

## **4.0 REMEDIAL INVESTIGATION ACTIVITIES**

The WCP East Grand Avenue WQARF Site RI included the advancement of soil borings, installation of monitor wells, groundwater monitoring, and aquifer testing. The objectives of the RI and field activities used to accomplish these objectives are discussed in the following sections.

### **4.1 OBJECTIVES OF THE RI**

The objectives of the RI were to:

1. Evaluate the lateral extent of VOCs in groundwater upgradient and downgradient from the VW&R facility and in the WCP East Grand Avenue WQARF Site.
2. Evaluate the concentration and distribution of VOCs in subsurface soils identified in previous investigations of the facility.
3. Characterize the physical properties of soils in the vadose zone and aquifer to evaluate their impact on contaminant migration.
4. Evaluate the vertical extent of VOC concentration in groundwater beneath and downgradient from the VW&R facility and in the WCP East Grand Avenue WQARF Site.
5. Evaluate the impact of groundwater extraction from the two SRP wells in the area on groundwater flow direction and contaminant distribution.
6. Provide data to construct a numerical groundwater flow and transport model to evaluate fate and transport of identified VOCs in the groundwater and the potential remedial alternatives to address that contamination.

Objectives 1 through 5 were accomplished during the RI. A numerical transport model was not constructed.

### **4.2 CURRENT FIELD ACTIVITIES**

Current RI activities were conducted in four phases: Phase III, Phase IV, Phase V, and Phase VI. Each phase is described in the following sections and a chronological summary of activities is presented in Table 4-1, which also includes a summary of activities from previous investigations. Evaluation and discussion of the analytical data collected during the current field activities can be found in Section 7.0.

Groundwater sampling activities were initiated after the Phase III monitor wells were installed in December 1999. Groundwater sampling was performed on a monthly basis for the first three months and then performed quarterly for the months thereafter. Monitor wells installed after December 1999 were also sampled monthly for the first three months and then incorporated into the quarterly sampling system. The groundwater monitor well network included monitoring wells within the VW&R facility boundaries, upgradient of the facility and downgradient of the facility. Figure 4-1 presents all wells sampled during the investigation and includes wells installed during each phase of the RI. Evaluation of the analytical results of collected groundwater samples are presented in Section 7.5.

Depth-to-groundwater data collected during the WCP East Grand Avenue WQARF Site RI have been used to calculate groundwater elevations. Groundwater elevations have been used to evaluate the direction of groundwater flow in the WCP East Grand Avenue WQARF Site and to determine the effects of groundwater pumping from the SRP wells. Groundwater elevation data are further discussed in Section 2.7 of this report.

#### **4.2.1 Phase III Field Activities**

Phase III activities conducted by WESTON included a vadose zone investigation on the VW&R facility and the installation and sampling of upgradient and downgradient monitor wells. Phase III activities were conducted from September 1999 through December 2000 and are summarized in Table 4-1.

##### **4.2.1.1 Vadose Zone Investigation**

A vadose zone soil investigation was performed at the VW&R facility to further assess the extent of VOC contamination detected during previous investigations at the facility. Ten soil borings, SB-8 through SB-17, were drilled within the boundaries of the VW&R facility (Figure 4-2).

###### **4.2.1.1.1 Soil Boring Location Rationale**

Soil boring locations were selected based on elevated concentrations of VOCs detected in soil and soil-gas samples collected during previous investigations. Borings SB-8 through SB-14

were advanced to depths ranging from 121 feet bgs to 127 feet bgs. Borings SB-15, SB-16 and SB-17 were advanced to depths ranging from 166 to 182 feet bgs to assess the vertical extent of VOC contamination.

#### **4.2.1.1.2 Lithologic Sample Rationale**

Lithologic samples were collected from each of the borings at 5-foot intervals with a split-spoon sampler driven ahead of a hollow stem auger (HSA). Lithologic information was recorded for each sample interval and headspace analyses were performed with an FID.

