APPENDIX M

PROCEDURES USED FOR WELL INSTALLATION AND GROUNDWATER, NAPL, SOIL AND SOIL GAS SAMPLING

APPENDIX M

PROCEDURES USED FOR WELL INSTALLATION AND GROUNDWATER, NAPL, SOIL AND SOIL GAS SAMPLING AT THE 7th STREET AND ARIZONA AVENUE WQARF SITE

WELL INSTALLATION PROCEDURES

Perched Groundwater Wells

Monitoring wells for the perched groundwater were installed using an auger rig or an air rotary casing hammer (ARCH) system with a tri-cone drill bit (Kleinfelder and HGC, 2003; HGC, 2007; 2008). 10-inch diameter boreholes were advanced to depths of 90 to 100 feet bgs. Soil was sampled at 5- or 10-foot intervals for lithologic characterization. Except at monitoring wells 7AZP-11 and 7AZP-12, a portion of each sample was placed in a resealable plastic bag and analyzed with a photoionization detector (PID) for VOC screening after allowing the soils to volatilize for several minutes. The soils were classified in accordance with American Society of Testing and Materials (ASTM) D 2488. Drill cuttings were contained in roll-off bins at the drilling site.

Monitoring wells 7AZP-1 through 7AZP-4 were constructed using 4-inch diameter Schedule-80 polyvinyl chloride (PVC) casing and 0.02-inch slotted screen (Kleinfelder and HGC, 2003). The other monitoring wells in perched groundwater were constructed using 4-inch diameter Schedule-40 PVC casing and 0.02-inch slotted screen (HGC, 2007, 2008). Wells were installed in 10-inch boreholes with a silica sand filter pack (U.S. Standard Sieve No. 10-20 grade silica sand) around the screened interval, followed by fine transition sand, and hydrated bentonite chips. The remaining annular space was filled with a cement-bentonite grout to within 2 to 10 feet of the land surface. All wells were completed below grade and protected with a flush-mounted, traffic-rated well vault.

Regional Aquifer Wells

Monitoring wells for the regional aquifer were installed using an ARCH system with a tri-cone drill bit to approximately 90 feet (Kleinfelder and HGC, 2003; HGC, 2007). A 10-inch steel conductor casing was installed to prevent the perched groundwater from contaminating the regional aquifer. The conductor casing was tremie grouted in place with cement and the drive casing was removed from the borehole simultaneously with the injection of the cement. After the

cement had hardened overnight, a boring was advanced through the cement plug using the ARCH method to a total depth of about 200 ft bgs. Grab samples were collected at 5- or 10-foot intervals.

Regional aquifer monitoring well 7AZR-1 was constructed using 4-inch diameter Schedule-80 PVC casing and 0.02-inch slotted screen (Kleinfelder and HGC, 2003). The monitoring wells for the remaining regional aquifer wells were constructed using 4-inch diameter Schedule-40 PVC casing and 0.02-inch slotted screen (HGC, 2007, 2008). The filter pack (U.S. Standard Sieve No. 10-20 grade silica sand) was slowly poured to fill the annular space between the borehole and the screen. The remainder of the annular space was tremie grouted to near the land surface with a slurry of Portland cement and 5 percent bentonite powder (dry weight). The upper section was filled with cement. The regional aquifer monitoring wells were completed below grade (i.e., flush mount) with an air-tight expanding casing plug in a traffic-rated vault.

Well Development

Groundwater monitoring wells were developed utilizing methods that included a combination of surging, bailing and/or pumping (HGC, 2007, 2008). Well development continued until the development water was clear or removal of at least 15 casing volumes of groundwater was achieved. All development water was placed in a portable water tank and discharged into the municipal sewer under permit with Pima County Waste Water Management.

Nested Vapor Wells

Nested vapor wells were installed using an auger rig. Three wells, or probes, were installed within each borehole, at depths of approximately 45 ft bgs, 30 ft bgs and 15 ft bgs. The probes consisted of 1-inch diameter PVC casings with a 1-foot long machine-cut slotted screen (0.020-inch slot size). The screened interval was bedded in U.S. Standard Sieve No. 10-12 sand to approximately 18 inches above the screen. The annular space was grouted above the sand pack to the bottom of the next probe. The nested wells were completed at the surface with a traffic-rated vault.

