Herman Kishner Trust B-1 and Maryland Square Shopping Center L.L.C.

FINAL GROUNDWATER MONITORING PLAN

Maryland Square PCE Site,
Las Vegas, Nevada
Facility ID No. H-000086
Version 1.0

August 5, 2016

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ACRONYMS AND ABBREVIATIONS

Arcadis	Arcadis U.S., Inc.
bgs	below ground surface
~~COC~~	~~chain of custody~~
EPA	United States Environmental Protection Agency
ft	foot or feet
HCl	hydrochloric acid
ml	milliliter
NDEP	Nevada Division of Environmental Protection
PCE	tetrachloroethene
QA/QC	quality assurance and quality control
TCE	trichloroethene
VOA	volatile organic analysis
VOC	volatile organic compound

1 INTRODUCTION

On behalf of Herman Kishner Trust B-1 and Maryland Square Shopping Center L.L.C., Arcadis U.S., Inc. (Arcadis) has prepared this *Draft Groundwater Monitoring Plan, Maryland Square PCE Site, Las Vegas, Nevada, Facility ID No. H-000086* (Monitoring Plan). The Monitoring Plan presents a monitoring schedule and monitoring method for wells associated with the Maryland Square Tetrachloroethene (PCE) Site (the Site).

The Site is composed of PCE-impacted soil and groundwater on the former Maryland Square Shopping Center property, located at 3661 South Maryland Parkway, Las Vegas, Nevada, and an off-site plume of PCE-contaminated groundwater. The location of the source area is shown on Figure 1, and well locations are shown on Figure 2.

2 OBJECTIVES

The objectives of this Monitoring Plan are to outline:

- a network of wells for quarterly groundwater level measurements,
- a network of wells, schedule, and suite of analyses for groundwater sampling,
- a no-purge groundwater sampling method, and
- a framework for evaluating no-purge data.

3 GROUNDWATER MONITORING PLAN

3.1 Background

The current quarterly groundwater sampling program includes a site-wide monitoring event in the first quarter, and slightly reduced events during the second, third, and fourth quarters. The monitoring well networks sampled during the second, third, and fourth quarters are “based on the relative PCE concentrations detected in individual monitoring wells in addition to the proximity of the monitoring well to the ascertained plume area” (Cardno ATC 2014).

The current groundwater monitoring plan was proposed in the *First Quarter 2016 Groundwater Monitoring and Sampling Report* dated April 18, 2016 (ATC 2016) and concurred to by the Nevada Division of Environmental Protection (NDEP) on April 28, 2016. This Monitoring Plan proposes to continue the NDEP-approved schedule for sampling site wells, and to expand the network of monitoring wells in which water levels are measured on a quarterly basis. This Monitoring Plan also proposes to use no-purge sampling methods to collect groundwater samples, and proposes a strategy for evaluating the data collected by no-purge sampling methods.

3.2 Monitoring Well Networks and Monitoring Frequency

3.2.1 Water Level Measurements

Water levels will be measured on a quarterly basis at site monitoring wells identified in Table 1 and shown on Figure 3. Water levels will be measured with a water level meter or interface probe to the nearest 0.01 foot (ft), following standard operating procedures included in Appendix A. Water level data will be stored in an electronic database following collection and included in groundwater monitoring reports. The data will be used to create groundwater elevation contour maps, which will be submitted in the groundwater monitoring reports.

3.2.2 Groundwater Sampling

The proposed quarterly groundwater sampling networks and schedule are presented in Table 1 and shown on Figures 4 through 6. The quarterly groundwater sampling networks are generally consistent with networks proposed in the *First Quarter 2016 Groundwater Monitoring and Sampling Report* dated April 18, 2016 and concurred to by NDEP on April 28, 2016.

The most notable change is the removal of MW-40CMT (also known as CMT-1) from the quarterly groundwater sampling networks. MW-40CMT is a multi-port groundwater monitoring well constructed with a continuous multi-channel tubing system. The multi-channel tubing system allow samples to be collected from seven separate screened intervals, located at depths of approximately 30, 35, 40, 45, 50, 55, and 60 feet below ground surface (ft bgs). The deepest port, MW-40CMT-60, has been blocked since 2012 (Tetra Tech 2013). Due to the small diameter of the tubing, the remaining ports cannot be sampled via no-purge methods. Arcadis proposes to remove MW-40CMT from the groundwater sampling network, and to replace it with nearby wells MW-20D1 and MW-20D2, which are screened from 24 to 45 and 55 to 65 ft bgs, respectively.

3.3 No-Purge Groundwater Sampling Method

No-purge groundwater sampling with HydraSleeve™ samplers (HydraSleeves) has been shown to produce comparable datasets to low-flow sampling methods (Parsons 2005). HydraSleeves are “no-purge” groundwater samplers that do not require groundwater monitoring wells to be purged prior to sample collection.

A HydraSleeve is made of a thin plastic tube, with a length of 30 inches (for 2-inch diameter wells) or 38 inches (for 4-inch diameter wells). The tube is tied or sealed at the bottom, and has a one-way reed valve at the top. The HydraSleeve is lowered into a well to an appropriate sampling depth, and the well is then allowed to equilibrate (ITRC, 2007)

After equilibration, a groundwater sample is collected by pulling the HydraSleeve upward. The upward motion causes the reed valve to open, allowing the HydraSleeve to fill with groundwater. Once the HydraSleeve is full the reed valve closes so that no water can enter or leave the sampler. Because of the action of the reed valve, the depth from which a HydraSleeve collects water is known (ITRC, 2007). Detailed site-specific procedures for deployment (placement of a HydraSleeve in a monitoring well) and retrieval (collection of a groundwater sample) are presented below.

3.3.1 Groundwater Sampling with HydraSleeve™ Samplers

HydraSleeves will be used in general accordance with the manufacturer's *Standard Operating Procedures: Sampling Groundwater with a HydraSleeve* (Appendix B), but with the addition of appropriate site-specific modifications. The HydraSleeves will be deployed so that the samplers collect water from the specific low-flow sampling depths reported in the *First Quarter 2016 Groundwater Monitoring and Sampling Report* (ATC 2016). These depths are presented in Table 2.

According to the manufacturer, a HydraSleeve will fill completely when pulled a distance equal to its length (GeoInsight 2016a). Therefore, to target the reported sample depth, the top of a HydraSleeve will be deployed at a depth of approximately one-half its length below the sampling depth. The deployment depth will be rounded to the nearest foot or half-foot. In rare instances the distance between the sample depth and the bottom of the well will be less than the length of the HydraSleeve. In such instances the HydraSleeve may be manually shortened to the length specified in Table 2 and/or deployed with a top weight to compress the sleeve.

The HydraSleeves will be allowed to rest in the wells for a sufficient period of time to allow groundwater in the monitoring well to return to pre-deployment conditions. According to the manufacturer, any stratification in a well column should return to pre-deployment conditions in 48 hours (GeoInsight 2016b).

To promote high-quality groundwater samples, Arcadis proposes to allow each HydraSleeve to rest for a minimum of 10 days before sampling. This value is based on the maximum estimated residence time of groundwater within the screened interval of the site monitoring wells (the "flushing time"). Flushing times were calculated for each well (Appendix C), using site-specific hydraulic conductivity values of 0.4 to 9.4 ft per day (Tetra Tech 2013) and a hydraulic gradient of 0.0131 ft per ft (ATC 2016). The calculated flushing times ranged from 3.7 hours to 7.3 days. The proposed 10-day resting period is significantly more conservative than either the manufacturer's guideline (of 48 hours) or the maximum calculated site-specific flushing time (of 7.3 days).

3.3.2 Groundwater Analyses

Groundwater samples will be collected from the HydraSleeves for analysis of volatile organic compounds (VOCs), including PCE, trichloroethene (TCE), 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride. The VOC analyses will be conducted by a Nevada-certified environmental laboratory using United States Environmental Protection Agency (EPA) Method 8260B.

After groundwater samples have been collected from the HydraSleeves for laboratory analyses, the following water quality parameters will be measured in situ at each sampled monitoring well: temperature, pH, specific conductance, dissolved oxygen, oxidation-reduction potential, and total dissolved solids. These field analyses will be conducted using an In-Situ SmarTROLL (or equivalent) multi-parameter meter in accordance with the manufacturer's standard operating procedures. The meter will be lowered in the well to the applicable "Low-flow sampling depth" shown in Table 2. It will be allowed to rest in the well for approximately five minutes before measurements of water quality parameters are collected.

Arcadis anticipates that water quality parameters will be measured in-situ at most or all sampling locations. However, if the meter cannot be lowered to the target depth at a given location, then water quality parameters will be measured at the surface. The capacity of a HydraSleeve is greater than the volume required for sampling, so some water should remain in each HydraSleeve after the laboratory containers have been filled. This residual water will be transferred from the HydraSleeve to a clean plastic container with a capacity of approximately 400 ml; the meter will then be inserted into the plastic container to collect water quality measurements. The sampling field records will note that water-quality parameters were measured at the surface. This procedure will have no effects on the laboratory samples, since it will be conducted only after all laboratory containers have been filled, as noted above,

Groundwater samples will not be collected or analysed for arsenic, chromium, chromium VI, or manganese. Analysis for metals in the vicinity of the 2012 injection tests (Tetra Tech 2013) was formerly required by a Short-Term Underground Injection Control General Permit GU07RS-52020. However, this permit was terminated in September 2013. Arcadis therefore proposes to cease analysis for these metals.

3.4 No-Purge Groundwater Sampling Transition

There is inherent variability in the groundwater analytical data, regardless of the sampling method. Sources of variability in groundwater analytical data may include, but are not limited to, attributes of the groundwater monitoring well, weather, groundwater level, and seasonality in contaminant concentrations. Arcadis proposes to evaluate variability and trends in historical groundwater data for each sampled site monitoring well in the forthcoming quarterly groundwater monitoring reports. Arcadis proposes to include the forthcoming no-purge sampling data in the historical trend and variability evaluations as discussed below.

