08/20/2026

Richard Kimble
Project Geologist
Artheon
1 Tower Center Blvd., 20th Floor
East Brunswick, New Jersey 08816

Dear Richard,

Triumvirate Environmental (TE) appreciates the opportunity to present our review and analysis of Ritzer Field soil data and provide insight into potential health risks associated with current use and future turf application.

It is our understanding that Ritzer Field at Columbia High School (Site) is:

- Currently an active school athletic field used for soccer and gym classes;
- Proposed to be upgraded with synthetic turf and ancillary improvements and
- Excavating, stockpiling, and disposing of arsenic contaminated soils will be conducted.

TE was asked to assess the potential hazard from exposure to arsenic impacted soil for faculty and students under current conditions. In addition, TE evaluated the potential hazard to workers engaged in the new field construction involving arsenic impacted soil removal.

HAZARD ASSESSMENT

TE received arsenic soil analytical data (Table 1) from Artheon, Inc. (Artheon) for the Ritzer Field site at Columbia High School in Maplewood, New Jersey (Site). Artheon also provided the statistical 95% upper confidence limit of the mean (95% UCL) of the data also known as the Exposure Point Concentration (EPC) (Table 2).

Arsenic concentration in Site surface soil (0–0.5 feet) exceeds the New Jersey Department of Environmental Protection (NJDEP) soil standards for residential exposure scenarios (Artheon, Table 1). Based on Table 1, the soil profile indicates that arsenic contamination is limited to the surface soil with exception of one subsurface soil sample results of 86.6 mg/kg.

According to NJDEP, the arsenic soil standard is controlled by ambient background (19 mg/kg). Based on Site history, there is no identified source of arsenic such as previous Site activities (pesticide use) or underlying bedrock or marine-influenced geologic deposits in the Coastal Plain (communication with Artheon).

CONCLUSIONS AND DISCUSSION

Given the current Site conditions, arsenic concentrations in the surface soil (0.5 feet) may pose a hazard for faculty and students based on NJDEP residential soil exposure conditions. Applying the Site-specific exposure conditions and using the NJDEP DERMAL/INGESTION ADULT RECRETATIONAL CALCULATOR**,** TE developed a Site-specific remediation criterion for arsenic based on the exposure assumptions of seasonal recreational use for 90 days a year during four years of high school attendance. The Site-specific arsenic soil remediation standard based on cancer for that exposure scenario is **34 mg/kg** (see Appendix)**.** The arsenic EPC of the surface soil (0-0.5 ft) did not exceed the Site-specific standard.

Since the Site will undergo soil removal activities, TE conducted an assessment as to the potential soil exposure that may be encountered in soil excavation, stockpiling and disposal of contaminated arsenic soils. Using the 2022 NJDEP calculator for INGESTION/DERMAL OUTDOOR WORKER CALCULATOR default exposure assumptions except for Site-specific duration of soil intrusive activities (0.5 year), TE evaluated the potential soil exposure conditions during construction. Based on the cancer endpoint, the Site-specific ingestion/dermal remediation standard for the outdoor worker involved in soil intrusion activities is **110 mg/kg** (see Appendix).

While the Site-specific arsenic outdoor worker soil concentration of 110 mg/kg is not exceeded by the Site arsenic soil EPCs (Artheon, Table 2), workers should be informed and precautions taken to limit the exposure to arsenic impacted soil in the Site Health and Safety Plan (HASP).

Sincerely,
Triumvirate



Deborah Barsotti, Ph.D., DABT

Ritzer Field Exposure

NJDEP 2022 Ingestion/Dermal Adult Recreational Calculator

Site Name:	Ritzer Field site at Columbia High School	Date:	
Contaminant:	Arsenic (total)	CAS No.:	7440-38-2
		Evaluated by:	dab

$$ID_c = \frac{TR * AT * LT * BW}{EF * ED * 10^{-6} kg/mg * [(CSF_O * IR) + (CSF_D * SA * AF * ABS_d)]}$$

$$ID_{nc} = \frac{THQ * AT * ED * BW}{(EF * ED * 10^{-6} kg/mg) * [(\frac{1}{RfD_O} * IR) + (\frac{1}{RfD_D} * SA * AF * ABS_d)]}$$

