% of the total risk. Thus the potential for noncancer effects to the construction worker was acceptable. The risk calculations for cancer risk ranged from  $2 \times 10^{-7}$  for benzo(b)fluoranthene and dibenz(a,h)anthracene to  $2 \times 10^{-6}$  for benzo(a)pyrene. The total cancer risk to the construction worker was  $4 \times 10^{-6}$ . Incidental ingestion of soil accounted for 92% of cancer risks. The Regulations set a cleanup and background risk of  $1 \times 10^{-5}$ . Therefore, the total cancer risk level of  $4 \times 10^{-6}$  is acceptable under the Regulations.

Due to the site's location along the Christina River, it was necessary to assess what potential impacts, if any, the site could pose to the environmental health of the river. The site will remain paved and will be re-developed, with the existing bulkhead being maintained, thus precluding erosion of site soils into the river. Groundwater loading values were also calculated to evaluate the possible effects of groundwater discharge into the Christina River. Loading values for all organic and metallic analytes detected in groundwater during both the Phase II and RI investigations were calculated based upon the measured groundwater flow rate at the site and the flow rate of the Christina River. Based upon these calculations, it was determined that there would be no exceedences of Delaware's Surface Water Quality Standards (DSWQS) by the discharge of site groundwater into the Christina.

## 4.0 INTERIM REMEDIAL ACTION ACTIVITIES

During excavation activities June 2004 for the sanitary manholes, a series of underground petroleum pipelines and associated soil contamination were discovered. Additionally, a previously abandoned 1,000 gallon UST was discovered. Some of these soils contained free product which DNREC required to be removed as part of the interim response action (IRA) performed under DNREC's oversight pursuant to HSCA. At that time, in an abundance of caution, it was decided that all other petroleum-impacted soils would be excavated to the maximum extent practicable to the water table and backfilled with clean fill as part of the IA. The UST was removed in accordance with the DNREC-TMB regulations. The impacted soils were removed and disposed of properly off-site as per the approved *Work Plan to Implement the Amended Final Plans of Remedial Action* (as amended) and the applicable UST regulations. In total, approximately 12,000 tons of petroleum-impacted soils were excavated and properly disposed of off-site. Additionally, approximately 120,000 gallons of potentially impacted groundwater was properly handled and disposed of off-site.

During the excavation activities, a total of 211 confirmatory soil samples were collected from the sidewalls and the floor of the excavation on a 20 foot by 20 foot grid spacing. Additionally, five (5) groundwater samples were collected in the vicinity of the petroleum-impacted soils. Based upon a review of all of the analytical data including the post-excavation results, it was determined that the only completed exposure pathway was the possible migration of vapors into the residential town home garages and crawl spaces. As a result, a vapor intrusion assessment for indoor air inhalation was conducted utilizing the United States Environmental Protection Agency (USEPA) model (Version 3.0 of the Johnson and Ettinger [J&E], 1991, soil-advanced and groundwater-advanced spreadsheets).

The initial modeling results indicated an unacceptable risk to human health for carcinogenic and non-carcinogenic compounds. However, due to the limitations associated with the model, additional site-specific soil gas data was required. This data was collected at three (3) locations, which had the highest levels of residual petroleum contamination. The results of the site-specific soil gas modeling indicate no unacceptable risks to human health, given the concrete slab foundations which are part of the already approved remedial action contained in the amended final plan for the prevention of dermal contact. Therefore, the previously proposed remedy contained within the amended final plan has been found to be protective in addressing the potential pathway of vapor intrusion. As the remedy will remain the same (i.e., the containment of the soils beneath the proposed building structures and asphalt parking lots), no further action is now required beyond the already completed IRA.

Additional confirmatory soil gas data may be collected as part of the operations and maintenance(O&M) Plan when the townhomes have been completed. Based upon the future monitoring results, additional remedial measures may be required in further amendments to the amended final plan for the site. This could include the operations and maintenance of the vapor barrier and ventilation system, which will be voluntarily installed under the concrete slab foundations, as well as possible improvements or upgrades of that system.

