DRAFT WORK PLAN FOR MITIGATION OF INDOOR AIR AND WELL WATER

MARYLAND SQUARE SHOPPING CENTER
3661 SOUTH MARYLAND PARKWAY
LAS VEGAS, NEVADA

SUBMITTED TO
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
BUREAU OF CORRECTIVE ACTIONS
901 SOUTH STEWART STREET, SUITE 4001
CARSON CITY, NEVADA 89701-5249

PREPARED FOR
HERMAN KISHNER TRUST
C/O MR. TOM VANDENBERG, ESQ.
707 WILSHIRE BOULEVARD, 45TH FLOOR
LOS ANGELES, CALIFORNIA 90017

PREPARED BY

TETRA TECH
639 ISBELL ROAD, SUITE 390
RENO, NEVADA 89509

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1.0 INTRODUCTION

The Maryland Square Tetrachloroethene (PCE) Site (the Site) is located near downtown Las Vegas, Nevada. The Site contains a dissolved PCE plume that extends from the location of the former Al Phillips the Cleaners (APTC), in the former Maryland Square Shopping Center at 3661 South Maryland Parkway, to more than 4,000 feet east (downgradient) (Figure 1-1). The central area of the plume is beneath a residential neighborhood. Nevada Department of Environmental Protection (NDEP) has installed subslab ventilation systems under several of the homes in the neighborhood to mitigate elevated concentrations of PCE in indoor air.

1.1 OBJECTIVES

This work plan describes the procedures that will be used to characterize, control, mitigate, and abate threats to human health via the vapor intrusion (VI) pathway. This work plan and the scope of work described herein has been developed to characterize the Site with respect to the VI pathway and to implement mitigation measures at homes with indoor air PCE concentrations that exceed the NDEP Interim Action Level for residential indoor air. Characterization of the site includes defining the extent of the groundwater PCE plume and assessing PCE in indoor air and soil vapor. The schedule for submittal of this work plan and implementation of the work will be in accordance with the schedule outlined in the Permanent Injunction Governing the Clean Up of Hazardous Substances at and Emanating from Maryland Square Shopping Center, dated December 27, 2010, issued in the U.S District Court, District of Nevada, Case No. 2:08-cv-01618 RCJ (GWF). The tasks and objectives of the work plan are listed below.

1. Define the extent of the PCE groundwater plume.

2. Provide indoor air sampling for homes within the Site that overlie groundwater containing PCE at a concentration of 100 micrograms per liter (µg/L) or more.

3. Design, install, and test the efficacy of additional subslab depressurization (SSD) systems if indoor air samples collected from unmitigated homes are found to contain PCE vapors at concentrations exceeding NDEP's Interim-Action Level (32 micrograms per cubic meter [$\mu g/m^3$] PCE), subject to homeowner approval.

4. Maintain and monitor existing SSD systems until they are no longer necessary to protect human health.

5. Identify any domestic wells within the 5 µg/L boundary of the plume and take appropriate action to assure that the drinking water standards for PCE and its degradation products are not exceeded in these water supply wells.

This work plan specifically provides for Items 1, 2 and 4 (defining the extent of the groundwater plume and monitoring indoor air and SSD systems) and the initial efforts required for Item 5, which includes identifying and sampling domestic wells. An amendment to the work plan will be prepared at the conclusion of these initial tasks to address Item 3 and the final task of Item 5, which will mitigate potential exposure associated with domestic supply wells.

1.2 SITE HISTORY

The APTC location was developed in 1969 as a dry cleaning operation in the Maryland Square Shopping Center. APTC assumed operation of the site later that same year, and continued to operate the dry cleaning facility until 2000. During a Phase II Environmental Site Assessment in 2000 as part of a property transaction, PCE was detected in shallow groundwater at the southeast corner of the APTC facility (Converse Consultants [Converse] 2000). A follow-up investigation identified PCE in soils beneath the operation area of the former APTC facility (Converse 2002).

Additional groundwater investigations through 2008 delineated the PCE plume over 4,000 feet east under the Boulevard Mall and a residential neighborhood that extends into the Las Vegas National Golf Course. By 2008, the investigations had defined the estimated extent of the plume that exceeds 100 µg/L in the downgradient area (Figure 1-1). However, the distal and lateral extents of the PCE plume have not been determined to a concentration of 5 µg/L.