A maximum of ten lithologic samples were collected from each borehole for laboratory analyses of VOCs. Soil samples were collected from the split-spoon sampler using an Encore™ sampling device in accordance with the procedures detailed in Section 5.1 of the Field Sampling Plan (FSP) (WESTON, 2001a). The rationale for soil sample collection and analysis was to:

- Characterize near-surface soils, up to 10 feet bgs, in areas with suspected contamination to identify potential surface source(s) and to obtain near-surface soil data for risk assessment purposes.
- Evaluate zones where lateral migration potentially occurred from downward-migrating fluids (i.e., immediately beneath areas of coarse-to-fine lithologic transitions).
- Provide coverage of the entire lithologic column from the surface to the groundwater table.
- Assess zones immediately above the water table to evaluate the potential migration of VOCs from the water table into overlying sediments.

Eight soil samples were submitted for physical properties testing including grain size, moisture content, density, specific gravity, permeability, and total organic carbon.

#### **4.2.1.1.3 Hydropunch® Groundwater Sampling**

As part of the vadose zone investigation, a Hydropunch® sampler was advanced to groundwater and samples were collected. Borings SB-15 through SB-17 included the collection of additional groundwater samples from depth specific intervals below the water table. The groundwater samples were collected using the Hydropunch® method as described in Section 5.3 of the FSP

(WESTON, 2001a). These samples were collected to define the distribution of contaminants in shallow groundwater beneath the facility and in the WCP East Grand Avenue WQARF Site.

#### **4.2.1.2 Phase III Monitor Well Installation**

During Phase III of the RI, additional groundwater monitor wells were installed upgradient and downgradient of the VW&R facility to:

- Evaluate the limits of groundwater contamination identified in previous investigations.
- Assess the groundwater flow direction and gradient near the facility and in the WCP East Grand Avenue WQARF Site.
- Evaluate the vertical extent of VOC contamination downgradient from the facility.
- Provide wells with which to monitor changes in extent and concentration of VOCs with respect to time.

Field activities associated with the installation of Phase III wells included utility location, drilling, well development, depth-to-groundwater measurements and wellhead elevation surveying.

##### **4.2.1.2.1 Phase III Monitor Well Location Rationale**

Monitor wells were installed on the east, south, southwest, west, and north sides of the VW&R facility to evaluate the lateral extent of contamination and to evaluate groundwater flow (Figure 4-1). Prior to initiating Phase III activities, groundwater elevation data suggested the groundwater flow direction varied from southwest to northwest. The variation in directional flow was attributed to seasonal pumping in SRP Well 10.5E-7.5N (WESTON, 1998). In 1999, ADEQ and SRP reached an agreement to discontinue pumping from 10.5E-7.5N, 11.2E-7.7N, and other SRP wells in the WCP area. The hydraulic gradient described in each rationale below is based on the assumption that the SRP wells would not be pumped and groundwater flow direction is to the southwest.

**Monitor Well WCP-40** was installed on the COP right-of-way along 29<sup>th</sup> Avenue to the northeast of existing wells WCP-28 and WCP-29. The well is positioned hydraulically upgradient from the center of the VW&R facility to evaluate the upgradient extent of VOC

contamination in groundwater. The well also provides information to evaluate groundwater flow direction.

**Monitor Well WCP-41** was installed on the COP right-of-way along 29th Avenue, southeast of existing wells WCP-28 and WCP-29 and south of monitor well WCP-40. This well is positioned hydraulically crossgradient from the center of the VW&R facility. The purpose of this well is to provide information concerning static water levels to evaluate groundwater flow southeast of the VW&R facility.

**Monitor Well WCP-42** was installed on the Western Plastics Corporation property, approximately 110 feet south of Whitton Avenue. This well is positioned hydraulically crossgradient and northwest of the center of the facility. The purpose of the well is to provide information concerning groundwater flow direction data near the north portion of the facility and evaluate the northern limits of shallow groundwater contamination associated with the VW&R facility.

**Monitor Well WCP-43** was installed on the COP right-of-way near the corner of 28<sup>th</sup> Avenue and Whitton Avenue, east of well WCP-40. The purpose of this well is to provide groundwater level and flow direction information and to evaluate the upgradient water quality data.

**Monitor Well WCP-44** was installed on the COP right-of-way of Osborn Road near its intersection with Grand Avenue. The purpose of the well is to evaluate the lateral extent of VOC contamination in shallow groundwater southwest of the VW&R facility. The well also provides information concerning the groundwater flow direction in this area.