3.4.1 Proposed Schedule

Arcadis proposes to commence no-purge groundwater sampling with HydraSleeves in the second quarter of 2016. The new method will be evaluated over three smaller quarterly events (in the second, third and fourth quarters of 2016) before the next comprehensive event is performed (in the first quarter of 2017).

This approach will allow adjustment and optimization of the new sampling method before the first quarter 2017 event is conducted. Furthermore, there will be three partial quarters of data collected with the new method by the end of 2016; these initial quarterly results will provide a baseline for evaluation of the data from the comprehensive first quarter 2017 event.

3.4.2 Proposed Data Evaluation

The objective of the planned statistical evaluations is to facilitate comparison of analytical results of no-purge groundwater samples with historical analytical results from samples collected from the Site.

Arcadis performed a preliminary evaluation of historical intra-well PCE concentration variability for Site samples; these preliminary evaluations indicate a moderate to significant amount of intra-well PCE concentration variability. Some historical variability may be related to a change in sampling method from traditional three casing volume purge to low-flow (implemented in the third quarter of 2007). Both low-flow and no-purge groundwater samples are considered depth discrete samples. Because groundwater samples collected by traditional three casing volume purge methods are not considered depth-discrete samples, concentrations from groundwater samples collected by this method were excluded from the analyses. Data were also screened further, as described below:

- Wells with fewer than three historical data points were not included in the analysis.
- Wells with greater than 50 percent of the data less than reporting limits (non-detect) were not included in the analysis.

- PCE concentration data less than reporting limits were set equal to the reporting limit.
- PCE concentration data representative of current site conditions were selected for analysis, in accordance with the NDEP letter dated April 28, 2016.
- Highly anomalous data from the March 2014 groundwater sampling event were excluded from the analysis. Specific anomalous data points were identified in the NDEP letter dated August 8, 2014.
- Anomalous data from the September 2014 groundwater sampling event were excluded from the analysis, in accordance with the NDEP letter dated December 17, 2014.

After focusing the evaluation on more recent low-flow results and on the most robust datasets, the intra well variability was slightly less; however, a fair amount of variability was still evident. Arcadis proposes to include an intra-well variability evaluation in forthcoming quarterly groundwater monitoring reports for each well sampled during the quarter.

Well MW-38 has been included as an example of the proposed intra-well variability evaluation (Appendix D). The method used to evaluate MW-38 may be modified, with NDEP concurrence, prior to submittal of the second quarter 2016 groundwater monitoring report.

Data points excluded from the evaluation of MW-38, and a rationale for excluding each data point, are presented in Appendix D. For limited datasets (wells with less than three data points), insufficient data are present to accurately understand variability or determine long-term trends, and accurate predictions of future concentrations cannot be made. Where a large portion of non-detect PCE concentrations is present, variability may be linked to the analytical method, not the sampling method. Arcadis proposes to set non-detect concentrations equal to the reporting limit in forthcoming evaluations. Arcadis does not propose to evaluate variability for datasets where over 50 percent of non-detect concentrations are present.

As part of the evaluation, Arcadis proposes to develop historical time-series charts to include time-series data for PCE concentrations for each sampled monitoring well. The charts will include the linear line-of-best-fit, and the upper and lower limits of the prediction interval. The linear line-of-best-fit will be a parametric linear regression line and will be calculated assuming a parametric model and that the residuals of the regression are normally distributed. Prediction intervals will be calculated in the following manner:

For a given sample size (n), The following expression provides the 100(1-α)% prediction interval for an individual Y given X:

Prediction Interval for individual predicted value $\hat{Y}(X_p)$

$$Y_I(X) = \hat{Y}\left(X_p\right) \pm \tau_{\propto/2} S_{Y\cdot X}\sqrt{\frac{1}{n} + \frac{(X_p - \bar{X})^2}{\sum X^2 - (\frac{1}{n})(\sum X)^2} + 1}$$

Where:

$S_{Y\cdot X}$ is the Standard Error for each value of Y with respect to each value X

$$S_{Y\cdot X} = \sqrt{\frac{1}{(n-2)}\left[\sum (Y - \bar{Y})^2 - \frac{\left[\sum (X - \bar{X})(Y - \bar{Y})\right]^2}{\sum (X - \bar{X})^2}\right]}$$

$\bar{X}$ is the Arithmetic Mean

$$\bar{X} = \frac{1}{n}\sum_{i}^{n} X_i$$

The prediction interval will be calculated, at a 90% confidence level, to predict the range of potential PCE concentrations expected on the target sampling date, for comparison with the actual concentration collected via no-purge sampling. An example of the proposed chart for MW-38 is included in Appendix D.

Statistical evaluations will be updated in each quarterly groundwater monitoring report to include no-purge data and to assess whether data collected via no-purge sampling are consistent with data and trends for historical samples. Arcadis expects that the prediction interval used in forthcoming quarterly groundwater monitoring reports will be concurred with by NDEP prior to submittal of the first report. Charts of statistical evaluations will be appended to quarterly groundwater monitoring reports. If a result obtained using no-purge methods lie between the upper and lower prediction limits for the forecasted value, based on historical trends, it will be deemed consistent with historical trends and variability. If it lies outside the upper and lower prediction limits, it will be deemed inconsistent with historical trends and variability.

When a no-purge result falls outside the upper and lower prediction limits, the time-series data will be further inspected to establish whether the no-purge result may be consistent with a recent change in trends or variability. Site-specific information will be reviewed to determine if any differences between anticipated and measured values may reflect changes in site conditions (e.g., groundwater elevations, sampling depth, or remedial activities), or if it more reflects the change in sampling method. Additionally, details of the implementation of no-purge sampling, including deployment depth, will be reviewed. If appropriate, Arcadis may recommend redevelopment of the well and/or characterization of the vertical distribution of target analytes by no-purge sampling at multiple depths. Strategies to optimize the comparability of no-purge and historical low-flow data will be proposed to NDEP.

3.5 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) samples will be collected as summarized below. These samples will be collected to verify that sample collection and handling procedures were performed adequately, and that they have not compromised the quality of the groundwater samples. Elements of QA/QC procedures include the methods used in equipment decontamination; appropriate sample preservation, containers, labeling, shipment, and chain-of-custody protocols; collection of field QA/QC samples; and laboratory QA/QC procedures.

3.5.1 Equipment Calibration Procedures

Field equipment will be maintained and calibrated per the manufacturer's instructions. Calibration will be checked and recorded every day during field activities.

3.5.2 Equipment Decontamination Procedures

Testing and sampling equipment that comes into contact with a monitoring well or groundwater will be decontaminated between uses at each monitoring well to prevent cross-contamination. Reusable equipment will be sprayed or washed with a Liquonox® and water solution, rinsed with distilled water, and allowed to air dry. Monitoring wells will be sampled in order based on previous analytical results, with sampling progressing from wells with non-detectable concentrations to wells with the highest concentrations.

Dedicated HydraSleeve™ sampling equipment (e.g., tether, clips, and weights) will be used in each well and left in that well between sampling events. Tether will be checked whenever the well is sampled and will be replaced as needed. Tether that is no longer considered serviceable will be properly discarded; it will not be reused in other wells. Clips and weights may be reused without decontamination if placed in the same well, but will be thoroughly scrubbed with a Liquonox® and water solution, rinsed with distilled water, and allowed to air dry prior to being installed in another well.

3.5.3 Sample Preservation and Containers

Samples for volatile organic compound (VOC) analysis will be collected in laboratory-supplied, new, clean 40 ml volatile organic analysis (VOA) glass vials. Sample containers with 0.5 ml of hydrochloric acid (HCl) will be delivered from the environmental laboratory. The purpose of the HCl is to retard or prevent any naturally occurring biodegradation of the analytes that may occur in the VOA vials during sample transit.

Samples will be collected directly into the laboratory-supplied container from the HydraSleeve™ sampler as per the manufacturer's standard operating procedures (Appendix B). Samples will be kept on ice at 4 degrees Celsius (°C) until delivered to the laboratory. Samples will be shipped directly to the approved environmental laboratory and analyzed within the allowable holding time.

3.5.4 Sample Labeling, Shipment, and Chain-of-Custody Protocols

Samples will be labeled in the field with a unique name and/or number for identification and tracking of sample information. QC samples will also be labeled with a unique location name and/or number.

After collection and labeling, all water samples will be placed in laboratory-supplied coolers and kept cooled on ice until received by a laboratory representative. Chain-of-custody records, listing each sample and the custody of the sample at all times, will be used to track all samples from the time of sampling to the arrival of samples at the laboratory. The chain-of-custody record will include the project name, signature of samplers, sample name or number, analytical methods requested, signatures of individuals involved in sample transfer, and signatures of individuals receiving the samples.

3.5.5 Field Quality Control Samples

Field QC samples will be collected, stored, transported, and analyzed in a manner consistent with the groundwater samples collected from the wells. The following QC samples will be collected to support the sampling activities:

- Field Duplicate Samples: Duplicate samples will be collected and analyzed from approximately 10 percent of the monitoring wells sampled. The duplicate samples will be collected immediately after the original sample. Duplicate samples will be collected, numbered, and handled in the same manner as the primary samples.

- Field Blank Samples: Field blanks will be collected to verify the quality of the water used for equipment decontamination. Field blank samples will be collected prior to the beginning of each field sampling event by pouring distilled or deionized water into laboratory-supplied VOA vials. Field blanks will be collected, numbered, and handled in the same manner as the primary samples.
- Equipment Blank Samples: Equipment blanks will be used to verify the cleanliness of the unused HydraSleeve™ samplers. Equipment blank samples will be collected prior to the beginning of each field sampling event by pouring distilled or deionized water through unused HydraSleeve™ samplers and then collecting the water in laboratory-supplied VOA vials. Equipment blanks will be collected, numbered, and handled in the same manner as the primary samples.
- Trip Blanks: Trip blanks will be prepared by the approved environmental laboratory and will consist of laboratory-grade distilled/deionized water placed into a clean, unused 40-ml VOA bottle to evaluate if the shipping and handling procedures are introducing contaminants into the samples, and if cross-contamination in the form of VOC migration has occurred between the collected samples. A trip blank will accompany each cooler containing VOC samples during field activities and during transport to the laboratory.

