MODIFIED EARLY RESPONSE ACTION PROPOSAL

FOR THE WEST VAN BUREN AREA

WATER QUALITY ASSURANCE REVOLVING FUND SITE

JULY 17, 2012

Submitted to the

Arizona Department of Environmental Quality

On Behalf of the

ROOSEVELT IRRIGATION DISTRICT

Prepared by

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Executive Summary

This Modified Early Response Action Proposal is submitted to Arizona Department of Environmental Quality (ADEQ) as an addendum to the existing Early Response Action (ERA) Work Plan, dated February 3, 2010 and approved by ADEQ on June 24, 2010. Consistent with recent discussions with ADEQ, this addendum to the existing ERA Work Plan is proposed in order to provide a more cost effective approach to accomplish the goals of the ERA remedial action.

This Modified ERA Proposal provides an optimized design approach to address the highest contaminated Roosevelt Irrigation District (RID) wells located in the West Van Buren Area (WVBA) and incorporates information and insights gained from the investigations prescribed by ADEQ in the existing ERA Work Plan approval letter (Tasks 1 through 4) and from the ongoing pilot testing under the RID-95 Wellhead Pilot Treatment System Proposal, dated August 18, 2011, whose implementation was agreed to by ADEQ by letter dated September 2, 2011.

Based on detailed consideration and analysis of this new information, RID proposes the following substantive modifications to the existing ERA Work Plan:

- Utilize wellhead treatment systems (liquid-phase granular activated carbon) in lieu of the central groundwater treatment facility;
- Eliminate the north-south lateral pipelines between the southern tier wells to the Salt Canal;
- Eliminate the gravity pipeline between the end of the Salt Canal and the RID Maintenance Yard (central treatment facility location); and,
- Utilize a combination of treatment and blending to effectively reduce the concentration of volatile organic compounds (VOCs) from several additional, lower concentration wells resulting, in lower volume of water being directly treated while providing a higher total volume of groundwater that is remediated to meet maximum contaminant levels (MCLs).

These modifications substantially increase the efficiency and effectiveness of the ERA remedial action as approved in the existing ERA Work Plan. Implementation of these modifications is estimated to result in the following performance improvements compared to the existing ERA Work Plan:

- Reduce capital costs of treatment infrastructure by approximately 50%;
- Reduce operation and maintenance costs by approximately 50%;
- Enable blending of treated water with untreated water from wells having lower contaminant concentration along the Salt Canal, effectively increasing the number of impacted RID wells that will be addressed (from 10 to 13 wells) and, thereby, increasing the total volume of contaminated groundwater remediated to below MCLs by approximately 50%;
- Significantly reduce the time required to implement the early response pump and treat action due to the simplified and modular nature of the wellhead treatment systems (compared to a central groundwater treatment facility) and the elimination of the construction of north-south lateral pipelines;
- Significantly reduce the scope and cost of the final groundwater remedy by reducing the number of impacted RID wells that will need to be addressed through supplemental remedial actions developed during the WVBA Water Quality Assurance Revolving Fund (WQARF) Site Feasibility Study (from 7 to 4 wells) and by providing effective mass contaminant removal and treatment by the earlier implementation of the wellhead groundwater pump, treat and blend systems that will remediate approximately 3500 pounds per year of VOC contamination in the regional groundwater; and,
- Significantly reduce the scope and cost of the final remedy at the West Osborn Complex (WOC) WQARF Site by addressing the groundwater contamination that is migrating into the WVBA WQARF Site and impacting and threatening to impact RID's wells.

1.0 INTRODUCTION

This Modified Early Response Action Proposal is submitted on behalf of the Roosevelt Irrigation District (RID) to the Arizona Department of Environmental Quality (ADEQ) as an addendum to the Early Response Action (ERA) Work Plan (Montgomery and Associates [M&A], 2010a) dated February 3, 2010 and approved by ADEQ with conditions in ADEQ's letter dated June 24, 2010 (ADEQ, 2010). For ease of reference, the existing, February 2010 ERA Work Plan is referred to herein simply as the ERA Work Plan. As recently discussed with ADEQ, this proposal provides a less expensive approach to accomplish the goals of the ERA remedial action voluntarily initiated by RID pursuant to Arizona Administrative Code R18-16-405 and the Agreement to Conduct Work between ADEQ and RID, signed and dated October 8, 2009. The purpose and scope of this Modified ERA Proposal are described in the following sections.

1.1 PURPOSE

The purpose of this Modified ERA Proposal is to provide ADEQ with a revised plan for accomplishing the objectives of the ERA as described in the ADEQ-approved ERA Work Plan while reducing the cost and time to implement the remedial actions. The revised approach provided in this proposal will also reduce the scope and cost of the final groundwater remedy for the West Van Buren Area (WVBA) and West Osborn Complex (WOC) Water Quality Assurance Revolving Fund (WQARF) Sites.

1.2 SCOPE

The approach outlined in this Modified ERA Proposal is intended to modify the conceptual treatment design provided in the ERA Work Plan approved by ADEQ on June 24, 2010 (ADEQ, 2010). This Modified ERA Proposal recommends a number of substantive changes to the current ERA. As an addendum to the existing ERA Work Plan, this proposal follows the section numbering of that approved work plan and only includes information that has been modified from that document. In addition to the information provided in Section 1.0 herein, the information provided in Section 1.0 of the ERA Work Plan is still relevant and accurate.

2.0 EARLY RESPONSE ACTION RATIONALE

Section 2.0 - Early Response Action Rationale, and associated subsections in the ERA Work Plan, are modified as indicated in the following sections.

2.1 Overview of Early Response Action

Section 2.1 of the ERA Work Plan refers to a "centralized treatment facility" that, under this Modified ERA Proposal, is being replaced with wellhead or distributed treatment facilities. Section 2.1 also indicates that groundwater pumped from the ten (10) most highly contaminated RID wells will be treated. In this Modified ERA Proposal, nine (9) of the most highly contaminated wells will be directly treated with wellhead treatment facilities, as further described in Section 4.2.1 and summarized in **Table 2**, herein.