Parameter	*Definition*	*Units*	*Default Scenario*	***Alternative Scenario***	
TR	Target Cancer Risk	unitless	1.00E-06	1.00E-06	
THQ	Target Hazard Quotient	unitless	1	1	
AT	Averaging Time	days/year	365	365	
LT	Lifetime	years	70	70	
EF	Exposure Frequency	days/year	350	90	changed
ED	Exposure Duration	years	20	4	changed
CSF_O	Oral Cancer Slope Factor	$(mg/kg\text{-}day)^{-1}$	1.5	1.5	
CSF_D	Dermal Cancer Slope Factor	$(mg/kg\text{-}day)^{-1}$	1.5	1.5	
RfD_O	Oral Reference Dose	mg/kg-day	0.0003	0.0003	
RfD_D	Dermal Reference Dose	mg/kg-day	0.0003	0.0003	
ABS_d	Dermal Absorption Fraction	unitless	0.03	0.03	
BW	Body Weight - adult	kg	80	80	
IR	Soil Ingestion Rate	mg/day	100	100	
SA	Skin Surface Area - adult	cm^2/day	6032	6032	
AF	Soil Adherence Factor	mg/cm^2	0.07	0.07	
ID_c	**Carcinogenic Health-Based Soil Criterion (ingestion only)**	mg/kg	1.9	38	
ID_c	**Carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	1.7	34	
ID_{nc}	**Non-carcinogenic Health-Based Soil Criterion (ingestion only)**	mg/kg	250	970	
ID_{nc}	**Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	220	860	

Soil Reporting Limit (mg/kg) = 0.5

Alternative Adult Ingestion/Dermal Soil Remediation Standard:

34 mg/kg ***Cancer-based***

TRIUMVIRATE ENVIRONMENTAL

Ritzer Field Exposure

NJDEP 2022 Ingestion/Dermal Adult Outdoor Worker Calculator

Site Name:	Ritzer Field Maplewood New Jersey	Date:	8/17/2026
Contaminant:	Arsenic (total)	CAS No.:	7440-38-2
		Evaluated by:	dab

$$ID_c = \frac{TR * AT * LT * BW}{EF * ED * 10^{-6} kg/mg * [(CSF_O * IR) + (CSF_D * SA * AF * ABS_d)]}$$

$$ID_{nc} = \frac{THQ * AT * ED * BW}{(EF * ED * 10^{-6} kg/mg) * [(\frac{1}{RfD_O} * IR) + (\frac{1}{RfD_D} * SA * AF * ABS_d)]}$$

Parameter	*Definition*	*Units*	*Nonresidential Scenario*	***Alternative Scenario***
TR	Target Cancer Risk	unitless	1.00E-06	1.00E-06
THQ	Target Hazard Quotient	unitless	1	1
AT	Averaging Time	days/year	365	365
LT	Lifetime	years	70	70
EF	Exposure Frequency	days/year	225	225
ED	Exposure Duration	years	25	0.5
CSF_O	Oral Cancer Slope Factor	$(mg/kg\text{-}day)^{-1}$	1.5	1.5
CSF_D	Dermal Cancer Slope Factor	$(mg/kg\text{-}day)^{-1}$	1.5	1.5
RfD_O	Oral Reference Dose	mg/kg-day	0.0003	0.0003
RfD_D	Dermal Reference Dose	mg/kg-day	0.0003	0.0003
ABS_d	Dermal Absorption Fraction	unitless	0.03	0.03
BW	Body Weight - adult	kg	80	80
IR	Soil Ingestion Rate	mg/day	100	100
SA	Skin Surface Area - adult	cm^2/day	3527	3527
AF	Soil Adherence Factor	mg/cm^2	0.12	0.12
ID_c	**Carcinogenic Health-Based Soil Criterion (ingestion only)**	mg/kg	2.4	120
ID_c	**Carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	2.1	110
ID_{nc}	**Non-carcinogenic Health-Based Soil Criterion (ingestion only)**	mg/kg	390	390
ID_{nc}	**Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	350	350

Soil Reporting Limit (mg/kg) = 0.5

changed

Alternative Adult Ingestion/Dermal Soil Remediation Standard:

110 mg/kg ***Cancer-based***

TRIUMVIRATE ENVIRONMENTAL

Table 1 - Arsenic Soil Analytical Results

Field Sample ID:				S1(0-0.5)			S2(0-0.5)			S3(0-0.5)			S4(0-0.5)			S5(0-0.5)			S1(1-1.5)			S2(1-1.5)		
Lab Sample ID:				460-338150-1			460-338150-2			460-338150-3			460-338150-4			460-338150-5			460-338150-6			460-338150-7		
Sampling Date:				10/28/2025			10/28/2025			10/28/2025			10/28/2025			10/28/2025			10/28/2025			10/28/2025		
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
Metals (mg/kg)																								
Arsenic	19	1,100	19	16.5	0.096	0.93	**25.3**	0.10	0.99	14.0	0.11	1.0	11.9	0.099	0.96	**22.5**	0.095	0.92	8.7	0.096	0.94	9.5	0.10	0.97
Field Sample ID:				S3(1-1.5)			S4(0.5-1)			S5(1-1.5)			S6(0-0.5)			S7(0-0.5)			S7(1-1.5)			S8(0-0.5)		
Lab Sample ID:				460-338150-8			460-338150-9			460-338150-10			460-356073-1			460-356073-2			460-356073-3			460-356073-4		
Sampling Date:				10/28/2025			10/28/2025			10/28/2025			7/23/2026			7/23/2026			7/23/2026			7/23/2026		
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
Metals (mg/kg)																								
Arsenic	19	1,100	19	4.8	0.10	0.97	7.6	0.097	0.94	5.8	0.10	0.99	17.6	0.12	1.2	**25.1**	0.11	1.1	14.5	0.11	1.0	**61.6**	0.11	1.1
Field Sample ID:				S9(0-0.5)			S10(0-0.5)			S10(1-1.5)			S11(0-0.5)			S11(1.5-2)			S12(0-0.5)			S13(0-0.5)		
Lab Sample ID:				460-356073-5			460-356073-6			460-356073-7			460-356073-8			460-356073-9			460-356073-10			460-356073-11		
Sampling Date:				7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026		
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
Metals (mg/kg)																								
Arsenic	19	1,100	19	**24.4**	0.12	1.1	9.9	0.10	0.99	5.6	0.10	0.97	15.9	0.11	1.1	6.2	0.10	1.0	**24.4**	0.11	1.1	**53.9**	0.11	1.1
Field Sample ID:				S14(0-0.5)			S14(1-1.5)			S15(0-0.5)			S16(0-0.5)			S16(1-1.5)			S17(0-0.5)			S18(0-0.5)		
Lab Sample ID:				460-356073-12			460-356073-13			460-356073-14			460-356073-15			460-356073-16			460-356073-17			460-356073-18		
Sampling Date:				7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026		
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
Metals (mg/kg)																								
Arsenic	19	1,100	19	**27.7**	0.11	1.0	15.0	0.10	0.97	**29.1**	0.12	1.2	**59.5**	0.11	1.1	11.2	0.11	1.1	**23.9**	0.11	1.0	**23.6**	0.11	1.1
Field Sample ID:				S18(1-1.5)			S19(0-0.5)			S20(0-0.5)			S20(1-1.5)			S21(0-0.5)			S22(0-0.5)			S22(1-1.5)		
Lab Sample ID:				460-356073-19			460-356073-20			460-356073-21			460-356073-22			460-356073-23			460-356073-24			460-356073-25		
Sampling Date:				7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026		
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
Metals (mg/kg)																								
Arsenic	19	1,100	19	13.5	0.11	1.0	16.2	0.11	1.1	**38.9**	0.11	1.1	**86.6**	0.11	1.1	9.2	0.11	1.0	18.5	0.11	1.0	8.9	0.11	1.0

Notes

mg/kg = milligrams per kilogram; ND = Not detected; NR = No Result (Not Analyzed); NA = Not Available (No Standard)

RSRS-ID = Residential Soil Remediation Standard - Ingestion-Dermal Exposure Pathway (N.J.A.C. 7:26D)

RSRS-I = Residential Soil Remediation Standard - Inhalation Exposure Pathway (N.J.A.C. 7:26D)

MGWSRS = Migration to Ground Water Soil Remediation Standard (N.J.A.C. 7:26D)

Bold Concentration exceeds RSRS-ID

Outlined concentration exceeds Default MGWSRS

Italics - Laboratory Reporting Limit (RL) exceeds standard

J : Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table 1 - Arsenic Soil Analytical Results