## 5.0 REMEDIAL ACTION OBJECTIVES

According to Section 8.4 (1) of the Regulations, site-specific remedial action objectives (RAOs) must be established for all plans of remedial action. The Regulations provide that DNREC set objectives for land use, resource use and cleanup levels that are protective of human health and the environment.

Qualitative objectives describe in general terms what the ultimate result of the remedial action, if necessary, should be. The following qualitative objectives are determined to be appropriate for the site:

- Prevent residential exposure to impacted media;
- Minimize potential exposure to site contaminants of concern for residents and construction workers at the site;
- Prevent environmental impacts, specifically to the Christina River, due to impacted media at the site; and
- Continue the use of public water for all purposes to the surrounding community.

These objectives are consistent with the current use of the site as a commercial use in an urban setting, New Castle County zoning policies, state regulations governing water supply and worker health and safety.

Based on the qualitative objectives, the quantitative objectives are:

1. Prevent human exposure to contaminated soils, groundwater **and volatile organic vapors** contaminated by VOCs, PAHs and metals that would result in a carcinogenic risk exceeding  $1 \times 10^{-5}$  or noncarcinogenic risks exceeding a HI of 1.0 for a residential scenario.
2. Prevent discharge of groundwater contaminated by VOCs, PAHs, and metals into the Christina River above Delaware Surface Water Quality Standards.

## 6.0 PROPOSED PLAN OF REMEDIAL ACTION

Based on DNREC's evaluation of the current site information, DNREC recommends that the following remedial actions be taken at the site which are the third amended proposed plan:

- The remedy is consistent with the August 2003 amended final plan of remedial action; therefore, no further action beyond the already performed interim action is required.

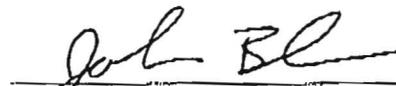
## **7.0 PUBLIC PARTICIPATION**

Pursuant to 7 Del. C. § 9107(e) (2), DNREC invites written comments on this proposed plan. The public comment period begins on Monday, August 9, 2004 and will close on Monday, August 30, 2004. Written comments should be submitted to The Department actively solicits public comments or suggestions on the proposed plan of remedial action and welcomes opportunities to answer questions. Please direct written comments to:

DNREC Site Investigation and Restoration Branch  
391 Lukens Drive  
New Castle, Delaware 19720  
Attention: Kristen Thornton

For verbal comments or additional information, please contact Kristen Thornton at (302) 395-2600. If so requested, a public hearing will be held on the third amended proposed plan. The hearing time and place will be announced, if said hearing is requested.

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John Blivins, Director  
Division of Air & Waste Management