3.5.6 Security of Groundwater Monitoring Wells

Groundwater monitoring wells MW-5, MW-6, MW-6D1, MW-6D2, MW-6D3, MW-13, MW-14I, MW-18, MW-19, MW-19I, MW-19D1, MW-19D2, MW-19D3, MW-20, MW-23, MW-25, MW-26, MW-27, MW-32 and MW-39 will be secured with a tamper-proof well seal in accordance with the letter from NDEP dated December 17, 2016.

4 REPORTING

Monitoring results will be summarized in quarterly groundwater monitoring reports, similar in scope and content to prior quarterly groundwater monitoring reports. Groundwater monitoring reports will be submitted by the end of the 28th day of the month following the close of the quarter.

5 REFERENCES

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6 ENVIRONMENTAL CERTIFICATION JURAT

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state, and local statutes, regulations, and ordinances.

Description of Services: Final Groundwater Monitoring Plan, Maryland Square PCE Site, Las Vegas, Nevada, Version 1.0, August 3, 2016

____ August 3, 2016 ____

Yun Y. Wang
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TABLES

Table 1
Fluid Level Measurement and Groundwater Sampling Networks and Frequencies
Herman Kishner Trust B-1 and Maryland Square Shopping Center L.L.C.
Maryland Square PCE Site, Las Vegas, Nevada

Well ID	Quarterly fluid level measurement network	First quarter sampling network	Second and fourth quarter sampling network	Third quarter sampling network	Comment
MW-1	**X**	X	X	X	
MW-2	**X**	X			
MW-3	**X**	X			
MW-4					Abandoned
MW-5	**X**	X	X	X	
MW-6	**X**	X	X	X	
MW-6D1	**X**	X	X	X	
MW-6D2	**X**	X			
MW-6D3	**X**	X		X	
MW-7	**X**	X		X	
MW-8	**X**	X			
MW-9	**X**	X		X	
MW-10	**X**	X			
MW-11	**X**	X			
MW-12	**X**	X			
MW-13	**X**	X		X	
MW-14	**X**	X		X	
MW-14I	**X**	X	X	X	
MW-15	**X**	X			
MW-16	**X**	X			
MW-17	**X**	X			
MW-18	**X**	X	X	X	
MW-19	**X**	X		X	
MW-19D1	**X**	X	X	X	
MW-19D2	**X**	X	X	X	
MW-19D3	**X**	X	X	X	
MW-19I	**X**	X	X	X	
MW-20	**X**	X			
MW-20D1	**X**	X	**X**	X	
MW-20D2	**X**	X	X	**X**	
MW-20D3	**X**	X	**X**	X	
MW-21	**X**	X			
MW-22	**X**	X			
MW-23	**X**	X		X	
MW-24	**X**	X			
MW-25	**X**	X		X	
MW-26	**X**	X		X	
MW-27	**X**	X		X	
MW-28	**X**	X			
MW-29	**X**	X			
MW-30	**X**	X			
MW-31	**X**	X			
MW-32	**X**	X		X	
MW-33	**X**	X			
MW-34	**X**	X			
MW-35	**X**	X			
MW-36	**X**	X			

Table 1
Fluid Level Measurement and Groundwater Sampling Networks and Frequencies
Herman Kishner Trust B-1 and Maryland Square Shopping Center L.L.C.
Maryland Square PCE Site, Las Vegas, Nevada

Well ID	Quarterly fluid level measurement network	First quarter sampling network	Second and fourth quarter sampling network	Third quarter sampling network	Comment
MW-37	**X**	X			
MW-38	**X**	X	X	X	
MW-39	**X**	X			
MW-40 CMT-30					One well with seven ports
MW-40 CMT-35					
MW-40 CMT-40					
MW-40 CMT-45					
MW-40 CMT-50					
MW-40 CMT-55					
MW-40 CMT-60					
MW-41	**X**	X	X	X	
MW-42	**X**	X	X	X	
MW-43	**X**	X	X	X	
OS-1					
VM-1					
VM-2					
SVE-1					

Notes:
· X = Well is a part of monitoring or sampling network indicated by heading of column.
· Groundwater samples will be analyzed for tetrachloroethene, trichloroethene, vinyl chloride, cis-1,2-dichloroethene, and 1,1-dichlorethene.
· Bold **X** = Wells added to a quarterly monitoring or sampling network.
· The only well removed from any monitoring or sampling network is MW-40 CMT.

Table 2
Proposed HydraSleeve Deployment Depths
Herman Kishner Trust B-1 and Maryland Square Shopping Center, L.L.C.
Maryland Square PCE Site, Las Vegas, Nevada

Well ID	Screened interval	Well diameter	Low-flow sampling depth	Anticipated HydraSleeve™ length	Anticipated HydraSleeve™ deployment depth
MW-1	10-30	2.0	23.0	2.5	24.5
MW-2	10-32	2.0	24.0	2.5	25.5
MW-3	10-31	2.0	25.0	2.5	26.5
MW-4	ABN	ABN	N/A	N/A	N/A
MW-5	10-32	2.0	24.0	2.5	25.5
MW-6	10-32	2.0	25.0	2.5	26.5
MW-6D1	50-60	2.0	55.0	2.5	56.5
MW-6D2	80-90	2.0	85.0	2.5	86.5
MW-6D3	100-110	2.0	105.0	2.5	106.5
MW-7	10-30	2.0	24.0	2.5	25.5
MW-8	10-30	2.0	25.0	2.5	26.5
MW-9	10-50	2.0	45.0 *	2.5	46.5
MW-10	10-30	2.0	26.0	2.0	27.0
MW-11	13.5-33.5	2.0	29.0	2.5	30.5
MW-12	13.5-33.5	2.0	24.0	2.5	25.5
MW-13	9-29	2.0	22.0	2.5	23.5
MW-14	15-40	2.0	24.5	2.5	26.0
MW-14I	40-55	4.0	47.5	3.2	49.0
MW-15	15-32	2.0	24.0	2.5	25.5
MW-16	19-32	2.0	30.5 **	1.0	31.0
MW-17	15-30	4.0	25.0	3.2	26.5
MW-18	5-26	4.0	17.0	3.2	18.5
MW-19	19-35	2.0	29.0	2.5	30.5
MW-19D1	31-51	2.0	41.0	2.5	42.5
MW-19D2	60-70	2.0	65.0	2.5	66.5
MW-19D3	92-102	2.0	97.0	2.5	98.5
MW-19I	34-54	4.0	40.0	3.2	41.5
MW-20	19-35	2.0	30.0	2.5	31.5
MW-20D1	25-45	2.0	36.0	2.5	37.5
MW-20D2	55-65	2.0	60.0	2.5	61.5
MW-20D3	90-100	2.0	95.0	2.5	96.5
MW-21	19-36	2.0	30.0	2.5	31.5
MW-22	15-36	4.0	31.0	3.2	32.5
MW-23	5-26	4.0	21.0	3.2	22.5
MW-24	5-26	4.0	17.0	3.2	18.5
MW-25	5-26	4.0	23.0	3.2	24.5
MW-26	10-36	4.0	27.0	3.2	28.5
MW-27	10-36	4.0	26.0	3.2	27.5
MW-28	15-36	4.0	25.0	3.2	26.5
MW-29	15-36	4.0	24.0	3.2	25.5
MW-30	20-41	4.0	30.0	3.2	31.5
MW-31	13.5-33.6	4.0	25.0	3.2	26.5
MW-32	13.5-33.7	4.0	27.0	3.2	28.5
MW-33	13.5-33.8	4.0	25.0	3.2	26.5
MW-34	unknown	2.0	24.0	2.5	25.5
MW-35	unknown	2.0	24.0	2.5	25.5

Table 2
Proposed HydraSleeve Deployment Depths
Herman Kishner Trust B-1 and Maryland Square Shopping Center, L.L.C.
Maryland Square PCE Site, Las Vegas, Nevada

Well ID	Screened interval	Well diameter	Low-flow sampling depth	Anticipated HydraSleeve™ length	Anticipated HydraSleeve™ deployment depth
MW-36	17-38	4.0	28.5	3.2	30.0
MW-37	17-38	4.0	29.0	3.2	30.5
MW-38	15-36	2.0	25.0	2.5	26.5
MW-39	15-36	2.0	31.0	2.5	32.5
MW-41	10-35	2.0	25.0	2.5	26.5
MW-42	10-35	2.0	26.0	2.5	27.5
MW-43	10-35	2.0	26.0	2.5	27.5
MW-40 CMT-30	30-30.6	0.8	Unknown	N/A	N/A
MW-40 CMT-35	35-35.6	0.8	Unknown	N/A	N/A
MW-40 CMT-40	40-40.7	0.8	Unknown	N/A	N/A
MW-40 CMT-45	45-45.6	0.8	Unknown	N/A	N/A
MW-40 CMT-50	50-50.6	0.8	Unknown	N/A	N/A
MW-40 CMT-55	55-55.6	0.8	Unknown	N/A	N/A
MW-40 CMT-60	60-60.6	0.8	Unknown	N/A	N/A

Notes:
· Screened interval is expressed in feet below ground surface.
· Well diameter is expressed in inches.
· Low-flow sampling depth is expressed in feet below top of casing (ft btc), and is based on *First Quarter 2016 Groundwater Monitoring and Sampling Report* (ATC, 2016).
· Anticipated HydraSleeve length is expressed in feet.
· Anticipated HydraSleeve deployment depth is expressed in ft btc.
· Anticipated HydraSleeve deployment depth is the depth of the top of the HydraSleeve.
· Anticipated HydraSleeve deployment depth = (low-flow sampling depth) + 0.5* (length of the HydraSleeve)
· Anticipated HydraSleeve deployment depth is rounded to the nearest half foot.
· Anticipated HydraSleeve deployment depth reflects the depth of the top of the HydraSleeve.
· ABN = Abandoned.
· N/A = Not applicable.
· * = MW-9 sampling depth proposed at 45.0 ft btc. Low-flow sampling depth in MW-9 has ranged from 30 ft btc to 49 ft btc, based on a review of groundwater sample collection logs attached to various quarterly groundwater monitoring reports. Low-flow sampling depth was most recently reported at 49 ft btc in March 2015 and 40 feet btc in February 2016.
· ** = MW-16 sampling depth proposed at 30.5 ft btc. The low-flow sampling depth was 31 ft btc (ATC 2016). Modifying the sampling depth by 0.5 feet will allow HydraSleeve to collect a groundwater sample at 30.5 ft btc.

