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May 17, 2017

Mr. Stephen A. Cobb, Chief
c/o Mrs. Brandi Little
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2059

Via Email

SUBJECT: Response to ADEM Review and Comments dated April 14, 2017 Re: *Risk Management – 2 Work Plan for Former Chemical Laundry and Motor Pool Area 1500, Parcel 94(7), Revision 1, McClellan, Anniston, Alabama,* dated January 12, 2017

Dear Mr. Cobb,

On behalf of the McClellan Development Authority (MDA), Matrix Environmental Services, LLC (MES) is pleased to resubmit the response to Alabama Department of Environmental Management (ADEM) review comments dated April 14, 2017 regarding the *Risk Management – 2 Work Plan for Former Chemical Laundry and Motor Pool Area 1500, Parcel 94(7), Revision 1 McClellan, Anniston, Alabama* and a revised Work Plan incorporating the responses to comments. This resubmittal includes an updated Table 1. No other changes were made to the May 2, 2017 submittal.

An electronic copy of the submittal has been provided to Mrs. Brandi Little via e-mail and two hard copies will follow by mail. Please contact me at (256) 847-0780 (Anniston) or (770) 594-0331 (Atlanta) should you have any questions or comments.

Sincerely,
Matrix Environmental Services, LLC

Richard Satkin, P.G.
McClellan Program Manager

Enclosures: Response to ADEM comments dated December 9, 2014

CC: Mrs. Brandi Little, ADEM
Mr. Robin Scott, MDA
Mr. Gerald Hardy, MES
Amy Huskey, Brown and Caldwell
MES Project Files

1. **Page 1-1, Section 1.1.** MDA states that the RM-2 evaluation will include the assumption that site occupants are adults in a non-residential setting. However, the Environmental Covenant (EC) for this site does not include a residential use restriction. The EC should be modified to include a residential use restriction or MDA should revise the text accordingly. Please address.

MDA Response:
Once the RM-2 has been completed and approved, the EC will be modified as necessary to address potential restrictions for residential use and future construction (i.e., potential restrictions on basements).

ADEM Evaluation of Comment 1: MDA states that the environmental covenant (EC) will be modified as necessary to address potential restrictions for residential use and future construction (i.e., potential restrictions on basements). ADEM notes that these receptors are not being evaluated in the subject document. A residential receptor should be addressed to determine whether the EC needs to be modified. Please address. Also, page 3-2, Section 3.4.1, states there are existing land use controls preventing residential use, which is not consistent with the EC. Please revise this section to be consistent with the EC.

MDA Response to ADEM Evaluation: The planned future land use for this site is technology and research park and is consistent with the assumption in Section 1.1 that the site occupants are adults in non-residential settings and therefore evaluation of a residential receptor is not warranted. Current land use controls (LUCs) prevent groundwater use for potable purposes and activities that would result in direct groundwater contact. The first sentence in Section 3.4.1 has been corrected to "The existing LUCs for the Site prevents groundwater use for potable purposes and activities that would result in groundwater contact (such as construction in the saturated zone)." Following the completion and approval of the RM-2 process, the existing EC will be modified as necessary to address any consistency issues.

ADEM Evaluation of Comment 1: ADEM notes that the existing land use controls (prevention of groundwater use for potable purposes and activities that would result in groundwater contact such as construction in the saturated zone) for the site do not prohibit development of a technology and research park nor do the restrictions prohibit development of the site for residential use. Therefore, an evaluation of the residential receptor pathway should be conducted to determine if the environmental covenant needs to be modified as the planned future land use and occupancy assumptions could be subject to change. Please address.

MDA Response to ADEM Evaluation: The RM-2 evaluation will also include assessing the residential receptor and Sections 1.1, 3.4.1 and Table 1 have been modified accordingly to reflect this assessment.

