EARLY RESPONSE ACTION

PUBLIC HEALTH EXPOSURE ASSESSMENT AND MITIGATION WORK PLAN

Prepared for:

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On Behalf of the
Roosevelt Irrigation District

WEST VAN BUREN AREA
WATER QUALITY ASSURANCE REVOLVING FUND SITE

June 16, 2011

Registered Professional Engineer (Environmental)
CERTIFICATE
31739
JOEL D.
PETERSON
Date Signed 6/16/11
ARIZONA, U.S.A.
Expires 09/30/2012

SYNERGY
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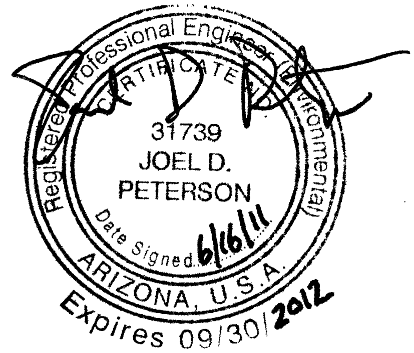

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WEST VAN BUREN AREA
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1.0 INTRODUCTION

Groundwater in the West Van Buren Area (WVBA) Water Quality Assurance Revolving Fund Site contains hazardous substances, principally volatile organic compounds (VOCs) that have impacted twenty (20) Roosevelt Irrigation District (RID) extraction wells. As the principal impacted water provider in the WVBA Site, the Arizona Department of Environmental Quality (ADEQ) acknowledged that the RID wells that extract and discharge VOC-contaminated groundwater to surface water are the major outflow of contamination from the Site [Terranext, 2008]. It was further noted that the RID canals provide a potential route of surface water [and contaminant] migration downstream of the WVBA.

RID relies on the wells within the WVBA Site to meet critical water supply needs and, consequently, submitted a Work Plan for conducting an Early Response Action (ERA) to restore a portion of these impacted wells for unrestricted use, including future use as a drinking water source [M&A, 2010]. Although the ERA was designed to capture and treat hazardous substances primarily as a well protection and restoration initiative, the action was also proposed to mitigate exposure pathways associated with the uncontrolled release of VOCs in groundwater pumped by RID from the WVBA Site.

Given the volatile nature of the contaminants of concern (COCs), this Public Health Exposure Assessment and Mitigation Work Plan (Work Plan) provides for more comprehensive investigations into the fate and transport of the COCs and assesses the potential for exposure of the public to these contaminants. Past investigations evaluated the impact of pumping contaminated groundwater but only focused on VOCs in water, "... assuming that no volatilization occurs..." [Terranext, 2001].

The results of this Work Plan will also provide data to assist in guiding the detailed design and implementation of engineering measures to control the volatilization of these contaminants and minimize potential public exposure.

ADEQ approved the ERA Work Plan, with conditions, in a letter dated June 24, 2010 (RID,2010). Among these conditions, ADEQ requested that RID provide specific documentation to assess potential public health exposure to VOCs and how these potential exposures will be mitigated during the ERA implementation. This Work Plan was prepared in response to that request with the intended purpose and scope of this work described below.

1.1 PURPOSE

The purpose of this Work Plan is to provide the framework to conduct a systematic assessment of the potential exposure of individuals living and working in the WVBA to the hazardous substances known to exist in the groundwater and portions of the RID water systems. This assessment will:

- assess the potential for public exposure to unacceptable levels of contamination by systematic sampling and analysis at several "worst case" locations in the WVBA;
- compare the analytical results to health-based guidance levels to make a screening-level determination as to whether these substances pose an imminent and significant risk to public health; and,
- using these results, develop detailed designs for engineering controls as mitigation measures to reduce the concentration of hazardous substances in the local environment.

1.2 SCOPE OF WORK

This Work Plan defines the work necessary to systematically assess public exposure pathways to VOC contamination from RID systems in the WVBA Site. Although there may be other possible VOC exposure pathways in the WVBA that could pose potential public health hazards, the scope of this Work Plan and the resulting Final Report are limited to the assessment of exposure from VOC releases associated with the RID pumping and conveyance of contaminated groundwater.

The exposure assessment proposed in this Work Plan does not constitute a quantitative risk assessment. These investigations and the resulting Final Report will provide a screening level assessment of potential exposure and provide data to assist in the development of detailed designs for engineering controls needed to limit these uncontrolled VOC emissions. A groundwater baseline risk assessment may be conducted as part of the WVBA Site Feasibility Study (FS), if required by

ADEQ, to quantify potential health and ecological risks and other routes of exposure associated with the contaminated groundwater.

These investigations are limited to the RID water infrastructure located in the WVBA, as shown in **Figure 1**, and focuses on air and water exposure pathways. Since no soil contamination exists within the RID properties within the WVBA, no soil exposure pathway is being considered under the scope of this Work Plan.

Sampling of water and air at the locations defined in this Work Plan will be conducted and analytical testing performed to determine the concentrations of the COCs at various points of RID operations within the WVBA. These data will be evaluated on a screening-level basis, comparing the concentrations to applicable health-based guideline values. These health-based guidelines include Arizona Surface Water Quality Standards (SWQS) (Arizona Administrative Code (A.A.C.) R18-11-109) and Arizona Aquifer Water Quality Standards (AWQS) (A.A.C. R18-11-406) for water samples, Arizona Department of Health Services (ADHS) Arizona Ambient Air Quality Guidelines (AAAQGs) (ADHS, 1999) for air samples, and Environmental Protection Agency (EPA) Regional Screening Levels (RSLs) (EPA, 2010) for both air inhalation and water consumption exposure pathways.

Based on this evaluation, a Final Report will be generated including analytical results, a comparison of these results to the screening criteria, and an assessment of the effectiveness of the planned mitigation measures to reduce the potential for public exposure. These data can then be used by ADEQ to determine whether additional health consultation or public health assessment is warranted.

1.3 CONTAMINANTS OF CONCERN

The COCs have been identified based on existing data obtained from samples collected by ADEQ and RID from the impacted RID groundwater extraction wells. There are six (6) hazardous substances that constitute the COCs due to their presence at significant concentrations in the WVBA. These contaminants are all VOCs, indicating that they readily volatilize and could pose a threat to human health through inhalation as well as ingestion and body contact. These primary COCs, comprising the commingled WVBA plume, are listed as follows (including the chemical name and the Chemical Abstract Service (CAS number):

- 1,1-Dichloroethene (1,1-DCE) CAS number 75-53-4
- Tetrachloroethene (PCE) CAS number 127-18-4
- Trichloroethene (TCE) CAS number 79-01-6
- 1,1,1-Trichloroethane (TCA) CAS number 71-55-6
- cis 1,2-Dichloroethene (cis 1,2-DCE) CAS number 156-59-2
- 1,1-Dichloroethane (1,1-DCA) CAS number 75-34-3

Only three (3) of these six (6) COCs are present in the impacted groundwater at concentrations high enough to pose a significant potential exposure to the public. Consequently, this Work Plan will address only those three (3) COCs; 1,1-DCE, PCE and TCE.

Chromium is also a COC that occurs locally within the WVBA boundaries. The concentrations of chromium in the impacted RID groundwater are well below the EPA maximum contaminant level (MCL) for drinking water. Chromium is also a non-volatile contaminant so there is no reasonable potential for an inhalation exposure pathway. Consequently, chromium is not being considered in the Work Plan.

2.0 IMPACTED RID WATER SYSTEMS

The RID water systems within the boundaries of the WVBA, impacted (or threatened to be impacted) by the groundwater contamination, include 32 groundwater extraction wells, the Salt Canal conveyance, several lateral conveyances and the Main Canal. These individual system elements are described in the following sections.

The magnitude of the impact, estimated by extrapolating ADEQ wellhead VOC sample results from impacted RID wells (contaminant concentrations) and RID historical pumping records (discharge volume), is approximately 3,400 pounds of COCs released to the local environment annually (2009 data).

2.1 GROUNDWATER EXTRACTION WELLS

RID maintains 32 groundwater extraction wells within the WVBA. Twenty (20) of these wells are impacted by COCs (16 above MCLs) and one well is presently not-in-service (RID-111). A list of the impacted RID wells, along with the concentration of COCs in each, is provided in **Table 1** and the locations of these wells are shown in **Figure 1**.

Each well has a field-fit discharge piping system that directs the groundwater from the pump into the Salt Canal or laterals (through receiver boxes) or directly into the Main Canal. The discharge piping from each well is uniquely configured to accommodate the well site location and orientation and, in all cases, provides an air gap by discharging into a gravity conveyance through the open atmosphere (air gap). No RID wells currently discharge into pressurized piping systems.

2.2 SALT CANAL

The RID Salt Canal is primarily an enclosed and underground gravity conveyance system that transports extracted groundwater from its origin, well number RID-114, westward collecting groundwater from wells RID-113 through RID-105 along the south side of Van Buren Street to its terminus at the Main Canal (at 83rd Avenue just south of Van Buren Street)(see **Figure 1**). The Salt Canal remains a gravity flow conveyance; however, over the 80+ years of operation it has been largely converted from its original configuration as an open canal to an enclosed conveyance.

2.2.1 Enclosed Canal

The enclosed portions of the Salt Canal are equipped with manholes at multiple locations along the conveyance to provide access for maintenance. The majority of manhole covers on the Salt Canal are of solid steel construction and provide an adequate seal to prevent exposure of the public to volatilized contaminants in the underlying headspace. However, some of the manhole covers in the older, eastern section of the conveyance have small (and sometimes multiple) openings in the covers. These manhole covers will be included in the assessment of potential public health exposure.