**Monitor Well WCP-45** was installed on the Shamrock Towing property west-southwest of well WCP-30. This well was positioned approximately downgradient of the VW&R facility, based on static water elevations calculated prior to its installation. This well was installed to evaluate the downgradient extent of VOC contamination associated with the VW&R facility.

**Monitor Well WCP-46** was installed on the Shamrock Towing property west-northwest of well WCP-30. The purpose of this well is to evaluate the northwestern extent of VOC contamination associated with the VW&R facility and provide groundwater elevation data.

**Deep Monitor Well WCP-48** was installed on the Shamrock Towing property approximately 20 feet north of WCP-45. The purpose of this well is to evaluate the vertical extent of VOC contamination associated with the VW&R facility. It is positioned approximately downgradient from the center of the facility.

#### **4.2.1.2.2 Phase III Hydropunch® Samples**

Hydropunch® samples were collected in each Phase III monitor well boring at or just below the water table prior to well installation.

During the installation of WCP-48, groundwater samples were collected at 30-foot depth increments to the total depth of the borehole using a Hydropunch® sampling device. Five groundwater samples were collected during drilling. The recovered groundwater samples were analyzed by Transwest Geochem, Inc. (Transwest) for specific VOCs using EPA Method 8260B.

#### **4.2.1.3 Phase III Lithologic Samples**

A lithologic log was created for each borehole drilled during Phase III RI activities from lithologic samples collected during the vadose zone investigation and groundwater monitor well installations. Soil samples were classified using the USCS in accordance with the American Society for Testing and Materials (ASTM) Standard Practice D2488. Lithologic descriptions were based on visual inspection of the soil for texture, color, moisture content, grain size distribution, and density. Soil descriptions were documented on lithologic logs for each borehole drilled during Phase III RI activities. Stratigraphic cross sections of the subsurface conditions beneath the VW&R facility and the WCP East Grand Avenue WQARF Site were developed from the boring logs to identify potential contaminant migration pathways. The results of the lithologic investigation were discussed in Section 2.5. Soil boring lithologic logs are provided in Appendix A.

#### **4.2.1.4 Phase III Groundwater Monitoring**

Phase III of the RI included six rounds of groundwater sampling beginning in December 1999 and ending in December 2000. The monitor well sampling network included monitor wells

WCP-15, WCP-16, WCP -17, WCP -28, WCP -29, and WCP -30 (all located within or directly adjacent to the VW&R facility), monitor wells WCP-40 through WCP-46, and monitor wells MWB-4, MWB-5, and MWB-6 located north of the UPS property (southwest of the VW&R facility) (Figure 4-1). Drinking water well MTP-1, located in the Michigan Trailer Park west of the VW&R facility, was added to the list of monitored wells during the second round of sampling. The EnecoTech monitor well, ENT-MW-2, located on the southern boundary of the Shamrock Towing property southwest of the VW&R facility, was added during the third round of monitoring. Deep monitor well WCP-48 was added to the list during the fifth round of groundwater sampling.

#### **4.2.2 Phase IV Field Activities**

The August 2000 technical memorandum documented the Phase III investigation results and concluded that additional upgradient and downgradient monitor wells were necessary to complete the delineation of VOC contamination in groundwater (WESTON, 2000). An aquifer pumping test was also recommended to evaluate aquifer characteristics. Phase IV activities included all recommendations contained in the August 2000 technical memorandum and were conducted from January 2001 through June 2001 (Table 4-1).

##### **4.2.2.1 Phase IV Monitor Well Installation**

Phase IV activities included the installation and sampling of nine additional groundwater monitor wells to further delineate the extent of VOC contamination. Other field activities included utility location prior to well placement, well development, depth-to-groundwater measurements, and wellhead elevation surveying.

###### **4.2.2.1.1 Phase IV Monitor Well Location Rationale**

Specific rationales for the placement of each Phase IV well are described below.

**Monitor Well WCP-47** was installed on the COP right-of-way along 31<sup>st</sup> Avenue. The purpose of this well is to evaluate groundwater quality and flow directions in the area. WCP-47 also acts as a sentinel well to evaluate the westward migration of VOC contamination associated with the

VW&R facility toward the SRP well and MTP-1, the drinking water well at Michigan Trailer Park.

**Monitor Well WCP-83** was installed in the COP right-of-way of 28<sup>th</sup> Avenue near the intersection of Osborn Road. This well is hydraulically crossgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality in the WCP East Grand Avenue WQARF Site.