6. ***Page 2-2, Section 2.4***. Please clarify if RM- 1 levels are being used as screening criteria to identify those chemicals for which RM-2 levels will be calculated. If so, this is inconsistent with the Alabama Risk-Based Corrective Action (ARBCA) guidance, which requires the use of preliminary screening levels (PSLs) to select those chemicals requiring evaluation in either the RM-I or RM-2 stage. Please update the entire document accordingly**.**

MDA Response:
The VOC detections which have been reported since 2013 were compared to May 2016 United States Environmental Protection Agency (USEPA) Regional Screening Levels. Based on this comparison, the five constituents listed in the RM-2 were retained as constituents of concern (COCs). The text has been revised accordingly.

ADEM Evaluation of Comment 6: The text on Page 2-3, Section 2.4 has not been revised as indicated in MDA's response. Also, please clarify which Environmental Protection Agency's Regional Screening Levels (e.g. receptor and media) and target level were used for the screening. In accordance with the Alabama Risk-Based Corrective Action (ARBCA) guidance, the preliminary screening levels should be based upon a Hazard Quotient of 0.1. Please revise the text accordingly.

MDA Response to ADEM Evaluation: Section 2.4 has been revised as follows "Groundwater concentrations are currently compared to Alabama Risk-Based Target Levels (RBTLs) in accordance with the Corrective Measures Implementation Plan (CMIP) (2015 Version 5). The RM-1 RBTLs were calculated by MES in accordance with ABRCA (2008) and were approved by ADEM in the letter dated June 24, 2015 (MES, 2015). Based on the proposed future land use for the Site, comparing results to the commercial RBTLs is appropriate for the Site. As an initial screening step for this Work Plan, concentrations of VOCs in groundwater from recent sampling events were first compared to May 2016 USEPA tap water (residential) Regional Screening Levels (RSLs) [Hazard Quotient (HQ) of 0.1] as discussed in Section 3.2."

ADEM Evaluation of Comment 6: MDA's response indicates that there is a discussion regarding tap water (residential) Regional Screening Levels (RSLs) [Hazard Quotient (HQ) of 0.1] in Section 3.2. Although Section 2.4 was revised per the response, the text in section 3.2 does not clearly indicate the use of a HQ of 0.1. Please modify the text to state that a HQ of 0.1 will be used.

MDA Response to ADEM Evaluation: The text in Section 3.2 has been modified.

7. ***Page 3-2, Section 3.4***. This section states that existing land use controls (LUC) restrict residential use. However, the Environmental Covenant (EC) for this site does not include a restriction for residential use. Please see Comment 1.

MDA Response:
See response to Number 1.

ADEM Evaluation of Comment 7: Please see ADEM's Evaluation of Comment 1.

MDA Response to ADEM Evaluation: See response to Number 1.

ADEM Evaluation of Comment 7: Please see ADEM's Evaluation of Comment 1.

MDA Response to ADEM Evaluation: See response to Number 1.

Risk Management-2 Work Plan
Former Chemical Laundry and Motor Pool Area
1500, Parcel 94(7)
McClellan, Anniston, Alabama

Prepared for
McClellan Development Authority
Anniston, Alabama
Revision 4 – May 17, 2017

Prepared by
Brown and Caldwell

In cooperation with
Matrix Environmental Services, LLC

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List of Abbreviations

ADEM	Alabama Department of Environmental Management
ARBCA	Alabama Risk-Based Corrective Action
BC	Brown and Caldwell
Cis-1,2-DCE	cis-1,2-Dichloroethene
cm	centimeter
CMIP	Corrective Measures Implementation Plan
COC	constituents of concern
DTSC	Department of Toxic Substances Control
ED	exposure duration
EF	exposure frequency
ET	exposure time
HI	hazard index
HQ	hazard quotient
IELCR	individual excessive lifetime cancer risk
IT	IT Corporation
JEM	Johnson and Ettinger model
LUC	land use control
m^3	cubic meter
MCL	maximum contaminant level
McClellan	Former Fort McClellan
MDA	McClellan Development Authority
MES	Matrix Environmental Services, LLC
µg	microgram
mg	milligram
RAGS	Risk Assessment Guidance for Superfund
RBTL	Risk-Based Target Level
RM	Risk Management
RSL	Regional Screening Level
SCEM	Site Conceptual Exposure Model
SVI	soil vapor intrusion
TCE	trichloroethylene
Trans-1,2-DCE	trans-1,2-dichloroethene
USEPA	United States Environmental Protection Agency
VC	Vinyl Chloride
VOCs	volatile organic compounds