FIGURES

\\Scottsdale-AZ\Project\Maryland Square\GIS\Projects\Q2 2016 GWMR\Figure 1 site vicinity map Q2 2016.mxd 7/15/2016

LEGEND

★ Approximate source area location

NOTES

· Topographic map source: USGS Topo Maps (2014-15).

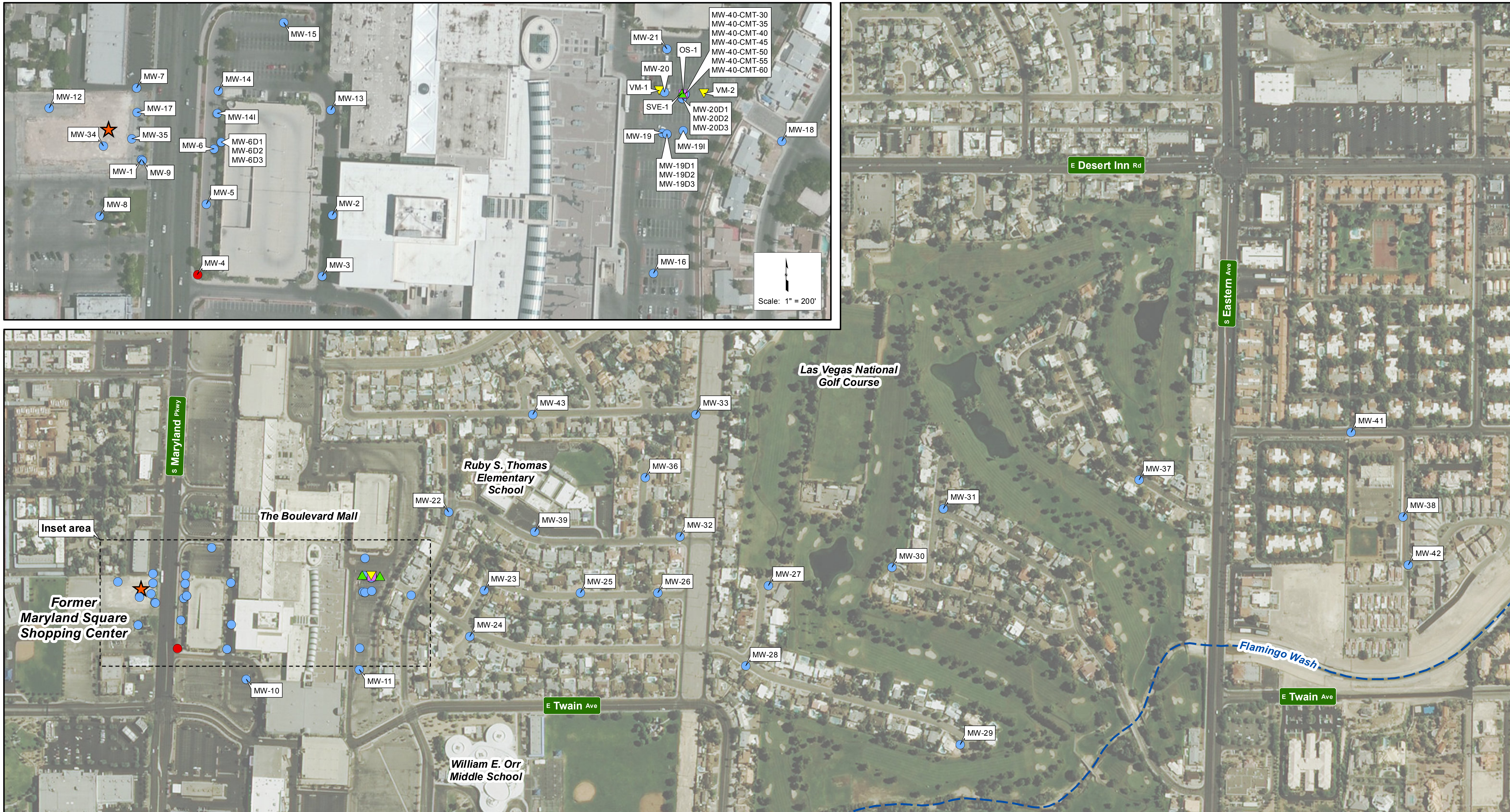
Feet
0 1,000 2,000
Scale: 1" = 2,000'

MARYLAND SQUARE PCE SITE
LAS VEGAS, NEVADA
GROUNDWATER MONITORING PLAN

SITE VICINITY MAP

ARCADIS

FIGURE
1



\\Scottsdale-AZ\Project\Maryland Square\GIS\Projects\GW monitoring plan 05-2016\Figure 2 well locations.mxd 5/24/2016

LEGEND

- ★ Approximate source area location
- Groundwater monitoring well (existing)
- Groundwater monitoring well (abandoned)
- Groundwater pumping well
- Ozone-peroxide sparge well (inactive)
- Soil vapor monitoring well (inactive)
- Soil vapor extraction well (inactive)
- Surface water feature

NOTES

· Aerial photo source: ESRI World Imagery.

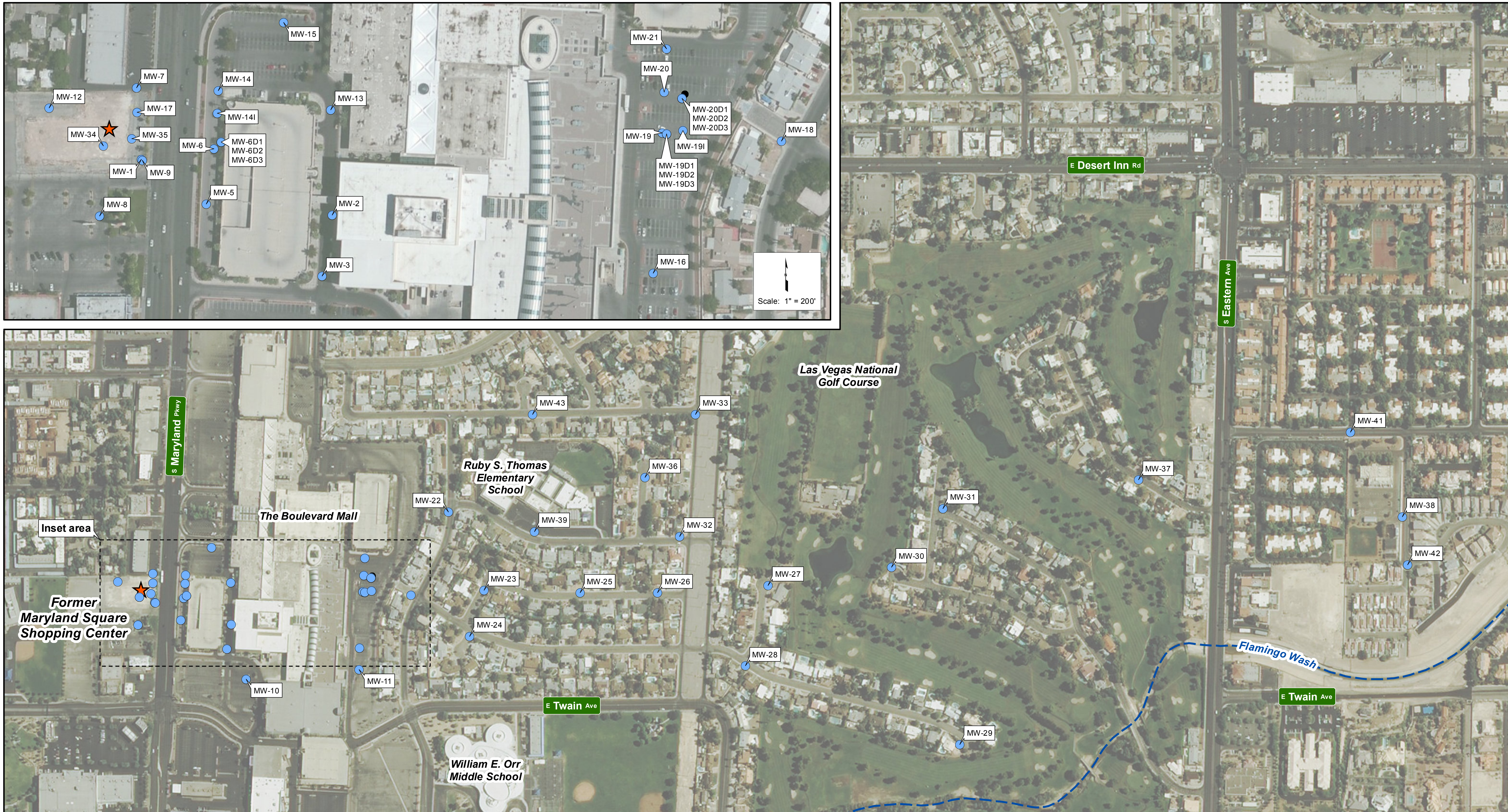
Feet
0 250 500
Scale: 1" = 500'

MARYLAND SQUARE PCE SITE
LAS VEGAS, NEVADA
GROUNDWATER MONITORING PLAN

SITE MAP WITH WELL LOCATIONS

ARCADIS

FIGURE
2



\\Scottsdale-AZ\Project\Maryland Square\GIS\Projects\GW monitoring plan 05-2016\Figure 3 GWL well locations.mxd 5/24/2016

LEGEND

- ★ Approximate source area location
- ● Groundwater monitoring well (sampled)
- ● Groundwater monitoring well (not sampled)
- - - Surface water feature

NOTES

· Aerial photo source: ESRI World Imagery.