2.2.2 Open Canal

The Salt Canal has two (2) remaining open sections consisting of concrete-lined canal, both located in the western extent of the Salt Canal. These open sections maintain the general canal alignment and gravity flow line/grade and are, therefore, several meters below the grade of the pavement adjacent to West Van Buren Street. These open canal sections are as follows:

- beginning approximately 800 feet west of 75th Avenue with the open section approximately 320 feet long;
- beginning approximately 250 feet west of 79th Avenue with the open section approximately 1,150 feet long.

A third section of open canal (immediately west of 69th Avenue, approximately 240 feet long), was enclosed in 2010 during City of Phoenix street improvements.

2.3 LATERALS

RID utilizes six (6) lateral conveyances within the margins of the WVBA to transport groundwater from wells that are not immediately adjacent to the Salt Canal or Main Canal. Four (4) of these laterals flow south from wells RID-89, RID-92, RID-95, and RID-100, to the Main Canal. The remaining two (2) laterals transport groundwater from the wells in the southeastern portion of the WVBA from RID-104, RID-103 and RID-101 to the Main Canal and from RID-102 to the north-south lateral serving RID-100 and on to the Main Canal. The majority of the RID laterals are enclosed; however, two (2) open sections still exist, as shown on **Figure 1**.

2.3.1 Enclosed Laterals

The enclosed sections of laterals consist of smaller-diameter gravity pipelines, typically less than 24 inches in diameter. These pipelines do not have manhole or clean-out access points and, therefore, present limited potential for public exposure to the contaminated groundwater being conveyed.

2.3.2 Open Laterals

There are only two (2) open lateral sections in the RID water systems in the WVBA, as follows:

- running north to south along the eastern side of 43rd Avenue approximately 850 feet south of West Buckeye Road. This section is an open, concrete-lined canal approximately 400 feet long. This open section of lateral is readily accessible to the public and is approximately three (3) feet below the grade of the adjacent 43rd Avenue.
- running east to west from immediately west of well RID-103 on the west side of 19th Avenue and north of Lower Buckeye Road; conveying groundwater from wells RID-104 and RID-103. This section is an open, concrete-lined canal approximately 1,400 feet long. This section is enclosed in a chain-link fence to discourage public access.

An open section running north to south along 27th Avenue was enclosed by RID in October of 2009 to eliminate public access and prevent the lateral from being used as a “swimming hole”, known to be frequented by local residents.

2.4 MAIN CANAL

The RID Main Canal originates just to the west of the 23rd Avenue Wastewater Treatment Plant (WWTP) located at 23rd Avenue and Lower Buckeye Road, and flows west along the southern margin of the WVBA. The Main Canal at this point receives grade A+ effluent from the WWTP as well as groundwater from the lateral serving wells RID-104, RID-103 and RID-101. In addition to the effluent, the Main Canal receives contaminated groundwater from the aforementioned laterals as well as uncontaminated and contaminated groundwater directly from wells immediately adjacent to the canal. Flow rates for the contaminated wells, and estimated COC mass releases, will be provided in the Task 1 Final Report.

3.0 EXPOSURE ASSESSMENTS

The estimated, combined mass of COCs released from the normal RID extraction well field operations, as previously stated, is approximately 3,400 pounds per year (based on RID historical well operations (2009 data) and associated water quality data). While previous investigations have addressed some of the issues regarding potential public exposure to surface water in the WVBA, this Work Plan provides for a more comprehensive, screening-level assessment of the potential for public exposure to contaminated water and air through ingestion, inhalation and body contact.

Exposure assessments will be conducted during a period when the RID well field within the WVBA is in sustained and relatively steady-state operation in order to evaluate the worst-case exposure scenario. Public exposure pathways to be considered will include inhalation, full- and partial-body contact, fish consumption and direct consumption (drinking). Since soil contamination has not been identified in or adjacent to any RID operations in the WVBA and is essentially confined to source areas, exposure to contaminants in soils will not be evaluated in this Public Health Exposure Assessment.

This Public Health Exposure Assessment will evaluate potential exposures for contaminants from the following RID water system elements: wellhead discharge points, well site perimeter (fence-line), headspace in the Salt Canal and lateral pipelines, the surface of the Main Canal and open sections of laterals and canals. This sampling will be conducted to investigate both the magnitude of potential direct exposure to the public (concentration-based) as well as to provide insight into the mass transfer of contaminants from the water into the air (volatilization mass balance) and dilution (where applicable) as this contaminated groundwater is discharged and transported through the RID water system.

Air sampling will consist of collection of 1-hour composite air samples and subsequent analysis using the Environmental Protection Agency (EPA) Method TO-15. Air sampling and analytical methods are described in detail in Sections 4.1.1 and 4.2.1, respectively. Water sampling will consist of collection of grab samples and subsequent analysis using EPA Method 8260B. Water sampling and analytical methods are described in detail in Sections 4.1.2 and 4.2.2, respectively.

Concentration-Based Investigations

The exposure assessments conducted under this Work Plan are concentration-based investigations that will attempt to determine the potential exposure to each of these COCs to nearby residents and industrial workers through ingestion, inhalation and direct contact.

Mass Balance Investigations

The mass balance investigations conducted under this Work Plan are intended to determine the *"... quantity of COCs released to the air through volatilization at the point of well discharge..."* and *"... from the surface of the canal..."* (ADEQ, 2010), as well as from other impacted RID system elements. Comparison of water quality data will provide an overall mass balance, defining losses due to volatilization and effects of dilution, where applicable. However, air sampling data cannot be used directly for quantifying the overall system mass balance. This data will only be useful in assessing the relative proportion of contaminants being volatilized from each of these system elements.

Conceptual Model

Conceptual schematics of the selected RID water systems being sampled are provided in **Figures 2 and 3. Figure 2** depicts the RID system from well RID-92 through the interconnecting lateral to the Main Canal and **Figure 3** depicts the RID system from RID-114 through the Salt Canal to the Main Canal. These figures illustrate the sampling approach for evaluating both the potential exposure pathways being assessed as well as the mass balance investigations. A summary of the sampling being conducted under this Work Plan is provided in **Table 2** and is described in the following sections. In this conceptual model and the accompanying sections that follow, air samples will be denoted as (**A1**), signifying air sample number 1, and water samples will be similarly denoted with (**W1**) signifying water sample number 1.

3.1 IMPACTED RID WELL SITES

Pumping of the impacted RID wells presents several pathways for potential release of VOCs to the environment and, therefore, possible exposure to the public. These possible exposure pathways include the "points of discharge" from the wells and the surrounding well site "fence-lines". These impacted wells discharge directly into the open Main Canal or into receiver boxes where the water is conveyed to the Main Canal through gravity laterals or the Salt Canal as previously described.

The concentrations of the COCs found in the various wells within the WVBA are provided in **Table 1**. As shown, wells RID-92 and RID-114 are two of the highest concentration wells in terms of total COCs. These two wells, and their interconnecting conveyances, provide sufficient access for assessing both the worst-case potential for public exposure and the VOC mass balance, as described in the following sections and illustrated in **Figure 2**, RID-92 to the Main Canal, and **Figure 3**, RID-114 to the Main Canal.

3.1.1 Points of Discharge

Direct exposure of workers to the COCs is possible by coming into close proximity to the point of discharge from the well piping. This potential exposure could occur to workers entering the well site and performing short-duration maintenance of the well during well operation. To assess the potential exposure of these workers to the COCs in the WVBA, two (2) of the highest contaminant concentration wells will be sampled. To assess the potential exposure from the point of discharge, RID will sample as follows:

- Air sampling in the headspace of the concrete receiver boxes that channel the well discharge at RID-114 (**A1**) and RID-92 (**A2**);
- Air sampling in the breathing zone immediately adjacent to the concrete receiver boxes at RID-114 (**A3**) and RID-92 (**A4**); and,
- Water sampling from the well discharge piping at RID-114 (**W1**) and RID-92 (**W2**).
- Water sampling from the well discharge piping at the other extraction wells along the Salt Canal, RID-105 through RID-113, inclusive ((**W3**) through (**W11**), respectively), and at the remaining contaminated RID extraction wells in the WVBA (RID-84 (**W12**), RID-89 (**W13**), RID-95 (**W14**), RID-100 (**W15**), RID-102 (**W16**), and RID-104 (**W17**))

The air samples collected in the headspace of the receiver structures, (**A1**) and (**A2**), will be used to evaluate the mass balance of the system (i.e., how much mass of COCs are retained in the water, and how much are released to the air). Air samples collected within the breathing zone immediately above the top of these receiving structures, (**A3**) and (**A4**), will be used to assess the relative level of potential exposure to industrial workers to the COCs released to the air from the impacted RID wells during operation. The water samples (**W1**) and (**W2**) will be used to assess the potential exposure to industrial workers from incidental contact with the water discharged from the wells and to evaluate the mass balance of the system. Water samples (**W3**) through (**W17**) will be used to provide a more comprehensive characterization of the COC releases across the site by providing a snapshot of contaminant concentrations. These water samples may be collected in conjunction with ADEQ's regularly scheduled WVBA sampling event if scheduling permits.

3.1.2 Well Site Fence-Line

Exposure to the general public may occur by inhalation of VOCs in ambient air originating from the impacted RID well sites. The closest point of direct public access to the impacted RID well discharge is at the fenced margins of the impacted RID well sites. With the volatile nature of the contaminants, prevailing winds could transport volatilized contaminants from this potential point of discharge across the site boundaries, possibly within the breathing zone. This Work Plan will assess the potential for exposure to the public in the breathing zone adjacent to impacted RID wells.

Wells RID-114 and RID-92 will be evaluated to assess this potential for exposure to the released contaminants. Since local weather conditions will play an important role in this assessment, meteorological data will be collected during these assessments and a "virtual" fence-line will be observed for the purposes of assessing the worst-case exposure scenario. This virtual fence-line will extend around the point of discharge along the four (4) major axes of the actual fence-line at a distance equal to the shortest distance from the point of discharge to the actual fence-line. By sampling along this virtual fence-line, the worst-case exposure will be assessed with maximum consideration of, and accommodation for, the variable wind directions likely to be encountered during the sampling event. Meteorological data will be collected as described in Section 4.1.1.

