

CDM Federal Programs Corporation

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February 15, 1996

Ms. Caroline Kwan
U.S. Environmental Protection Agency
290 Broadway
New York, NY 10278

PROJECT: EPA ARCS Contract 68-W9-0024
Work Assignment 073-2P1D
Tutu Well Field Site
St. Thomas, U.S. Virgin Islands

DOC. NO.: 7720-073-EP-CJWW

SUBJECT: Addendum to Final Human Health Risk Assessment

Dear Ms. Kwan:

Per your request of January 31, 1996, CDM Federal Programs Corporation (CDM Federal) has recalculated the risks for exposure to soils at the Tillett Gardens and Art Center Area of the Tutu Wells Site to reflect the current concentrations of volatile organic compounds detected in soil samples collected by EPA in August 1995. A brief addendum and revised risk tables are attached.

EPA collected additional samples following development of the Feasibility Study to confirm soil concentrations of polychlorinated biphenyls (PCBs) reported in 1988 samples and to better delineate the area potentially requiring remediation. The new sampling results showed that PCBs are no longer present in soils from this area. Therefore, as the attached risk tables show, the carcinogenic risks from exposure to soils at the Tillett Gardens and Art Center Area now fall within or below EPA's target risk range.

The non-carcinogenic hazard index of 6.1 for children, however, still exceeds the target level of 1. This risk was generally unchanged from the original baseline risk assessment since it is attributed to inorganics (manganese), which were not re-analyzed in the August 1995 samples. CDM Federal believes the manganese levels in soil in the Tillett Gardens and Art Center Area do not represent a remediation concern for the following reasons:

- 1) The maximum manganese concentrations fall within the range of concentrations detected in background samples;
- 2) Current soil concentrations may be lower than the concentrations used in the baseline risk assessment; and

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- 3) The principal adverse health effect of manganese is ~~increased~~ hypertension.
Soils are therefore not usually remediated based on a manganese risk alone.

It should also be noted that EPA is currently re-evaluating the reference dose (RfD) for manganese. If the proposed new RfD for manganese was used in the calculations, the non-carcinogenic hazard index for children would drop to 3.6.

If you have any questions concerning this addendum, please call me at (212) 785-9123.

Sincerely,

CDM FEDERAL PROGRAMS CORPORATION



Sally Odland, P.G.
Work Assignment Manager

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ADDENDUM
TO THE
BASELINE HUMAN HEALTH RISK ASSESSMENT

TUTU WELLS SITE

February 1996

The baseline human health risk assessment for the Tutu Wells Site was completed in 1994. The conclusions of the assessment indicated that residential exposure to surface soils in the Tillett Gardens and Art Center Area showed carcinogenic risks in exceedance of the upper-bound of the target risk range (i.e., greater than $1.0E-04$) (Table 5-1). These risks were due largely to Aroclor 1242 which had been reported in surface soil samples collected in 1988. The total hazard index for child ingestion and inhalation of surface soil exceeded the target level of 1.0 ($HI = 6.1$) (Table 5-2). The exceedance was due largely to manganese.

Additional surface soil samples were collected from the Tillett Gardens and Art Center Area in August 1995 to confirm the contaminant concentrations and to better define the area of soil that would be remediated. Grab samples were collected from five locations. In addition, a blind duplicate was collected from one location. Each sample was analyzed for volatile organic compounds (VOCs) and PCBs (Aroclors). No PCBs were detected in any of the samples (Table 1). Three VOCs, including acetone, 2-hexanone, and 4-methyl-2-pentanone, were detected in sample Tutu 6. VOCs were not detected in any other samples collected in 1995.

Because the new sampling results represent current site conditions, CDM Federal substituted the VOC and PCB results from the additional samples were substituted for VOC and PCB concentrations used in the original baseline risk calculations. Since inorganics analysis was not conducted on the additional samples, it was assumed that inorganics concentrations were unchanged from the original data.

Risks for adult and children residents for the ingestion, dermal contact, and inhalation routes

of exposure were recalculated (Tables 2 through 4). The maximum concentrations of VOCs were conservatively used in the risk calculations, rather than the 95% upper confidence limit (UCL) concentrations. It should be noted that VOCs were not selected as chemicals of concern (COCs) for the Tillett Gardens and Art Center Area in the original baseline risk assessment.