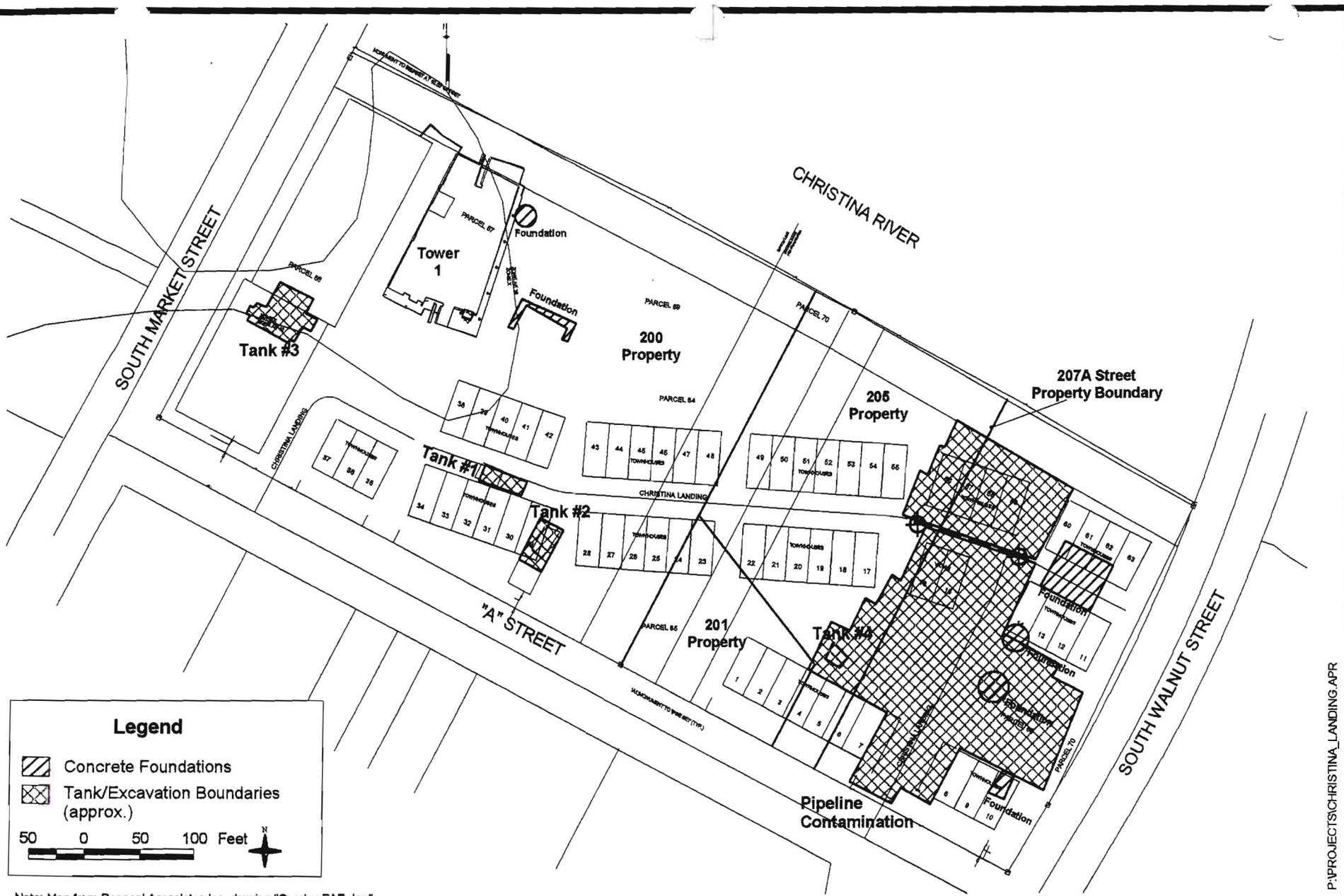
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## **Figures 1 & 2 from Remedial Investigation Report**

**Prepared by EA Engineering, Science and Technology, Inc., September 2001.**

**Figure 1: Site Location/Topographic Map**





**Legend**

- Concrete Foundations
- Tank/Excavation Boundaries (approx.)

50 0 50 100 Feet

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Note: Map from Pennoni Associates Inc. drawing "Overlay.EAE.dwg".