2.2 Attainment of Administrative Code Goals

The descriptions of Administrative Code Goals in the ERA Work Plan are still relevant and accurate. No changes are proposed.

2.3 Consistency With Statute

The Consistency With Statute overview in the ERA Work Plan is still relevant and accurate. No changes are proposed.

2.4 Information Used to Develop ERA

In addition to the information provided in Section 2.4 of the ERA Work Plan, several additional sources of recent information have been considered in development of this Modified ERA Proposal. This recent information was obtained through completion of work under the following tasks that were stipulated by ADEQ in its ERA Work Plan approval letter (ADEQ, 2010):

- ERA Task 1 - Public Health Exposure Assessment and Mitigation Work Plan
- ERA Task 2 - Well Investigations Work Plan
- ERA Task 3 - Groundwater Modeling Work Plan
- ERA Task 4 - Engineering Design Study

Section 2.4 of the ERA Work Plan also references "conceptual engineering design work" conducted by HDR Engineering, Inc. (HDR), which focused on the centralized treatment facility approach. While the design concept has been modified, the information provided in the HDR ERA Conceptual Design Technical Memo (see Attachment A of the ERA Work Plan) is still relevant and valid in that it provides the basis for cost comparison of the wellhead/distributed approach provided in this proposal.

3.0 SUMMARY OF SITE CONDITIONS

Section 3.0 - Summary of Site Conditions, and associated subsections in the ERA Work Plan, are modified as indicated in the following sections.

3.1 West Van Buren Area Site

The overview of the WVBA Site in the ERA Work Plan is still relevant and accurate. No changes are proposed.

3.2 Physical Setting

The Physical Setting overview in the ERA Work Plan, and associated subsections, are still relevant and accurate. No changes are proposed.

3.3 Hydrological Conditions

The description of Hydrological Conditions in the ERA Work Plan is still relevant and accurate. No changes are proposed.

3.4 Groundwater Conditions

The description of Groundwater Conditions in the ERA Work Plan is still relevant and accurate, with one exception. Recent investigations of fluid flow within the RID wells do not support the general statement in this section of the ERA Work Plan that a downward vertical gradient exists over most of the WVBA Site. The findings obtained at well RID-95 indicate that at this location there is an upward gradient that results in upward movement of groundwater from the Lower Alluvial Unit (LAU) to the Upper Alluvial Unit (UAU) under non-pumping conditions (M&A, 2012).

3.5 Nature and Extent of Groundwater Contamination

There have been additional data collected on groundwater quality in many of the contaminated RID wells; however, **Figures 4** through **13** in the ERA Work Plan that depict the extent and spatial variation of the contaminants of concern (COCs) are still representative of the general Site conditions. All of the COCs addressed in the WVBA ERA are volatile organic compounds (VOCs).

The information provided in **Table 1** of the ERA Work Plan, Summary of Water Quality Data, has been updated to reflect the latest water quality data collected by ADEQ. The updated water quality data listed in **Table 1** in this Modified ERA Proposal is only provided for the impacted RID wells.

3.6 Sources of Contamination

The description of Sources of Contamination in the ERA Work Plan is still relevant and accurate. No changes are proposed.

3.7 Impact of Groundwater Contamination on RID Wells and Operations

Section 3.7 of the ERA Work Plan notes that 32 RID production wells are located within the WVBA Site, indicating that 31 wells are operational and 1 well, RID-111, "is currently inoperable." RID-111 was recently replaced (in the same location) and the new well (RID-111R) is now operational, pumping approximately 3,000 gallons per minute (gpm). This well was replaced in order to facilitate Task 2 Well Investigations, required by ADEQ, without reducing RID's available water supply as protected by A.R.S. 49-282.06.B.4.b.

3.8 Summary of Site Status

There are a number of significant efforts currently underway or completed in the WVBA Site since the ERA Work Plan was approved in June 2010. These efforts are as follows:

- Proposed Remedial Objectives (ROs) were developed and issued on May 16, 2011 by ADEQ (ADEQ, 2011a);
- Task 1 work, detailed in the Public Health Exposure Assessment and Mitigation Work Plan (Synergy Environmental [Synergy], 2011a), was completed and results were submitted to ADEQ on September 16, 2011, in a Summary Report (Synergy, 2011b);
- Task 2 work, detailed in the Well Investigation Work Plan (M&A, 2010b), was completed at RID-95 and reported to ADEQ in the RID-95 Well Investigation Technical Memorandum (M&A, 2012); well investigations were recently conducted at RID-111R, and are currently underway at RID-92;
- Task 3 work, detailed in the Groundwater Modeling Work Plan (M&A, 2011a), is currently underway;

- Engineering pilot studies, detailed in the RID-95 Wellhead Pilot Treatment System Proposal (Synergy, 2011c), with implementation agreed to by ADEQ by letter dated September 2, 2011 (ADEQ, 2011b), were completed and treatment systems installed at four (4) RID wells [RID-89, RID-92, RID-95 and RID-114] (all currently in operation); and,
- In conjunction with RID, water quality sampling was conducted by ADEQ at many of the contaminated RID wells in June 2010, April 2011 and September 2011.

In addition to the WVBA technical efforts listed above, the Final Feasibility Study (FS) Report for the West Osborn Complex (WOC) WQARF Site, immediately north of and adjacent to the WVBA Site, was recently issued by ADEQ. Key ADEQ findings and conclusions in the WOC Final FS Report that are equally applicable, relevant or appropriate for the WVBA WQARF Site include:

1) ROs for groundwater use are based on the current and reasonably foreseeable uses of water at the Site for drinking water purposes based on the needs of the impacted water providers in the Site;

2) proposed treatment technologies must achieve drinking water standards for COCs;

3) liquid-phase granular activated carbon (LGAC), a Best Available, Demonstrated Treatment Technology (BADCT), was the selected treatment technology to cost-effectively ensure reliable and fail-safe removal of COCs; and,

4) ADEQ requires all remediation technology to provide vapor capture/control to prevent pollutant transfer from one environmental media to another and to provide a high degree of public protection against potential exposure to VOCs in the air.