GROUNDWATER SAMPLING PROCEDURES

Groundwater Level Measurements

Depth to water and LNAPL thickness measurements were collected from perched groundwater monitoring wells from 2002 to 2013 using a Solinst oil/water interface probe, capable of

measuring water and product levels to ±0.01 foot. Water levels in the regional wells were made using a Slope Indicator water level sounder capable of measuring to ±0.01 foot. The water depth was measured to a reference point on the north side of the top of the well casing. Water level measurements were used to evaluate the direction of groundwater flow, as well as the gradient.

Groundwater levels were collected as described in Appendix A.1 of the RI/FS Work Plan (HGC, 2013). Water level data were converted to groundwater elevations using measuring point top of casing well elevations.

Perched Groundwater Well Sampling

Purging and Geochemical Parameters

Well purging, monitoring of stability indicator parameters and groundwater sampling were conducted as prescribed in the RI/FS Work Plan (HGC, 2013). Samples were collected first from wells with no measurable LNAPL, followed by wells containing LNAPL. Wells without LNAPL were generally sampled in order of increasing VOC concentration, as determined from the previous round sampling results. This was repeated for the wells containing LNAPL.

The perched groundwater wells were purged to remove stagnant water from the casing using a low-flow bladder pump. The pump was set at approximately 5 feet below the static water level. Temperature, pH, electrical conductance, oxidation-reduction potential, and dissolved oxygen content were measured with a YSI Professional Plus with a flow-through cell at 5- to 10-minute intervals until three successive measurements were within the stability parameter established criteria (HGC, 2013). Turbidity was also measured. Field records of previously unreported measurements are found on the groundwater sampling forms provided as Appendix D.

Perched groundwater wells with measurable LNAPL were purged using protective casing to enable the pump to be lowered into the groundwater without contacting LNAPL. These wells were sampled after the non-LNAPL wells in order of increasing VOC concentration. A 2-inch, PVC casing (“stinger”), capped on the bottom with aluminum foil to enable the sampling pump to be lowered into the groundwater without passing directly through the LNAPL layer, was used to sample the LNAPL wells.

Groundwater Samples

Groundwater samples were collected from the low-flow bladder pump discharge tubing at each of the wells after purging was completed. Samples were collected in three 40-milliliter (mL)

vials with Teflon-lined caps using hydrochloric acid as a preservative for analysis by EPA Method 8260B. The vials were tilted during sample collection to minimize agitation of the sample and mitigate loss of volatile constituents. After capping, the vials were checked to ensure that no bubbles were entrained in the sample. Groundwater samples for geochemical analysis were collected in the appropriate laboratory-supplied bottles. All groundwater samples were labeled with the well name from which the sample was collected (i.e. 7AZP-1) and placed in a cooler with ice to maintain the samples at approximately 4 degrees Celsius (ºC) and accompanied by a trip blank, temperature blank, and Chain-of-Custody form inside the cooler.

Samples were delivered under Chain-of-Custody documentation to a laboratory certified by the Arizona Department of Health Services. Groundwater samples were analyzed for VOCs by EPA Method 8260B, inorganics and geochemical parameters by EPA Method 300.0 and EPA-approved SM 2320B, SM 5310B, and RSK-175.

Regional Aquifer Well Sampling

Regional groundwater sampling was conducted at the Site from 2002 to 2012 using conventional purge and sample techniques. A subcontracted driller performed the well purging using a variable speed pump attached to a flow-through cell to monitor groundwater field parameters. Water level drawdown, pumping rate, and field parameters were monitored and recorded approximately every 5 minutes. When field parameters were stable, as specified in the RI/FS Work Plan (HGC, 2013), groundwater samples were collected directly from the discharge of the pump into 40-milliliter (mL) vials with Teflon-lined caps using hydrochloric acid as a preservative for analysis by EPA Method 8260B. To limit disturbance of the sample, the vials were tilted to allow the sample to gently flow down the side. VOA vials were filled until the convex surface of the sample liquid protrudes from the mouth of the vial (reverse meniscus).