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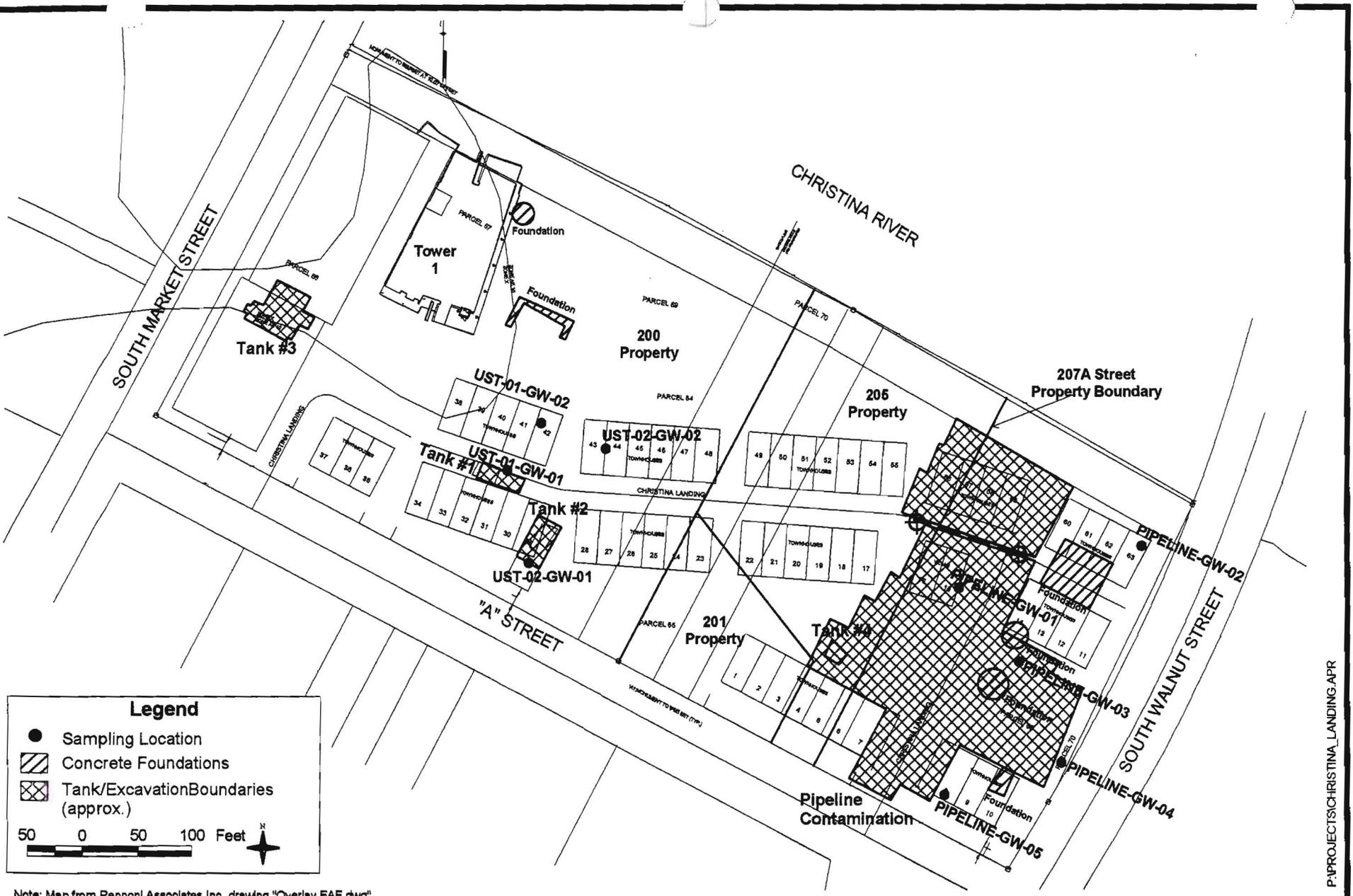


**CHRISTINA LANDING**  
WILMINGTON, DELAWARE

**Figure 2-1**  
**Site Plan**

**JULY 2004**

**Figure 2: Sampling Locations**



Note: Map from Pennoni Associates Inc. drawing "Overlay.EAE.dwg".

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**CHRISTINA LANDING**  
WILMINGTON, DELAWARE

**Figure 2-2**  
**Groundwater Sample Locations**  
**JULY 2004**

**APPENDIX A**

**RISK ASSESSMENT SUMMARY**  
**CHRISTINA LANDING**  
**WILMINGTON, DELAWARE**

*Prepared for*

Buccini/Pollin Group  
23 Industrial Boulevard  
New Castle, DE 19720

*Prepared by*

EA Engineering, Science, and Technology, Inc.  
15 Loveton Circle  
Sparks, MD 21152  
(410) 771-4950

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## 1.0 INTRODUCTION

EA Engineering, Science, and Technology, Inc. (EA) has prepared this report to summarize the potential risks to human health in the vicinity of the Christina Landing construction project, located on the south side of the Christina River between Market Street, Walnut Street, and A Street in Wilmington, Delaware. Risk assessments, performed in 2002 as part of a remedial investigation of the site, were based on exposure to site soil at three properties: 200 S. Market Street, 201/205 A Street, and 207 A Street (see Attachments A, B, and C). In July 2004, a soil vapor risk evaluation was also performed for the 207 A Street property (see Attachment D). This document is a summary of the results of these risk assessments.

