

**RIO SALADO HABITAT RESTORATION PROJECT  
GROUNDWATER CONTINGENCY RESPONSE PLAN  
CITY OF PHOENIX, ARIZONA**



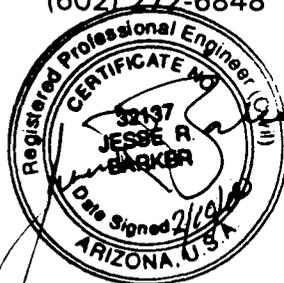
**AGRA** Earth & Environmental

ENGINEERING GLOBAL SOLUTIONS

**RIO SALADO HABITAT RESTORATION PROJECT  
GROUNDWATER CONTINGENCY RESPONSE PLAN  
CITY OF PHOENIX, ARIZONA**

*Submitted To:*  
City of Phoenix Engineering &  
Architectural Services Department  
200 West Washington Street, 7<sup>th</sup> Floor  
Phoenix, Arizona 85003-1611

*Submitted By:*  
AGRA Earth & Environmental, Inc.  
3232 West Virginia Avenue  
Phoenix, Arizona 85009-1502  
(602) 272-6848



February 10, 2000

**AGRA JOB NO. 0-114-002022**

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*Tiffany O. Looff*

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Tiffany O. Looff, P.G.  
Project Geologist



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Jesse R. Barker, P.E.  
Senior Engineer

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TABLE 1	Summary of Action Level Calculations for Daylighted Groundwater Exposure Scenario
TABLE 2	Potential Chemical Hazards
TABLE 3	Response



## 1.0 INTRODUCTION

At the request of the City of Phoenix, AGRA Earth & Environmental, Inc. (AGRA) has prepared this Groundwater Contingency Response Plan for the Rio Salado Habitat Restoration Project. The scope of this Groundwater Contingency Response Plan is based on conversations between AGRA and City of Phoenix personnel, and the results of the Risk Management Assessment and Monitoring Program Report (RMA; AGRA, 2000). The Groundwater Contingency Response Plan is intended to 1) augment the Rio Salado Habitat Restoration Project site-specific Health and Safety Plan, and 2) outline the procedures to be implemented in the event that daylighted groundwater (*i.e.*, groundwater present at the surface, either in excavations, in ponds, or flowing), containing concentrations of constituents of concern (COC) above risk-based action levels (RBALs) established in the RMA, is encountered during construction activities.

## 2.0 BACKGROUND

The City of Phoenix, in conjunction with the United States Army Corps of Engineers (USACE) and the Maricopa County Flood Control District, is proposing to undertake an environmental restoration project for a five mile reach (Phoenix Reach) along the Salt River in the City of Phoenix, Arizona. This project is part of the overall Rio Salado Habitat Restoration project along the urban reaches of the Salt River. Currently, the Phoenix Reach is a dry river bed with minimal or no vegetation and/or habitat and the area surrounding this portion of the Salt River has been used for gravel mining, landfills and other industrial activities. The overall objective of the restoration project is to enhance riparian habitat along the Phoenix Reach in order to restore local flora and fauna and provide incidental recreational opportunities.

The plan for the Phoenix Reach is to use shallow groundwater to create a perennial low flow channel in the river bed. Initially, this groundwater may be brought to the surface during construction of the low flow channel and associated features and will then be discharged downstream of the construction area, either within or downstream of the restored reach.

The ground water underlying the project area has been found to be contaminated with varying levels of industrial chemicals. Therefore, an assessment of risk to human health from this water was completed to increase worker safety and ensure that groundwater discharged to the surface downstream of the project will not endanger public health during or following construction. Appropriate RBALs, which are protective of human receptors likely to be in the general vicinity during the restoration project, were established for COC in the RMA and Monitoring Program developed by AGRA for the City of Phoenix. The evaluation indicated that exposure to daylighted groundwater, as the primary source of COC, posed the highest potential risk, and that the on-site trench worker had the greatest risk of exposure. Consequently, exposure to daylighted groundwater containing concentrations of COC above the RBALs is not permissible.