0 250 500 Feet

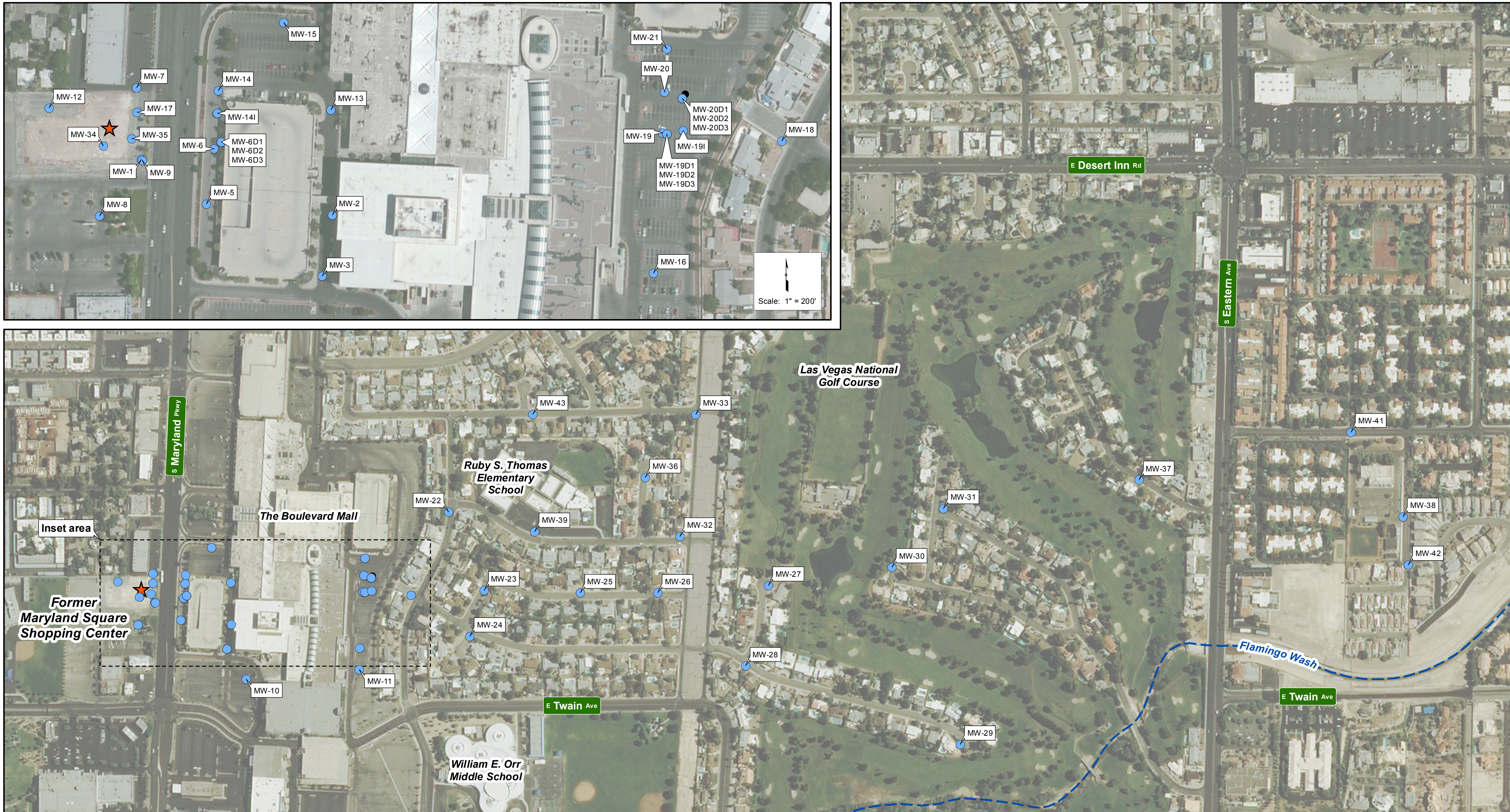
Scale: 1" = 500'

MARYLAND SQUARE PCE SITE
LAS VEGAS, NEVADA
GROUNDWATER MONITORING PLAN

PROPOSED WATER LEVEL MONITORING WELLS

ARCADIS

FIGURE
3



\\Scottsdale-AZ\Project\Maryland Square\GIS\Projects\GW monitoring plan 05-2016\Figure 4 GWQ Q1 well locations.mxd 5/24/2016

LEGEND

- ★ Approximate source area location
- Groundwater monitoring well (sampled)
- Groundwater monitoring well (not sampled)
- Surface water feature

NOTES

· Aerial photo source: ESRI World Imagery.

0 250 500 Feet

Scale: 1" = 500'

MARYLAND SQUARE PCE SITE
LAS VEGAS, NEVADA
GROUNDWATER MONITORING PLAN

PROPOSED FIRST QUARTER WATER QUALITY MONITORING WELLS

ARCADIS

FIGURE
4

LEGEND

- ★ Approximate source area location
- Groundwater monitoring well (sampled)
- Groundwater monitoring well (not sampled)
- Surface water feature

NOTES

· Aerial photo source: ESRI World Imagery.

Feet
0 250 500
Scale: 1" = 500'

MARYLAND SQUARE PCE SITE
LAS VEGAS, NEVADA
GROUNDWATER MONITORING PLAN

PROPOSED SECOND AND FOURTH QUARTER WATER QUALITY MONITORING WELLS

ARCADIS

FIGURE
5

\\Scottsdale-AZ\Project\Maryland Square\GIS\Projects\GW monitoring plan 05-2016\Figure 5 GWQ Q2-Q4 well locations.mxd 5/25/2016

LEGEND

- ★ Approximate source area location
- Groundwater monitoring well (existing)
- Groundwater monitoring well (abandoned)
- Surface water feature

NOTES

· Aerial photo source: ESRI World Imagery.

Feet
0 250 500
Scale: 1" = 500'

MARYLAND SQUARE PCE SITE
LAS VEGAS, NEVADA
GROUNDWATER MONITORING PLAN

PROPOSED THIRD QUARTER WATER QUALITY MONITORING WELLS

ARCADIS

FIGURE
6

\\Scottsdale-AZ\Project\Maryland Square\GIS\Projects\GW monitoring plan 05-2016\Figure 6 GWQ Q3 well locations.mxd 5/24/2016

APPENDIX A

Fluid Level Measurement Standard Operating Procedures

Infrastructure, environment, facilities

Imagine the result

Water Level Measurement

Rev. #: 2

Rev Date: February 24, 2011

Approval Signatures

Prepared by: ______________________ Date: 02/24/2011

Reviewed by: ______________________ Date: 02/24/2011
(Technical Expert)

I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to describe procedures to measure and record groundwater and surface-water elevations. Water levels may be measured using an electronic water-level probe, oil-water level indicator, or a pressure transducer from established reference points (e.g. top of casing). Reference points will be surveyed to evaluate fluid elevations relative to mean sea level (msl). This SOP describes the equipment, field procedures, materials, and documentation procedures to measure and record groundwater and surface-water elevations using the aforementioned equipment.

This is a standard (i.e., typically applicable) operating procedure which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project work plans or reports.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, shall be available during water level measurements:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan
- Equipment decontamination supplies
- Electronic water-level indicator
- Electronic oil-water level indicator
- Mini-Troll® or Troll® pressure transducer
- In-Situ™ data logger

- Laptop computer with the Win-Situ software package installed
- Photoionization detector (PID) and/or organic vapor analyzer
- Non-phosphate laboratory soap (Alconox or equivalent)
- Deionized/distilled water
- 150-foot measuring tape
- Solvent (methanol/acetone) rinse
- Portable containers
- Hacksaw
- Pliers
- Plastic sheeting
- “Write-in-the-Rain” Field logbook and or PDA (Personal Digital Assistant)
- Indelible ink pen.

IV. Cautions

Electronic water-level probes and oil-water interface probes can sometimes produce false-positive readings. For example, if the inside surface of the well has condensation above the water level, then an electronic water-level probe may produce a signal by contacting the side of the well rather than the true water level in the well. To produce reliable data, the electronic water level probe and/or interface probe should be raised and lowered several times at the approximate depth where the instrument produces a tone indicating a fluid interface to verify consistent, repeatable results.

The graduated tape or cable with depth markings is designed to indicate the depth of the electronic sensor that detects the fluid interface, but not the depth of the bottom of the instrument. When using these devices to measure the total well depth, the additional length of the instrument below the electronic sensor must be added to the apparent well depth reading, as observed on the tape or cable of the instrument, to obtain the true total depth of the well. If the depth markings on the tape or cable are worn or otherwise difficult to read, extra care must be taken in obtaining the depth readings.

V. Health and Safety Considerations

The HASP will be followed, as appropriate, to ensure the safety of field personnel. Access to wells may expose field personnel to hazardous materials such as contaminated groundwater or oil. Other potential hazards include stinging insects that may inhabit well heads, other biologic hazards, and potentially the use of sharp cutting tools (scissors, knife). Appropriate personal protective equipment (PPE) will be worn during these activities. Field personnel will thoroughly review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives.

VI. Procedure

Electronic Water-Level Indicators and Oil-Water Indicators

Calibration procedures and groundwater level measurement procedures for electronic water-level indicators and oil-water indicators are described in the sections below.

Calibration Procedures

The indicator probe will be tested to verify that the meter has been correctly calibrated by the manufacturer. The following steps will be used to verify the accuracy of the indicator:

1. Measure the lengths between each increment marker on the indicator with a measuring tape. The appropriate length of indicator measuring tape, suitable to cover the depth range for the wells of interest, will be checked for accuracy.

2. If the indicator measuring tape is inaccurate, the probe will be sent back to the manufacturer.

3. Equipment calibration will be recorded in the field logbook and/or PDA.

Groundwater Level Measurement Procedures

A detailed procedure for obtaining water elevations will be as follows:

1. Identify site and monitoring well number in field notebook along with date, time, personnel and weather conditions using indelible ink.

2. Use safety equipment as specified in the Health and Safety Plan.

3. Decontaminate the indicator probe and tape in accordance with the appropriate cleaning procedures.

4. Place clean plastic sheeting on the ground next to the well.

5. Unlock and open the monitoring well cover while standing upwind from the well.

6. Measure the volatile organics present in the monitoring well head space with a PID and record the PID reading in the field logbook.