## 2.0 EXPOSURE PATHWAYS AND RECEPTORS OF CONCERN

Based upon the proposed plan of remedial action for the site, which includes capping with clean fill, placement of geotextile to separate clean fill from potentially contaminated soil (also to include a deed restriction on site excavation), the potential complete pathway from media at these properties are:

- potential exposure to soil for construction worker (and similar site workers)
- potential exposure to groundwater (with residential receptors having the highest potential for exposure)
- potential exposure to vapor (with residential receptors having the highest potential for exposure)

Quantitative exposure estimates for construction workers included the incidental ingestion of soil and dermal contact with this soil. Residential or commercial exposure estimates were not originally proposed during the RI, nor conducted, because the original proposed plan for remediation was to cover these sites with a marker barrier and 2 ft of clean fill material. It is a basic tenet of risk assessment that if there is no exposure to a contaminated medium, then there is no risk from that medium. Because these sites were proposed to be covered with 2 ft of clean fill, there would be no exposure to the soils that contain chemicals with potential to cause risk. Consequently it is not necessary to conduct residential or commercial human health risk assessment for direct contact with, or ingestion of, soil.

Similarly, the groundwater in this area is not used as a drinking water source, and no exposure of residents or any other human health receptor to groundwater is expected. No human health risk assessment is necessary for groundwater in this case.

The only other potential for exposure to humans from contaminants at these sites is from vapors that may volatilize to living spaces of the new residences/townhouses (townhouse garages and crawlspaces) where residents may inhale them, a circumstance that has been assessed using the Johnson and Ettinger (J&E) model (summarized in Attachment D).

### 3.0 SUMMARY OF SOIL/CONSTRUCTION WORKER RISK ASSESSMENTS

#### 3.1 Identification of Chemicals of Potential Concern

For exposure of construction workers to Chemicals of Potential Concern (COPC), the concentrations of chemicals in soil were compared to Delaware Department of Natural Resources and Environmental Control (DNREC) Uniform Risk-Based Standards (URS) for soil. If the concentrations exceeded DNREC URS soil values, the maximum detected concentrations were compared with U.S. Environmental Protection Agency (EPA) Region III Risk Based Concentration (RBC) residential screening values. If the maximum detected concentration exceeded the residential RBC, the chemical was designated a COPC, and a quantitative risk assessment was performed. COPC for the three property locations are as follows:

**200 S. Market Street:** benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, benz(a)anthracene, aluminum, iron, manganese, and arsenic.

**201/205 A Street.:** benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, benz(a)anthracene, arsenic, iron, and manganese.

**207 A Street.:** benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, benz(a)anthracene, benzene, aluminum, arsenic, iron, and manganese.

#### 3.2 Reasonable Maximum Exposure Calculation

Data for the identified COPC at each location were examined to determine if they were log normally or normally distributed using the Shapiro-Wilk W statistic. No data were found to be normally distributed. The majority of data were log normally distributed, in which case the H-Statistic was used to estimate the Reasonable Maximum Exposure (RME). In cases where the data fit neither normal nor log normal distributions (dibenz(a,h)anthracene at 200 S. Market Street and arsenic at 201/205 A Street) a log normal distribution was assumed (consistent with U.S. EPA guidance) and the H-Statistic used to estimate the RME. RME values used for the risk assessment can be found in Attachments A, B, and C for the three properties.

#### 3.3 Exposure Parameters

Appropriate RME exposure parameters for the incidental ingestion of soil and dermal contact with soil by the construction worker were assigned using standard guidance documents. It was

assumed that the construction worker was exposed for 150 days with an exposure duration of one year and the construction worker weighed 70 kg. For the dermal exposure it was assumed that 5,300 cm<sup>2</sup>/event of skin was exposed and that the soil adherence factor was 0.1 based on guidance documents. Details can be found in Tables 5-2 and 5-3 of Attachments A, B, and C.