### 3.0 RISK-BASED ACTION LEVELS

The Rio Salado RMA was conducted to identify allowable RBALs which would be protective of human health for receptor populations over the entire project area, regardless of location, throughout the duration of construction for the Rio Salado Habitat Restoration Project. The analysis focused on daylighted groundwater, sediment and air, and the potential effects of human contact with these media during construction of the project components. The evaluation has utilized exposure routes including dermal contact, inhalation and ingestion to evaluate risk potential. The RBALs do not predict a concentration which may be present at a given location at a given time. Actual concentrations may be subject to change over time, as affected groundwater moves through the project area. Overall, the result of the RMA has indicated that appropriately managing risk in groundwater will address risk posed by other media.

Table 1 provides a summary of RBALs derived utilizing the site-specific parameters and algorithms for exposure in daylighted groundwater. Of the compounds reported in groundwater from several locations adjacent to the project area, maximum concentrations of 1,1-dichloroethene, 1,2-dichloroethane, benzene, toluene, tetrachloroethene, trichloroethane, vinyl chloride, arsenic and mercury were reported at levels which exceed the most stringent action level.

### 4.0 POTENTIAL CONSTITUENTS OF CONCERN

The historic groundwater data and the results of the RMA indicated that the following contaminants present in the groundwater have the greatest potential to be COC in the Phoenix Reach:

1,1-dichloroethene	1,2-dichloroethane
benzene	toluene
tetrachloroethene	trichloroethene
mercury	arsenic
vinyl chloride	

Additionally, a statistical summary of all analytical data indicated that Polynuclear Aromatic Hydrocarbons (PAHs) and methyl-tertiary butyl ether (MTBE) were not evaluated at any of the available sites in the vicinity of the Phoenix Reach. These are analytes commonly associated with many types of industrial processes and petroleum releases; therefore, all PAHs and MTBE were included as potential COC.

Each of these chemical classes contains contaminants that have similar chemical properties and structures and, therefore, similar toxicological effects on humans. Table 2 provides a summary of the routes of entry, and potential acute and chronic health effects. It should be

noted that the health effects listed in Table 2 would result from overexposure to these compounds, and that daylighted groundwater sampling for these compounds is required before it can be determined if overexposure will occur during restoration activities at the Phoenix Reach.

## **5.0 GROUNDWATER CONTINGENCY RESPONSE PLAN TO MINIMIZE WORKER RISK**

The Groundwater Contingency Response Plan is intended to augment the Rio Salado Habitat Restoration Project site-specific Health and Safety Plan, and to outline the procedures to be implemented in the event that daylighted groundwater containing concentrations of COC above RBALs established in the RMA, is encountered during construction activities. The Groundwater Contingency Response Plan addresses engineering controls, modifications to personal protective equipment, modifications to work schedules, water sampling procedures, and appropriate laboratory sample analysis to minimize or mitigate exposure to daylighted groundwater containing contaminant concentrations above the RBALs. This document is intended to supplement the site-specific Health and Safety Plan in regards to this issue. The site-specific Health and Safety Plan should be consulted on all health and safety issues not specifically addressed by this Groundwater Contingency Response Plan.

AGRA has identified three potential contingency response scenarios:

- Scenario 1 daylighted groundwater is encountered for which no information concerning the COC is available;
- Scenario 2 daylighted groundwater which is known to contain concentrations of COC above the prescribed RBALs is encountered; and
- Scenario 3 daylighted groundwater is encountered that is not believed to contain concentrations of COC above the RBALs, but site-specific conditions warrant further investigation. These conditions may include odor, visible contamination, or reported worker discomfort as a result of contact with daylighted groundwater.

Groundwater Contingency Response Scenario 1 occurs if daylighted groundwater is encountered in areas of the project for which no information is available regarding the concentrations of potential COC present. Since little data are available for COC concentrations in groundwater beneath the Rio Salado channel at this time, this contingency response scenario will occur most frequently, especially at the beginning of the project.