The revised risk calculations indicate that carcinogenic risks at the Tillett Gardens and Art Center area are within the EPA target risk range of 10^{-4} to 10^{-6} and approximately two orders of magnitude lower than the original calculated baseline risks of 10^{-3} . The individual pathway and receptor risks are $8.2\text{E-}06$ (adult ingestion), $5.5\text{E-}07$ (adult inhalation), $1.9\text{E-}05$ (child ingestion), and $6.4\text{E-}07$ (child inhalation) (Table 5). The 30-year combined risk for adult + child is $2.9\text{E-}05$. These risks were solely attributed to arsenic. Risks for dermal contact were not calculated as no dermal absorption factors were available for COCs.

The hazard index of 6.1 for the child, calculated using additional VOC and PCB data and baseline inorganics data, was generally unchanged, since the baseline hazard index was attributed to inorganics (Table 6). The additional VOC data had no significant impact on the hazard index.

TABLE 1
TUTU WELLS SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
TILLET GARDENS AND ART CENTER

CONCENTRATION (ug/kg)

CHEMICALS	Frequency of Detection	Range of Concentrations		Location of Maximum	Range of Non-detect Concentrations		
		Minimum	Maximum		Minimum	-	Maximum
<u>VOCs</u>							
Acetone	1/5	19	19	Tutu 6	11 U	-	27 U
2- Hexanone	1/5	7 J	7 J	Tutu 6	11 U	-	11 U
4-Methyl-2-Pentanone	1/5	21	21	Tutu 6	11 U	-	11 U
<u>Pesticides/PCBs</u>							
Aroclors	0/5	--	--	--	33 U	-	87 U

Sample Group:

Tutu 1, Tutu 2, Tutu 3 (duplicate of Tutu 2), Tutu 4, Tutu 5, and Tutu 6.

TABLE 2

SURFACE SOIL INGESTION PATHWAY
TUTU WELLS SITE - PRESENT/FUTURE - USE SCENARIO
REVISED RISKS TO RESIDENTS IN THE TILLET GARDENS AND ART CENTER AREA

CARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INGESTION EXPOSURE: Adults

$$\begin{array}{l} \text{Chronic Daily Intake=} \\ \text{(mg/kg-day)} \end{array} \quad \begin{array}{l} \text{Soil} \\ \text{Concentration} \end{array} \times \begin{array}{l} \text{Ingestion} \\ \text{Rate} \end{array} \times \begin{array}{l} \text{Conversion} \\ \text{Factor} \end{array} \times \begin{array}{l} \text{Fraction} \\ \text{Ingested} \end{array} \times \begin{array}{l} \text{Exposure} \\ \text{Frequency} \end{array} \times \begin{array}{l} \text{Exposure} \\ \text{Duration} \end{array} \times \frac{1}{\text{Body Weight}} \times \frac{1}{\text{Averaging Time}}$$
$$\begin{array}{l} \text{mg/kg} \end{array} \times \begin{array}{l} \text{X } 100 \text{ mg/day} \end{array} \times \frac{1 \text{ kg}}{1000000 \text{ mg}} \times \begin{array}{l} \text{X } 1 \\ \text{(unitless)} \end{array} \times \begin{array}{l} \text{X } 350 \text{ days/year} \end{array} \times \begin{array}{l} \text{X } 24 \text{ years} \end{array} \times \frac{1}{70 \text{ kg}} \times \frac{1}{25550 \text{ days}}$$

Chemicals	Soil Concentration	Ingestion Rate	Conversion Factor	Fraction Ingested	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Slope Factor (SF)	RISK = (CDI*SF)
Arsenic	1.00E+01	100	1.0E-06	1	350	24	70	25550	4.7E-06	1.75E+00	8.2E-06