In order to assess this potential exposure pathway, RID will sample as follows:

- Air sampling at four (4) locations along the virtual fence-line in the breathing zone at RID-114 (**A5**) through (**A8**) and at RID-92 (**A9**) through (**A12**); and,
- Air sampling at two (2) locations that are distant enough to represent background ambient air quality, (**A13**) and (**A14**). Background air sampling is discussed in detail in Section 3.5.

In the case of well RID-114, the discharge from the well also enters an open-topped "diversion box" approximately 30 feet west (down stream) of the fenced well site along the south side of Van Buren Street. This structure is open to the atmosphere and is located adjacent to the sidewalk on the south side of Van Buren Street. Consequently, this structure represents a potential public exposure pathway through inhalation. In order to assess this potential exposure pathway, RID will conduct additional sampling as follows:

- Air sampling in the headspace of the diversion box (**A15**) and in the breathing zone immediately adjacent to the concrete diversion box (**A16**).

3.2 SALT CANAL

Potential exposure to contaminated groundwater flowing through the Salt Canal will be assessed in both the enclosed sections of this "canal" (actually a pipeline through the majority of its length) and the remaining open sections of the Salt Canal, as described in the following sections.

3.2.1 Enclosed Canal

While the Salt Canal is actually an enclosed pipeline for the majority of its reach, it is a gravity-flow pipeline and, as such, has headspace and presents the opportunity for volatilized COCs to escape. This possibility for COCs to escape from the headspace represents a potential exposure pathway to the public. In order to assess this potential exposure pathway, RID will sample as follows:

- Air sampling in the headspace under one of the first manhole covers that provides reasonable exposure potential (i.e., has holes or grating in the manhole cover) downstream from RID-114 (**A17**);
- Air sampling in the headspace inside the Salt Canal pipeline where the pipeline becomes open canal (approximately 76th Avenue) (**A18**); and,
- Water sampling from the Salt Canal at the point of acquisition of the (**A17**) headspace sample (**W18**).

This air sampling data will be used to assess the potential for public exposure and the water data (**W18**) will be used in concert with the wellhead water quality data from RID-114 (**W1**) to evaluate the mass balance, and determine the overall losses to volatilization.

3.2.2 Open Canal

The last two (2) remaining sections of open Salt Canal represent potential exposure pathways including inhalation, partial- and full-body contact, fish consumption and ingestion (drinking). These open sections present possible exposure of the public through these pathways and will be assessed through sampling of the up-stream open section, located just west of 75th Avenue. Sampling at this point will consist of the following:

- Water sampling at the point of discharge from the enclosed pipeline to the open canal (**W19**); and,
- Air sampling above the surface of the water immediately downstream of the point of discharge from the enclosed pipeline to the open canal (**A19**).

3.3 OPEN LATERALS

While the majority of the open laterals in the WVBA have been converted to enclosed pipelines, an open lateral still exists east of the 23rd Avenue Wastewater Treatment Plant and another south of well RID-92, as described in Section 2.3.2. The lateral serving well RID-92 was the focus of ADEQ investigations in 2000, the results of which were provided in the report, "RID Canal Characterization Report, WVBA", dated February of 2001 (Terranext, 2001).

In that document, Terranext reported that TCE concentrations in water decreased from 72 micrograms per liter (μg/L) at the point of discharge from RID-92, to 56 μg/L at a distance of 200 feet downstream, which equates to a loss of approximately 22% of the total TCE mass. Similar results were shown for PCE with wellhead concentrations of 22 μg/L decreasing to 15 μg/L at a distance of 200 feet downstream, which equates to a loss of approximately 32% of the total PCE mass. No air sampling was conducted during this canal characterization. The only reasonable conclusion for these observed losses is that the VOCs volatilized from the water during discharge and conveyance (no additional water entering the lateral that could have caused decreases due to dilution).

While much of the lateral that was sampled in 2000 has been enclosed, one section of open lateral still exists today. This open section of lateral represents another potential exposure pathway to the local public. Therefore, in order to assess this potential exposure pathway, and to assist in constructing a mass balance for this element of the RID system, RID will conduct the following sampling:

- Air sampling in the headspace of the enclosed lateral pipeline where the pipeline transitions into open lateral, if the headspace is accessible (**A20**;
- Air sampling above the surface of the water in the open section of the RID-92 lateral (**A21**);
- Water sampling at the open lateral canal (**W20**); and,
- Water sampling at the point of discharge of the lateral into the RID Main Canal (**W21**).

3.4 MAIN CANAL

The Main Canal will be sampled to determine the concentration of COCs in both air and water. Water sample results are available from previous sampling events and this data will be included in this assessment. In order to assess the potential for exposure to COCs in the Main Canal, RID will sample as follows:

- Air sampling immediately above the surface of the water in the Main Canal approximately ten (10) feet downstream from the point of discharge of the lateral serving RID-92, above the inferred mixing zone (**A22**);
- Air sampling immediately above the surface of the water in the Main Canal at the point of discharge of the Salt Canal into the Main Canal (**A23**);
- Water sampling of the Main Canal approximately 500 feet downstream of the point of discharge of the Salt Canal (**W7**); and,
- Air sampling at the same place as above (**A20**).

As stated, this Work Plan will incorporate water quality data collected in previous investigations, building on the analytical results from the June 2010 and April 2011 ADEQ canal sampling events. These data will be added to the new data set and considered during analysis of results and development of detailed design specifications for implementation of the proposed mitigation measures.

3.5 BACKGROUND AIR SAMPLING LOCATIONS

Determination of background levels of COCs will be accomplished by selecting a minimum of two locations away from known sources but within the general vicinity of the primary sampling locations. Known sources include extraction well sites, open sections of the Salt Canal and laterals, and the Main Canal. Unknown sources may also exist. Selecting background locations that are away from current industrial and commercial activity will minimize the impact due to potential sources. Areas such as undeveloped or agricultural land, schools, or parks will be considered. Number of samples and specific locations will be determined in cooperation with ADEQ technical staff prior to initiation of sampling.

4.0 SAMPLING AND ANALYSIS

This section provides a Sampling and Analysis Plan (SAP) that describes methods and procedures to collect and analyze air and groundwater samples in conjunction with this Public Health Exposure Assessment and Mitigation Work Plan. This section provides additional guidance to the existing Field Sampling and Analysis Plan (FSAP) for the WVBA (BE&K/Terranext, 2000a)

A site-specific Quality Assurance Project Plan (QAPP) (BE&K/Terranext, 2000b) has been prepared and will be complied with; however, this SAP provides additional details specific to the planned air and water sampling described in this Work Plan.

4.1 SAMPLING METHODS

The following sections provide details regarding the sampling methods that will be utilized for the air and water sampling described in this Work Plan. Sampling will be conducted consistent with the provisions of the site-specific Health and Safety Plan (HASP) (RID, 2011).

4.1.1 Air Sampling

Air sampling will be conducted in accordance with standard practices to the maximum extent possible using sampling equipment, procedures and meteorological data collection as described in the following sections.

Sampling Equipment

Laboratory analysis of VOCs in air requires a relatively large sample volume to achieve low-level detection levels. Consequently, a 6-liter stainless steel Summa® canister (or equivalent) will be used for field collection of air samples for VOC analyses. Summa® canisters are stainless steel vessels which have had the internal surfaces specially passivated to produce a chemically inert interior.

The canisters are pre-cleaned, evacuated, and equipped with a pre-calibrated flow intake regulator and vacuum gauge. The flow intake regulator will be calibrated to allow a constant fill rate of the 6-liter Summa® canisters over the 1-hour sample period. All sampling equipment will be provided by the analytical laboratory conducting VOC analyses, and will include certification of cleaning and calibration.

Sampling Procedure

The following are step-by-step sampling procedures for collection of air quality data.

1. Unpack the Summa® canisters from the transport packaging. Verify that all equipment components are present and the canister valve is closed. Each canister will be provided with a high-purity flow controller, integrated particulate filter, and vacuum gauge. These elements constitute a single individual sample train, certified by the analytical lab. Each of the individual sampling trains will be maintained as delivered, with no switching or replacement of any of the elements.

2. Mark each canister with a discrete sample number. The sample number, the Summa® canister serial number, and the flow controller serial number will be indicated on the chain-of-custody record. Affix a tag directly to the sample container. Write information on the tag providing sample identification in indelible, waterproof ink.

3. Place the canisters at the sample locations described in this Work Plan. For fence-line locations, canisters will be placed at approximate breathing zone elevation (i.e., 4 to 6 feet above ground surface).

4. When ready to initiate sampling, connect the flow controller, particulate filter and vacuum gauge equipment to the canister, and confirm that the canister valve is closed. The flow controllers are specifically designed for collecting 1-hour samples.

5. Open the canister valve and record the sampling start time. The vacuum gauge will register the level of vacuum present. Record this value on the tag of the Summa® canister, in the field log book and on the chain-of-custody record. The

initial vacuum of the canister should be greater than 25 inches of mercury. If the canister vacuum is less than 25 inches of mercury, do not use and replace with backup canister.

6. Check the vacuum gauge reading of the canisters frequently during the 1-hour sampling period to ensure the flow control regulators are working properly. Record gauge readings and note any anomalous conditions. If any canister drops to 2 inches of mercury prior to the end of the 1-hour sampling period, record the final canister pressure, the time and the ambient temperature, and then close the valve.

7. At the end of the 1-hour sampling period, record the final canister pressure, the time and ambient temperature, and then close the valve.