Groundwater Contingency Response Scenario 2 conditions are present if daylighted groundwater containing concentrations of COC known to be above the RBALS is encountered.

This scenario may occur more frequently in later phases of the project after daylighted groundwater monitoring and sampling data have been collected in the project area.

Under Groundwater Contingency Response Scenario 3 conditions, daylighted groundwater is believed to contain concentrations of COC below RBALS. However, site-specific conditions such as odor, visible contamination, or reported worker discomfort as a result of contact with daylighted groundwater indicate that additional investigation is appropriate. This scenario may occur at any time during the project.

## 5.1 SITE CONTROL MEASURES

AGRA feels that site control measures in some form should be implemented at all times during the construction activities. The implementation of site measures will vary according to the contingency response scenario encountered or anticipated.

### 5.1.1 Work Zone Definition

In order to minimize exposure potential, AGRA recommends the establishment of an exclusion zone surrounding construction activities. The exclusion zone should be designed to restrict access to unauthorized personnel, but accommodate necessary equipment. Fencing and road barriers may be appropriate to restrict public vehicle and foot traffic. Caution tape and posted signs and placards indicating restricted access should be placed in appropriate locations surrounding the construction site. Additional personnel responsible for restricting site access may also be appropriate, depending upon the size of the exclusion zone or the applicable scenario.

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If unusual site conditions such as strong odors or staining or worker discomfort related to contact with daylighted groundwater or sediment are reported, site personnel should be removed from the immediate area until the potential for adverse impacts to health or safety can be evaluated. Site access should be restricted to those personnel responsible for assessing the site conditions.

?

Whenever possible, avoid ponded water, damp sediments, or discolored areas. Avoid sitting or laying on the ground, or leaning against excavation sidewalls to the maximum extent practicable.

In the event that sediments associated with daylighted groundwater containing elevated concentrations of COC (above RBALS) becomes dry, routine dust suppression techniques (*i.e.* periodic water truck sprinkling) may be considered if airborne dust occurs.

### 5.1.2 Air Monitoring

Monitoring and analysis of the breathing zone at test borings that encounter daylighted groundwater can also provide information prior to field construction activities. Personal air samples may be collected in the breathing zone of selected workers engaged in tasks which place the workers near daylighted groundwater for extended periods of time; however, the sensitivity of these personal devices may be limited to concentrations above the RBALs.

BY WHO?

Air monitoring for exposure during field operations should be conducted to provide further assurance that no health hazard is present at the site. Volatile organic compounds (VOC) monitoring with a photoionization detector (PID) or flame ionization detector (FID) or equivalent can be performed during excavation activities; however, these instruments may not be sensitive enough to detect airborne VOCs at concentrations at or below the RBALs. Air monitoring that is more sensitive but requires a longer duration can be performed at an excavation site prior to the initiation of field activities.

### 5.1.3 Training

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Limited training is required at all sites where hazardous substances are present, even if it can be demonstrated that no exposure to concentrations above action levels will occur. In general, the limited training must include information regarding the health effects of exposure to the substance(s) to which employees potentially may be exposed, and information regarding actions to minimize exposure. The training should include communication of the content of both the site-specific Health and Safety Plan and this Groundwater Contingency Response Plan.

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### 5.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

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Personal protective equipment (PPE) will be required for certain field operations, based on the potential for contaminant exposures. It is anticipated that United States Environmental Protection Agency (EPA) Level D protection as recommended by the site Health and Safety Plan will be appropriate for most site activities which do not involve contact with daylighted groundwater. The results of the RMA indicated that exposure to groundwater containing concentrations of COC above the RBALs is not permissible. Under Scenario 1 conditions, the concentrations of potential COC present in the daylighted groundwater, if contacted, are not known. Under Scenario 2 conditions, the concentrations of potential COC present in contacted daylighted groundwater are known to exceed the RBALs. Unusual site conditions such as odor, present in Scenario 3 conditions, warrant additional investigation to determine the potential for negative impacts to health and safety. The following PPE is required to minimize worker exposure when daylighted groundwater is encountered in Scenario 2 conditions and until concentrations of COC below the RBALs can be established in Scenario 1 conditions. The PPE may also be required for those personnel involved with additional

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investigation activities. If the concentrations of COC present are below the RBALs, Level D PPE will be appropriate. This list does not include PPE that may be required to minimize risk to workers from physical hazards.