TOTAL RISK = 8.2E-06

CARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INGESTION EXPOSURE: Children (0 - 6 years)

$$\begin{array}{l} \text{Chronic Daily Intake=} \\ \text{(mg/kg-day)} \end{array} \quad \begin{array}{l} \text{Soil} \\ \text{Concentration} \end{array} \times \begin{array}{l} \text{Ingestion} \\ \text{Rate} \end{array} \times \begin{array}{l} \text{Conversion} \\ \text{Factor} \end{array} \times \begin{array}{l} \text{Fraction} \\ \text{Ingested} \end{array} \times \begin{array}{l} \text{Exposure} \\ \text{Frequency} \end{array} \times \begin{array}{l} \text{Exposure} \\ \text{Duration} \end{array} \times \frac{1}{\text{Body Weight}} \times \frac{1}{\text{Averaging Time}}$$
$$\begin{array}{l} \text{mg/kg} \end{array} \times \begin{array}{l} \text{X } 200 \text{ mg/day} \end{array} \times \frac{1 \text{ kg}}{1000000 \text{ mg}} \times \begin{array}{l} \text{X } 1 \\ \text{(unitless)} \end{array} \times \begin{array}{l} \text{X } 350 \text{ days/year} \end{array} \times \begin{array}{l} \text{X } 6 \text{ years} \end{array} \times \frac{1}{15 \text{ kg}} \times \frac{1}{25550 \text{ days}}$$

Chemicals	Soil Concentration	Ingestion Rate	Conversion Factor	Fraction Ingested	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Slope Factor (SF)	RISK = (CDI*SF)
Arsenic	1.00E+01	200	1.0E-06	1	350	6	15	25550	1.1E-05	1.75E+00	1.9E-05

TOTAL RISK = 1.9E-05

30-YEAR COMBINED RISK (ADULT + CHILD) = 2.7E-05

TABLE 2

SURFACE SOIL INGESTION PATHWAY
TUTU WELLS SITE - PRESENT/FUTURE - USE SCENARIO
REVISED RISKS TO RESIDENTS IN THE TILLET GARDENS AND ART CENTER AREA

NONCARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INGESTION EXPOSURE: Adults

$$\text{Chronic Daily Intake= (mg/kg-day)} = \frac{\text{Soil Concentration (mg/kg)} \times \text{Ingestion Rate (100 mg/day)} \times \text{Conversion Factor (1 kg / 1000000 mg)} \times \text{Fraction Ingested (1 (unitless))} \times \text{Exposure Frequency (350 days/year)} \times \text{Exposure Duration (24 years)} \times \frac{1}{\text{Body Weight (70 kg)}} \times \frac{1}{\text{Averaging Time (8760 days)}}$$

Chemicals	Soil Concentration	Ingestion Rate	Conversion Factor	Fraction Ingested	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Reference Dose (RfD)	HQ= CDI/RfD
Acetone	1.90E-02	100	1.0E-06	1	350	24	70	8760	2.6E-08	1.0E-01	2.6E-07
Antimony	5.05E+00	100	1.0E-06	1	350	24	70	8760	6.9E-06	4.0E-04	1.7E-02
Arsenic	1.00E+01	100	1.0E-06	1	350	24	70	8760	1.4E-05	3.0E-04	4.6E-02
Manganese	8.69E+02	100	1.0E-06	1	350	24	70	8760	1.2E-03	5.0E-03	2.4E-01
4-Methyl-2-Pentanone	2.10E-02	100	1.0E-06	1	350	24	70	8760	2.9E-08	8.0E-02	3.6E-07
Vanadium	9.59E+01	100	1.0E-06	1	350	24	70	8760	1.3E-04	7.0E-03	1.9E-02

HAZARD INDEX = 3.2E-01

NONCARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INGESTION EXPOSURE: Children (0-6 years)

$$\text{Chronic Daily Intake= (mg/kg-day)} = \frac{\text{Soil Concentration (mg/kg)} \times \text{Ingestion Rate (200 mg/day)} \times \text{Conversion Factor (1 kg / 1000000 mg)} \times \text{Fraction Ingested (1 (unitless))} \times \text{Exposure Frequency (350 days/year)} \times \text{Exposure Duration (6 years)} \times \frac{1}{\text{Body Weight (15 kg)}} \times \frac{1}{\text{Averaging Time (2190 days)}}$$