The Final WOC FS Report also confirmed ADEQ's findings in the 2008 Draft Remedial Investigation Report for the WVBA WQARF Site that the WOC groundwater contamination plume is continuing to migrate in a southwesterly direction and into the WVBA WQARF Site and, therefore, is impacting or threatening to impact RID wells in the WVBA WQARF Site. The result is the continued transfer of groundwater contamination from the WOC WQARF Site to the RID well field in the WVBA WQARF Site, leaving the environmental impacts and costs to address much of the WOC groundwater contaminants to fall on RID.

Section 3.8 of the ERA Work Plan also states that, of the 32 RID wells within the WVBA, 18 of these wells are currently contaminated. Current data show there are 23 contaminated RID wells with 17 contaminated with VOC concentrations that exceed the Environmental Protection Agency's Maximum Contaminant Levels (MCLs).

4.0 DESCRIPTION OF EARLY RESPONSE ACTION

Section 4.0 - Description of ERA in the ERA Work Plan, has been substantially modified as depicted in **Figure 14** and summarized in **Table 2** herein. The following sections describe the proposed modifications.

4.1 ERA CONCEPTUAL DESIGN

The remedial action described in this Modified ERA Proposal, like the ERA Work Plan, was selected using best available Site information, best available scientific information concerning remedial methods and technologies, and best engineering judgment. This modified ERA, however, is further refined by the information and data obtained from recent activities conducted in accordance with the supplemental Tasks set forth in the ADEQ's June 24, 2010 approval letter (ADEQ, 2010) for the ERA Work Plan and in the RID-95 Wellhead Pilot Treatment System Proposal.

4.1.1 Potential Remedial Alternatives

The potential remedial alternatives discussed in the ERA Work Plan are still relevant and accurate. No changes are proposed.

4.1.2 Alternatives Evaluation

Wellhead Treatment Using GAC versus Centralized Treatment Using GAC - information and performance data obtained from installation and operation of the four (4) wellhead treatment systems installed and currently operating under the RID-95 Wellhead Pilot Treatment System initiative demonstrate that wellhead treatment using BADCT is feasible and less expensive than a centralized treatment. Where land access is restricted at several target RID well sites, reconnaissance surveys and preliminary contacts with adjacent land owners indicate that it is feasible to acquire sufficient land to construct the necessary wellhead treatment systems identified in this Modified ERA Proposal.

4.2 ERA CONCEPTUAL DESIGN ELEMENTS

The core engineering design elements of the original ERA approach, as detailed in the ADEQ-approved ERA Work Plan, include: 1) a centralized groundwater treatment facility (CGTF); 2) physical improvements to existing pipelines and canals; 3) modifications to existing extraction wells; and 4) new pipelines. The following sections briefly recap the ERA Work Plan design elements and describe proposed design modifications, where applicable.

4.2.1 Treatment Facilities

The ERA Work Plan includes a CGTF designed to treat 20,000 gpm of water from ten (10) of the most highly contaminated RID wells using LGAC. Four (4) of these wells (RID-89, RID-92, RID-95, and RID-100), the "southern-tier wells", were to be piped approximately ¾ mile north to the Salt Canal and three (3) of the lower concentration wells along the Salt Canal (RID-105, RID-109, and RID-110) were to be piped the same distance south to existing laterals to provide capacity in the Salt Canal for the addition of the four (4) southern-tier wells. The CGTF was to include the following major system components: wet well, pump station, prefilters, LGAC contactors, flush and backwash support systems, and instrumentation and controls.

This Modified ERA would consist of wellhead LGAC treatment systems, in lieu of the CGTF, at nine (9) of the most highly contaminated RID wells. Based on information and performance data obtained from the pilot wellhead treatment systems installed and operated at RID-89, RID-92, RID-95, and RID-114, it was determined that wellhead treatment is feasible and provides the following benefits:

- Reduces capital costs by approximately 50%, from approximately $34MM to approximately $18MM;
- Reduces operation and maintenance (O&M) costs by approximately 50%, from approximately $3-$4MM per year to approximately $1.5-$2MM per year;
- Enables blending of treated water with untreated water from wells having lower contaminant concentration along the Salt Canal, effectively increasing the number of impacted RID wells that will be addressed (from 10 to 13 wells), thereby increasing the total volume of contaminated groundwater remediated to below MCLs by approximately 50%;
- Significantly reduces the time required to implement the early response pump and treat action due to the simplified and modular nature of the wellhead treatment systems (compared to a CGTF) and the elimination of the north-south lateral pipelines and the Salt Canal extension pipeline; and,
- Significantly reduces the scope and cost of the final groundwater remedy by reducing the number of impacted RID wells that will need to be addressed by supplemental remedial actions developed during the WVBA Site FS (from 7 to 4 wells) and by providing effective mass contaminant removal and treatment by the earlier implementation of the wellhead groundwater pump, treat and blend systems that will remediate approximately 3500 pounds per year of VOC contamination in the regional groundwater.

The concept of blending treated and untreated wells along the Salt Canal is a new element introduced in this Modified ERA Proposal. Combining the treated groundwater from wells RID-106, RID-111, RID-112, RID-113, and RID-114 with untreated groundwater from lower contaminant concentration wells RID-105, RID-107, RID-108,

RID-109, and RID-110, will achieve a blended water quality that is well below current MCLs at the point of discharge of the Salt Canal into the Main Canal.

The Salt Canal is primarily an enclosed pipeline except for two (2) remaining open sections to be enclosed under this ERA as described in Section 4.2.2 below. Once fully enclosed, the point of discharge to RID Main Canal will be the first point of reasonable potential public exposure and will serve as the point of compliance to achieve MCLs for the VOCs. This blending approach is summarized in **Table 3** which provides the mathematical projection of water quality from blending treated wells with untreated wells, and shows the worst-case, blended VOC concentrations at this point of compliance.