1. Chemical-resistant clothing - Criteria used to select protective clothing must include consideration of heat stress in addition to liquid/dirt and chemical resistance. Selected clothing should be made of a breathable material in order to address heat stress issues.
2. Boots - Polyvinyl chloride (PVC) boots should afford adequate protection against incidental contact with daylighted groundwater exhibiting concentrations of COC above RBALs. These will be steel-toed boots as appropriate for the work tasks being performed.
3. Gloves - Chemical-resistant PVC gloves will be worn if daylighted groundwater is encountered.

If disposable chemical-resistant clothing is utilized, its disposal must be properly managed.

Respiratory protection may be required based upon the results of air monitoring performed in the work area. Additional personal protective equipment should be utilized based on an assessment of exposures.

### 5.3 MODIFICATION TO WORK SCHEDULES

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When daylighted groundwater is initially encountered in a construction area, work should cease immediately. If the concentrations of COC in the daylighted groundwater are unknown, the personnel responsible for sampling and monitoring the daylighted groundwater should be notified immediately so that a water sample can be collected for monitoring and laboratory analysis. Work may proceed after the appropriate water sample has been collected, but before the concentrations of COC in the daylighted groundwater are known, only after the appropriate PPE identified in Section 5.2 has been donned and only if contact with the daylighted groundwater can be avoided.

Work in areas where unusual site conditions are reported will cease until the nature and cause of the conditions can be adequately investigated. Workers will be removed from the area as a precaution.

### 5.4 MONITORING AND SAMPLING

A sample of daylighted groundwater encountered during construction in any previously unsampled area should be collected and analyzed for the list of COC. The list consists of the VOCs and metals which were present at concentrations above RBALs in groundwater samples collected from locations adjacent to the site. PAHs and MTBE are included in the preliminary list of monitored potential COC for daylighted groundwater until sufficient information

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regarding concentrations can be collected to establish or disregard MTBE or any PAH constituents as a COC. Additionally, daylighted groundwater should be monitored for physical parameters including turbidity, total suspended solids (TSS), total dissolved solids (TDS), pH, and specific conductance. Monitoring of these parameters will assist evaluating of changes in general conditions of the water chemistry at the Site. Sampling and analysis at previously unsampled locations will be conducted in accordance with the site water quality sampling and analysis plan or monitoring plan.

Sampling and monitoring of daylighted groundwater in areas where COC concentrations are known to exceed the RBALs will be addressed in the site monitoring plan. Sampling locations and frequency, field parameters, and laboratory analysis will be specified by the site monitoring plan.

Sampling and monitoring of daylighted groundwater in areas which fall into the Groundwater Contingency Response Scenario 3 category may or may not be included in the site monitoring plan. The investigation of the unusual site conditions may require additional monitoring and sampling of the daylighted groundwater or sediment in the area. This sampling will be conducted in accordance with the site monitoring plan for the COC and for other constituents, as appropriate, to determine the nature and cause of the unusual conditions.

## 5.5 SUMMARY OF RESPONSE

Table 3 presents a summary of the anticipated response for each of the contingency response scenarios described above. The applicability of required actions for each contingency response scenario are indicated in the appropriate column.

## 5.6 OVEREXPOSURE

Any employee at this site who develops signs or symptoms indicating possible overexposure involving contaminated daylighted groundwater or sediment will be required to seek medical attention within 24 hours, and to notify his or her supervisor. The incident will be reported as soon as possible in writing. The worker's employer shall ensure that the employee is appropriately tested for the listed COC, to determine if overexposure is the cause of the employee's reported symptoms. A physician's written opinion will be required prior to the employee's return to normal site activities.