Chemicals	Soil Concentration	Ingestion Rate	Conversion Factor	Fraction Ingested	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Reference Dose (RfD)	HQ= CDI/RfD
Acetone	1.90E-02	200	1.0E-06	1	350	6	15	2190	2.4E-07	1.0E-01	2.4E-06
Antimony	5.05E+00	200	1.0E-06	1	350	6	15	2190	6.5E-05	4.0E-04	1.6E-01
Arsenic	1.00E+01	200	1.0E-06	1	350	6	15	2190	1.3E-04	3.0E-04	4.3E-01
Manganese	8.69E+02	200	1.0E-06	1	350	6	15	2190	1.1E-02	5.0E-03	2.2E+00
4-Methyl-2-Pentanone	2.10E-02	200	1.0E-06	1	350	6	15	2190	2.7E-07	8.0E-02	3.4E-06
Vanadium	9.59E+01	200	1.0E-06	1	350	6	15	2190	1.2E-03	7.0E-03	1.8E-01

HAZARD INDEX = 3.0E+00

30-YEAR COMBINED HAZARD (ADULT + CHILD) = 3.3E+00

TABLE 3

SURFACE SOIL DERMAL CONTACT PATHWAY
TUTU WELLS SITE - PRESENT/FUTURE - USE SCENARIO
REVISED RISKS TO RESIDENTS IN THE TILLET GARDENS AND ART CENTER AREA

CARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL DERMAL CONTACT EXPOSURE: Adults

Chronic Daily Intake= (mg/kg-day)	Soil Concentration	X	Conversion Factor	X	Skin Surface Area	X	Adherence Factor	X	Absorption Factor	X	Exposure Frequency	X	Exposure Duration	X	$\frac{1}{\text{Body Weight}}$	X	$\frac{1}{\text{Averaging Time}}$
	mg/kg	X	$\frac{1 \text{ kg}}{1000000 \text{ mg}}$	X	5065 cm ² /day	X	1 mg/cm ²	X	(unitless)	X	350 events/year	X	24 years	X	$\frac{1}{70 \text{ kg}}$	X	$\frac{1}{25550 \text{ days}}$

Chemicals	Soil Concentration	Conversion Factor	Skin Surface Area	Adherence Factor	Absorption Factor	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Slope Factor (SF)	RISK = (CDI*SF)
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No COCs have dermal absorption factors.

CARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL DERMAL CONTACT EXPOSURE: Children (0-6 years)

Chronic Daily Intake= (mg/kg-day)	Soil Concentration	X	Conversion Factor	X	Skin Surface Area	X	Adherence Factor	X	Absorption Factor	X	Exposure Frequency	X	Exposure Duration	X	$\frac{1}{\text{Body Weight}}$	X	$\frac{1}{\text{Averaging Time}}$
	mg/kg	X	$\frac{1 \text{ kg}}{1000000 \text{ mg}}$	X	1270 cm ² /day	X	1 mg/cm ²	X	(unitless)	X	350 events/year	X	6 years	X	$\frac{1}{15 \text{ kg}}$	X	$\frac{1}{25550 \text{ days}}$

Chemicals	Soil Concentration	Conversion Factor	Skin Surface Area	Adherence Factor	Absorption Factor	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Slope Factor (SF)	RISK = (CDI*SF)
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No COCs have dermal absorption factors.

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SURFACE SOIL DERMAL CONTACT PATHWAY
TUTU WELLS SITE - PRESENT/FUTURE - USE SCENARIO
REVISED RISKS TO RESIDENTS IN THE TILLET GARDENS AND ART CENTER AREA

NONCARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL DERMAL CONTACT EXPOSURE: Adults

Chronic Daily Intake= (mg/kg-day)	Soil Concentration	X Conversion Factor	X Skin Surface Area	X Adherence Factor	X Absorption Factor	X Exposure Frequency	X Exposure Duration	X $\frac{1}{\text{Body Weight}}$	X $\frac{1}{\text{Averaging Time}}$
	mg/kg	X $\frac{1 \text{ kg}}{1000000 \text{ mg}}$	X 5065 cm ² /day	X 1 mg/cm ²	X (unitless)	X 350 events/year	X 24 years	X $\frac{1}{70 \text{ kg}}$	X $\frac{1}{8760 \text{ days}}$

Chemicals	Soil Concentration	Conversion Factor	Skin Surface Area	Adherence Factor	Absorption Factor	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Reference Dose (RfD)	HQ= CDI/RfD
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No COCs have dermal absorption factors.

NONCARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL DERMAL CONTACT EXPOSURE: Children (0-6 years)

Chronic Daily Intake= (mg/kg-day)	Soil Concentration	X Conversion Factor	X Skin Surface Area	X Adherence Factor	X Absorption Factor	X Exposure Frequency	X Exposure Duration	X $\frac{1}{\text{Body Weight}}$	X $\frac{1}{\text{Averaging Time}}$
	mg/kg	X $\frac{1 \text{ kg}}{1000000 \text{ mg}}$	X 1270 cm ² /day	X 1 mg/cm ²	X (unitless)	X 350 events/year	X 6 years	X $\frac{1}{15 \text{ kg}}$	X $\frac{1}{2190 \text{ days}}$

Chemicals	Soil Concentration	Conversion Factor	Skin Surface Area	Adherence Factor	Absorption Factor	Exposure Frequency	Exposure Duration	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Reference Dose (RfD)	HQ= CDI/RfD
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No COCs have dermal absorption factors.

TUT 000 0620

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SURFACE SOIL INHALATION OF PARTICULATES PATHWAY
TUTU WELLS SITE - FUTURE-USE SCENARIO

REVISED RISKS TO RESIDENTS (INSIDE AND OUTSIDE RESIDENCE) IN THE TILLET GARDENS AND ART CENTER AREA

CARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INHALATION EXPOSURE: Adults

Chronic Daily Intake= (mg/kg-day)	Soil	X	Susp.	X	Resp.	X	Inhalation	X	Exposure	X	Exposure	X	Exposure	X	Conv.	X	$\frac{1}{\text{Body Wt}}$	X	$\frac{1}{\text{Avging Time}}$					
	Concen.		Soil		Fraction		Rate		Time		Frequency		Duration		Factor									
	mg/kg	X	0.070 mg/m3	X	(unitless)	X	0.83 m3/hr	X	18 hrs/day	X	350 days/yr	X	24 years	X	$\frac{1 \text{ kg}}{1000000 \text{ mg}}$	X	$\frac{1}{70 \text{ kg}}$	X	$\frac{1}{25550 \text{ days}}$					
Chemicals	Soil		Susp.		Resp.		Inhalation		Exposure		Exposure		Exposure		Conv.		Body		Averaging	Chronic Daily	Slope	RISK =		
	Concen.		Concen.		Fraction		Rate		Time		Frequency		Duration		Factor		Weight		Time	Intake (CDI)	Factor (SF)	(CDI*SF)		

Arsenic	1.00E+01		7.0E-02		0.75		0.83		18		350		24		1.0E-06		70		25550	3.7E-08	1.50E+01	5.5E-07
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TOTAL RISK = 5.5E-07

CARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INHALATION EXPOSURE: Children (0-6 years)

Chronic Daily Intake= (mg/kg-day)	Soil	X	Susp.	X	Resp.	X	Inhalation	X	Exposure	X	Exposure	X	Exposure	X	Conv.	X	<u>1</u>	X	<u>1</u>					
	Concn.		Soil		Fraction		Rate		Time		Frequency		Duration		Factor		Body Wt		Avging Time					
	mg/kg	X	0.070 mg/m3	X	(unitless)	X	0.83 m3/hr	X	18 hrs/day	X	350 days/yr	X	6 years	X	<u>1 kg</u>	X	<u>1</u>	X	<u>1</u>					
															1000000 mg		15 kg		2190 days					
Chemicals	Soil		Susp.		Resp.		Inhalation		Exposure		Exposure		Exposure		Conv.		Body		Averaging	Chronic Daily	Slope	RISK =		
	Concn.		Concn.		Fraction		Rate		Time		Frequency		Duration		Factor		Weight		Time	Intake (CDI)	Factor (SF)	(CDI*SF)		