Section 1

Introduction

This Alabama Risk-Based Corrective Action (ARBCA) Risk Management-2 (RM-2) Work Plan has been prepared by Brown and Caldwell (BC) on behalf of Matrix Environmental Services, LLC (MES) for the Former Chemical Laundry and Motor Pool Area 1500, Parcel 94(7), hereafter referred to as the "Site," located at the former Fort McClellan (McClellan) in Anniston, Alabama, for submittal to the Alabama Department of Environmental Management (ADEM).

1.1 Project Objectives and Assumptions

The goal of this RM-2 evaluation is to develop alternate cleanup levels through the ARBCA program. The RM-2 evaluation differs from the RM-1 in that the RM-2 utilizes site-specific exposure factors and fate and transport parameters wherever possible. The purpose of this Work Plan is to provide the technical rationale, methods, and procedures necessary to complete a RM-2 evaluation for the Site. The RM-2 will include the following:

- Use of Johnson & Ettinger model (JEM) Version 3.1 (2004) for soil vapor intrusion (SVI) to assess total risks due to volatilization of impacted groundwater;
- Update of JEM to reflect current United States Environmental Protection Agency (USEPA) Risk Assessment Guidance for Superfund (RAGS) procedures for inhalation exposure as well as updated toxicity factors;
- Conservative assumption of a basement for SVI evaluation purposes;
- Assumption that Site occupants are children and adults in a residential setting and adults in a non-residential setting;
- Calculation of total chemical of concern (COC) cumulative risks.

1.2 Report Organization

This Work Plan has been organized into the following sections:

- Section 1. Introduction
- Section 2. Background
- Section 3. Site Conceptual Exposure Model (SCEM)
- Section 4. Risk Evaluation
- Section 5. References

Section 2

Background

The Site description provided herein is based on investigation work conducted to date and is briefly outlined in the following sections. The history, geology, soil, and hydrogeology of the Site are described in greater detail in the Draft Remedial Investigation Report, Former Chemical Laundry and Motor Pool Area 1500, Parcel 94(7), by IT Corporation (IT) (2002).

2.1 Site Background and History

The Site is located in the central area of McClellan, along Langley Avenue and south of St. Clair Road. It was formerly used as a vehicle and maintenance facility, including gas stations, and garment impregnation facilities. The garment impregnation facilities reportedly laundered garments to neutralize chemical warfare material. The impregnation plants reportedly used large volumes of toluene or ethyl alcohol, and possibly wax and "chlorinated oil." The buildings have been demolished and two concrete slab foundations remain at the Site along with concrete sumps or grease pits. The remainder of the Site is covered with asphalt pavement.

2.2 Site Geology, Soil, and Hydrogeology

The lithologic sequence encountered at the Site consists of an upper interval of residuum 6 to 50 feet thick overlying fractured, weathered limestone. Bedrock has been mapped as Ordovician-age Little Oak and Newala Limestones, undifferentiated, and Mississippian/Ordovician-age Floyd and Athens Shale, undifferentiated. An asymmetric anticlinal fold strikes northeast across the parcel and plunges to the southwest.