All groundwater samples were labeled with the well name and placed in a cooler with ice to maintain the samples at approximately 4 ºC. Samples were accompanied by a trip blank and temperature blank, and were delivered under Chain-of-Custody documentation to an Arizona-certified laboratory for analysis by EPA Method 8260B.

LNAPL SAMPLING PROCEDURES

LNAPL sampling was performed from 2002 to 2012 as described in the RI/FS Work Plan (HGC, 2013). Samples of the floating LNAPL were collected from the designated wells after groundwater sampling was complete to avoid mixing the LNAPL with groundwater prior to

sampling. LNAPL sampling was accomplished using a weighted, disposable bailer that was lowered into the well until the top of the bailer was just below the surface of the LNAPL, as determined during fluid-level measurement. The bailer was removed from the well and any aqueous phase liquid was drained from the bottom tap of the bailer.

A sample of the LNAPL was placed in a clean 40-milliliter VOA vial supplied by the analytical laboratory. The sample was transferred from the bottom tap on the bailer to the vial and allowed to flow gently down the tilted side of the vial to minimize disturbance of the sample. VOA vials were filled until the convex surface of the sample liquid protrudes from the mouth of the vial (reverse meniscus).

Filled VOA vials were capped immediately and checked for air bubbles. If bubbles were found, the vial and its contents were discarded and a fresh VOA vial was used to collect another sample from the discharge. The vials were labeled, placed in a plastic resealable bag, and stored on ice in a cooler immediately after sample collection was completed. LNAPL samples were kept completely separate from the groundwater samples to avoid cross-contamination. Samples were submitted, under Chain-of-Custody, to an Arizona-certified laboratory for analysis of VOCs by EPA Method 5035/8260B (as oil).

SOIL SAMPLING PROCEDURES

Soil Sampling from 7AZP Boreholes

In 2002, perched groundwater well borings at locations 7AZP-2, 7AZP-3 and 7AZP-4 were drilled using hollow stem augers and sampled every 5 feet to a target total depth of 85 ft bls using a split spoon sampler. The regional aquifer soil boring at location 7AZR-1, drilled using an air-rotary casing rig, was sampled every 5 feet from 95 ft bls to 200 ft bls. Soil samples were collected only below the aquitard in this boring. The recovered soil samples were obtained in pre-cleaned brass sleeves. Soil samples were screened by headspace analysis for evidence of organic vapors using a handheld PID. The end of the center sleeve covered with the most soil was identified for laboratory sub-sampling and analysis. The two ends of the brass sleeve were covered with Teflon sheeting, plastic caps and then sealed to the sleeve with polyethylene adhesive tape to minimize vapor exchange.

The sample name, collection time, and date was recorded with permanent black marker on the brass sleeve. The sealed sleeve was placed in a zip-lock bag, stored on ice in a cooler until delivery to the analytical laboratory. The samples were transported under Chain-of-Custody

protocol to Turner Laboratories, Inc., of Tucson, Arizona for analysis of VOCs by Method 8260AZ.

One sample from each borehole showing no indication of VOCs (based on field screening) closest to 30 ft bls in the perched groundwater and 130 ft bls in the underlying regional aquifer zone was submitted for Total Organic Carbon (TOC) analysis by leach method SW 9060. Turner Laboratories submitted these samples to SPL Laboratories of Houston, Texas, a sub-contracted laboratory (Kleinfelder and HGC, 2003).

Soil Sampling from OC-1 Borehole

Twelve soil samples were collected at 5-foot intervals from soil boring OC-1 from 5 to 60 feet bls in 2006. Soil samples were submitted for laboratory analysis to Environmental Science Corporation in Mt. Juliet, Tennessee. All twelve samples were subjected to testing for gasoline range and diesel range TPH using Method 8015AZ. The samples were also analyzed for PAHs using EPA Method 8310. Samples from depths of 45 and 55 feet bls were analyzed for Resource Conservation and Recovery Act (RCRA) metals using EPA Method 6010 for arsenic, barium, cadmium, chromium, lead, selenium, and silver and EPA Method 7471 for mercury.