Arsenic	1.00E+01		7.0E-02		0.75		0.83		18		350		6		1.0E-06		15		25550	4.3E-08	1.50E+01	6.4E-07
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TOTAL RISK = 6.4E-07

30-YEAR COMBINED RISK (ADULT + CHILD) = 1.2E-06

TUT 008 0621

SURFACE SOIL INHALATION OF PARTICULATES PATHWAY
TUTU WELLS SITE - FUTURE-USE SCENARIO
REVISED RISKS TO RESIDENTS (INSIDE AND OUTSIDE RESIDENCE) IN THE TILLET GARDENS AND ART CENTER AREA

NONCARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INHALATION EXPOSURE - Adults

$$\begin{aligned} \text{Chronic Daily Intake=} & \text{Soil} \times \text{Soil} \times \text{Resp.} \times \text{Inhalation} \times \text{Exposure} \times \text{Exposure} \times \text{Exposure} \times \text{Conv.} \times \frac{1}{\text{Body Wt}} \times \frac{1}{\text{Aving Time}} \\ & \text{(mg/kg-day)} \quad \text{Concen.} \quad \text{Concen.} \quad \text{Fraction} \quad \text{Rate} \quad \text{Time} \quad \text{Frequency} \quad \text{Duration} \quad \text{Factor} \quad \text{mg/kg} \quad \text{X 0.070 mg/m}^3 \quad \text{X (unitless)} \quad \text{X 0.83 m}^3/\text{hr} \quad \text{X 18 hrs/day} \quad \text{X 350 days/yr} \quad \text{X 24 years} \quad \text{X} \quad \frac{1 \text{ kg}}{1000000 \text{ mg}} \quad \text{X} \quad \frac{1}{70 \text{ kg}} \quad \text{X} \quad \frac{1}{8760 \text{ days}} \end{aligned}$$

Chemicals	Soil Concen.	Susp. Soil Concen.	Resp. Fraction	Inhalation Rate	Exposure Time	Exposure Frequency	Exposure Duration	Conv. Factor	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Reference Dose (RfD)	HQ= CDI/RfD
Manganese	8.69E+02	7.0E-02	0.75	0.83	18	350	24	1.0E-06	70	8760	9.3E-06	1.4E-05	6.7E-01
4-Methyl-2-Pentanone	2.10E-02	7.0E-02	0.75	0.83	18	350	24	1.0E-06	70	8760	2.3E-10	2.3E-02	9.8E-09

HAZARD INDEX = 6.7E-01

NONCARCINOGENS - REASONABLE MAXIMUM CASE SURFACE SOIL INHALATION EXPOSURE - Children (0-6 years)

$$\begin{aligned} \text{Chronic Daily Intake=} & \text{Soil} \times \text{Soil} \times \text{Resp.} \times \text{Inhalation} \times \text{Exposure} \times \text{Exposure} \times \text{Exposure} \times \text{Conv.} \times \frac{1}{\text{Body Wt}} \times \frac{1}{\text{Aving Time}} \\ & \text{(mg/kg-day)} \quad \text{Concen.} \quad \text{Concen.} \quad \text{Fraction} \quad \text{Rate} \quad \text{Time} \quad \text{Frequency} \quad \text{Duration} \quad \text{Factor} \quad \text{mg/kg} \quad \text{X 0.070 mg/m}^3 \quad \text{X (unitless)} \quad \text{X 0.83 m}^3/\text{hr} \quad \text{X 18 hrs/day} \quad \text{X 350 days/yr} \quad \text{X 6 years} \quad \text{X} \quad \frac{1 \text{ kg}}{1000000 \text{ mg}} \quad \text{X} \quad \frac{1}{15 \text{ kg}} \quad \text{X} \quad \frac{1}{2190 \text{ days}} \end{aligned}$$