In addition to completing the closure of the Salt Canal, all of the discharge structures of wells along the Salt Canal will be enclosed to minimize emissions of volatilized VOCs to the atmosphere, as described in the Public Health Exposure Assessment and Mitigation Summary Report (Synergy, 2011b).

4.2.2 Salt Canal Improvements

Improvements to the Salt Canal are still planned, as stated in the ERA Work Plan, which will include replacing open sections of canal with below-grade pipe to prevent volatilization of VOCs from untreated wells to the atmosphere and restrict public access to contaminated water. There are currently only two (2) remaining open reaches on the Salt Canal: (1) approximately 220 feet of open canal east of 77th Avenue and (2) approximately 1,150 feet of open canal west of 79th Avenue. The third reach included in the ERA Work Plan, approximately 220 feet near 68th Avenue, has been converted to below-grade piping as part of a recent City of Phoenix street improvement project.

4.2.3 Well Modifications

Well modifications described in the ERA Work Plan were primarily intended to enable remote operation and monitoring of the extraction wells and minimize point source release of VOCs from well discharge structures. There are no substantive changes to these aspects of Section 4.2.3 of the ERA Work Plan.

A secondary aspect of the Well Modifications section of the ERA Work Plan was to determine whether the bottom portion of deeper RID wells, those penetrating through the Middle Alluvial Unit (MAU) and into the LAU, needed to be sealed off from the UAU to isolate pumping to the upper, contaminated groundwater zones and prevent migration of contaminants from the UAU into the underlying MAU and LAU through conduit flow. The results of well investigations at RID-95 demonstrated that there is an upward gradient under non-pumping conditions, preventing the downward movement of contaminants and any vertical cross-contamination of alluvial units.

4.2.4 New Pipelines

A number of new pipelines were planned in the ERA Work Plan including eight (8) individual segments extending over 25,000 linear feet, consisting of:

- a new 48-inch gravity flow pipeline connecting the terminus of the Salt Canal at 83rd Avenue to the CGTF located at 84th Avenue;
- four (4) new pressurized pipelines, ranging in size from 10- to 20-inches in diameter, to convey water from the highly contaminated southern-tier wells (RID-89, RID-92, RID-95, and RID-100) north to the Salt Canal; and,
- three (3) new pressurized pipelines, ranging in size from 12- to 16-inches in diameter, to convey water from the lower concentration contaminated wells located on the Salt Canal (RID-105, RID-109, and RID-110) south to existing laterals and, from there, to the Main Canal by gravity flow.

These new pipelines are no longer necessary under the Modified ERA Proposal. Elimination of these new pipelines significantly reduces the ERA capital costs (by approximately $7 million), reduces O&M costs associated with pumping and pipeline maintenance, reduces implementation impacts to the local public (e.g. street excavation and traffic restrictions), and substantially reduces the time to achieve full ERA implementation by eliminating the lengthy task of pipeline design, permitting and construction.

4.3 ERA IMPLEMENTATION

The Modified ERA Proposal will employ the Design-Build (DB) implementation approach, as in the ERA Work Plan. The ERA modifications described herein, however, result in changes to the current two-phase implementation as described in the following sections.

The ERA Work Plan specified treatment of all VOCs to non-detectable levels (typically 0.5 micrograms per liter). This Modified ERA Proposal is based on treatment of "target VOCs", those VOCs that exceed MCLs, to non-detectable levels and **not** treatment of all VOCs to non-detect concentrations. Several of the VOCs present in the contaminated groundwater are below MCLs and are substantially more difficult to remove through the LGAC process than the target VOCs. Consequently, allowing these "deminimis" VOCs, those VOCs that are already present at concentrations below MCLs, to pass through the LGAC vessels will result in a significant reduction in O&M costs while achieving MCLs for all VOCs. This approach will enable much longer LGAC bed life compared to GAC replacement at the first detection of these deminimis VOCs in the treatment system effluent.

Table 2 has been revised to include mass removal estimates that include only target VOCs. The VOC concentrations in **Table 2** have also been updated to include the latest ADEQ sampling results and the reduced flow rates due to treatment system head losses. There is currently no water quality data for RID-111R since it just began pumping and has not yet stabilized. Therefore, VOC concentrations in RID-111R are assumed to be equal to the nearest up gradient well, RID-112. Mass removal estimates will be updated when stabilized and representative water quality data from RID-111R are available.

4.3.1 PHASE 1

The Phase 1 objectives in the ERA Work Plan were to protect RID wells along the Main Canal that are not currently impacted and to begin groundwater treatment in an efficient, economical, effective and expedient manner. This Phase included treatment of all of the wells on the Salt Canal, including some with relatively low VOC concentrations (still above MCLs) and one (1) well with VOC concentrations below MCLs (RID-105).

Phase 1 of the Modified ERA Proposal consists of installation and operation of the four (4) wellhead treatment systems included in the RID-95 Wellhead Pilot Treatment System Proposal (Synergy, 2011c). These four (4) wells are among the highest contaminated wells, and treatment of these wells has resulted in substantial VOC mass removal. Three of these wells are southern-tier wells that are located much closer to the unimpacted RID wells along the Main Canal and, therefore, are more effective in protecting these currently unimpacted RID wells.

Phase 1 design and construction has been completed and wellhead treatment at all four (4) wells is currently underway. The most recent information regarding volumes of groundwater treated and VOC mass removed from these Phase 1 wells is available in the May 2012 Monthly Progress Report - RID-95 Wellhead Pilot Treatment Systems (Synergy, 2012a).

Production capacity of these four (4) wells has decreased as a result of the additional head losses through the treatment systems. Reductions in pump output have been observed in each well with average losses of approximately 10%. Well RID-92 has the highest production capacity loss of approximately 18%. RID intends to recover this lost capacity at each of these wells as part of this ERA through well equipment replacement and installation of an additional treatment skid at RID-92. Additional engineering assessment is needed to determine the most appropriate means of restoring the lost water production capacity that resulted from the wellhead treatment under the ERA and this assessment will occur as part of the Modified ERA.