**Monitor Well WCP-84** was installed in the COP right-of-way of 29<sup>th</sup> Avenue between Whitton Avenue and Osborn Road. This well is hydraulically crossgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the WCP East Grand Avenue WQARF Site.

**Monitor Well WCP-85** was installed on the northeast portion of the Hanson Pipe property near the Grand Canal and 27<sup>th</sup> Avenue. This well is hydraulically upgradient from the VW&R facility and is designed to monitor the groundwater elevations and groundwater quality within the eastern extent of the WCP East Grand Avenue WQARF Site.

**Monitor Well WCP-86** was installed on commercial property to the south of the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the southern extent of the WCP East Grand Avenue WQARF Site.

**Monitor Well WCP-87** was installed on the southern half of the Shamrock Towing property. This well is approximately downgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the WCP East Grand Avenue WQARF Site.

**Monitor Well WCP-88** was installed on a commercial property along 30<sup>th</sup> Avenue, south of Grand Avenue. This well is hydraulically downgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the southwestern extent of the WCP East Grand Avenue WQARF Site.

**Monitor Well WCP-89** was installed on a commercial property to the west of the UPS/Southwest Roofing property. This well is approximately downgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the western extent of the WCP East Grand Avenue WQARF Site.

**Monitor Well WCP-90** was installed on a commercial property on Weldon Avenue north of the Grand Canal. This well is designed to monitor groundwater elevations and groundwater quality within the northern extent of the WCP East Grand Avenue WQARF Site.

#### **4.2.2.1.2 Phase IV Lithologic Samples**

A lithologic log was recorded for each borehole drilled during Phase IV RI activities from lithologic samples collected during monitor well installations. Samples were classified using the USCS protocol in accordance with the ASTM Standard Practice D2488. Soil descriptions were documented on lithologic logs for each borehole drilled during Phase IV of the RI. Stratigraphic cross sections of the subsurface conditions beneath the VW&R facility and the WCP East Grand Avenue WQARF Site were developed from the boring logs to identify potential contaminant migration pathways. The results of the lithologic investigation were discussed in Section 2.5.

Nine soil samples were also submitted for physical properties testing. Analysis included grain size analysis, porosity, moisture content, density, specific gravity, total organic carbon, and permeability.

#### **4.2.2.2 Phase IV Groundwater Monitoring**

Phase IV of the RI included Rounds 7 through 10 of groundwater sampling beginning in February 2001 and ending in June 2002. The groundwater monitor well sampling network included the wells monitored during Phase III and monitor wells WCP-47 and WCP-83 through WCP-90 (Figure 4-1). Monitor wells MGL-1, MGL-2, and MGL-3, located on the southern portion of the Mogul property southwest of the VW&R facility, were added in the eighth round of monitoring.

### **4.2.2.3 Aquifer Pumping Tests**

The August 30, 2000 technical memorandum to the ADEQ that summarized the Phase III RI results recommended performing aquifer tests to further evaluate aquifer characteristics at the WCP East Grand Avenue WQARF Site.

In preparation for the aquifer testing, WESTON redeveloped monitor wells WCP-28 and WCP-29. Step-drawdown tests were conducted on May 10, 2001 on each of these wells. The tests involved recording the drawdown at each well while operating a submersible pump at several steady-state pumping rates. The data collected during the step drawdown test were used to design the aquifer pumping test.

The aquifer pumping test was conducted at monitor well WCP-29 on May 23, 2001. Monitor wells WCP-15, WCP-16, WCP-28, and WCP-84 were used as observation wells and monitor wells WCP-17 and WCP-42 were used as background wells. The details and results of the aquifer test are discussed in Section 2.7.3.

### **4.2.3 Phase V Field Activities**

Phase V field activities included the drilling and installation of seven shallow monitor wells to further assess groundwater quality within the WCP East Grand Avenue WQARF Site. Field activities associated with the installation of these monitor wells were initiated in June 2001 and included, but were not limited to, utility location for well placement, drilling, well development, depth-to-groundwater measurements, sampling, and well head elevation surveying (Table 4-1). Hydropunch<sup>®</sup> samples were collected from each borehole prior to well installation.