The soil type at the Site is classified as Anniston and Allen series and the Philo series. Anniston and Allen gravelly loams consist of strongly acidic, deep well-drained soils that have developed in old local alluvium. Along the bank of Ingram Creek, the soil is classified as the Philo and Stendal fine sandy loams. The Philo series consists of strongly acidic, moderately well-drained soils that have developed in local and general alluvium.

Groundwater flow in the residuum generally conforms to surface topography and flows predominantly to the northeast towards Ingram Creek as shown on Figure 1. Groundwater flow in the bedrock appears to be structurally controlled, following the general trend of the underlying limestone and flowing away from the inferred location of the anticlinal fold hinge. The depth to groundwater at the Site is variable. During the past three years (January 2014 to January 2016), the depth to groundwater in residuum monitoring well MW03 (only residuum well currently monitored) has ranged from 2.84 to 3.57 feet (ft) below ground surface (bgs) and the depth to groundwater within the bedrock monitoring wells currently monitored has ranged between 2.64 and 24.60 ft bgs. The depth to groundwater within bedrock monitoring well MW11 has ranged between 20.39 and 23.11 ft bgs over the last three years and between 20.39 and 24.7 ft bgs over the last fifteen years (since November 2001).

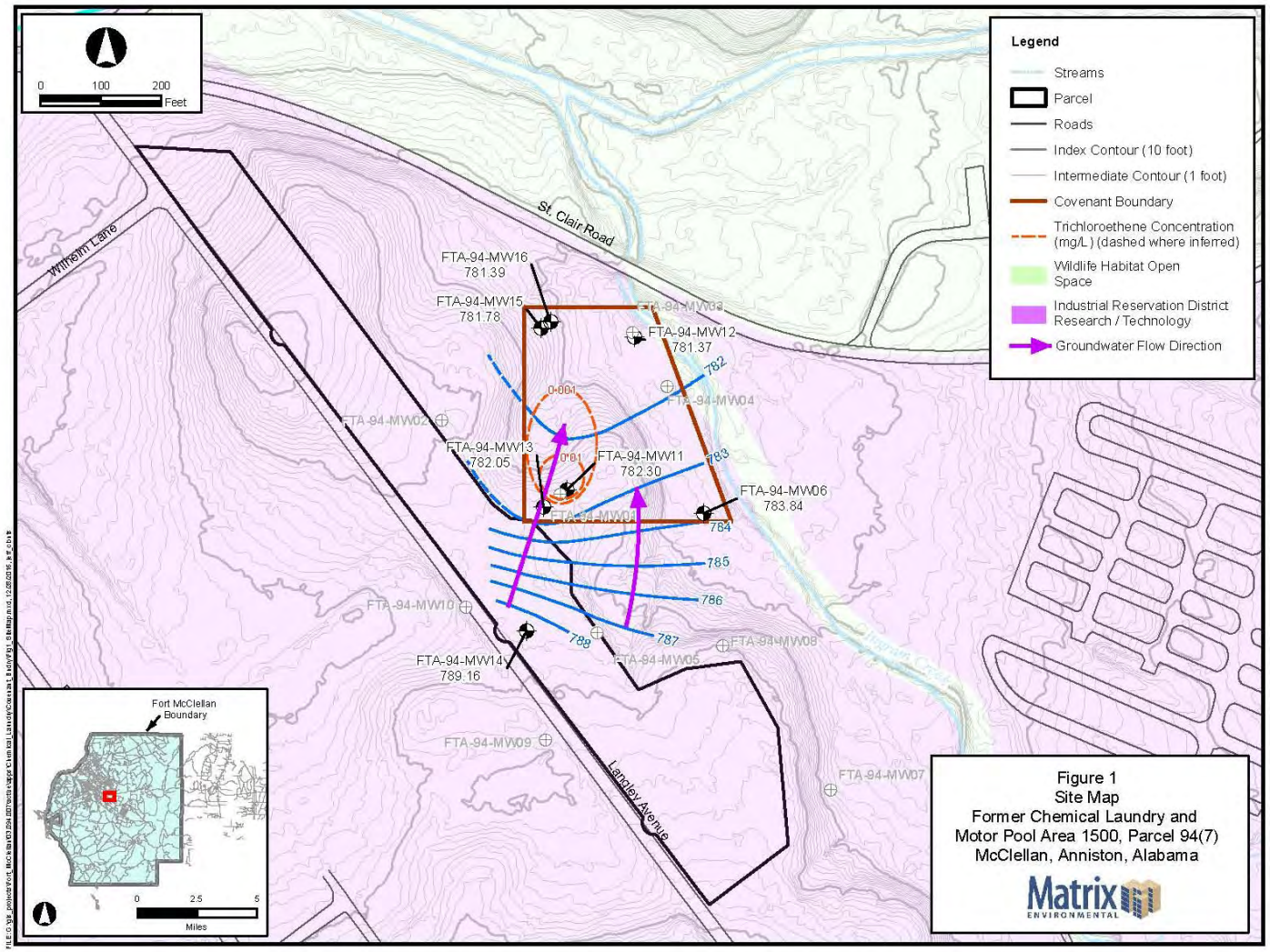

Figure 1 – Site Map

2.3 Land Use and Land Use Controls

Proposed future land use for the Site is a technology and research park, as proposed in the Re-Use Plan (EDAW Inc., 1997, amended by the Joint Powers Authority in June 2005). Existing land use controls (LUCs) at the Site include a restriction on the consumptive or other use of groundwater, and direct contact with the groundwater below the Site, unless proper safety and disposal measures approved by ADEM are implemented. Environmental Covenant Number FY-12-08.00 for the Site in accordance with the Alabama Uniform Environmental Covenants Act, Code of Alabama 35-19-1 through 35-19-14, was filed in Probate on August 12, 2014. The restrictions apply to the covenant boundary (see Figure 1) located downgradient of the Parcel 94(7) where concentrations of volatile organic compounds (VOCs) were detected in groundwater.