## 5.7 EMERGENCY RESPONSE NOTIFICATION REQUIREMENTS

Although every attempt will be made to prevent exposure to COC which may be present in daylighted groundwater at the site, an emergency situation may arise. If an emergency situation does occur, site personnel should refer to the Emergency Response Contingency Plan of the site Health and Safety Plan

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## **5.1 SITE CONTROL MEASURES**

AGRA feels that site control measures in some form should be implemented at all times during the construction activities. The implementation of site measures will vary according to the contingency response scenario encountered or anticipated.

### **5.1.1 Work Zone Definition**

In order to minimize exposure potential, AGRA recommends the establishment of an exclusion zone surrounding construction activities. The exclusion zone should be designed to restrict access to unauthorized personnel, but accommodate necessary equipment. Fencing and road barriers may be appropriate to restrict public vehicle and foot traffic. Caution tape and posted signs and placards indicating restricted access should be placed in appropriate locations surrounding the construction site. Additional personnel responsible for restricting site access may also be appropriate, depending upon the size of the exclusion zone or the applicable scenario.

If unusual site conditions such as strong odors or staining or worker discomfort related to contact with daylighted groundwater or sediment are reported, site personnel should be removed from the immediate area until the potential for adverse impacts to health or safety can be evaluated. Site access should be restricted to those personnel responsible for assessing the site conditions.

Whenever possible, avoid ponded water, damp sediments, or discolored areas. Avoid sitting or laying on the ground, or leaning against excavation sidewalls to the maximum extent practicable.

In the event that sediments associated with daylighted groundwater containing elevated concentrations of COC (above RBALS) becomes dry, routine dust suppression techniques (*i.e.* periodic water truck sprinkling) may be considered if airborne dust occurs.

### **5.1.2 Air Monitoring**

Monitoring and analysis of the breathing zone at test borings that encounter daylighted groundwater can also provide information prior to field construction activities. Personal air samples may be collected in the breathing zone of selected workers engaged in tasks which place the workers near daylighted groundwater for extended periods of time; however, the sensitivity of these personal devices may be limited to concentrations above the RBALs.

Air monitoring for exposure during field operations should be conducted to provide further assurance that no health hazard is present at the site. Volatile organic compounds (VOC) monitoring with a photoionization detector (PID) or flame ionization detector (FID) or equivalent can be performed during excavation activities; however, these instruments may not be sensitive enough to detect airborne VOCs at concentrations at or below the RBALs. Air monitoring that is more sensitive but requires a longer duration can be performed at an excavation site prior to the initiation of field activities.

### **5.1.3 Training**

Limited training is required at all sites where hazardous substances are present, even if it can be demonstrated that no exposure to concentrations above action levels will occur. In general, the limited training must include information regarding the health effects of exposure to the substance(s) to which employees potentially may be exposed, and information regarding actions to minimize exposure. The training should include communication of the content of both the site-specific Health and Safety Plan and this Contingency Response Plan.

## **5.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)**

Personal protective equipment (PPE) will be required for certain field operations, based on the potential for contaminant exposures. It is anticipated that United States Environmental Protection Agency (EPA) Level D protection as recommended by the site Health and Safety Plan will be appropriate for most site activities which do not involve contact with daylighted groundwater. The results of the RMA indicated that exposure to groundwater containing concentrations of COC above the RBALs is not permissible. Under Scenario 1 conditions, the concentrations of potential COC present in the daylighted groundwater, if contacted, are not known. Under Scenario 2 conditions, the concentrations of potential COC present in contacted daylighted groundwater are known to exceed the RBALs. Unusual site conditions such as odor, present in Scenario 3 conditions, warrant additional investigation to determine the potential for negative impacts to health and safety. The following PPE is required to minimize worker exposure when daylighted groundwater is encountered in Scenario 2 conditions and until concentrations of COC below the RBALs can be established in Scenario 1 conditions. The PPE may also be required for those personnel involved with additional investigation activities. If the concentrations of COC present are below the RBALs, Level D

PPE will be appropriate. This list does not include PPE that may be required to minimize risk to workers from physical hazards.