#### **4.2.3.1 Phase V Monitor Well Installation**

Phase V of the RI included the installation of monitor wells WCP-92 through WCP-98. Field drilling activities were conducted on July 2 through July 27, 2001.

##### **4.2.3.1.1 Phase V Monitor Well Location Rationale**

Specific rationales for the locations of the monitor wells are provided below.

**Monitor Well WCP-92** was installed in the COP right-of-way on Catalina Drive east of 31<sup>st</sup> Avenue. This monitor well is located hydraulically downgradient from the VW&R facility and Mogul facility. The placement of this monitor well was based on groundwater analytical results obtained from Mogul facility wells MGL-1 through MGL-3 (Figure 4-1). WCP-92 was installed to further assess the downgradient extent of VOCs detected in groundwater.

**Monitor Well WCP-93** was installed in the COP right-of-way on Osborn Road west of 29<sup>th</sup> Avenue. This monitor well is located near the southeastern portion of the property. Historical data indicated that the eastern property boundary was accessible by railcar and used for chemical distribution and offloading. This monitor well was installed to assess the dispersion of VOCs detected in groundwater beneath the VW&R facility and to monitor groundwater elevations.

**Monitor Well WCP-94** was installed in the COP right-of-way on 33<sup>rd</sup> Avenue north of Earll Drive. This monitor well is located hydraulically downgradient from the VW&R facility and was installed to further assess the downgradient extent of VOCs detected in groundwater.

**Monitor Well WCP-95** was installed in the COP right-of-way on Weldon Avenue west of 27<sup>th</sup> Avenue. This well is located hydraulically upgradient from the VW&R facility. Groundwater sample analytical results obtained from groundwater monitor wells WCP-43 and WCP-85 indicated concentrations of VOCs above the laboratory MDLs. Monitor well WCP-95 is positioned hydraulically upgradient from these monitor wells to assess the upgradient extent of VOCs detected in groundwater and to evaluate variations in groundwater elevations north of the canal.

**Monitor Well WCP-96** was installed in the COP right-of-way on 31<sup>st</sup> Avenue near the UPS facility. This well is located hydraulically downgradient from the VW&R facility and was designed to monitor groundwater elevations and assess the downgradient extent of VOCs detected in groundwater.

**Monitor Well WCP-97** was installed in the COP right-of-way on 28<sup>th</sup> Avenue south of Osborn Road. This well is located hydraulically crossgradient from the VW&R facility. This well was

designed to monitor groundwater elevations and to further assess the lateral extent of VOCs detected in the groundwater.

**Monitor Well WCP-98** was installed in the COP right-of-way on 26<sup>th</sup> Drive south of Osborn Road. This well is located crossgradient from the VW&R facility. This well was designed to monitor groundwater elevations and to further assess the lateral extent of VOCs detected in groundwater.

#### **4.2.3.1.2 Phase V Lithologic Samples**

Lithologic samples were collected at 5-foot intervals during the installation of the Phase V monitor wells. Samples were classified using the USCS protocol in accordance with the ASTM Standard Practice D2488. Stratigraphic cross sections of the subsurface conditions beneath the VW&R facility and the WCP East Grand Avenue WQARF Site were developed from the logs and analytical data to identify potential contaminant migration pathways. The results of the lithologic investigation were discussed in Section 2.5.

Fourteen soil samples were also submitted for physical property testing. Analysis included grain size, moisture content, density, permeability, porosity, and total organic carbon.

#### **4.2.3.2 Phase V Groundwater Monitoring**

Phase V of the RI included Rounds 11 through 13 of groundwater sampling beginning in July 2001 and ending in November 2001 (Table 4-1). The monitor wells sampled during Round 11 included all of the wells sampled in previous rounds with the addition of monitor wells WCP-92 through WCP-98 (Figure 4-1).

Passive diffusion bag (PDB) samplers were installed in nine wells prior to Round 12 groundwater sampling to test the feasibility of using PDB samplers in future studies and monitoring in the WCP East Grand Avenue WQARF Site. PDB samplers were installed in WCP-16, WCP-17, WCP-28, WCP-29, WCP-85, WCP-87, WCP-88, WCP-93, and WCP-94. Groundwater samples were collected during Round 12 from each of these wells using both the PDB sampling methodology and pump discharge sample methodology. Groundwater samples

were also collected from WCP-92, WCP-95, WCP-96, WCP-97, and WCP-98 during Round 12 using the pump only.