4.3.2 PHASE 2

The Phase 2 objectives in the ERA Work Plan were to enhance plume capture and VOC removal by treating impacted groundwater from the remaining RID wells with the highest total VOC concentrations. This required design and construction of seven (7) new north-south pipelines and was conceived to take several additional years to complete.

Phase 2 of the Modified ERA Proposal consists of equipping five (5) additional RID wells with the high VOC concentrations with wellhead treatment. These additional wells (RID-100, RID-106, RID-111, RID-112, and RID-113) will be equipped with wellhead treatment systems similar to those constructed at the pilot treatment system sites, as illustrated in Figure 14.

As discussed in Phase 1, the production capacity of these additional wells will also be reduced due to head losses through the treatment systems. RID intends to recover this lost capacity at each well as part of this ERA.

5.0 ERA TASKS

Section 5.0 - ERA Tasks, and associated subsections in the ERA Work Plan, are unchanged except as provided in the following sections.

5.1 Task 1 - Meetings

The Meetings discussed in the ERA Work Plan are still relevant and accurate. No changes are proposed.

5.2 Task 2 - Community Involvement

The Community Involvement provisions in the ERA Work Plan are still relevant and accurate. No changes are proposed.

5.3 Task 3 - Data Collection and Analysis

The Data Collection and Analysis provisions in the ERA Work Plan are still relevant and accurate. No changes are proposed. As noted previously, however, additional water quality data have been collected by ADEQ from the impacted RID wells. The most recent data are included in **Table 1**.

5.4 Task 4 – Permits and Property Access

The Permit and Property Access provisions in the ERA Work Plan have changed somewhat as a result of the modified ERA design approach and in light of the recently completed wellhead treatment systems. The elimination of seven (7) lateral pipeline runs on major Phoenix streets and under railroad tracks will simplify permitting and coordination with outside parties.

Under the Modified ERA Proposal, all of the construction work associated with the ERA will take place on existing RID property or in RID easements, except at those well sites where additional land must be acquired in order to support placement of the wellhead treatment systems.

It is anticipated that additional land will need to be procured from adjacent property owners at well sites RID-100, RID-106, RID-112, and RID-113 due to the limited size of the well sites and placement of the well within those sites.

5.5 Task 5 – Design

Under the approach outlined in this Modified ERA Proposal, detailed engineering design will be greatly simplified and streamlined due to the previous detailed engineering design efforts completed as part of the RID-95 Wellhead Pilot Treatment System initiative. The basic design of each wellhead treatment system is essentially identical with the only differences being the orientation of the treatment skid(s) and interconnecting piping. These unique aspects of each wellhead treatment system will be influenced by the individual site conditions such as available space and constraints imposed by existing infrastructure.

The basic design of these wellhead treatment systems has been demonstrated to be reliable and effective in removing the target VOCs as well as to be protective of public health by providing redundancy and fail-safe operational controls, as demonstrated in the 1-Month Technology/Design Demonstration Report - RID-95 Pilot System (Synergy, 2012b). Consequently, RID proposes to provide ADEQ with only the final detailed engineering design documents for each of the wellhead treatment systems, and Salt Canal improvements, for review and approval prior to commencement of construction.

5.6 Task 6 - Construction

The Construction provisions in the ERA Work Plan are still relevant and accurate. No changes are proposed.

5.7 Task 7 - System Testing and Start-Up

The System Testing and Start-Up provisions in the ERA Work Plan are still relevant and accurate with the exception of the reference to the CGTF and the lateral feeder pipelines that have been eliminated from the ERA design. System testing and start-up will be conducted, with ADEQ oversight, on each of the additional wellhead treatment systems.

5.8 Task 8 - Operation and Maintenance

The O&M provisions in the ERA Work Plan are still relevant and accurate. The existing Early Response Action Operation and Maintenance Plan - Wellhead Treatment Systems (Synergy, 2012c), addressing O&M of the existing four (4) wellhead treatment systems, will be updated, and provided to ADEQ for review and approval, during implementation of this Modified ERA Proposal to address the O&M of these additional five (5) wellhead treatment systems.

6.0 SCHEDULE

The Schedule provided in the ERA Work Plan has been revised to reflect the anticipated work schedule of the Modified ERA Proposal. Due to the uncertainty in the time to obtain approval of this Modified ERA Proposal and to secure project funding, the schedule is defined by approximate task frequency (for recurring tasks) and estimated task duration (for non-recurring tasks). This revised schedule is summarized below.

Task 1 - Meetings

Meetings with ADEQ will be held on a quarterly basis or more frequently as needed based on project activity.

Task 2 - Community Involvement

Meetings with the community will be scheduled and coordinated by ADEQ.

Task 3 - Data Collection and Analysis

Data is being collected and analyzed on an ongoing basis.

Task 4 - Permits and Property Access

Permits required for construction activities will be obtained as part of those efforts, and included in the Task 6 - Construction schedule.

Acquisition of additional property adjacent to the existing well sites is anticipated to take six (6) to 12 months from approval of the Modified ERA Proposal and availability of project funding.

Task 5 - Design

Design of the modifications to the Salt Canal is anticipated to take three (3) to six (6) months following approval of the Modified ERA Proposal and availability of project funding.

Design of individual wellhead treatment systems is anticipated to take approximately four (4) months from acquisition of additional property, where required, or from approval of the Modified ERA Proposal and availability of project funding, where additional property is not required.

Task 6 - Construction

Construction of the modifications to the Salt Canal is anticipated to take approximately six (6) months from completion and approval of the associated design documents.

Construction of the wellhead treatment systems is anticipated to take 12 to 16 months from completion and approval of the associated design documents.

Task 7 - System Testing and Start-Up

Testing and start-up of the wellhead treatment systems is anticipated to take two (2) months following completion of construction of each of the systems.

Task 8 - O&M Plan

Revision of the existing O&M Plan, covering the wellhead treatment systems currently in operation, is anticipated to take two (2) months from completion of the final design documents.