8. The final pressure of a 6-L canister should range between 2 and 5 inches of mercury once the canister is full and has equilibrated to ambient temperature. Any canister having a final pressure greater than 5 inches of mercury will require pressurization by the lab, resulting in sample dilution and elevated reporting limits. Any canister that was closed prior to completion of the 1-hour sampling period (at 2 inches of mercury) will still provide valid data but will be flagged to indicate that the data do not represent a 1-hour sample.

9. Confirm that the valve is closed and then remove the sample train.

10. Repackage the sampling equipment. Complete and maintain the chain-of-custody record and ensure that Summa® canisters are properly labeled. Verify that the sample number, canister serial number and flow controller serial number are properly documented on the canister tag, chain-of-custody record and the field log book.

11. Return the canisters to the laboratory (via hand delivery) with the signed chain-of-custody record as specified in Section 4.2.4.

Meteorological Data Collection

In order to adjust for unpredictability in wind direction during the sample collection time frame, air samples will be collected in the four cardinal wind directions at each well site while concurrently monitoring actual onsite wind direction. A Davis Instrument, Vantage Pro2 portable weather station, (or similar), will be used to collect local meteorological data including wind speed and wind direction. These meteorological data will be recorded on a data logger at a maximum of 2-minute intervals during the 1-hour air sample collection period. The portable weather station will be set up in an open area at each well site to obtain meteorological data at the approximate breathing zone elevation.

4.1.2 Water Sampling

To the extent possible, water quality samples will be collected and analyzed following protocols developed by ADEQ in the WVBA FSAP (BE&K/Terranext, 2000a).

Sampling Equipment & Procedure

Prior to sampling, RID will confirm that each production well has been operating for a minimum of 48 hours. Each well will be purged using the dedicated sample port located on the discharge piping within the well site enclosure. Electrical conductivity (EC), pH and temperature of the purged groundwater will be measured utilizing a Hanna Probe meter (or equivalent). Field measurements will be recorded on field data sheets (see **Appendix A**) and will continue until stabilization is observed. Stabilization will be defined as that point at which the EC and temperature of two consecutive measurements are within 10 percent and pH values are within 0.2 standard units. Once stabilization is observed, a sample will be collected. All purge water will be collected in a five (5) gallon bucket (or additional, if necessary), and will be disposed at the receiver/collection box at each well site.

Water quality samples will be collected in sets of three (3) 40-milliliter volatile organic analysis (VOA) vials preserved with 1:1 hydrochloric acid (HCl). Samples will be collected with zero headspace. Each VOA vial will be tilted to approximately 45 degrees of vertical, and filled using a flow rate of approximately 1,000 milliliters per minute of sample. The vial will be filled to the brim and then, using the cap, a small amount of water shall be added until a meniscus is formed. The vial will then be capped, turned upside down, and tapped to verify no headspace. Small air bubbles will be accepted, however, if an air bubble (or accumulation of air bubbles) larger than pea size is observed, the sample will be discarded and the location re-sampled. Samples will be stored in a cooler with wet ice at 4° Celsius (C), ± 2°C, and hand delivered to the analytical laboratory.

4.2 ANALYTICAL METHODS AND PROCEDURES

Air and water samples will be analyzed following protocols developed by ADEQ in the WVBA FSAP, to the extent possible. These protocols include quality control provisions and sample documentation and management practices as described in the following sections.

4.2.1 Air Sample Analyses

Ambient air samples will be submitted to Airtech Environmental Laboratories (Airtech) in Phoenix, Arizona and analyzed for TCE, PCE and 1,1-DCE following EPA Method TO-15 by selective ion monitoring (SIM). Using EPA Method TO-15 SIM, Airtech offers low-level detection capabilities for air testing of VOCs. Should sample concentrations exceed the maximum calibration curve for the SIM method, standard TO-15 will be performed and noted on the analytical report. Airtech is certified by ADHS under license number AZ0740. Airtech's quality assurance (QA) manual will be provided under separate cover.

The method reporting limit (MRL) for TCE cited by Airtech is 0.04 parts per billion by volume (ppbv) or approximately 0.21 micrograms per cubic meter ($\mu g/m^3$). The MRL, also referred to as the practical quantitation level (PQL), is the minimum amount of an analyte that can be quantitatively measured with a specified degree of confidence, within the accuracy and precision guidelines of specified analytical procedures. The TCE reporting limit cited does not take into account any sample dilution that may be required to pressurize the sample canister or dilution that may be necessary due to matrix interference.

Data quality control practices will be in accordance with the Airtech standard operating procedure for analysis of VOCs by EPA Method TO-15 SIM. Standard quality control requires analysis of a laboratory control standard (LCS), LCS duplicate, internal standard, and surrogate analytes with each sample set. The TO-15 SIM method requires analytical accuracy to fall within a range of 60 to 140 percent recovery for internal standards and 70 to 130 percent for surrogates. Laboratory duplicates must be less than or equal to 25 relative percent difference (RPD). Data quality control outside of these limits will be re-run, if possible, or flagged to qualify the reporting results.

4.2.2 Water Sample Analyses

Water samples will be analyzed for VOCs following EPA Method 8260B and submitted to TestAmerica, Inc. (TestAmerica) of Phoenix, Arizona, an ADHS-approved analytical laboratory. The laboratory MRLs for the primary contaminants (i.e., TCE, PCE and 1,1-DCE) is 0.50 micrograms per liter ($\mu g/L$), respectively. TestAmerica is an environmental testing laboratory certified by ADHS under license number AZ0728. Their QA manual will be provided under separate cover.

Data quality control practices will be in accordance with the TestAmerica standard operating procedure for analysis of VOCs by EPA Method 8260B. Standard quality control requires analysis of a LCS, LCS duplicate, internal standard, and surrogate analytes with each sample set. The 8260B method requires analytical accuracy to fall within a series of ranges of percent recoveries for internal standards and surrogates (available in QA manual). Laboratory duplicates must be less than or equal to 25 RPD. Data quality control outside of these limits will be re-run if possible, or appropriately flagged with the reporting results.

4.2.3 Quality Control

Quality control (QC) measures will be employed to evaluate both the field sampling procedures and techniques as well as the laboratory procedures and performance of instrumentation.

Field QC samples (including trip blanks and field duplicates) will be collected to help evaluate conditions resulting from field conditions and activities. Field QC samples may be used to evaluate variability in environmental sampling and analysis of organic contaminants.

Field Duplicate Samples

Field duplicate samples will be collected simultaneously and as close as possible (i.e., proximity) to a primary sample under identical conditions. The duplicate sample will be treated independently of its counterpart in order to assess field sampling procedures and laboratory precision and accuracy, through comparison of the results, and collected at frequency of 10 percent of the primary samples, with minimum of one per day of sampling. Duplicate samples will be preserved, packaged, and sealed in the same manner as the primary samples. A separate sample number and identification will be assigned to the duplicate, and it will be submitted blind to the laboratory. Identity of the duplicate sample will be recorded in the field log book.

Field duplicate samples will be collected for both air and water samples.

Trip Blank Samples

Trip blank samples are used to determine if VOC water samples have been contaminated during transport from the field to the lab. The trip blanks are prepared by the laboratory by filling a VOA vial head-space free with organic free water, preserved with 1:1 HCl, labeled as "TB" with the preparation date included on the custody seal. Trip blanks will be included in each cooler used to transport water samples to the laboratory. The results of the trip blanks are a key aspect of overall quality control system for the sampling program, and will be included in the analytical results report.

Laboratory Quality Control Samples

The laboratory analyzes certified standards including matrix spike samples and duplicates to demonstrate accuracy on a daily basis. Since samples to be used as matrix spikes are randomly selected by the laboratory analyst after receipt of samples, it is understood that such analyses may or may not include samples from any given sampling event or location.

Laboratory procedures will be evaluated using field duplicate samples, matrix spikes and other internal procedures defined by the analytical method and analytical laboratory.

4.2.4 Sample Documentation and Management

Documentation of Sample Collection

Comprehensive notes will be taken to document conditions and details of the sampling event. Detailed notes will be written in a project field logbook or on preprinted project log forms / field data sheets. Note keeping will be sufficiently complete and accurate to provide a factual and objective reconstruction of all pertinent field activities. Field logbooks or project log forms will be on consecutively numbered pages signed by the individual making the entries. At a minimum, the following information will be recorded during the collection of each air sample:

- Sample location, description, and GPS measurement of location
- Site or sampling area sketch showing sample location and measured distances
- Sampler's name(s) and affiliation
- Date and time of sample collection
- Duration of sample collection
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, operation of vacuum gauge and flow controllers, etc.)
- Serial numbers of the sample containers and flow control regulators

Each water sample will include documentation of the sample location, date and time of sample collection, and the sample identification.

All documentation will be made in indelible ink. Corrections made to any document will be made by drawing a line through the error and entering the correct information. Both the error and the correct information must be readable. The person making the correction will initial the document where changes are made.

Sample Custody

Chain-of-custody records are completed for groups of samples collected each day. The chain-of-custody record will be completed as samples are collected. Example chain-of-custody records for Airtech and TestAmerica are provided as **Appendix B** and will accompany the samples to the laboratory. Information to be entered on each chain-of-custody record includes:

- project name
- project manager/contact person
- sampler's(s') name(s) and signature(s)
- date and time of collection
- sample matrix identification
- number of containers collected for each sample
- sample identification number, as well as canister serial number and corresponding flow controller serial number for air samples
- initial and final canister pressure (air samples only)
- analyses requested
- turn-around-time requested
- dates of possession
- name and signature of person relinquishing samples
- date of sample receipt
- time of sample receipt
- name and signature of person receiving the samples
- remarks pertinent to sample collection, preparation, preservation, and analyses

Sample Containers, Preservative, Storage and Shipment

<u>Air Samples</u>

Air samples will be collected in pre-cleaned 6-liter Summa® (or equivalent) canisters. The canisters are provided by the laboratory and should be received immediately prior to the field sampling program. Each canister will be provided as a 100% certified sampling train, including the flow controller, particulate filter and canister. Each individual sampling train will be maintained as delivered and no elements will be switched or replaced. A Summa® canister will hold a high vacuum for up to 30 days but after this period, low level concentrations of typical VOCs may be present and ambient air data for a canister may be suspect. Consequently, all canisters should be used within 15 days of cleaning to ensure they are free of VOCs prior to use.