Due to high concentrations of benzene in ENT-MW-2, groundwater sampling of this well was discontinued during Round 13. All other monitor wells previously sampled were included in Round 13; however, a sample was not collected from WCP-15 during this round due to insufficient water in the well. The only additional monitor well added during this round was MWB-14, located north of the UPS property.

A second sampling port at MTP-1, designated MTP-2, was also added during Round 12. Both MTP-1 and MTP-2 designate groundwater samples collected from the one drinking water well located at the Michigan Trailer Park. MTP-2 was sampled from a spigot located on a building north of the MTP-1 wellhead. As in previous sampling rounds, the sample designated MTP-1 was collected from the spigot located at the wellhead. The Michigan Trailer Park sampling frequency was changed to monthly for both of these sampling ports.

#### **4.2.4 Phase VI Field Activities**

Phase VI field activities included the drilling and installation of seven shallow monitor wells. Field activities associated with the installation of these monitor wells were initiated in November 2001 and concluded in December 2001. Field activities included, but were not limited to, utility location for well placement, drilling, well development, depth-to-groundwater measurements, sampling, and wellhead elevation surveying (Table 4-1). Hydropunch<sup>®</sup> samples were collected from WCP-100 and WCP-200 prior to well installation.

##### **4.2.4.1 Phase VI Monitor Well Installation**

Phase VI of the RI included the installation of monitor wells WCP-99, WCP-100, and WCP-200 through WCP-204 (Figure 4-1). Field drilling activities were conducted on November 14 through December 17, 2001.

##### **4.2.4.1.1 Phase VI Monitor Well Location Rationale**

Specific rationales for the locations of the monitor wells are provided below.

**Monitor Well WCP-99** was installed on private property east of 27<sup>th</sup> Avenue and south of the Grand Canal. This well is located between SRP well 11.2E-7.7N and the VW&R facility and was installed to investigate possible additional sources of VOC contamination in groundwater.

**Monitor Wells WCP-100, WCP-200, and WCP-201** were installed on the VW&R facility property to replace existing monitor wells WCP-16, WCP-15, and WCP-17, respectively, due to declining groundwater elevations. WCP-15 was subsequently abandoned by Vopak. The remaining wells (WCP-16 and WCP-17) will be maintained for possible use as remedial SVE wells.

**Monitor Well WCP-202** was installed in the COP right-of-way south of the Grand Avenue frontage road on 30<sup>th</sup> Avenue. This well is located hydraulically downgradient from the VW&R facility and will assist in evaluating groundwater analytical data for the determination of a possible separation of contaminant plumes.

**Monitor Well WCP-203** was installed near the intersection of Weldon Avenue and Grand Avenue. This monitor well is located hydraulically upgradient from the Michigan Trailer Park drinking water well. This well investigates the potential upgradient sources that could impact the Michigan Trailer Park well.

**Monitor Well WCP-204** was installed in the COP right-of-way on 33<sup>rd</sup> Avenue. The placement of this monitor well was based on groundwater analytical data obtained from WCP-94 and is located hydraulically downgradient from the VW&R facility and monitor well WCP-94. WCP-204 further assesses the downgradient extent of VOCs detected in groundwater.

#### **4.2.4.1.2 Phase VI Lithologic Samples**

Lithologic samples were collected at 5-foot intervals during the installation of the Phase VI monitor wells. Samples were classified using the USCS protocol in accordance with the ASTM Standard Practice D2488. The results of the lithologic investigation were discussed in Section 2.5. No soil samples were submitted for physical properties testing during this portion of the investigation.

#### **4.2.4.2 Phase VI Groundwater Monitoring**

Phase VI groundwater sampling included Rounds 14 and 15 in addition to the monthly sampling of MTP-1 and MTP-2 (Table 4-1). Due to pump equipment failure, completion of Round 14 groundwater sampling was not possible. Monitor wells WCP-90, WCP-100, WCP-202, and WCP-204 were sampled. No other monitor wells were sampled during Round 14. Phase VI groundwater sampling activities began in December 2001 and ended in January 2002.