1. Chemical-resistant clothing - Criteria used to select protective clothing must include consideration of heat stress in addition to liquid/dirt and chemical resistance. Selected clothing should be made of a breathable material in order to address heat stress issues.
2. Boots - Polyvinyl chloride (PVC) boots should afford adequate protection against incidental contact with daylighted groundwater exhibiting concentrations of COC above RBALs. These will be steel-toed boots as appropriate for the work tasks being performed.
3. Gloves - Chemical-resistant PVC gloves will be worn if daylighted groundwater is encountered.

If disposable chemical-resistant clothing is utilized, its disposal must be properly managed.

Respiratory protection may be required based upon the results of air monitoring performed in the work area. Additional personal protective equipment should be utilized based on an assessment of exposures.

### **5.3 MODIFICATION TO WORK SCHEDULES**

When daylighted groundwater is initially encountered in a construction area, work should cease immediately. If the concentrations of COC in the daylighted groundwater are unknown, the personnel responsible for sampling and monitoring the daylighted groundwater should be notified immediately so that a water sample can be collected for monitoring and laboratory analysis. Work may proceed after the appropriate water sample has been collected, but before the concentrations of COC in the daylighted groundwater are known, only after the appropriate PPE identified in Section 5.2 has been donned and only if contact with the daylighted groundwater can be avoided.

Work in areas where unusual site conditions are reported will cease until the nature and cause of the conditions can be adequately investigated. Workers will be removed from the area as a precaution.

### **5.4 MONITORING AND SAMPLING**

A sample of daylighted groundwater encountered during construction in any previously unsampled area should be collected and analyzed for the list of COC. The list consists of the VOCs and metals which were present at concentrations above RBALs in groundwater samples collected from locations adjacent to the site. PAHs and MTBE are included in the preliminary list of monitored potential COC for daylighted groundwater until sufficient information regarding concentrations can be collected to establish or disregard MTBE or any PAH

constituents as a COC. Additionally, daylighted groundwater should be monitored for physical parameters including turbidity, total suspended solids (TSS), total dissolved solids (TDS), pH, and specific conductance. Monitoring of these parameters will assist evaluating of changes in general conditions of the water chemistry at the Site. Sampling and analysis at previously unsampled locations will be conducted in accordance with the site water quality sampling and analysis plan or monitoring plan.

Sampling and monitoring of daylighted groundwater in areas where COC concentrations are known to exceed the RBALs will be addressed in the site monitoring plan. Sampling locations and frequency, field parameters, and laboratory analysis will be specified by the site monitoring plan.

Sampling and monitoring of daylighted groundwater in areas which fall into the Contingency Response Scenario 3 category may or may not be included in the site monitoring plan. The investigation of the unusual site conditions may require additional monitoring and sampling of the daylighted groundwater or sediment in the area. This sampling will be conducted in accordance with the site monitoring plan for the COC and for other constituents, as appropriate, to determine the nature and cause of the unusual conditions.

## **5.5 SUMMARY OF RESPONSE**

Table 3 presents a summary of the anticipated response for each of the contingency response scenarios described above. The applicability of required actions for each contingency response scenario are indicated in the appropriate column.

## **5.6 OVEREXPOSURE**

Any employee at this site who develops signs or symptoms indicating possible overexposure involving contaminated daylighted groundwater or sediment will be required to seek medical attention within 24 hours, and to notify his or her supervisor. The incident will be reported as soon as possible in writing. The worker's employer shall ensure that the employee is appropriately tested for the listed COC, to determine if overexposure is the cause of the employee's reported symptoms. A physician's written opinion will be required prior to the employee's return to normal site activities.