There are no special storage or handling requirements for air sample canisters. The canisters will not be cooled or placed on ice since that may cause condensation of water vapor. The canisters will be hand delivered to Airtech in the original packaging on the same day that samples are collected.

The hold time for samples collected in inert canisters is analyte specific. The analytical method states that many VOCs are stable when stored in a canister for up to 30 days. However, due to the expected low level of VOCs for this project, arrangements will be made with the analytical laboratory to analyze samples and report the results within ten (10) business days following receipt of samples.

Water Samples

Water samples will be submitted as soon as possible (i.e., on the date of sampling or the following morning at the latest) to TestAmerica with requested turnaround time of five (5) business days and VOC analyses following EPA Method 8260B, which has a hold time of 14 days.

5.0 DATA INTERPRETATION

The air and water quality data obtained will to be used to provide a screening-level assessment, not to calculate a numerical risk value but whether any guidelines or standards are being exceeded and whether these results suggest that an imminent risk to public health or the environment exists. Air and water sampling results will be managed, evaluated and interpreted as described in the following sections.

5.1 AIR SAMPLING RESULTS

The evaluation of potential exposure to COCs in the air will be based on comparison to the AAAQGs, developed by the ADHS (ADHS, 1999), and the Regional Screening Levels (RSLs) for residential and industrial air, developed by EPA Region 9 (EPA, 2010). AAAQGs and RSLs are provided in Table 3.

AAAQGs provide both 1-hour and 24-hour numerical guidelines. These guidelines use occupational exposure limits established or recommended by the United States Occupational Safety and Health Administration (OSHA), the National Institute of Occupational Safety and Health (NIOSH), and the National Institute for Environmental Health Sciences (NIEHS). Therefore, these guidelines are considered appropriate for use in determining relative exposure potential to the general public as well as industrial workers. Annual AAAQGs use cancer slope factors published by the EPA at the time the AAAQGs were established.

The AAAQGs were prepared for the ADEQ Air Programs Division by the ADHS. As stated in the introduction to these guidelines, "*AAAQGs are residential screening values that are protective of human health, including children. Chemical* *concentrations in air that exceed AAAQGs may not necessarily represent a health risk. Rather, when contaminant concentrations exceed these guidelines, further evaluation may be necessary to determine whether there is a true threat to human health.*"

The RSLs were developed by EPA to provide a risk-based methodology to assist those involved in decision-making at hazardous waste sites in determining whether levels of contamination found at the site warrant further investigation and/or risk assessment. RSLs are based on default exposure parameters and factors that represent "reasonable maximum exposure" conditions for long-term/chronic exposures and are based on the methods outlined in EPA's Risk Assessment Guidance for Superfund, Part B Manual (EPA, 1991).

Consistent with the AAAQG and the RSL methodology, should any COC be determined to exceed these guidelines/limits, further evaluation may be warranted. Based on these results, ADEQ will determine whether additional investigation is warranted or whether implementation of planned mitigation measures will adequately address potential exposure concerns.

5.2 WATER SAMPLING RESULTS

Water sampling results will be compared to the Arizona SWQS (A.A.C. R18-11-109) and Arizona AWQS (A.A.C. R18-11-406). SWQS are provided for the applicable designated uses, as follows:

Full Body Contact/Partial Body Contact: These standards will address the concerns regarding potential exposure due to swimming and/or bathing in the impacted water.

Fish Consumption: These standards will address concerns regarding potential exposure due to consuming fish caught in the RID Main Canal.

Drinking Water: These standards will address concerns regarding potential exposure due to consuming water from the Main Canal, the Salt Canal and open laterals.

Water samples from extraction wells will also be compared to AWQS to assess compliance with standards for aquifer quality.

The SWQS and AWQS numerical limits are provided in **Table 3**.

6.0 MITIGATION MEASURES

The RID plans to implement mitigation measures for the ADEQ-approved Early Response Action Work Plan (RID, 2010), including engineering controls to remove VOCs from contaminated groundwater that is pumped and conveyed by RID. RID is taking these actions, such as providing treatment by granular activated carbon for the most highly contaminated wells, to restore the RID wells and water supply for unrestricted use and maximize mass removal of contaminants.

Additional mitigation measures have also been proposed for controlling discharges into the air at a number of points in the impacted RID water system. The need for implementation of these additional mitigation measures will be evaluated based on the results of air quality sampling as described in this Work Plan.

The results of the analytical testing conducted under this Work Plan and the data interpretation previously described will be used to assist in guiding the detailed design and implementation of engineering measures to optimally control the volatilization of these contaminants and minimize potential public exposure.

7.0 FINAL REPORT

This assessment will compile and analyze data and provide specific information to address the following objectives:

- Document existing impacts and routes of public exposure from releases of VOCs in contaminated groundwater impacting RID well operations, water conveyance, and uses; and,
- Evaluate how proposed operational and engineering controls of the ERA will mitigate the exposure to VOCs and protect public health and welfare.

The information generated through this Work Plan will be organized into a Final Report following the outline provided as **Appendix C**. Further definition of the information that will be compiled, analyzed, and included in this assessment is given through annotation of the Final Report outline as follows.

In addition to an **Introduction** section that will specifically define the purpose and objectives of this assessment, the summary report will include a **Background** discussion organized into the following subsections:

> **Site Location and Physical Characteristics** – This section will include a description of the WVBA Site and review of relevant physiographic, demographic, geographic, and hydrogeologic conditions of the Site and surrounding region. This overview will include a summary of the type and distribution of major land and water uses within the WVBA.

History of Contamination – This section will provide a summary of sampling and tabulated results of water quality analyses of RID extraction wells and graphical depiction of contaminant trends over time. The summary will include the recent sampling and analyses of RID extraction wells and canals that occurred in June 2010 and April 2011.

Contaminants of Concern – This section will identify the known chemical contaminants that have been detected in RID extraction wells and WVBA groundwater monitoring wells, and notable chemical and physical properties of the identified COCs. In addition, this section will discuss environmental standards, requirements, criteria, and limitations that may be applicable or relevant and appropriate requirements related to public exposure routes for the COCs and planned groundwater response action.

The next section of the Final Report will feature an **Exposure Assessment Based on Existing Conditions** to document the potential public exposure to hazardous substances associated with VOC releases from current RID well operations, water conveyance, and groundwater use in the WVBA Site. This segment will be organized into the following subsections:

Overview of RID Water Operations – This section will provide a summary of RID water operations in the WVBA to document sources of water supply, well construction, registered pumping capacity, historical and current groundwater pumping, locations of open conveyance canals and buried water distribution pipelines, and an overview of the RID water distribution system and well operations. The summary will include records of historical pumping of all RID wells to illustrate well use and groundwater pumping requirements to meet seasonal water demands.

Contamination Impact on RID Water System – This section will present an estimate of the annual volume of contaminated groundwater pumped from RID extraction wells in the WVBA and the annual VOC mass that is discharged from the contaminated wells into the water distribution system. These estimates will be based on the most recent (e.g. 2008 through 2010) reported RID groundwater pumping data and reported VOC concentrations in the RID extraction wells.

Routes of Exposure – This section will identify pathways that may lead to public exposure to COCs by ingestion, skin contact, and inhalation associated with current RID well operations, water conveyance, and groundwater use in the WVBA Site.

Following this assessment of existing public health exposure, the Final Report will analyze the **Exposure Mitigation Provided by the Planned RID Early Response Action.** This segment will be organized into the following subsections:

Key Elements of Planned Early Response Action – This section will provide an overview and rationale of RID's planned ERA, including proposed well modifications, wellhead volatilization controls, water conveyance improvements, new pipelines, and a new centralized groundwater treatment facility. A discussion of how these modifications and additional facilities will limit exposure to VOCs in the contaminated groundwater supply will be included.

Groundwater Treatment Engineering Controls – This section will describe how the planned ERA will remove and eliminate VOCs through design, construction, and operation of a centralized groundwater treatment facility. This analysis will include an estimate of the annual volume of contaminated groundwater that will be pumped and the total VOC mass that will be captured and treated by implementation of the ERA.

RID Water Distribution System Engineering Controls – This section will document engineering controls that will be integrated into the well and water distribution system to reduce exposure to VOCs. This assessment will clarify how specific engineering controls will: 1) reduce point source discharges of VOCs to the atmosphere; 2) restrict non-point sources of VOC releases to the environment; and 3) limit exposure resulting from unauthorized public access to the RID canals for bathing, swimming, and drinking.

RID Water System Operational Controls – This section will explain the anticipated operational approach for RID water supply management and well use that will be instituted with the ERA. A summary of RID guidelines for prioritizing well use will be provided. These guidelines will specify how RID will operate their well field to meet seasonal water demands, prioritize pumping to maximize groundwater withdrawals from wells tied into the ERA, and limit pumping of peripheral wells in order to improve hydraulic containment of the contaminant plume and enhance VOC mass removal.

The Final Report will provide **Summary and Conclusions** that will quantify and compare the mass of VOCs that are released into the environment from current RID well operations in the WVBA and that which would occur upon implementation of the ERA to demonstrate how the planned ERA will reduce VOC releases to the environment to mitigate the associated public health exposure.

8.0 SCHEDULE

The following tentative schedule is provided for planning purposes. Acceleration of this schedule will be pursued in order to obtain information at the earliest opportunity to address concerns regarding potential public health exposure and to respond with appropriate mitigation actions.