7. Allow the water level in the well to equilibrate with atmospheric pressure for a few minutes. Locate a measuring reference point on the monitoring well casing. If one is not found, create a reference point by notching the highest point on the inner casing (or outer if an inner casing is not present) with a hacksaw. All downhole measurements will be taken from the reference point. Document the creation of any new reference point or alteration of the existing reference point.

8. Measure to the nearest 0.01 foot and record the height of the inner and outer casing from reference point to ground level.

9. Slowly lower the level indicator probe until it touches the bottom of the well. Record the total depth of the well from the top of the inner casing (or outer casing if inner casing is not present). Measure depth to water level as the probe is drawn back up through the water column. If used to measure the level of surface water, slowly lower from the surveyed reference point, as appropriate. Double check all measurements and record depths to the nearest 0.01 foot.

10. Decontaminate the instrument using appropriate cleaning procedures.

11. Lock the well when all activities are completed.

Pressure Transducers

The detailed procedure for obtaining water elevations using a Mini-Troll® or Troll® pressure transducer with an In-Situ™ data logger and the Win-Situ software package will be as follows:

<u>Setup Procedures</u>

1. Connect the Mini-Troll® or Troll® transducer to a laptop computer serial port.

2. Open the Win-Situ software package on the laptop computer.

3. Verify that the Win-Situ software recognizes the transducer.

4. Synchronize the clock on the laptop computer with that of the transducer.

5. Add a test to the transducer and input the specifications of the test (e.g., frequency of data collection, start data collection).

6. Disconnect the transducer from the laptop computer, and prepare the transducer for field deployment.

Field Procedures

1. Decontaminate all equipment entering the monitoring well using appropriate cleaning procedures.

2. Connect transducer to laptop computer, and start the Win-Situ program.

3. Lower the transducer gently below the water table or surface-water level.

4. Take a water level reading from the transducer using the Win-Situ software package. Lift the transducer approximately 1-foot, and verify the transducer response on the Win-Situ program (i.e. depth to water should be 1-foot less).

5. Upon verification, set the transducer to the desired depth. Position the instrument below the lowest anticipated water level, but not so low that its range will be exceeded at the highest anticipated water level. The maximum operating depth below water is equal to 2.31 feet times the psi rating of the transducer (e.g., 23.1 feet for a 10 psi transducer).

6. Secure the cable at the well head or fixed object adjacent to surface-water body to prevent drift and movement.

7. Obtain a manual water-level reading using the procedure noted above, and record the measurement in the field notebook or PDA.

8. Set reference point (e.g. depth to water, groundwater elevation) and input it into the Win-Situ software package.

9. Periodically download data and collect additional manual depth-to-water measurements using the same water-level or oil-water indicator probe used during the equipment setup to verify the accuracy of the transducer.

VII. Waste Management

Decontamination fluids, PPE, and other disposable equipment will be properly stored on site in labeled containers and disposed of properly. Be certain that waste containers are properly labeled and documented in the field log book. Review appropriate waste management SOPs, which may be state- or client-specific.

VIII. Data Recording and Management

Groundwater level measurements should be documented in the field logbook and/or PDA. The following information will be documented in the field logbook:

- Sample identification
- Measurement time
- Total well depth
- Depth to water

Groundwater elevations recorded using a Mini-Troll® or Troll® pressure transducer with an In-Situ™ data logger and the Win-Situ software package will be downloaded and stored in the central project file.

IX. Quality Assurance

As described in the detailed procedure, the electronic water-level meter and/or oil-water interface probe will be calibrated prior to use versus an engineer's rule to ensure accurate length demarcations on the tape or cable. Fluid interface measurements will be verified by gently raising and lowering the instrument through each interface to confirm repeatable results.

X. References

No literature references are required for this SOP.

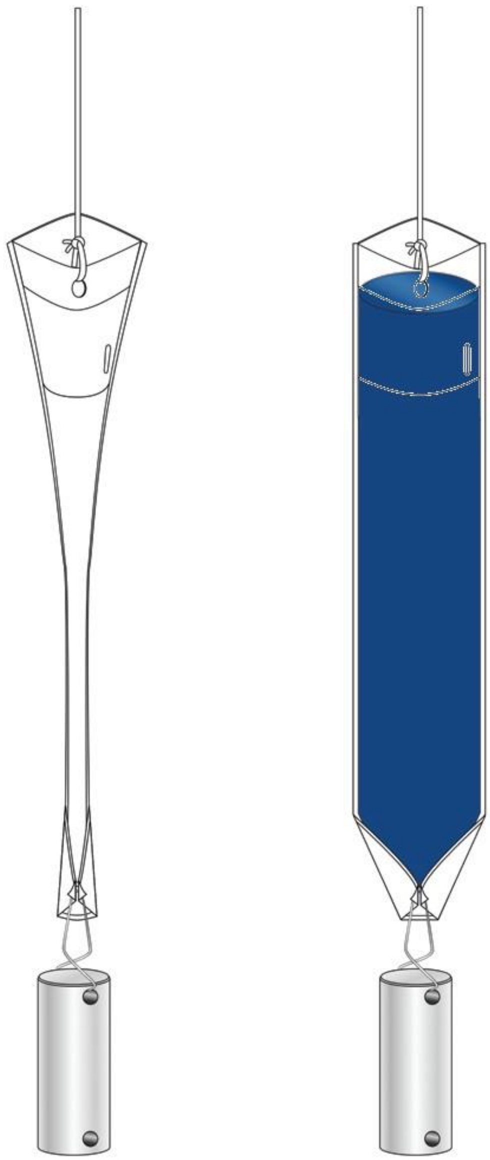
APPENDIX B

Standard Operating Procedures: Sampling Groundwater with a HydraSleeve

HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure: Sampling Groundwater with a HydraSleeve



This guide should be used in addition to field manuals and instructions appropriate to the chosen sampling device (i.e., HydraSleeve, SpeedBag or Super/Skinny Sleeve).

Find the appropriate field manual and instructions on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact:
GeoInsight, P.O. Box 1266, Mesilla Park, NM 88047
800-996-2225, info@hydrasleeve.com.

Table of Contents

Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect groundwater samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only. It excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative groundwater samples depends on the natural movement of groundwater (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of groundwater for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term groundwater monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

Description of the HydraSleeve

The basic HydraSleeve (Figure 1) consists of the following components*:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75" OD and are available in a variety of sizes. An optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.

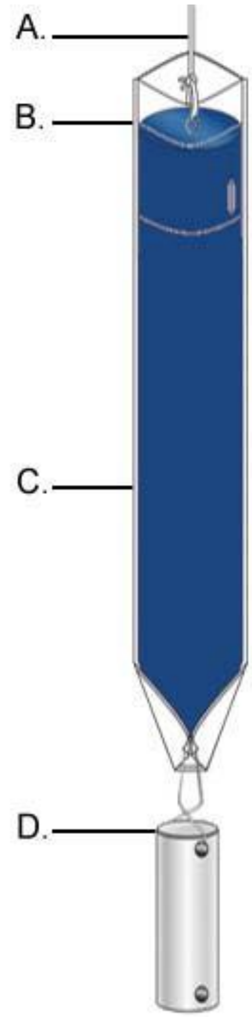


Figure 1. HydraSleeve components.

∗ Other configurations such as top weighted assemblies and Super/SkinnySleeves are available.

> **Note:** The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

Table 1. Dimensions and Volumes of HydraSleeve Models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 600 mls HydraSleeve	~600mls	30”	2.5”	1.4”
Standard 1-liter HydraSleeve	~1 Liter	38”	3”	1.9”
Super/SkinnySleeve 1-liter	~1 Liter	38”	2.5"	1.5”*
Super/SkinnySleeve 1.5-liter	~1.5 Liters	52”	2.5”	1.5”*
Super/SkinnySleeve 2-liter	~2 Liters	66"	2.5"	1.5"*
4-Inch HydraSleeves				
Standard 2.5 liter	~2 Liters	38”	4”	2.7”

* outside diameter on the Heavy Duty Universal Super/SkinnySleeves is 1.5" however when using with schedule 40 hardware the O.D. of the assembly will be 1.9"

It's also recommended that you size the diameter of the HydraSleeve according to the diameter of the well (i.e. use 2-inch HydraSleeves in 2-inch wells). Using smaller sleeves in larger diameter wells (i.e. 2-inch HydraSleeves in 4-inch wells) will result in a longer fill rate and will require special retrieval instructions (explained later).

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

HydraSleeves can be custom-fabricated by the manufacturer in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied using a HydraSleeve.

HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen. It fills by pulling it up through the screen a distance equivalent to the length of the sampler when correctly sized to the well diameter. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2" ID PVC well, 50' total depth, 10' screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2" well (2.5" flat width/1.5" filled OD x 30" long, 600 ml volume), deploy the sampler so the weight (a 5 oz., 2.5" long weight with a 2" long clip) rests at the bottom of the well. The top of the sleeve is thus set at ~34" above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30" before it is filled; therefore, it is full (and the top check valve closes) at approximately 64" (5.3 feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

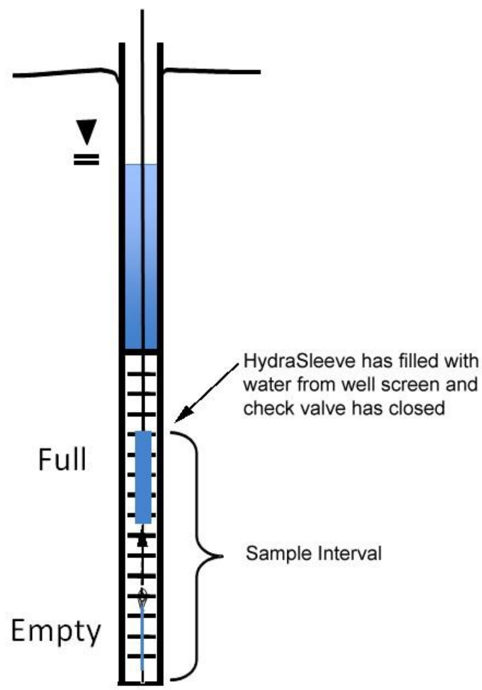


Figure 2. Correct Placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

The solution? Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6"of the bottom of the well. When the HydraSleeve is recovered, it will fill within 36" (3 feet) from the bottom of the well, or 2-feet before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