7.0 REFERENCES CITED

Additional references cited in Modified ERA Proposal are as follows:

Arizona Department of Environmental Quality, 2010, **Conditional Approval of a Water Quality Assurance Revolving Fund (WQARF) Early Response Action (ERA) Work Plan for the West Van Buren Registry Site**: June 2010.

_____, 2011a, **Proposed Remedial Objectives Report, West Van Buren Water Area WQARF Registry Site, Phoenix, Arizona**: May 16, 2011.

_____, 2011b, **Review of RID–95 Wellhead Pilot Treatment System Proposal Work Plan**: September 2, 2011.

Montgomery and Associates, 2010a, **Work Plan, Roosevelt Irrigation District Early Response Action, West Van Buren Water Quality Assurance Revolving Fund Site**: February 3, 2010.

_____, 2010b, **Well Investigation Work Plan, Roosevelt Irrigation District Early Response Action, West Van Buren Area Water Quality Assurance Revolving Fund Site**: November 24, 2010.

_____, 2011a, **Groundwater Modeling Work Plan for Wellhead Pilot Treatment Systems, Roosevelt Irrigation District Early Response Action, West Van Buren Area Water Quality Assurance Revolving Fund Site**: October 27, 2011.

_____, 2012, **Technical Memorandum, Investigations at Well RID-95, Roosevelt Irrigations District Early Response Action, West Van Buren Water Quality Assurance Revolving Fund Site**: January 11, 2012.

Synergy Environmental, 2011a, **Early Response Action Public Health Exposure Assessment and Mitigation Work Plan**: June 16, 2011.

_____, 2011b, **Early Response Action Public Health Exposure Assessment and Mitigation Summary Report**: September 16, 2011.

_____, 2011c, **Early Response Action RID-95 Wellhead Pilot Treatment System Proposal**: August 18, 2011.

_____, 2012a, **May 2012 Monthly Progress Report - RID-95 Wellhead Pilot Treatment Systems**: June 2012

_____, 2012b, **1-Month Technology/Design Demonstration Report: RID-95 Pilot System**: May 2012.

_____, 2012c, **Early Response Action Operation and Maintenance Plan - Wellhead Treatment Systems**: May 2012.

TABLES

TABLE 1
SUMMARY OF WATER QUALITY DATA
ROOSEVELT IRRIGATION DISTRICT WELLS
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

WELL IDENTIFIER			**RID-83**	**RID-84**	**RID-85**	**RID-86**	**RID-89**	**RID-91**	**RID-92**
DATE SAMPLED			09/14/11	09/14/11	06/07/10	09/14/11	09/14/11	09/13/11	09/14/11
	Units	MCL							
1,1,1-Trichloroethane (TCA)	ug/l	200	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chloroform	ug/l	--	<0.50	<0.50	<0.50	<0.50	**2.6**	<0.50	**2.9**
1,1-Dichloroethane (1,1-DCA)	ug/l	--	<0.50	<0.50	<0.50	<0.50	**0.81**	<0.50	**2.0**
1,1-Dichloroethene (1,1-DCE)	ug/l	7	<0.50	**0.94**	<0.50	<0.50	**2.8**	<0.50	**4.4**
1,2-Dichloroethane	ug/l	5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
cis-1,2-Dichloroethene	ug/l	70	<0.50	<0.50	<0.50	<0.50	**2.5**	<0.50	**6.7**
trans-1,2-Dichloroethene	ug/l	100	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tetrachloroethene (PCE)	ug/l	5	<0.50	**7.8**	<0.50	<0.50	**8.0**	<0.50	**12**
Trichloroethene (TCE)	ug/l	5	<0.50	**1.1**	<0.50	<0.50	**28**	**1.1**	**65**
Total VOCs:	ug/l	--	<0.50	**9.8**	<0.50	<0.50	**45**	**1.1**	**93**
Total Target VOCs:	ug/l	--	--	**7.8**	--	--	**36**	--	**77**

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TABLE 1
SUMMARY OF WATER QUALITY DATA
ROOSEVELT IRRIGATION DISTRICT WELLS
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

WELL IDENTIFIER			RID-93	RID-94	RID-95	RID-99	RID-100	RID-101	RID-102
DATE SAMPLED			09/13/11	09/13/11	09/13/11	09/13/11	09/13/11	09/04/08	06/08/10
	Units	MCL							
1,1,1-Trichloroethane (TCA)	ug/l	200	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chloroform	ug/l	--	<0.50	<0.50	**1.1**	**0.54**	**1.2**	<0.50	**0.73**
1,1-Dichloroethane (1,1-DCA)	ug/l	--	<0.50	<0.50	**4.3**	<0.50	**2.5**	<1.0	<0.50
1,1-Dichloroethene (1,1-DCE)	ug/l	7	<0.50	**0.94**	**7.5**	**1.2**	**4.0**	**2.0**	<0.50
1,2-Dichloroethane	ug/l	5	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50
cis-1,2-Dichloroethene	ug/l	70	<0.50	<0.50	**8.9**	<0.50	**4.6**	<0.50	**0.81**
trans-1,2-Dichloroethene	ug/l	100	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tetrachloroethene (PCE)	ug/l	5	**0.60**	**1.2**	**4.0**	**5.6**	**5.8**	<0.50	**17**
Trichloroethene (TCE)	ug/l	5	**1.0**	**0.67**	**52**	<0.50	**15**	<0.50	**0.72**
Total VOCs:	ug/l	--	**1.6**	**2.8**	**78**	**7.3**	**33**	**2.0**	**19**
Total Target VOCs:	ug/l	--	--	--	**60**	**5.6**	**21**	--	**17**

TABLE 1
SUMMARY OF WATER QUALITY DATA
ROOSEVELT IRRIGATION DISTRICT WELLS
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