Chemicals	Soil Concen.	Susp. Soil Concen.	Resp. Fraction	Inhalation Rate	Exposure Time	Exposure Frequency	Exposure Duration	Conv. Factor	Body Weight	Averaging Time	Chronic Daily Intake (CDI)	Reference Dose (RfD)	HQ= CDI/RfD
Manganese	8.69E+02	7.0E-02	0.75	0.83	18	350	6	1.0E-06	15	2190	4.4E-05	1.4E-05	3.1E+00
4-Methyl-2-Pentanone	2.10E-02	7.0E-02	0.75	0.83	18	350	6	1.0E-06	15	2190	1.1E-09	2.3E-02	4.6E-08

HAZARD INDEX = 3.1E+00

30-YEAR COMBINED HAZARD INDEX (ADULT + CHILD) = 3.8E+00

TUT 008 0622

TUTU WELLS SITE
COMBINING CARCINOGENIC RISKS ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	INDIVIDUAL CANCER RISK	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO RISK
SURFACE SOIL				
Tillett Gardens and Art Center Area	Residents: Adults	Ingestion	8.2E-06	Arsenic
		Dermal Contact	NA	--
		Inhalation of Particulates	5.5E-07	--
		Total Carcinogenic Risk =	8.8E-06	Arsenic
	Children (0-6 years)	Ingestion	1.9E-05	Arsenic
		Dermal Contact	NA	--
		Inhalation of Particulates	6.4E-07	--
		Total Carcinogenic Risk =	2.0E-05	Arsenic
	Fire Dept./Texaco gas station/ Antilles auto parts/ Ramsay motor co. Area	Ingestion	1.3E-06	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.7E-09	--
		Total Carcinogenic Risk =	1.3E-06	--
Curriculum Center Building Area (Present-Use)	Site Workers (Employees)	Ingestion	3.7E-06	--
		Dermal Contact	NA	--
		Total Carcinogenic Risk =	3.7E-06	--
Curriculum Center Building Area (Future-Use)	Site Workers (Employees)	Ingestion	9.1E-07	--
		Dermal Contact	NA	--
		Inhalation of Particulates	4.5E-08	--
		Total Carcinogenic Risk =	9.6E-07	--
O'Henry dry cleaners and Liquor Barn Area	Site Workers (Employees)	Ingestion	9.7E-06	--
		Dermal Contact	NA	--
		Inhalation of Particulates	3.4E-07	--
		Inhalation of VOCs	4.9E-07	--
		Total Carcinogenic Risk =	1.1E-05	--
Tillett Gardens and Art Center Area (Future-Use)	Construction Workers	Ingestion	5.7E-05	--
		Dermal Contact	4.3E-05	--
		Inhalation of Particulates	6.6E-09	--
		Total Carcinogenic Risk =	1.0E-04	--

TUT 008 0623

COMBINING NONCARCINOGENIC HAZARD INDEX VALUES ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	INDIVIDUAL HAZARD INDEX	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO HAZARD INDEX VALUES
SURFACE SOIL				
Tillett Gardens and Art Center Area	Residents: Adults	Ingestion	3.2E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	6.7E-01	--
		Total Hazard Index =	9.9E-01	--
	Children (0-6 years)	Ingestion	3.0E+00	Manganese
		Dermal Contact	NA	--
		Inhalation of Particulates	3.1E+00	Manganese
		Total Hazard Index =	6.1E+00	Manganese
Fire Dept./ Texaco gas station/ Antilles auto parts/ Ramsay motor co. Area	Site Workers (Employees)	Ingestion	9.7E-02	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.0E-01	--
		Total Hazard Index =	3.0E-01	--
Curriculum Center Building Area (Present-Use)	Site Workers (Employees)	Ingestion	2.5E-01	--
		Dermal Contact	NA	--
		Total Hazard Index =	2.5E-01	--
Curriculum Center Building Area (Future-Use)	Site Workers (Employees)	Ingestion	2.3E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.1E-01	--
		Total Hazard Index =	4.4E-01	--
O'Henry dry cleaners and Liquor Barn Area	Site Workers (Employees)	Ingestion	1.5E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.1E-01	--
		Inhalation of VOCs	NA	--
		Total Hazard Index =	3.6E-01	--
Tillett Gardens and Art Center Area (Future-Use)	Construction Workers	Ingestion	9.9E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.4E-02	--
		Total Hazard Index =	1.0E+00	--