2.4 Preliminary Screening Evaluation

Groundwater concentrations are currently compared to Alabama Risk-Based Target Levels (RBTLs) in accordance with the Corrective Measures Implementation Plan (CMIP) (2015 Version 5). The RM-1 RBTLs were calculated by MES in accordance with the version of ABRCA in effect at the time (2008) and were approved by ADEM in the letter dated June 24, 2015 (MES, 2015). Based on the proposed future land use for the Site, comparing results to the commercial RBTLs is appropriate for the Site. As an initial screening step for this Work Plan, concentrations of VOCs in groundwater from recent sampling events were first compared to May 2016 USEPA tap water (residential) Regional Screening Levels (RSLs) [Hazard Quotient (HQ) of 0.1] as discussed in Section 3.2.

2.5 Basis of RM-2 Evaluation Development

In accordance with ARBCA (2017), "A Risk Management-2 (RM-2) evaluation may be conducted when…(ii) RM-1 assumptions are significantly different from site-specific conditions, so that the estimated RM-1 cumulative risks may not be representative of site-specific conditions." This condition applies to the Site because the RM-1 RBTLs are based on exposure via use of groundwater as a water supply. Even for commercial uses, the RBTLs assume that half the daily drinking water comes from Site groundwater. Since groundwater use is expressly prohibited, these exposures do not apply. Therefore, an RM-2 that addresses potential actual exposures is appropriate.

Section 3

Site Conceptual Exposure Model (SCEM)

The objectives of the SCEM are: 1) to characterize the exposure setting with respect to land use, 2) to identify relevant human and ecological receptors, and 3) to identify relevant and appropriate exposure pathways that can serve as risk endpoint for the RM-2 evaluation. The SCEM identifies the relationships between the contamination source, environmental release mechanisms, impacted media, exposure routes, and receptor populations. The SCEM is summarized in the following sections.