WELL IDENTIFIER			**RID-103**	**RID-104**	**RID-105**	**RID-106**	**RID-107**	**RID-108**	**RID-109**
DATE SAMPLED			06/08/10	06/08/10	09/13/11	09/13/11	09/13/11	09/13/11	09/13/11
	Units	MCL							
1,1,1-Trichloroethane (TCA)	ug/l	200	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chloroform	ug/l	--	<0.50	**0.77**	<0.50	**1.6**	**1.3**	**1.1**	**2.3**
1,1-Dichloroethane (1,1-DCA)	ug/l	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1-Dichloroethene (1,1-DCE)	ug/l	7	**1.4**	**0.76**	**0.67**	**5.1**	**2.6**	**0.96**	**2.7**
1,2-Dichloroethane	ug/l	5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
cis-1,2-Dichloroethene	ug/l	70	<0.50	<0.50	<0.50	**1.0**	<0.50	<0.50	<0.50
trans-1,2-Dichloroethene	ug/l	100	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tetrachloroethene (PCE)	ug/l	5	<0.50	**6.0**	**3.0**	**23**	**7.9**	**6.8**	**5.4**
Trichloroethene (TCE)	ug/l	5	<0.50	**0.79**	**0.52**	**7.5**	**7.1**	**3.0**	**6.3**
Total VOCs:	ug/l	--	**1.4**	**8.3**	**4.2**	**38**	**19**	**12**	**17**
Total Target VOCs:	ug/l	--	**--**	**6.0**	**--**	**31**	**15**	**6.8**	**12**

TABLE 1
SUMMARY OF WATER QUALITY DATA
ROOSEVELT IRRIGATION DISTRICT WELLS
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

WELL IDENTIFIER			RID-110	RID-111R[1]	RID-112	RID-113	RID-114
DATE SAMPLED			09/13/11	--	09/13/11	09/13/11	09/13/11
	Units	MCL					
1,1,1-Trichloroethane (TCA)	ug/l	200	<0.50	--	<0.50	<0.50	<0.50
Chloroform	ug/l	--	**3.3**	--	**3.2**	**2.6**	**1.8**
1,1-Dichloroethane (1,1-DCA)	ug/l	--	<0.50	--	<0.50	**0.93**	**2.6**
1,1-Dichloroethene (1,1-DCE)	ug/l	7	<0.50	--	**0.57**	**1.9**	**3.7**
1,2-Dichloroethane	ug/l	5	<0.50	--	<0.50	<0.50	<0.50
cis-1,2-Dichloroethene	ug/l	70	<0.50	--	**1.4**	**2.8**	**9.2**
trans-1,2-Dichloroethene	ug/l	100	<0.50	--	<0.50	<0.50	<0.50
Tetrachloroethene (PCE)	ug/l	5	**6.3**	--	**3.0**	**2.8**	**3.1**
Trichloroethene (TCE)	ug/l	5	**1.3**	--	**10**	**19**	**53**
Total VOCs:	ug/l	--	**11**	--	**18**	**30**	**73**
Total Target VOCs:	ug/l	--	**6.3**	--	**10**	**19**	**53**

EXPLANATION:

ug/l = micrograms per liter
MCL = Maximum Contaminant Level
VOCs = Volatile Organic Compounds
Target VOCs = Compounds at or above respective MCLs.
Shading indicates VOC concentration equals or exceeds respective MCL.
Analytical results are the most recently available from ADEQ.
[1] A replacement well for RID-111R was started up during June 2012, and therefore, no water quality data is available at this time.

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TABLE 2
MODIFIED ERA WELL FLOW RATES AND CONTAMINANT DATA
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

PHASE DESCRIPTION	WELL NAME	PUMPING RATE (gpm)[1]	TOTAL VOCs (ug/l)[2]	TOTAL TARGET VOCs (ug/l)[3]	ESTIMATED MASS OF TOTAL TARGET VOCs CAPTURED (pounds per year)[4]
PHASE 1 - PILOT WELLHEAD TREATMENT SYSTEMS INITIATIVE	RID-89	3,100	45	36	490
	RID-92	1,300	93	77	439
	RID-95	1,700	78	60	444
	RID-114	2,500	73	53	582
	TOTAL:	**8,600**	--	--	**1,955**
PHASE 2 - ADDITIONAL WELLHEAD TREATMENT SYSTEMS	RID-100	2,100	33	21	192
	RID-106	1,500	38	31	201
	RID-111R[5]	2,700	18	10	118
	RID-112	1,700	18	10	75
	RID-113	2,300	30	19	192
	TOTAL:	**10,300**	--	--	**778**
COMBINED PHASE 1 AND PHASE 2 MASS CAPTURED:					**2,733**

EXPLANATION:

RID = Roosevelt Irrigation District
gpm = gallons per minute
VOCs = Volatile Organic Compounds
ug/l = micrograms per liter
MCL = Maximum Contaminant Level
TCE = Trichloroethene
PCE = Tetrachloroethene
1,1-DCE = 1,1-Dichloroethene

[1] Phase 1 pumping rates are based on actual data obtained from wells in treatment mode. Phase 2 pumping rates are based on RID production data with an estimated 10% derating for future treatment system head losses. Pumping rate loss based on empirical data obtained during Phase 1 work.

[2] Sum of concentrations for all VOCs, including those VOCs currently below MCLs (see Table 1).

[3] Sum of concentrations for TCE, PCE and 1,1-DCE (where 1,1-DCE exceeds the MCL) (see Table 1).

[4] Mass removal assumes 100% duty for Phase 1 and Phase 2 wells.

[5] VOC concentrations for RID-112 assumed for RID-111R since water quality data are not available for the replacement well at this time.