Work Plan Submittal - June 1, 2011

ADEQ Review and Comment - June 16, 2011

Modification and re-submittal of Work Plan - June 17, 2011

Conduct Sampling Program - June 27 through 29, 2011

Laboratory Analyses - 2 weeks - July 13, 2011

Data Analysis and Informal Reporting (if warranted) - July 22, 2011

Final Report Submittal - within 60 days of receipt of data - September 14, 2011

Mitigation Measures Implementation - to be scheduled depending on nature, extent and approval of recommended measures.

9.0 REFERENCES CITED

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Synergy Environmental, LLC

TABLES

SYNERGY ENVIRONMENTAL, LLC

Table 1

COC Concentrations in RID Wells in the WVBA

RID Well Number	1,1-DCE	TCE	PCE	Month/Year of Sample
84	0.76	1.2	**8.8**	Jun-10
89	2.7	**32**	**8.7**	Jun-10
92	4.4	**84**	17	Jun-10
94	0.85	ND	0.69	Jun-10
95	**8.2**	**47**	4.9	Jun-10
99	1.4	ND	**7**	Jun-10
100	**9.3**	**34**	**7.8**	Sep-08
101	2	ND	ND	Sep-08
102	ND	0.72	**17**	Jun-10
103	1.4	ND	ND	Jun-10
104	0.76	0.79	**6**	Jun-10
105	0.66	0.57	3.4	Jun-10
106	5.7	**10**	**27**	Jun-10
107	3.6	**9.5**	10	Jun-10
108	0.71	1.7	**6.7**	Apr-11
109	3	**6.5**	**6.9**	Jun-10
110	ND	1.9	**7.9**	Jun-10
111	NIS	NIS	NIS	Jun-10
112	0.76	**17**	4.5	Jun-10
113	ND	**18**	4.2	Mar-08
114	4.0	**66**	3.6	Apr-11

(all values in μg/L)

AWQS Aquifer Water Quality Standards
MCL Maximum Contaminant Level
ND Non-Detect
NIS Not In Service
μg/L Microgram per liter

values in **BOLD** exceed the MCL and AWQS

Synergy Environmental, LLC

Table 2

Summary of Sampling To Be Conducted

WATER SAMPLES

Sample ID	Sample Location	Purpose	Assessment Criteria	Target Information
W1	Well Discharge @ RID-114	Mass Balance and Site Characterization	AWQS	Quantify Losses Due To Volatilization
W2	Well Discharge @ RID-92	Mass Balance and Site Characterization	AWQS	Quantify Losses Due To Volatilization
W3	Well Discharge @ RID-105	Site Characterization	AWQS	Assess Trend in COC Concentrations
W4	Well Discharge @ RID-106	Site Characterization	AWQS	Assess Trend in COC Concentrations
W5	Well Discharge @ RID-107	Site Characterization	AWQS	Assess Trend in COC Concentrations
W6	Well Discharge @ RID-108	Site Characterization	AWQS	Assess Trend in COC Concentrations
W7	Well Discharge @ RID-109	Site Characterization	AWQS	Assess Trend in COC Concentrations
W8	Well Discharge @ RID-110	Site Characterization	AWQS	Assess Trend in COC Concentrations
W9	Well Discharge @ RID-111	Site Characterization	AWQS	Assess Trend in COC Concentrations
W10	Well Discharge @ RID-112	Site Characterization	AWQS	Assess Trend in COC Concentrations
W11	Well Discharge @ RID-113	Site Characterization	AWQS	Assess Trend in COC Concentrations
W12	Well Discharge @ RID-84	Site Characterization	AWQS	Assess Trend in COC Concentrations
W13	Well Discharge @ RID-89	Site Characterization	AWQS	Assess Trend in COC Concentrations
W14	Well Discharge @ RID-95	Site Characterization	AWQS	Assess Trend in COC Concentrations
W15	Well Discharge @ RID-100	Site Characterization	AWQS	Assess Trend in COC Concentrations
W16	Well Discharge @ RID-102	Site Characterization	AWQS	Assess Trend in COC Concentrations
W17	Well Discharge @ RID-104	Site Characterization	AWQS	Assess Trend in COC Concentrations
W18	Salt Canal In Manhole (same as [A17])	Mass Balance	N/A	Quantify Losses Due To Volatilization
W19	Open Section Of Salt Canal	Exposure Assessment	SWQS/RSL	Public Health (DW/PBC/FBC/FC Limits)
W20	Open Section of RID-92 Lateral	Exposure Assessment	SWQS/RSL	Public Health (DW/PBC/FBC Limits)
W21	RID-92 Lateral Discharge Into Main Canal	Mass Balance and Exposure Assessment	SWQS/RSL	Quantify Losses Due To Volatilization Public Health (DW/PBC/FBC Limits)
W22	Main Canal Approx. 500 Ft. Downstream of Salt Canal Discharge Point	Exposure Assessment	SWQS/RSL	Public Health (DW/PBC/FBC/FC Limits)

AAAQG	Arizona Ambient Air Quality Guidelines (Arizona Department of Health Services, 1999 Update)
AWQS	Aquifer Water Quality Standards (Arizona Revised Statutes 49-223)
RSL	Regional Screening Levels (EPA Region 9, updated November 2010)
SWQS	Surface Water Quality Standards (Arizona Administrative Code R18-11-109 and Appendix A)

SYNERGY ENVIRONMENTAL, LLC

Table 2 (CONT.)

Summary of Sampling To Be Conducted

AIR SAMPLES

Sample ID	Sample Location	Purpose	Assessment Criteria	Target Information
A1	Headspace @ RID-114 Receiver Box	Mass Balance	N/A	Quantify Losses Due To Volatilization
A2	Headspace @ RID-92 Receiver Box	Mass Balance	N/A	Quantify Losses Due To Volatilization
A3	Breathing Zone @ RID-114 Receiver Box	Exposure Assessment	AAAQG/RSL	Industrial Worker
A4	Breathing Zone @ RID-92 Receiver Box	Exposure Assessment	AAAQG/RSL	Industrial Worker
A5	Breathing Zone @ RID-114 Fence Line	Exposure Assessment	AAAQG/RSL	Public Health
A6			AAAQG/RSL	
A7			AAAQG/RSL	
A8			AAAQG/RSL	
A9	Breathing Zone @ RID-92 Fence Line	Exposure Assessment	AAAQG/RSL	Public Health
A10			AAAQG/RSL	
A11			AAAQG/RSL	
A12			AAAQG/RSL	
A13	Background Sample Locations	Exposure Assessment	AAAQG/RSL	Public Health / Control Samples
A14			AAAQG/RSL	
A15	Headspace In RID-114 Diversion Box	Mass Balance	N/A	Quantify Losses Due To Volatilization
A16	Breathing Zone @ RID-114 Diversion Box	Exposure Assessment	AAAQG/RSL	Public Health/Industrial Worker
A17	Headspace In Salt Canal Manhole	Mass Balance	N/A	Quantify Losses Due To Volatilization
A18	Headspace In Salt Canal Pipe @ Opening	Mass Balance	N/A	Quantify Losses Due To Volatilization
A19	Surface of Salt Canal @ Open Section	Exposure Assessment	AAAQG/RSL	Public Health
A20	Headspace In RID-92 Lateral @ Opening	Mass Balance	N/A	Quantify Losses Due To Volatilization
A21	Surface of RID-92 Lateral @ Open Section	Exposure Assessment	AAAQG/RSL	Public Health
A22	Surface of Main Canal @ RID-92 Discharge	Exposure Assessment	AAAQG/RSL	Public Health
A23	Surface of Main Canal @ Salt Canal Discharge	Exposure Assessment	AAAQG/RSL	Public Health

AAAQG	Arizona Ambient Air Quality Guidelines (Arizona Department of Health Services, 1999 Update)
AWQS	Aquifer Water Quality Standards (Arizona Revised Statutes 49-223)
RSL	Regional Screening Levels (EPA Region 9, updated November 2010)
SWQS	Surface Water Quality Standards (Arizona Administrative Code R18-11-109 and Appendix A)