3.1 Characterization of Exposure Setting

Groundwater is the only identified impacted medium at the Site. The future use of the Site will be limited to commercial activities (i.e., a technology and research park). As previously indicated, the existing LUC prevents exposure to groundwater either directly through usage or incidentally during excavation.

3.2 COCs

As an initial screening step, concentrations of VOCs in groundwater from recent sampling events were first compared to USEPA tap water RSLs at an HQ of 0.1 (May 2016). Based on this comparison, the results of groundwater samples from residuum and bedrock monitoring wells indicate that the Site COCs include the following VOCs: trichloroethene (TCE) and vinyl chloride (VC). Chlorobenzene and TCE degradation products, cis-1,2-dichloroethene (cis-1,2-DCE) and trans-1,2-dichloroethene (trans-1,2-DCE) did not exceed their respective USEPA RSLs from the last two events; therefore, they were not retained for this modeling effort. COC concentrations above RM-1 RBTLs and May 2016 tap water RSLs are limited to well FTA-94-MW11, which is screened in the bedrock at a depth of 57.2 to 67.2 feet below ground surface, and will be the focus of the RM-2 evaluation.

3.2.1 Physical and Chemical Properties

Physical and chemical parameters for use in the limited RM-2 evaluation for each Site-specific COC will be selected from the JEM.

3.2.2 Toxicological Properties

Current inhalation toxicity factors (unit risk factors and reference concentrations) will be input into the JEM spreadsheets. These updated toxicity factors will be taken from the most recent USEPA RSL table (May 2016).

3.3 Contaminant Fate and Transport

Fate and transport parameters that will be used in the limited RM-2 are incorporated in the JEM spreadsheet and are shown in Table 1. Default values will be used with the exception of several Site-specific values as detailed below and in Section 3.4.3:

- **Thickness of the vadose zone and depth to groundwater**. Since model inputs will involve the maximum concentrations from the January 2016 event in monitoring well FTA-94-MW11, the depth to water observed in that well during the January 2016 event will be used in the model. This is more conservative than the guidance suggestion of using depth to bedrock, which is greater than the depth to groundwater at this location.
- **Average groundwater temperature**. The average groundwater temperature will be selected from the average groundwater temperatures measured at the wells sampled during the January 2016 monitoring event.
- **Soil type**. The soil type above bedrock for the Former Chemical Laundry and Motor Pool Area generally consists of clay as described in the well construction logs for the following monitoring wells: FTA-94-MW03, -MW04, - MW05, -MW06, -MW08, - MW11, -MW12, -MW-13, -MW-14, -MW15, and -MW16. As observed on the well logs, the coarsest soil type noted was silt (at MW04 only); therefore, silt will be selected as the soil type for this RM-2.

In addition, Site-specific groundwater concentrations will be input, as indicated in Table 1.

3.4 Potential Receptors and Exposure Pathways

An exposure pathway consists of the following four elements:

1. A source or mechanism of chemical release
2. A transport or retention medium
3. A point of contact between the receptor and the chemical
4. A route of exposure at the point of contact

The potential receptors and exposure pathways are discussed in the following sections.

3.4.1 Potential Human Receptors

The existing LUCs for the Site prevent groundwater use for potable purposes and activities that would result in direct groundwater contact (such as construction in the saturated zone). In addition, the COCs above RBTLs are present in the bedrock groundwater (FTA-94-MW11) at a depth that substantially exceeds the potential construction zone. Therefore, there are two possible future exposure routes associated with groundwater the Site:

- Direct contact with surface water (Ingram Creek or Cane Creek) that has been impacted by groundwater migration and discharge: this pathway is potentially complete for area residents. In the development of the RBTLs, this receptor was assumed to be an adolescent trespasser, and
- Inhalation of COCs in indoor air in a future structure through SVI from groundwater; this receptor would be a building occupant, either a resident (more likely based on projected Site use) or a commercial worker. Both commercial and residential receptors will be considered in order to provide an assessment of potential risks under different final land uses.