TABLE 3
WELL BLENDING SUMMARY
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

RID WELL #	FLOW RATE[1] (gpm)	TARGET VOCs[2] TCE (ug/l)	TARGET VOCs[2] PCE (ug/l)	SALT CANAL BLENDING SUMMARY % Removal	SALT CANAL BLENDING SUMMARY TCE Presented as ug/l	SALT CANAL BLENDING SUMMARY PCE Presented as ug/l
105	1900	0.52	3.0	0	0.52	3.0
106	1500	7.5	23	100	0	0
107	2100	7.1	7.9	0	7.1	7.9
108	1900	3.0	6.8	0	3	6.8
109	2400	6.3	5.4	0	6.3	5.4
110	2900	1.3	6.3	0	1.3	6.3
111R[3]	2700	10	3.0	100	0	0
112	1700	10	3.0	100	0	0
113	2300	19	2.8	100	0	0
114	2500	53	3.1	100	0	0
RESULTING CONCENTRATIONS @ DISCHARGE TO MAIN CANAL:					**1.8**	**3.0**

EXPLANATION:

TCE = Trichloroethene
PCE = Tetrachloroethene
ug/l = micrograms per liter

[1] Flow rate for RID-114 is based on actual data. Other flow rates are based on RID production data with an estimated 10% derating to account for expected head losses.

[2] Analytical results are the most recently available from ADEQ.

[3] Water quality data for RID-111R estimated based on nearest upgradient well, RID-112.

7.8 Concentration is at or greater than Maximum Contaminant Level (MCL).

106 RID well equipped with wellhead treatment. Treatment will result in removal of TCE and PCE to non-detectable levels, which are assumed to be zero in this model.

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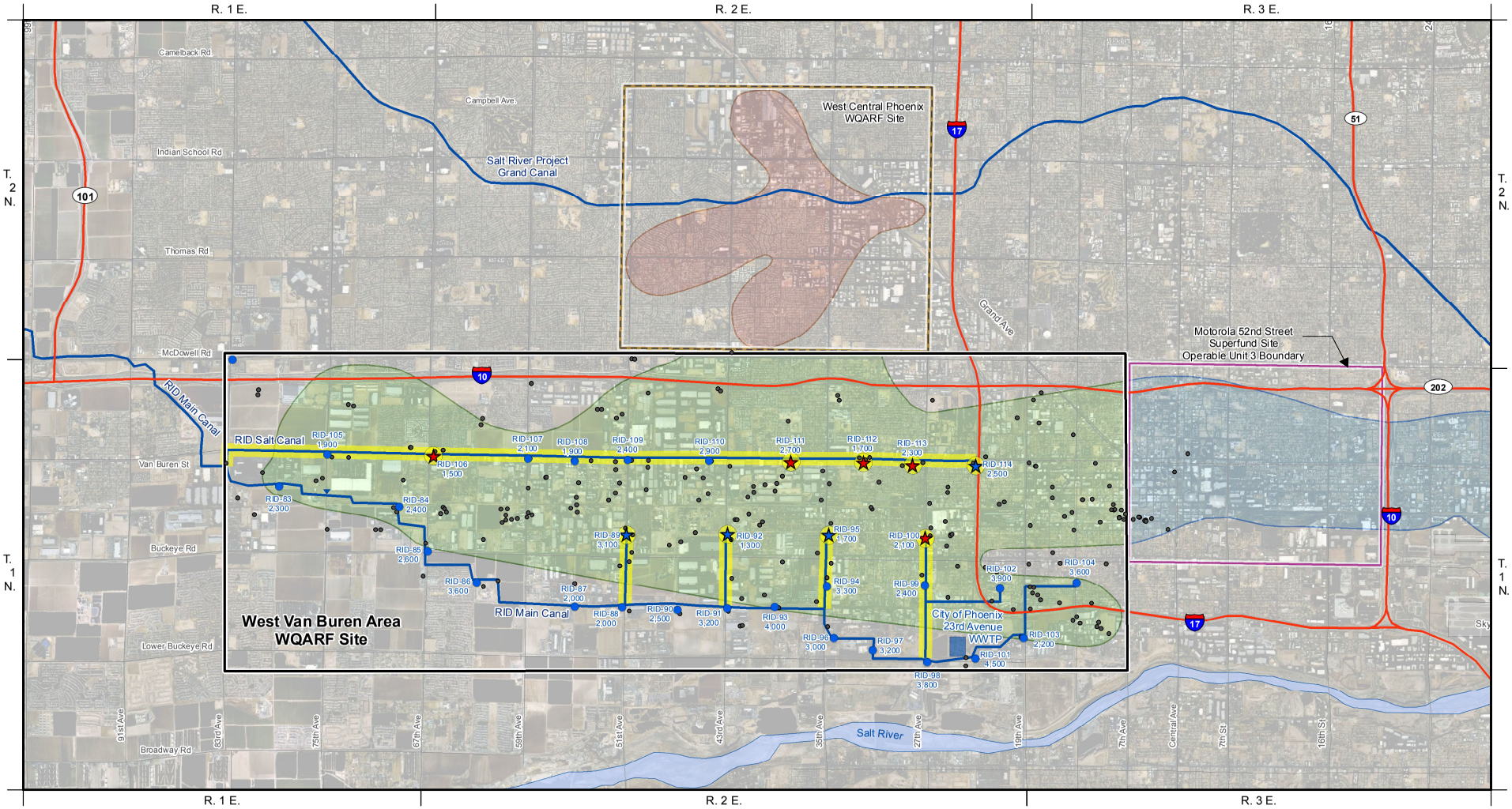
ILLUSTRATIONS



EXPLANATION

- Roosevelt Irrigation District Well
- RID-89 — Well ID
- 3,100 — Estimated Pumping Rate (gpm), [After Treatment Where Applicable]
- Monitor Well
- Phase 1 Early Response Actions
- Phase 2 Early Response Actions
- Existing Canal or Pipeline
- Interstates
- Local Streets

- Estimated Extent of Impacted Groundwater in WVBA WQARF Site Based 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
- Early Response Action (see Table 2 for a summary of phased implementation)

Abbreviations

WVBA - West Van Buren Area
WQARF - Water Quality Assurance Revolving Fund
WWTP - Waste Water Treatment Plant
RID - Roosevelt Irrigation District
gpm - Gallons Per Minute

N

0 5,000 Feet

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Roosevelt Irrigation District
Early Response Action Work Plan
West Van Buren Area WQARF Site

MODIFIED EARLY RESPONSE ACTION

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2012

FIGURE 14