Monitor wells not included in Round 15 groundwater sampling were MGL-1, MGL-2, MGL-3, MWB-4, MWB-5, WCP-15, WCP-16, and WCP-17. As described in Section 4.2.4.1.1, WCP-100, WCP-200, and WCP-201 replaced WCP-15, WCP-16, and WCP-17. Previously sampled wells and the newly installed Phase VI monitor wells were sampled during Round 15.

In addition to groundwater sampling, pressure transducers were installed in monitor wells WCP-43, WCP-85, WCP-95, WCP-99, WCP-83, and WCP-97 to monitor groundwater levels and to assess the effects of infiltration water from the Grand Canal. Solinst<sup>®</sup> 3001 Mini LT Levelogger<sup>®</sup> pressure transducers were installed in December 2001. These pressure transducers provided information needed to evaluate the effect of the Grand Canal on flow and contaminant movement in the WCP East Grand Avenue WQARF Site area.

### **4.3 PERMITS AND UNDERGROUND UTILITY CLEARANCES**

WESTON obtained the necessary property access agreements, permits, and utility clearances as described in Section 4.1 of the FSP, prior to initiating field investigation activities (WESTON, 2001a). WESTON also reviewed COP maps for the location of storm sewers not included in the Blue Stake utility locate. COP right-of-way permits were issued to the ADEQ under the revocable permit #RP-91011.

### **4.4 GROUNDWATER ELEVATION AND WELL SURVEY DATA**

WESTON contracted private surveying companies to provide latitude and longitude, land surface elevation, and top of well casing elevation survey data for monitor wells installed during Phase III through Phase VI of the WCP East Grand Avenue WQARF Site RI. An Arizona registered

land surveyor conducted the surveying activities. The surveyors provided the horizontal data based on the Arizona Central Zone's North America Datum of 1927 (NAD27) State Plan Coordinate Grid and vertical elevations based on the National Geodetic Vertical Datum of 1929 (NGVD29) as currently used by the COP. All wells were surveyed in accordance with the requirements of the most recent *ADEQ Locational Data Policy (LDP) #0034.001, Level One*.

## **4.5 LABORATORY ANALYSES**

Laboratory analyses were performed on soil, Hydropunch<sup>®</sup> groundwater, and groundwater monitor well samples collected during the WCP East Grand Avenue WQARF Site RI. Soil and water samples of IDW were also collected and submitted for analysis. The following sections discuss the laboratories performing the analyses, analyses performed, the laboratory quality assurance/quality control (QA/QC) program, and the data validation methods employed during the investigation.

### **4.5.1 Analytical Laboratories**

All analytical laboratories subcontracted during the WCP East Grand Avenue WQARF Site RI were licensed by the Arizona Department of Health Services (ADHS) to perform each analysis requested. Laboratories subcontracted during the course of the investigation are listed below.

#### **4.5.1.1 Severn Trent Laboratories**

Hydropunch<sup>®</sup> (except for those collected during the deep well installation), groundwater, and soil samples collected during this RI were submitted to Severn Trent Laboratories–Chicago (STL) for analysis. The laboratory prepared a Level IV CLP equivalent data package for each sample delivery group (SDG), submitted to the laboratory. Results were also supplied in electronic format.

The data packages included a complete set of CLP forms or CLP equivalent forms for the sample results and the QC data package, plus copies of the completed chain-of-custody (COC) forms. The analytical data package included analytical results, blank sample results, both laboratory and

client sample identifications, appropriate dates, method reporting limits, method references, surrogate recoveries as appropriate, and the laboratory's name and address. The custody forms included the receipt of the sample and the laboratory's internal tracking. The QC data package included a tabular list of the laboratory's sample identification, spiking concentrations, recoveries, percentage calculations, and acceptance windows. Raw data provided included chromatograms, instrument print outs, injection logs, digestion/preparation logs, and standard logs.

#### **4.5.1.2 Transwest Geochem**

Hydropunch<sup>®</sup> samples collected during the installation of WCP-48 were analyzed by Transwest. The laboratory prepared Level III data packages, plus copies of the completed COC forms. The analytical package included analytical results, blank sample results, both laboratory and client sample identifications, appropriate dates, method reporting limits, method references, and matrix spike and blank spike results. Analytical results were also supplied in electronic format.

#### **4.5.1.3 ATL, Inc.**

Physical analyses of soils collected during the vadose zone investigation and Phase IV well installation were conducted by ATL, Inc. (ATL) of Phoenix, Arizona. Analyses included soil density (specific gravity), soil porosity, permeability, moisture content, total organic carbon, and grain-size analysis.