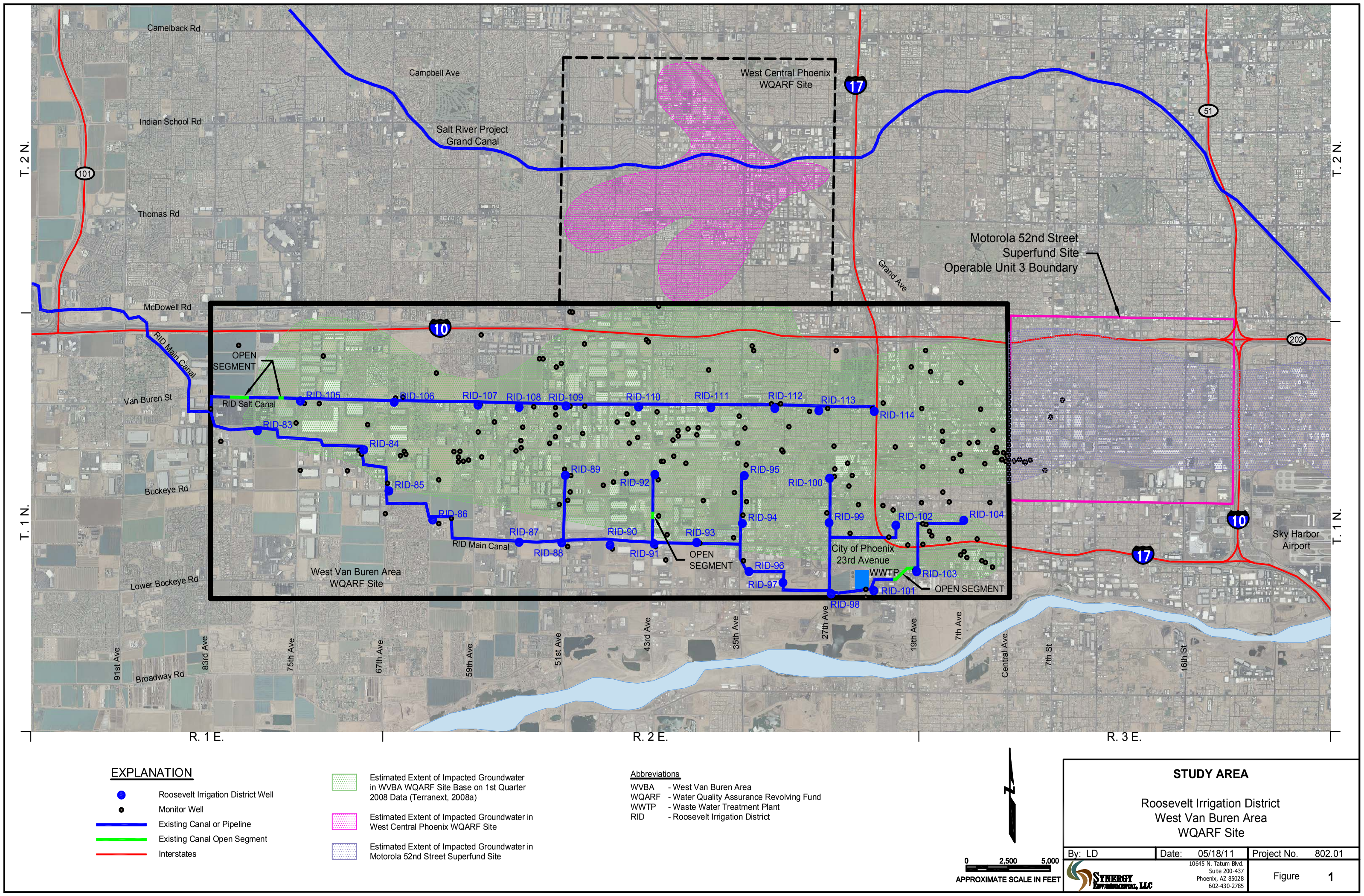
TABLE 3

Screening Level Standards and Guidelines

COC	AIR (all values in μg/m³)					WATER (all values in μg/L)					
	AAAQGs			RSLs		SWQS				AWQS	RSLs
	1-hr.	24-hr.	Annual	Residential	Industrial	PBC	FBC	FC	DW	MCL	Tap Water
1,1-DCE	130	63	---	2.1	8.8	46,667	46,667	7,143	7	7	340
TCE	810	210	0.58	1.2	6.1	280	280,000	29	5	5	2.0
PCE	1,300	640	1.7	0.41	2.1	9,333	9,333	261	5	5	0.11

AAAQG s Arizona Ambient Air Quality Standards
AWQS Aquifer Water Quality Standards
1,1-DCE 1,1-dichloroethylene, CAS number 75-35-4
MCL Maximum Contaminant Level
PCE Perchloroethylene, synonym: tetrachloroethylene, CAS number 127-18-4
TCE Trichloroethylene, CAS number 79-01-6
RSLs Regional Screening Levels
SWQS Surface Water Quality Standards
μg/L Microgram per liter
μg/m³ Microgram per cubic meter

FIGURES



Camelback Rd
Indian School Rd
Thomas Rd
McDowell Rd
Van Buren St
Buckeye Rd
Lower Buckeye Rd
Broadway Rd
Campbell Ave
Salt River Project Grand Canal
West Central Phoenix WQARF Site
Motorola 52nd Street Superfund Site Operable Unit 3 Boundary
Grand Ave
RID Main Canal
RID Salt Canal
OPEN SEGMENT
RID-83
RID-84
RID-85
RID-86
RID-87
RID-88
RID-89
RID-90
RID-91
RID-92
RID-93
RID-94
RID-95
RID-96
RID-97
RID-98
RID-99
RID-100
RID-101
RID-102
RID-103
RID-104
RID-105
RID-106
RID-107
RID-108
RID-109
RID-110
RID-111
RID-112
RID-113
RID-114
West Van Buren Area WQARF Site
City of Phoenix 23rd Avenue WWTP
Sky Harbor Airport
91st Ave
83rd Ave
75th Ave
67th Ave
59th Ave
51st Ave
43rd Ave
35th Ave
27th Ave
19th Ave
7th Ave
Central Ave
7th St
16th St
T. 2 N.
T. 1 N.
R. 1 E.
R. 2 E.
R. 3 E.
EXPLANATION
Roosevelt Irrigation District Well
Monitor Well
Existing Canal or Pipeline
Existing Canal Open Segment
Interstates
Estimated Extent of Impacted Groundwater in WVBA WQARF Site Base on 1st Quarter 2008 Data (Terranext, 2008a)
Estimated Extent of Impacted Groundwater in West Central Phoenix WQARF Site
Estimated Extent of Impacted Groundwater in Motorola 52nd Street Superfund Site
Abbreviations
WVBA - West Van Buren Area
WQARF - Water Quality Assurance Revolving Fund
WWTP - Waste Water Treatment Plant
RID - Roosevelt Irrigation District
0 2,500 5,000
APPROXIMATE SCALE IN FEET
STUDY AREA
Roosevelt Irrigation District
West Van Buren Area
WQARF Site
By: LD
Date: 05/18/11
Project No. 802.01
10645 N. Tatum Blvd. Suite 200-437 Phoenix, AZ 85028 602-430-2785
Figure 1

FIGURE 2
Schematic of RID-92 to Lateral to Main Canal

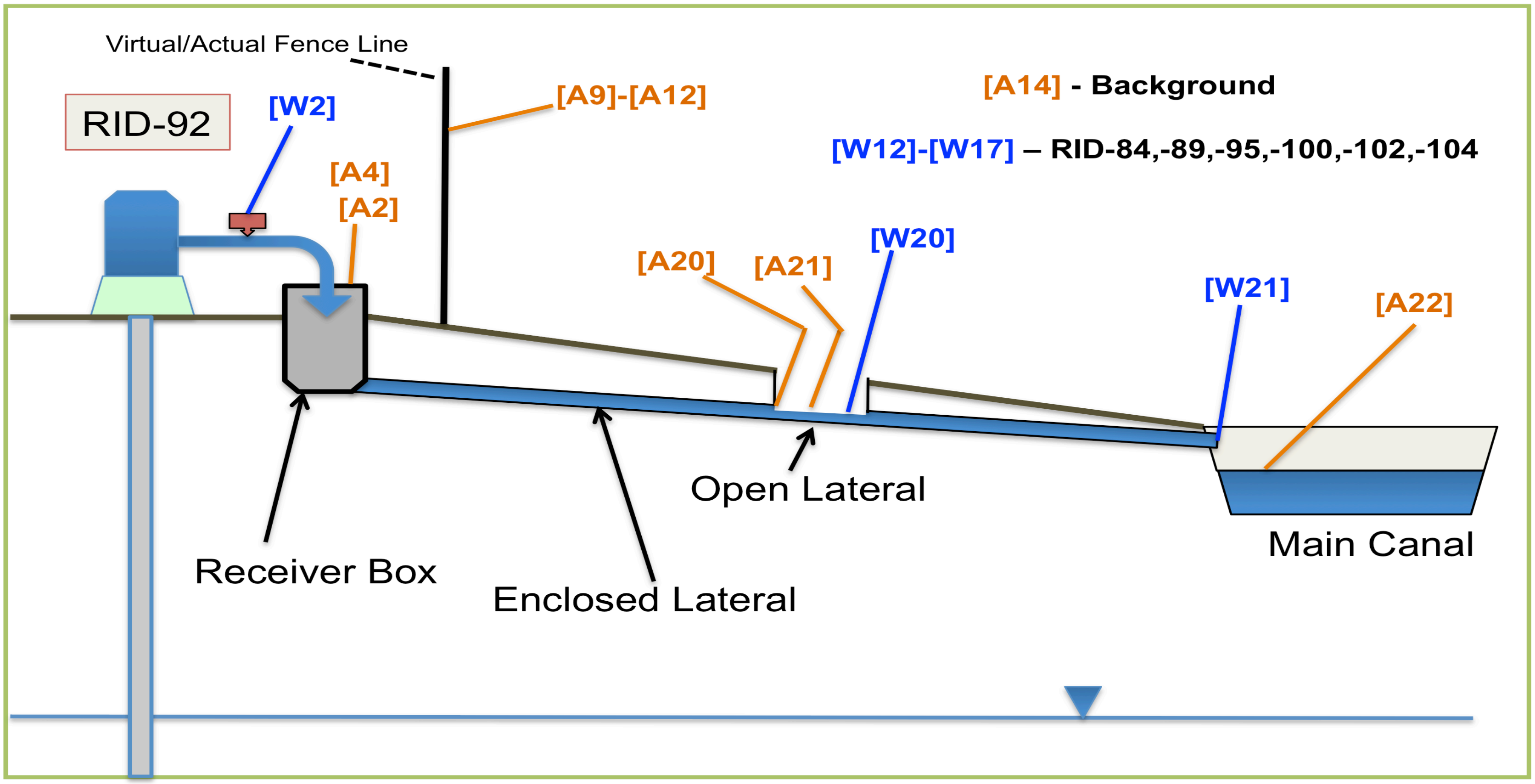
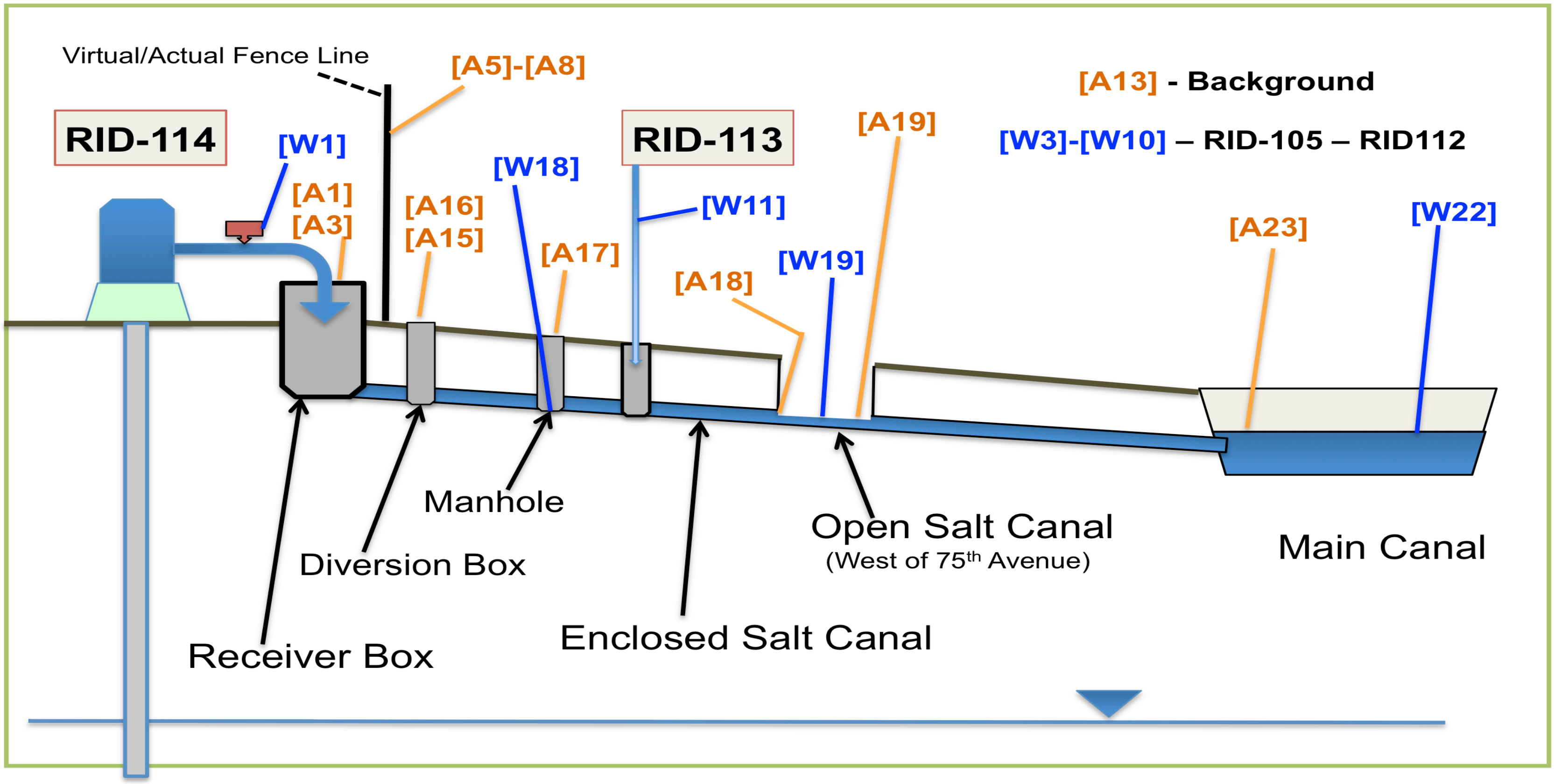