## **5.7 EMERGENCY RESPONSE NOTIFICATION REQUIREMENTS**

Although every attempt will be made to prevent exposure to COC which may be present in daylighted groundwater at the site, an emergency situation may arise. If an emergency situation does occur, site personnel should refer to the Emergency Response Contingency Plan of the site Health and Safety Plan

**TABLES**

<b>TABLE 1</b>	<b>SUMMARY OF ACTION LEVEL CALCULATIONS FOR DAYLIGHTED GROUNDWATER EXPOSURE SCENARIO</b>
<b>TABLE 2</b>	<b>POTENTIAL CHEMICAL HAZARDS</b>
<b>TABLE 3</b>	<b>RESPONSE</b>

Summary of Action Level Calculations for Daylighted Groundwater Exposure Scenario

Constituent	Residential	Commercial/Industrial	Trespassing Recreationalist		Construction Foreman		Construction Worker		Most Stringent Action Level (mg/L)
	Action Level at Grade Control Structures (mg/L)	Action Level at Grade Control Structures (mg/L)	Non-carcinogenic Action Level (mg/L)	Carcinogenic Action Level (mg/L)	Non-carcinogenic Action Level (mg/L)	Carcinogenic Action Level (mg/L)	Non-carcinogenic Action Level (mg/L)	Carcinogenic Action Level (mg/L)	
<b>volatiles</b>									
1,1,1-Trichloroethane	40,260	42,273	135.9040572		167.1573585		113.6096204		113.61
1,1-dichloroethene	2	3	1.595563628	0.00951771	2.844906604	0.011277588	2.158582788	0.007573975	0.0076
1,2-dichloroethane	5	5	9.687637089	0.053193153	3.643359142	0.024761456	2.120712914	0.014565336	0.0146
Bromodichloromethane	254	266	2.694688939	0.256302128	1.284637191	2.19100518	0.757397469		0.26
Benzene	15	16	0.142072076	0.037293215	0.10333901	0.05966375	0.064757484	0.04570502	0.037
Chlorobenzene	77	81	1.045144412		0.371935566		0.216236978		0.22
Dibromochloromethane	1	2	3.754568849	0.06040686	1.305856168	0.026932746	0.757397469	0.015779114	0.02
Ethyl benzene	2,008	2,108	3.716102584		9.975251388		10.83078381		3.72
Tetrachloroethene	244	257	0.931368206	0.007001689	2.643682341	0.036647455	3.029589878	0.652928853	0.007
Trichloroethene	77	81	0.337999806	0.062164307	1.750501974	0.184682677	20.07103294	0.220907595	0.062
Toluene	1,350	1,417	5.649067678		5.670405653		3.786987347		3.79
Vinyl chloride	1	1	0.961935053	0.005463179	0.326713034	0.00672384	0.189349367	0.004418152	0.00
Xylene	12,258	12,871	150.0903235		52.2846787		30.29589878		30.30
<b>metals</b>									
Arsenic	NA	NA	0.31799143	0.024890863	13.38976505	1.096238074	NA	NA	0.025
Barium	NA	NA	21.86709319		157.5770925		NA	NA	21.87
Chromium	NA	NA	386.4532288		3033.978319		NA	NA	386.45
Mercury	NA	NA	0.071087481		0.472731278		NA	NA	0.071
Nickel	NA	NA	4.398104251		28.74580916		NA	NA	4.40
Lead	NA	NA	2.803748703		85.5585393		NA	NA	2.80
Antimony	NA	NA	0.016260125		0.090044053		NA	NA	0.02
Thallium	NA	NA	0.943380464		174.6798278		NA	NA	0.94
<b>semivolatiles</b>									
Acenaphthene	NA	NA	5.651823344		30.48699286		NA	NA	5.65
Acenaphthylene	NA	NA	2.249180325		12.10432631		NA	NA	2.25
Anthracene	NA	NA	13.04845761		70.0908817		NA	NA	13.05
Benzo(a)anthracene	NA	NA	0.018119079	0.00024789	0.09726981	0.001332463	NA	NA	0.00
Benzo(a)pyrene	NA	NA	0.029381404	0.000017	0.157577093	8.99413E-05	NA	NA	0.00
Benzo(b)fluoranthene	NA	NA	0.005631436	0.000167557	0.030202276	0.000899413	NA	NA	0.00
Benzo(g,h,i)perylene	NA	NA	0.000477751		0.00255717		NA	NA	0.00
Benzo(k)fluoranthene	NA	NA	0.000151236	0.0000450	0.000809509	0.000241069	NA	NA	0.00
Chrysene	NA	NA	0.115962103	0.0247890	0.622526785	0.133246315	NA	NA	0.02
Dibenz(a,h)anthracene	NA	NA	0.005447102	0.0000075	0.029180943	3.99739E-05	NA	NA	0.00
Fluoranthene	NA	NA	3.24931333		17.50856583		NA	NA	3.25
Fluorene	NA	NA	2.594894848		13.96336481		NA	NA	2.59
Indeno(1,2,3-cd)pyrene	NA	NA	0.018570471	0.000105938	0.099522374	0.00056805	NA	NA	0.00
Naphthalene	NA	NA	1.648777945		9.134903914		NA	NA	1.65
Phenanthrene	NA	NA	0.886676741		4.795824555		NA	NA	0.89
Pyrene	NA	NA	0.380829541		2.040463642		NA	NA	0.38