Field Sample ID:				**S23(0-0.5)**			**S24(0-0.5)**			**S24(1-1.5)**			**S25(0-0.5)**			**S25(1-1.5)**			**S26(0-0.5)**			**S27(0-0.5)**		
Lab Sample ID:				460-356073-26			460-356073-27			460-356073-28			460-356073-29			460-356073-30			460-356073-31			460-356073-32		
Sampling Date:				7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026		
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
Metals (mg/kg)																								
Arsenic	19	1,100	19	**23.0**	0.11	1.1	**20.6**	0.11	1.0	5.5	0.10	1.0	13.9	0.11	1.1	5.9	0.10	0.97	13.9	0.11	1.1	14.3	0.11	1.1
Field Sample ID:				**S28(0-0.5)**			**S28(1-1.5)**			**S29(0-0.5)**			**S29(0.5-1)**			**S30(0-0.5)**			**S30(1-1.5)**			**FB072326**		
Lab Sample ID:				460-356073-33			460-356073-34			460-356073-35			460-356073-36			460-356073-37			460-356073-38			460-356073-39		
Sampling Date:				7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026		
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			µg/L		
Metals (mg/kg)																								
Arsenic	19	1,100	19	7.6	0.11	1.1	5.3	0.11	1.0	6.4	0.11	1.1	4.0	0.11	1.0	8.8	0.10	1.0	4.7	0.11	1.0	ND	0.48	2.0
Field Sample ID:				**S9(0-0.5)**			**S14(0-0.5)**			**S21(0-0.5)**			**S23(0-0.5)**			**S28(0-0.5)**								
Lab Sample ID:				460-356073-5			460-356073-12			460-356073-23			460-356073-26			460-356073-33								
Sampling Date:				7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026								
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL						
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg								
Metals (mg/kg)																								
Arsenic III (Trivalent Arsenic)	NA	NA	NA	0.038 F1F2	0.022	0.023	0.043	0.021	0.023	ND	0.020	0.021	0.041	0.022	0.024	ND	0.021	0.022						
Field Sample ID:				**S9(0-0.5)**			**S14(0-0.5)**			**S21(0-0.5)**			**S23(0-0.5)**			**S28(0-0.5)**								
Lab Sample ID:				460-356073-5			460-356073-12			460-356073-23			460-356073-26			460-356073-33								
Sampling Date:				7/23/2026			7/23/2026			7/23/2026			7/23/2026			7/23/2026								
Parameter	RSRS-ID	RSRS-I	MGWSRS	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL	Result	MDL	RL						
	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg								
Wetchem (mg/kg)																								
Lloyd Kahn Total Organic Carbon	NA	NA	NA	24,000	100	122	18,700	92.7	113	22,300	92.8	113	21,100	97.3	119	25,100	97.6	119						

Notes

mg/kg = milligrams per kilogram; ND = Not detected; NR = No Result (Not Analyzed); NA = Not Available (No Standard)

RSRS-ID = Residential Soil Remediation Standard - Ingestion-Dermal Exposure Pathway (N.J.A.C. 7:26D)

RSRS-I = Residential Soil Remediation Standard - Inhalation Exposure Pathway (N.J.A.C. 7:26D)

MGWSRS = Migration to Ground Water Soil Remediation Standard (N.J.A.C. 7:26D)

Bold Concentration exceeds RSRS-ID

Outlined concentration exceeds Default MGWSRS

Italics - Laboratory Reporting Limit (RL) exceeds standard

J : Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

F1 : MS and/or MSD recovery exceeds control limits.

F2 : MS/MSD RPD exceeds control limits

Table 2: Arsenic Soil Concentration Statistics

COC[1]	MGWSRS[2] (mg/kg)	N[3]	ND	> SRS (%)	Minimum (mg/kg)	Maximum (mg/kg)	Median[4] (mg/kg)	Mean[5] (mg/kg)	95% UCL[6] (mg/kg)
All Soil (0-2')									
Arsenic	19.0	48	0 (0%)	33%	4	**86.6**	14.2	18.8	**22.8**
Surface Soil (0-0.5')									
Arsenic	19.0	30	0 (0%)	50%	6.4	**61.6**	**19.6**	**22.6**	**27.4**
Subsoil (0.5'+)									
Arsenic	19.0	18	0 (0%)	6%	4	**86.6**	6.9	12.4	16.0
Subsoil (0.5'+) Without Outlier									
Arsenic	19.0	17	0 (0%)	0%	4	15	6.2	8.04	9.55

Notes:

[1]COC - Contaminant of Concern

[2] MGWSRS - NJDEP Migration to Groundwater Soil Remediation Standard

[3] N - Total number of samples

[4]50th Percentile Detects and Non-Detects (ProUCL)

[5]Kaplan-Meier Mean including Non-Detects (ProUCL)

[6]Suggested 95% Upper Confidence Limit of Mean including Non-Detects (ProUCL)

Bold concentrations exceed NJDEP MGWSRS