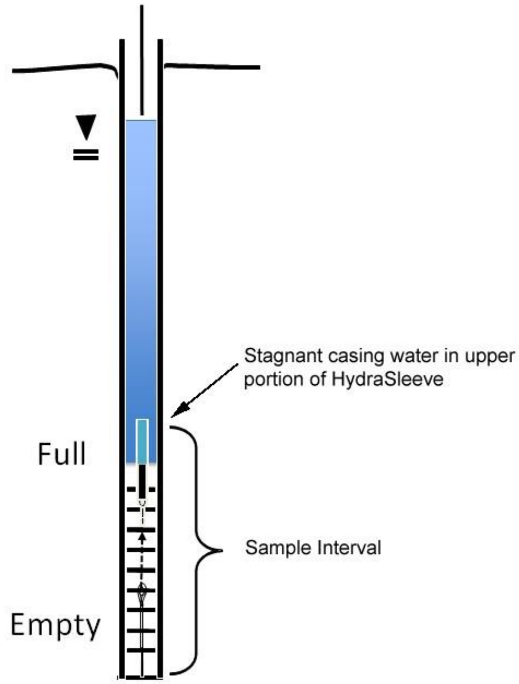


Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

NOTE: Using smaller diameter HydraSleeves (2-inch) in larger diameter wells (4-inch) causes a slower fill rate. Special retrieval methods are necessary if this is your set up (shown later in this document).

Procedures for Sampling with the HydraSleeve

Collecting a groundwater sample with a HydraSleeve is usually a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a groundwater contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve.

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the Basic HydraSleeve*

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.

2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.

3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.

4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, if spring clips are not being utilized, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together to align the holes and slide the weight clip through the holes.

6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

*See Super/SkinnySleeve assembly manual and HydraSleeve Field Manual for other assembly instructions.

II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

> **Note:** Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

> **Note:** Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The basic HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In some cases, like when useing the SpeedBags, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

  NOTE: If using top weights additional equilibration time is needed to allow the top weight time to compress the HydraSleeve into the bottom of the well.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event.

  In periodic (i.e., quarterly, semi-annual, or annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.
2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)
3. Measure the water level in the well.
4. Use one of the following 3 retrieval methods. In all 3 scenarios, when the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

a. In one smooth motion, pull the tether up 30"-60" (the length of the sampler) at a rate of about 1foot per second (or faster). The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1:1 ratio or the length of the HydraSleeve). This is analogous to coring the water column in the well from the bottom up.

b. There are times it is recommended that the HydraSleeve be oscillated in the screen zone to ensure it is full before leaving the screen area. Pull up 1-3 feet, let the sleeve assembly drop back down and repeat 3-5 times before pulling the sleeve to the surface. The collection zone will be the oscillation zone. ***When in doubt use this retrieval method.***

c. SpeedBags require check valve activation before retrieving to the surface. This means pull hard 1-2 feet once; let the assembly drop back down and then pull up to the surface.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.
6. Discard the small volume of water trapped in the Hydrasleeve above the check valve by pinching it off at the top under the stiffeners (above the check valve).

v. Sample Collection

NOTE: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

Be sure you have discarded the water sitting above the check valve – see step #6 above.

1. Remove the discharge tube from its sleeve.
2. Hold the HydraSleeve at the check valve
3. Puncture the HydraSleeve at least 3-4 inches below the reinforcement strips with the pointed end of the discharge tube. NOTE: For some contaminants (VOC's/sinkers) the best location for discharge is the middle to bottom of the sampler. This would be representative of the deeper portion of the well screen.
4. Discharge water from the HydraSleeve into your sample containers. Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.
5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column needs to be sampled, the HydraSleeve can be deployed with an optional top weight in addition to a bottom weight. The top weight will collapse the HydraSleeve to a very short (approximately 6” to 24”) length, depending on the length and volume of the sampler. This allows the HydraSleeve to fill in a water column only 3’ to 10’ in height (again) depending on the sampler size.

Multiple Sampler Deployment

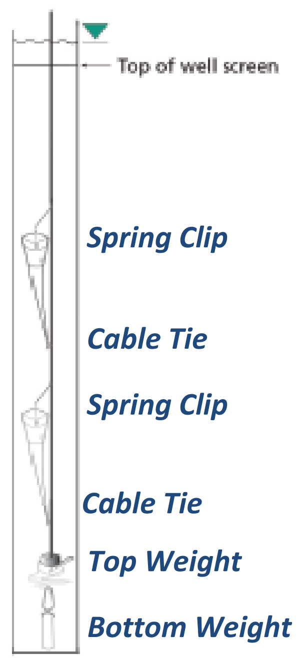
Multiple sampler deployment in a single well screen can accomplish two purposes:

1. It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
2. It can accommodate the need for collecting field indicator parameter measurements.
3. It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

It is possible to use up to 3 standard 30” HydraSleeves deployed in series along a single tether to collect samples from a 10’ long well screen without collecting water from the interval above the screen. The samplers must be attached to the tether at both the top and bottom of the sleeve, and the bottom assembly will need a top weight. Attach the tether at the top with a spring clip (available from the manufacturer and is provided with top weights). Attach each subsequent sleeve to the tether at the bottom using a cable tie (or optional sand weight clip). The samplers must be attached as seen in figure 4.

- The first will have a bottom weight attached to the bottom and a top weight attached to the top of the sleeve. Connect the tether to the top Spring Clip.
- The second attached immediately above the first, using a spring clip at the top and cable tie (or sand weight clip at the bottom.
- The third (attached the same as the second) immediately above the second

Figure 4



If there is enough saturated well screen multiple sleeves can be used in tandem without a top weight on the bottom as shown here.

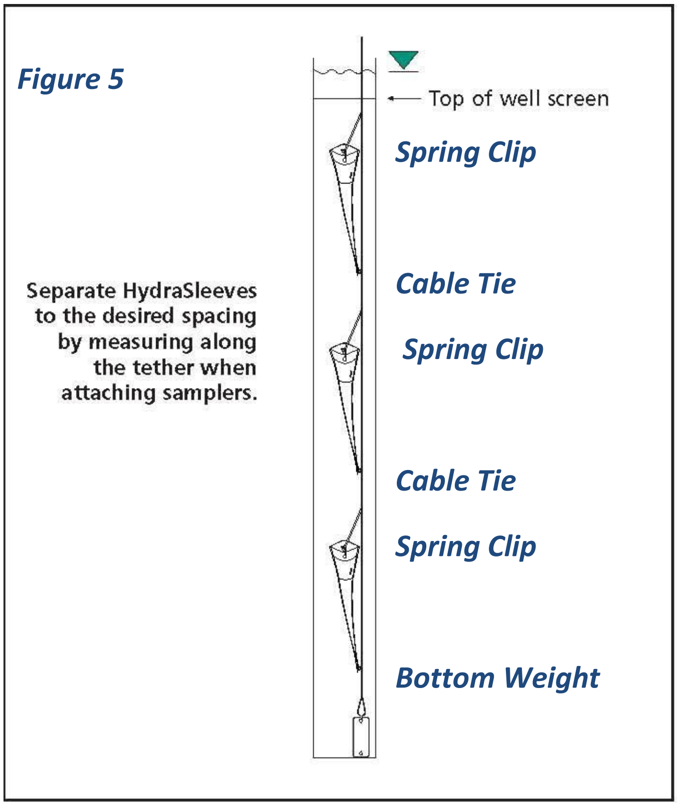


Figure 5. Multiple HydraSleeve deployment

If there is a need for only 2 samplers, they can be installed as follows. The first sampler can be attached to the tether as described above, a second attached to the bottom of the first using your desired length of tether between the two and the weight attached to the bottom of the second sampler (figure 6). This method can only be used with 2 samplers; 3 or more HydraSleeves in tandem need to be attached as described above.

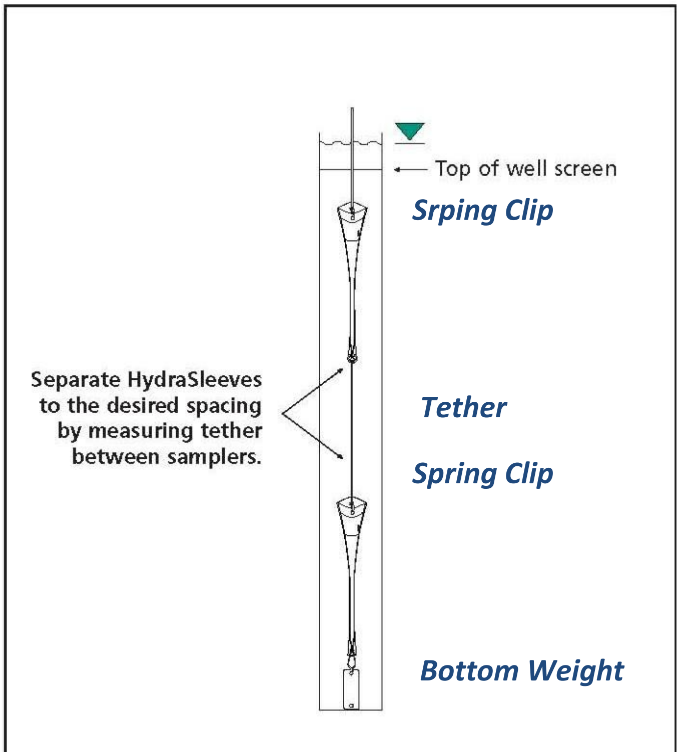


Figure 6. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight will be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

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McAlary, T. A. and J. F. Barker, 1987, Volatilization Losses of Organics During groundwater Sampling From Low-Permeability Materials, groundwater Monitoring Review, Vol. 7, No. 4, pp. 63-68

Parsons, 2005, Results Report for the Demonstration of No-Purge groundwater Sampling Devices at Former McClellan Air Force Base, California; Contract F44650-99-D-0005, Delivery Order DKO1, U.S. Army Corps of Engineers (Omaha District), U.S. Air Force Center for Environmental Excellence, and U.S. Air Force Real Property Agency