#### **4.5.1.4 Columbia Analytical Services, Inc.**

PDB samples collected during Round 12 groundwater sampling were submitted to Columbia Analytical Services, Inc. (Columbia) for analysis. The laboratory prepared Level IV data packages for each SDG submitted and results were also supplied in electronic format. The Columbia Level IV data packages included the same information as data packages received from STL as described in Section 4.5.1.1.

#### **4.5.1.5 Phoenix National Laboratories, Inc.**

Physical analyses of soil samples collected during the Phase V well installation were conducted by Phoenix National Laboratories, Inc. (PNL). Analyses included soil density (specific gravity), soil porosity, permeability, moisture content, total organic carbon, and grain-size analysis.

#### **4.5.2 Analytical Methods**

Methods selected to analyze samples collected during the WCP East Grand Avenue WQARF Site RI are specified in the Quality Assurance Project Plan (QAPP) (WESTON, 1999). Table 4-2 presents a summary of requested analyses by SDG for all samples submitted for chemical laboratory analysis.

##### **4.5.2.1 Groundwater Analyses**

Both monitor well and Hydropunch<sup>®</sup> groundwater samples were analyzed for VOCs using EPA Method 8260B. Round 6 groundwater samples from WCP-28 and WCP-29 were also analyzed for SVOCs using EPA Method 8270, as requested by ADEQ.

##### **4.5.2.2 Soil Analyses**

Soil samples were analyzed for VOCs using EPA Method 8260B. Soil samples were preserved and/or extracted according to the ADEQ requirements for the implementation of EPA Method 5035. Selected lithologic samples collected from borings during the vadose zone investigation and Phase IV well installation were also tested for physical properties including:

- Soil density (specific gravity)—ASTM D-2937.
- Soil porosity—EPA Method 9100.
- Moisture content—ASTM D-2216.
- Total organic carbon—Walkley-Black method.
- Grain-size analysis—ASTM D-422.
- Permeability—ASTM D-2434.

### 4.5.2.3 IDW Analyses

All composite soil samples were analyzed for VOCs in accordance with EPA Method 8260B and 13 priority pollutant metals in accordance with EPA Methods 6010B and 7471A. Select soil composite samples were also analyzed for ignitability in accordance with EPA Method 1010 and paint filter in accordance with EPA Method 9095 to further characterize soil IDW. Paint filter and flashpoint were added to the list of requested analyses for soil IDW following the deep well installation. Composite IDW groundwater samples were analyzed for VOCs in accordance with EPA Method 8260B, 13 priority pollutant metals in accordance with EPA Method 200.7/245.1 or EPA Method 6010B/7470, and pH in accordance with EPA Method 9041.

### 4.5.3 Data Quality Assessment

The quality of analytical data was assessed through validation. Quality by Design (QBD), a third party data validation company, completed data validation on groundwater and soil analytical packages completed by STL. Analytical results for IDW samples, WCP-48 Hydropunch<sup>®</sup> samples submitted to Transwest, and PDB samples submitted to Columbia were not validated by QBD. Results of physical testing analysis done on soil samples collected during the vadose zone investigation, Phase IV, and Phase V well installations were also not validated by QBD. Results of the data quality assessments are presented in Section 6.0.

#### 4.5.3.1 Data Validation Methods

Data validation was performed according to the guidelines found in the following documents:

- *Functional Guidelines for Evaluating Organics Analyses*, EPA, revised 1994.
- *Remedial Investigation/Feasibility Study Quality Assurance Project Plan, Van Waters and Rogers Facility*, WESTON, September 1999.
- Criteria listed in the referenced method.

Data validation performed by QBD also included the following steps:

- Comparison of electronic data deliverables (EDDs) with the laboratory's hard copy report for consistency and accuracy.

- Review of the COC associated with each SDG to ensure all samples listed on the COC form were reported in the laboratory deliverables, that a date and time of sampling were provided, and that the sample custody trail was complete. Sample condition upon receipt was also reviewed to determine that the samples were not compromised during shipping.
- Review of appropriate documentation to ensure all samples were properly preserved and analyzed within technical holding times and that no deviations from proper handling and identification occurred.