The completeness and suitability of these pathways as the basis for an RM-2 evaluation is discussed below.

3.4.2 Surface Water Pathway Evaluation

The nearest surface water body is an intermittent stream, Ingram Creek, located approximately 250 feet from FTA-94-MW11. Five surface water samples collected from Ingram Creek were analyzed for VOCs (as provided in the Remedial Investigation report). There was one low-level, J-flagged detection in WS-94-SW/SD01 of TCE and one low-level, J-flagged detection of methylene chloride in WS-94-SW/SD-05. Although

it is not known if groundwater from this well is discharging to the stream, the resulting concentration in surface water is trace. In addition, due to the intermittent and unlikely contact with the stream by humans in this commercial setting, this pathway is likely de Minimis.

Five surface water samples were collected for chemical analysis at the locations shown on Figure 2-2 of the Remedial Investigation (see Appendix A) based on drainage pathways. Samples were collected in 1998 and 2000. Results indicated very low level detections of acetone and chloroform; however, these constituents were also detected in laboratory blanks. TCE was detected at a very low concentration (0.23 micrograms per liter) at one of the locations in 1998. Methylene chloride was also detected at one location at a very low level; however this constituent was not considered a Site COC. Monitoring wells FTA-94-MW03, -MW06, and MW12 are likely the sentinel wells that would detect groundwater potentially discharging to Ingram Creek. More recent data indicate that VOCs have been non-detect in FTA-94-MW06 and MW12, with very low level detections (i.e., below reporting limit) of Site COCs (cis-1,2-DCE and TCE) indicating that discharge of potentially impacted groundwater to surface water is highly unlikely. Additionally, a seep survey was conducted by IT in 2000 to determine the presence of seeps. Based on observations, seeps, springs, or wet areas were not observed in the survey area, nor were there any observable changes in the survey area, nor were there any observable changes in vegetation type, vegetation type, vegetation distribution, odors, or other evidence suggesting intermittent seeps may exist at the Site.

3.4.3 Vapor Intrusion Pathway Evaluation

COCs in groundwater may have the potential to volatilize into the subsurface and eventually to indoor air.

The advanced JEM will be used to estimate the transport, concentrations and risk of contaminant vapors from the subsurface (groundwater) into indoor air. Inputs for the model are summarized in Table 1, below. Default inputs for the JEM will be used except where noted below.

Table 1. Expected JEM Inputs

Variable	Assumption Used	Comments
Groundwater concentration	Representative Concentrations (RCs)]	RCs will be based on an evaluation of the data available from the past one to three years of sampling, per ARBCA guidance (Section A.3.3).
Average groundwater temperature	10 degrees Celsius	Site specific
Depth below grade to bottom of enclosed floor space	200 centimeters (cm)	Conservative assumption is that a building has a basement.
Depth below grade to water table	1280 cm	Because the target wells of concern are in bedrock, depth to water is not a relevant variable. Soil vapor intrusion modeling guidance only considers migration through the vadose zone. Therefore, the depth input in the model is the top of rock, which conservatively assumes that there is no attenuation between the bedrock groundwater and the interface of the rock and vadose zone. This value is fixed for each well. The depth to bedrock value observed for FTA-94-MW11 will be used as the model input.
Soil type	Well-specific	Silt
Average vapor flow rate into building	5 liters/minute	Model default
Soil vapor permeability	5.6E-09 cm^2	Default model-assigned value based on soil type (silt)
Soil dry bulk density	1.35 $grams/cm^3$	Default model-assigned value based on silt
Soil porosity	0.489	Default model-assigned value based on silt