Robin, M. J. L. and R. W. Gillham, 1987, Field Evaluation of Well Purging Procedures, groundwater Monitoring Review, Vol. 7, No. 4, pp. 85-93

APPENDIX C

Calculation of Maximum Required Equilibration Period (Flush-out Time) Based on Well Geometry and Darcy Velocity

APPENDIX C
CALCULATION OF MAXIMUM REQUIRED EQUILIBRATION PERIOD (FLUSH-OUT TIME) BASED ON WELL GEOMETRY AND DARCY VELOCITY

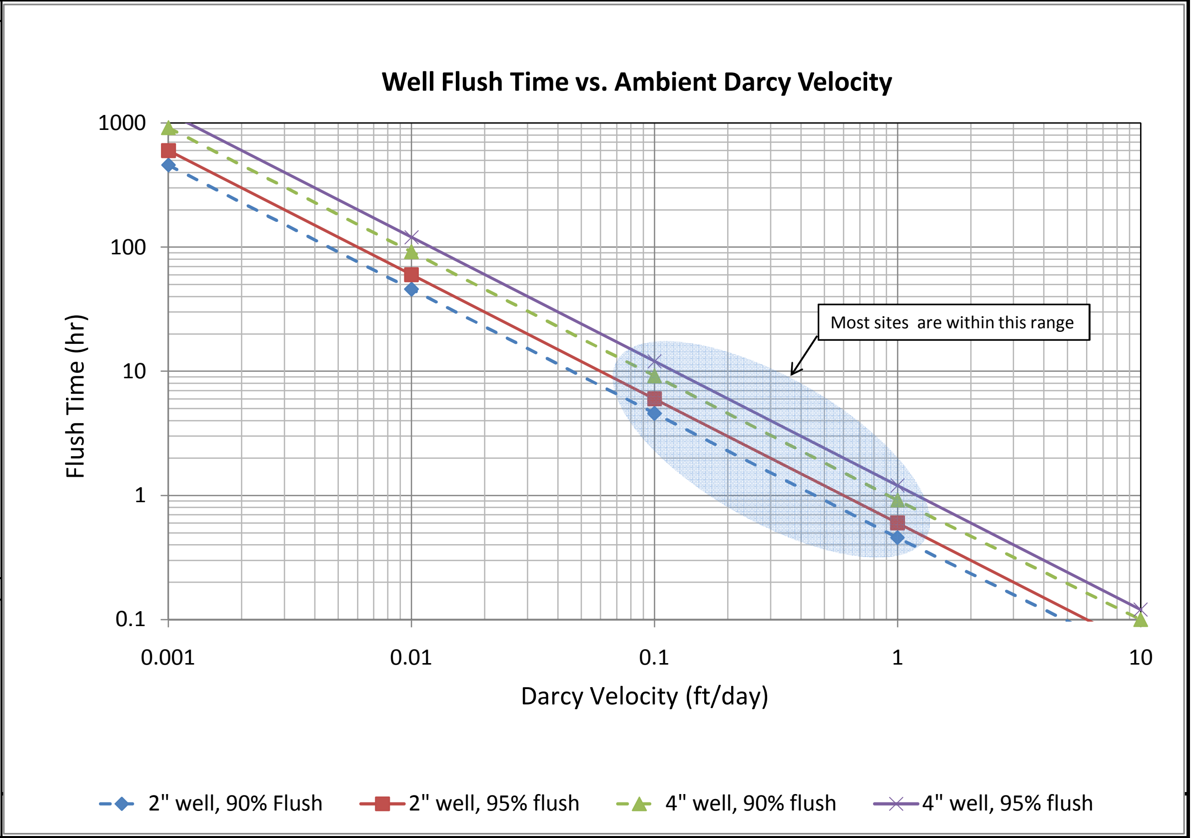
Example Calculations

Well Diam (inches)	Darcy v (ft/day)	Flush %	Flush Time (hours)
2	0.001	90	458
2	0.01	90	46
2	0.1	90	4.6
2	1	90	0.46
2	10	90	0.05
2	0.001	95	600
2	0.01	95	60
2	0.1	95	6.0
2	1	95	0.60
2	10	95	0.06
4	0.001	90	917
4	0.01	90	92
4	0.1	90	9.2
4	1	90	0.92
4	10	90	0.10
4	0.001	95	1200
4	0.01	95	120
4	0.1	95	12.0
4	1	95	1.20
4	10	95	0.12

General Equation for Flushing Time

t = [0.25 wd / (vd cf)] [-ln (1-f)]

where:
t = maximum required flushing time (hours)
wd = well diameter (inches)
vd = Darcy velocity, Ki (feet per day)
K = hydraulic conductivity (feet per day)
i = hydraulic gradient (dimensionless)
cf = flow convergence factor (typically between 2 and 3)
example calcs. assume cf = 2.5
f = % flush expressed as fraction
(e.g., 95% = 0.95, 90% = 0.90, etc.)

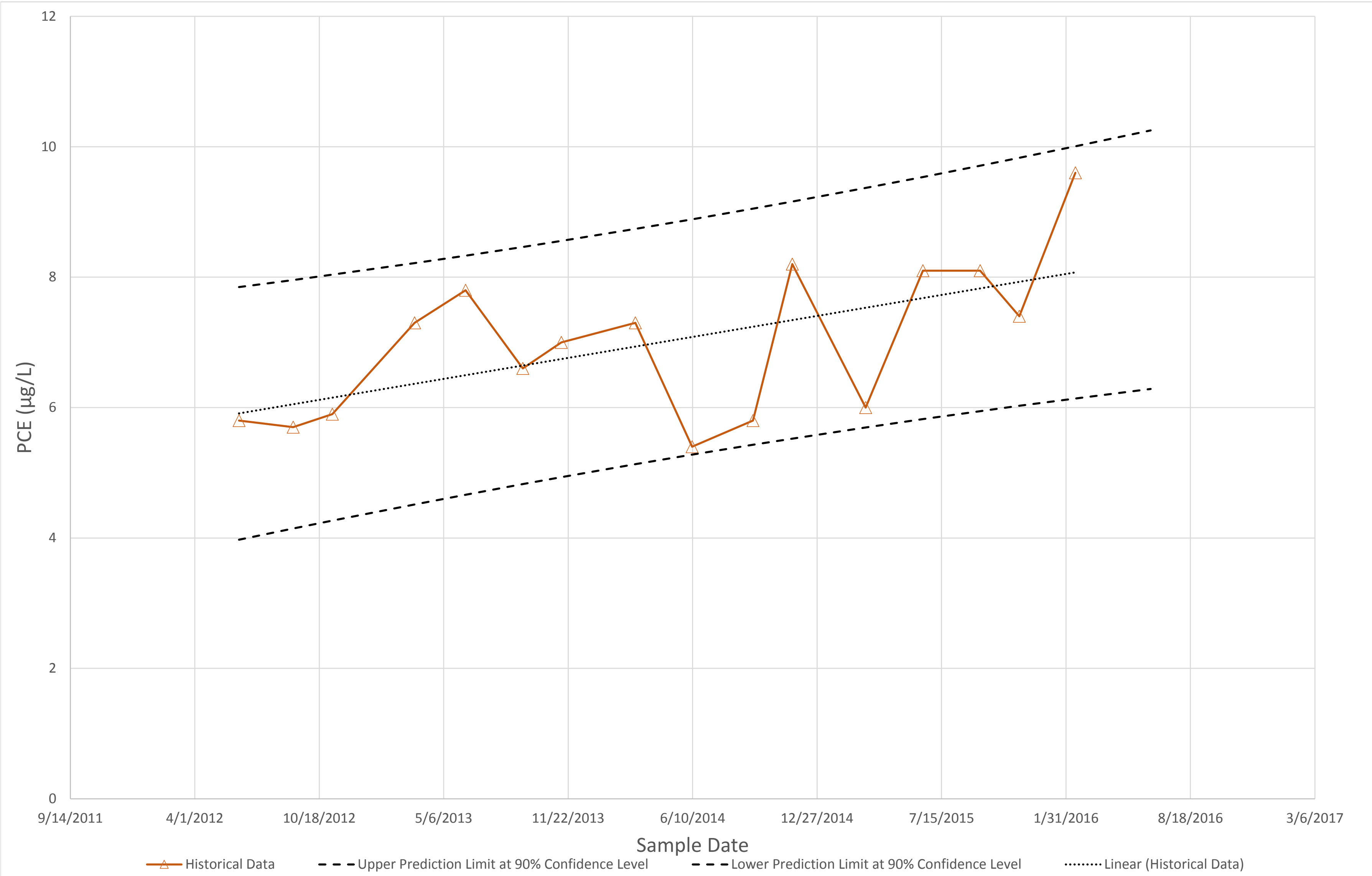


(*Based on:* Gaspar, E., and M. Onescu. 1972. Radioactive tracers in hydrology. Elsevier Publishing Co., Amsterdam)

APPENDIX D

Example of Proposed Statistical Evaluations

Groundwater Sampling Data
Variability Analysis, June 2012 - February 2016*
MW-38



*** Refer to Table D-1 for the results of data screening**

Table D-1
MW-38 Data Screening for Variability Analysis
Herman Kishner Trust B-1 and Maryland Square Shopping Center L.L.C.
Maryland Square PCE Site, Las Vegas, Nevada

Date	PCE Concentration	Explanation
Jun 2012	5.8	Data used in analysis of variability for low-flow sampling method
Sep 2012	5.7	
Nov 2012	5.9	
Mar 2013	7.3	
Jun 2013	7.8	
Sep 2013	6.6	
Nov 2013	7	
Mar 2014	7.3	
Jun 2014	5.4	
Sep 2014	5.8	
Nov 2014	8.2	
Mar 2015	6	
Jun 2015	8.1	
Sep 2015	8.1	
Nov 2015	7.4	
Feb 2016	9.6	

Notes:
· Concentrations are expressed in micrograms per liter (µg/L).
· PCE = Tetrachloroethene.
· Bold type = data used in analysis of variability for low-flow sampling method.
· Grey type = data not used in analysis of variability for low-flow sampling method.

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