### **3.4 Toxicity Assessment**

Integrated Risk Information System (IRIS) references were examined to determine the appropriate noncancer reference doses (RfDs) and cancer slope factors (CSFs), and dermal guidance was used for appropriate oral-to-dermal extrapolation factors. Details may be found in Attachments A, B, and C.

### **3.5 Risk Characterization**

The results of the risk assessment for each of the three property locations follow.

#### **3.5.1 200 S. Market Street**

Based on the risk assessment for 200 S. Market Street, non-cancer risks to construction workers from the incidental ingestion of chemicals in total soil and dermal contact with total soil were acceptable. Cancer risks exceeded acceptable State risk levels ( $1.0 \times 10^{-5}$ ) at  $1.3 \times 10^{-5}$ . Cancer risks were driven by polycyclic aromatic hydrocarbons (PAH), primarily benzo(a)pyrene, with smaller contributions from benzo(b)fluoranthene and benz(a)anthracene. All three of these PAH were found at appreciably higher concentrations in Sample GP-3 from the 0 to 2 ft interval, indicative of a potential localized higher concentration.

#### **3.5.2 201/205 A Street**

Based on the risk assessment for 201/205 A Street, non-cancer risks to construction workers from the incidental ingestion of chemicals in total soil and dermal contact with total soil were acceptable. Cancer risks of  $4 \times 10^{-6}$  from the incidental ingestion and dermal contact with total soil were below the State acceptable standard risk of  $1 \times 10^{-5}$  and are therefore acceptable.

### 3.5.3 207 A Street

Based on the risk assessment for 207 A Street, non-cancer risks to construction workers from the incidental ingestion of chemicals in total soil and dermal contact with total soil were acceptable once target organs are taken into account. Cancer risks exceed acceptable State risk levels ( $1.0 \times 10^{-5}$ ) at  $1.4 \times 10^{-5}$ . Arsenic was responsible for cancer risks of  $3 \times 10^{-6}$ . These risks were driven by arsenic concentrations in two samples, MW-4 (3-5 ft) at 41 mg/kg and MW-6 (4-6 ft) at 17 mg/kg. In addition to arsenic, PAH contributed to cancer risks, primarily benzo(a)pyrene, with smaller contributions from dibenz(a,h)anthracene and benzo(b)fluoranthene. All three of these PAH were found at appreciably higher concentrations in Sample MW-6 (4-6 ft), indicative of a potential localized higher concentration.

#### 4.0 SUMMARY OF VAPOR INTRUSION ASSESSMENT AT 207 A STREET

A soil gas survey and vapor intrusion assessment was conducted for the Christina Landing construction project. The report is summarized in this section; the entire report is included in this document as Attachment D.

The purpose of this investigation was to provide a preliminary evaluation of the potential inhalation risks to future onsite occupants and current occupants of the property and identify, as appropriate, additional investigation activities and/or mitigation requirements for the site.

An initial evaluation was performed to determine if available soil and groundwater data indicate that additional investigation(s) should be performed at the site. Specifically, conservative inputs were used in the J&E model, including the highest reported concentrations of constituents in soil and groundwater at the site. Based upon the initial runs of the J&E model (Table 1), the runs indicated that soil gas samples should be collected, in order to accurately reflect the soil gas conditions at the site.

To further evaluate potential vapor intrusion risks at the site, soil gas samples were collected from the areas of highest soil and groundwater impacts at the site. Specifically, one soil vapor sample was collected from each of three townhouse locations (designated as townhouse lots 7, 8, and 14) and submitted for laboratory analysis. Results were used in the more advanced soil-gas J&E model (USEPA 2003). The more advanced modeling effort concluded that, based on transfer of soil vapor to indoor air (crawl space and garage), cancer risks ranged from  $1.97 \times 10^{-7}$  to  $1.21 \times 10^{-6}$ , which are within acceptable risk ranges (Table 2). Non-cancer risks ranged from 0.045 to 0.1, again within acceptable risk ranges.

In summary, based on the soil gas sampling data available (believed to be worst case) at the time of this assessment, soil gas modeling results do not indicate any unacceptable carcinogenic or non-carcinogenic risks associated with vapor intrusion to the future residential townhomes.