NA - Not applicable because inhalation is the only exposure route for these receptors: Metals and semi-volatile constituents do not volatilize from water.

**TABLE 2**  
**POTENTIAL CHEMICAL HAZARDS**  
 Potential Effects and Routes of Entry

CHEMICAL	ROUTE OF ENTRY	POTENTIAL EFFECTS OF HIGH DOSES <sup>1</sup>	
		Acute	Chronic
Chlorinated Hydrocarbons	Inhalation. Ingestion. Dermal Contact.	Hematological effects. Respiratory inflammation. Death.	Carcinogenic. Gastrointestinal Effects. Cardiovascular Effects.
Petroleum Hydrocarbons	Inhalation. Ingestion. Dermal Contact.	Central Nervous System Depression. Respiratory Arrest. Asphyxiation.	Carcinogenic. Hematological Effects. Immune System and Nervous System Effects. .
MTBE	Inhalation. Ingestion. Dermal Contact.	Dizziness. Headaches. Gastrointestinal Irritation. Nose and Throat Irritation.	Suspected Carcinogen. Liver, Kidney and Nervous System Damage. Suspected Developmental Toxicity.
PAHs	Inhalation. Ingestion. Dermal Contact.	Dermatitis. Bronchitis.	Carcinogenic. Impaired Bladder, Kidneys, and Respiratory System. Dermatitis.
Mercury	Inhalation. Ingestion. Dermal Contact.	Impaired Respiratory, Cardiovascular and Gastrointestinal Systems.	Effects on Kidney and Central Nervous System.
Arsenic	Inhalation. Ingestion. Dermal Contact.	Respiratory Irritation. Skin Pigmentation. Gastrointestinal Disturbances. Ulceration of Nasal Septum and Skin.	Carcinogenic. Liver, Kidney, Lung, Lymphatic Dysfunction. Dermatitis.

<sup>1</sup> Toxicological Profile. U.S. Department of Health and Services, Public Health Service, Agency for Toxic Substances and Disease Registry (ATSDR).

**TABLE 3  
RESPONSE**

<b>SCENARIO</b>	<b>SITE CONTROL MEASURES</b>	<b>PPE (in addition to Level D)</b>	<b>WORK SCHEDULE MODIFICATION</b>	<b>SAMPLING</b>
1 - COC concentrations are unknown	X	X	X	X
2 - COC concentrations are known to be above RBALs	X	X	X	
3 - COC concentrations are believed to be below RBALs, but unusual site conditions are observed	X	X	X	X
4 - COC concentrations are below RBALs or daylighted groundwater is not present	X			