SOIL GAS SAMPLING PROCEDURES

Passive Soil Gas Sampling

A passive soil gas survey was conducted in 2002. Twenty-six passive soil gas sampling modules (GORE-SORBER® Screening Modules) were installed on a 44-foot grid interval at depths of 2- to 3-feet bgs. Installation and retrieval procedures are detailed in Kleinfelder and HGC (2003). Upon retrieval, each module was immediately placed into a volatile organic analysis (VOA) vial, packed with trip blanks and shipped to W.L. Gore & Associates of Elkton, Maryland for analysis of VOCs by Modified EPA Method 8260.

Soil Vapor Well Sampling

Soil vapor samples were collected from nested vapor probes and groundwater wells across the Site from 2002 to 2012 in accordance with ADEQ *Soil Vapor Sampling Guidance* (ADEQ, 2008) and the RI/FS Work Plan (HGC, 2013). Prior to sampling monitoring wells, depth-to-water was measured and recorded. During sampling, weather conditions, sampling depth, purge volumes, volume of vapor extracted, sample containers used, vacuum before and after collection, and other observations were recorded.

Groundwater monitoring wells and soil vapor probes were fitted with a gas-tight, no-glue wellhead sampling port and valve at the surface and purged prior to sample collection to ensure a representative sample. At least three casing volumes of soil vapor (based on probe depth or monitoring well depth-to-water) was purged from the probe or well using a 1-HP rotary vane air purge pump, or another air pump capable of pumping at a rate of at least 0.5 standard cubic feet per minute (scfm) while under a vacuum of 26 inches of Hg. The vacuum on the well/probe at the soil vapor sampling port was observed so that it did not exceed 5 inches Hg during purging (a flow rate of 200 ml per minute is typical), to minimize air infiltration through the ground surface during sampling. The effluent soil vapor from the purge pump was monitored using a portable PID during purging. After purging, soil vapor samples were collected in SUMMA® canisters. After sample collection, canisters were properly packed and shipped under Chain-of-Custody to a certified Arizona laboratory for analysis of VOCs by EPA Method TO-15.

Shallow Soil Gas Sampling

Shallow soil gas sampling was conducted in May 2013. Prior to drilling, a Bluestake survey was conducted at the work site to clear it of underground utility conflicts. A private utility locator surveyed for privately-owned utilities over the entire source property.

Enviro-Drill Inc, the subcontracted driller, used a Simco Earthprobe 200 push probe rig equipped with a 0.02 slot stainless steel screen and drive point for driving a decontaminated 3/4" soil gas probe. At each drive point location, new ¼" polyethylene tubing was attached just above the screen and brought to the sampling equipment above land surface. The tubing was attached to a vacuum purge pump capable of producing a vacuum of 25" Hg. Soil gas flow was controlled using a rotameter with flow rates ranging between 0.25 and 2 liters per minute (L/min). Each probe was purged at approximately 1 L/min while exhaust gases were monitored using a PID. After a maximum PID reading was reached, a soil gas sample was collected in a 1 liter Summa canister equipped with a 5 minute flow controller. Twelve soil gas samples were collected from across the source property from a depth of around 5 feet bls at 11 locations and from a depth of 10 feet bls at one location, the latter location chosen based on maximum PID concentrations. Summa canister samples were shipped to the analytical laboratory, Airtech Environmental Inc., under Chain-of-Custody for analysis by EPA Method TO-15 with a 72-hour turnaround time.

REFERENCES

ADEQ. 2008. Soil Vapor Sampling Guidance. July 10. Revised May 19, 2011.

Hydro Geo Chem, Inc. (HGC). 2007. Monitor Well Installation Report, 7th Street and Arizona Avenue WQARF Site, Tucson, Arizona. June 8, 2007.

HGC. 2008. Monitor Well Installation Report, 7th Street and Arizona Avenue WQARF Site, Tucson, Arizona. January 21, 2008.

HGC. 2013. Remedial Investigation/Feasibility Study Work Plan, 7th Street and Arizona Avenue WQARF Site, Tucson, Arizona. March 8, 2013.

Kleinfelder and HGC. 2003. Early Response Action Evaluation Report, 7th Street and Arizona Avenue Water Quality Assurance Revolving Fund (WQARF) Site Tucson, Arizona. July 2003.