FIGURE 3
Schematic of RID-114 to Salt Canal to Main Canal



APPENDICES

Synergy Environmental, LLC

APPENDIX A

EXAMPLE FIELD DATA SHEETS

SYNERGY ENVIRONMENTAL, LLC

FIELD DATA SHEET FOR GROUNDWATER SAMPLING

Project: ____________________ RID Well/Canal Site: __________________ On-Site:__________ Off-Site:___________ Page ____ of ____

SAMPLE ID	SAMPLE DATE	TIME	TEMP (°C)	pH (S.U.)	E.C. (uS)	FIELD METER	ANALYSIS	COMMENTS/NOTES

SYNERGY
ENVIRONMENTAL, LLC

Airtech Environmental Laboratories, LLC

Ambient Air Sampling Plan (AASP)

#: _______

Sampling Co.

Date: ________________

Company Name: ____________________________ Sampler's Name: ______________________________

Consulting Firm:

Company Name: _________________________________ Project Name: ________________________

Project Manager: _______________________________ Project Number: ______________________

Sampling Site's Information

Location: ____ Client's ID: _______________________

Address: ____

Describe the site location: ____

____

Sampling Train

Canister : 1.0 L ☐ 6.0 L ☐ Silanized: Y ☐ N ☐

Grab Sampler: One min ☐ Two min ☐ Five min ☐ Other: ______________________

One min = Taking one minute to fill one liter canister.

Time Integrated Sampler ☐ Sampling duration: One hour ☐ 4 hour ☐ 8 hour ☐ 12 hour ☐

24 hour ☐ Other: ______________________________

Sampling start: Date: ______________ Time: ___________ Gauge read: ________ inch, Hg

Sampling End: Date: ______________ Time: ___________ Gauge read: ________ inch, Hg

Any tubing used on the sampling train? No ☐ Yes ☐ If yes, fill the information below:

Tubing type: Tygon ☐ Teflon ☐ Vinyl ☐ PVC ☐ Other: ______________________

Tubing used from the sampling point to canister: Length: ______ inch ID ______ inch

Are all parts of Sampling Train tested in the lab before sampling? Y ☐ N ☐

Comments: ____

Weather

Temperature: ________ F° ☐ C° ☐ Sunshine ☐ Cloudy ☐ Rain ☐

Wind: Mild ☐ Middle ☐ Strong ☐

At the sampling point: Upwind ☐ Downwind ☐

Comments: ____

Field Duplicate Y ☐ N ☐ If Yes, fill in the blanks blow:

Describe the duplicate sample site position and fill separate AASP Form: ______________________

____

Sampling site Inspection Note:

____

____

4620 E. Elwood Street, Suite 13, Phoenix, AZ 85040
● Phone:480-968-5888 ● Fax: 480-966-1888 ● yshi@azairlab.com

Page 1 of 1

SYNERGY ENVIRONMENTAL, LLC

APPENDIX B

EXAMPLE CHAIN-OF-CUSTODY RECORDS

Airtech Environmental Laboratories (AEL)

Chain of Custody

4620 E.Elwood Street, Suite 13, Phoenix, AZ 85040 480-968-5888 (phone) 480-966-1888 (fax)

Customer :	Page_____ of _____	AEL Lab #
Address:	Sampler: Phone:	
	Project Name: / Project Number:	
City, State, Zip:	Project location:	
Contact:	P.O. Number:	
Phone: / Fax:	Fax Results: Y N	
E-Mail Address:	E-Mail Results: Y N	

Sample Receipt	Turn Around Request	Sample Type
Temperature_______________ °C	_____ 24 Hours _____ 48 Hours	A: ambient air
Custody Seals: Yes______ No______	_____ 72 Hours	I: indoor air
Custody Seals Intact: Yes_____ No_____	_____ 5 working Day	S: soil extraction vapor
Total # of Containers:___________	_____ Standard 10 Working Days	O: other

Sample Information

AEL Lab #	Serial # Canister	Serial # Grab/TIS	Canister (L)	Client's Sample Identification	Start sampled Date	Start sampled Time	End sampled Date	End sampled Time	Gauge read, inch Hg Start	Gauge read, inch Hg End	Description Sample Type	Analysis: TO-15 full list	TO-15 BTEX only	TO-15 SIM	(Other)
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				
			6 1								A I S O				

Instructions / Special Requirements:

Date:	Time:	Samples Relinquished By:	Received By:

Chain of Custody QA-Form SR-Rev.02-0810

Phoenix
4625 E Cotton Center Blvd
Suite 189
Phoenix, AZ 85040
phone 602.437.3340 fax 602.454.9303

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Synergy Environmental, LLC	Tel/Fax:	Lab Contact:	Carrier:	_______ of ______ COCs
10685 N. Tatum Blvd, Suite 200-437	**Analysis Turnaround Time**			Job No.
Phoenix, AZ 85028	Calendar (C) or Work Days (W)			
(602) 430-2785	TAT if different from Below			
N/A	☐ 2 weeks			SDG No.
Project Name:	☐ 1 week			
Site:	☐ 2 days			
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type	Matrix	# of Cont.	Filtered Sample	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H_2SO_4; 4=HNO_3; 5=NaOH; 6= Other

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* *Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

APPENDIX C

OUTLINE OF FINAL REPORT

SYNERGY
ENVIRONMENTAL, LLC

PROPOSED OUTLINE FOR SUMMARY REPORT

PRELIMINARY EXPOSURE ASSESSMENT AND MITIGATION
ROOSEVELT IRRIGATION DISTRICT
PLANNED EARLY RESPONSE ACTION

I. INTRODUCTION

A. Purpose of Assessment
B. Specific Objectives

II. BACKGROUND

A. Site Location and Physical Characteristics
B. History of Contamination
C. Contaminants of Concern

III. EXPOSURE ASSESSMENT: EXISTING CONDITIONS

A. Overview of RID Water Operations
B. Contamination Impact on RID Water System
C. Routes of Exposure

IV. EXPOSURE MITIGATION: EARLY RESPONSE ACTION

A. Key Elements of Planned Early Response Action
B. Groundwater Treatment Engineering Controls
C. RID Water Distribution System Engineering Controls
D. RID Water System Operational Controls

V. SUMMMARY AND CONCLUSIONS

VI. IMPLEMENTATION SCHEDULE