Table 1. Expected JEM Inputs		
Variable	**Assumption Used**	**Comments**
Soil water-filled porosity	0.167 cm^3/cm^3	Default model-assigned value based on silt
Enclosed space floor thickness	10 cm	Model default
Soil/building pressure differential	40 grams/cm-$second^2$	Model default
Enclosed floor space length	1000 cm	Model default – conservative based on small area
Enclosed floor space width	1000 cm	Model default - conservative based on small area
Enclosed floor space height	366 cm	Model default - conservative based on small area
Floor-wall seam crack width	0.1 cm	Model default
Indoor air exchange rate	0.25 [1/hour (hr)]	Model default
Averaging time for carcinogens (AT_C)	70 years (yrs)	By definition set to lifetime
Averaging time for noncarcinogens (AT_{nc})	25 yrs commercial 26 yrs residential	By definition equivalent to exposure duration
Exposure Duration (ED)	25 yrs commercial 26 yrs residential	Default assumption for commercial/industrial Default assumption for residential
Exposure Frequency (EF)	250 days/yr commercial 350 days/yr residential	Default assumption for commercial/industrial Default assumption for residential
Exposure Time (ET)	8 hrs/day commercial 24 hrs/day residential	Default assumption for commercial/industrial Default assumption for residential

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Section 4

Risk Evaluation

A cumulative risk evaluation will be completed as part of the RM-2 using the JEM for SVI. For carcinogenic effects, risk is quantified using the Individual Excess Lifetime Cancer Risk (IELCR), which represents an increase in the probability of an individual developing cancer due to exposure to a COC or group of chemicals through complete routes of exposure.

For non-carcinogens, risk is quantified using a Hazard Quotient (HQ), which represents the ratio of the estimated dose for a chemical and a route of exposure to the reference dose. When a receptor is exposed to multiple COCs through multiple routes of exposures, which is often the case, HQs are added together to estimate the Hazard Index (HI).

The equations used in the limited RM-2 evaluation will be consistent with those specified in the JEM with the following highlighted changes:

$$IELCR = \frac{URF \times EF \times ED \times ET \times C_{bldg}}{AT_c \times 365\ {}^{days}/_{yr} \times 24\ {}^{hrs}/_{day}}$$

$$HQ = \frac{EF \times ED \times ET \times C_{bldg} \times 0.001\ {}^{mg}/_{\mu g}}{RfC \times AT_{nc} \times 365\ {}^{days}/_{yr} \times 24\ {}^{hrs}/_{day}}$$

where:

IELCR	=	Incremental Excess Lifetime Carcinogenic Risk (unitless)
HQ	=	Hazard Quotient (unitless)
AT_C	=	Averaging Time - Carcinogenic
AT_{nc}	=	Averaging Time - Non-carcinogenic
URF	=	Unit Risk Factor [cubic meters per microgram ($m^3/\mu g$); chemical specific]
RfC	=	Reference Concentration [milligram per m^3 (mg/m^3); unitless]
EF	=	Exposure frequency (days/ yr)
ED	=	Exposure duration (yrs)
ET	=	Exposure time (hrs/day)
C_{bldg}	=	Building air concentration ($\mu g/m^3$; calculated by model)

These modifications add the variable ET, which accounts for the portion of the day over which inhalation exposure occurs. This variable was introduced by the USEPA into updated inhalation risk assessment practice in 2009. JEM spreadsheets developed for use subsequent to that [such as by the California EPA Department of Toxic Substances Control (DTSC)] include this variable. Note that the addition of this scaling variable has no effect on risks to residential receptors, who are assumed to be continuously exposed.

Total risks and hazards for the COCs will be summed as follows:

$$\text{Total IELCR} = \sum \text{IELCRs}$$

$$HI = \sum HQs$$

where:

HI = Hazard Index (unitless)

Final risks will be compared with the ARBCA limits. For the RM-2 evaluation, the use of a target Site-wide IELCR (i.e., the sum of the IELCR for each COC and each complete route of exposure) of 1×10^{-5} is required. The use of a target Site-wide HI (sum of individual HQs) of 1.0 is required.

Section 5

References

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