In 2007, an investigation evaluated the potential for PCE to volatilize from the shallow groundwater water and migrate into homes that overlie groundwater containing PCE (URS Corporation [URS] 2007). The maximum PCE soil vapor concentration detected at the top of the groundwater table was 170,000 µg/m^3 (Figure 1-2), and the highest concentration detected along Spencer Street was 46,000 µg/m^3 at a depth of 5 feet bgs (Figure 1-3).

In response, NDEP sampled indoor air in 97 homes and two schools between fall 2007 and winter 2007-2008. Of the homes sampled, 15 homes had indoor air with PCE concentrations greater than the NDEP indoor air Interim-Action Level of 32 µg/m^3 (Broadbent 2010). SSD systems were installed at 14 of these homes, which were subsequently retested to assure that the systems were successfully mitigating PCE vapor concentrations. If indoor air concentrations remained above the NDEP interim action level, the SSD systems underwent performance testing (e.g., testing of in-home pressure differential) and were modified to achieve PCE concentrations less than 32 µg/m^3 in indoor air. Subsequent sampling confirmed that all homes with the SSD systems exhibited PCE concentrations less than 32 µg/m^3 in indoor air (Broadbent 2010).

1.3 PHYSICAL SETTING AND SITE HYDROGEOLOGY

The Site is located in the central eastern portion of the Las Vegas Valley. Precipitation on the Valley floor averages 4.16 inches per year as reported by the Western Region Climate Center (WRCC 2010). Most precipitation occurs during the months of July and August and during the winter (Wild 1990). Potential evapotranspiration ranges from 1 to 19 inches per month from winter to summer months (Shevenell 1996).

Las Vegas Valley is a structural basin filled with 3,000 to 15,000 feet of sediments in the Basin and Range Province of the northern Mojave Desert (Langenheim and others 1998). In the east central valley area, including the Site, coarse-grained sediments interfinger with heterogeneous playa deposits (e.g., sandy silt, silty sand, clayey sand, sandy clay, caliche) (Figure 1-4) (Plume 1989, Leising 2004). Coarse sediments generally serve as aquifers, while the silts, clays, and caliche often act as confining layers (Zikmund 1996). The upper unit of heterogeneous sand, silt, and clay sediments is termed the Las Vegas Wash Aquitard (Figure 1-5). Based on well logs on file with Nevada Department of Water Resources (NDWR), this unit may be 100 feet thick in the area of the Site. The shallow groundwater system that has been investigated to define the distribution of PCE at the Site is within the upper 30 to 50 feet of the Las Vegas Wash Aquitard.

Groundwater in the Las Vegas Wash Aquitard is generally brackish and considered non-potable, with total dissolved solids (TDS) ranging from 900 to 4,300 mg/L in monitoring wells installed across the Site (Tetra Tech, Inc. [Tetra Tech] 2011). Water quality in the Las Vegas Wash Aquitard generally degrades in an easterly, downgradient direction with increasing concentrations of TDS, sulfate, and sodium. The elevated salinity is a result of evapotranspiration, dissolution of saline minerals in soils and rocks, and infiltration of irrigation water (Zikmund 1996). The groundwater in the Las Vegas Wash Aquitard in the area of the Site is a calcium-magnesium-sulfate water with a lesser bicarbonate component (Leising 2004).

Lithologic data are available in borehole logs from 33 monitoring wells installed at the Site during 2000 to 2008. The geology of the Site consists of interbedded sequences of sand, sandy silt, sandy clay, and silty clay with frequent zones of caliche and intermixed gravel scattered throughout (Figure 1-6). The depth to groundwater generally varies between 9 and 28 feet below ground surface (bgs) across the Site. Based on water level data obtained in June 2010, shallow groundwater flows east with a gradient that ranges from 0.0124 to 0.0132 feet/foot (Figure 1-7) (Tetra Tech 2010). Historical groundwater elevations indicate the water table has varied by about 5 feet throughout the monitoring period (2000 to 2011).

2.0 DELINEATION OF THE GROUNDWATER PLUME

Currently, 33 monitoring wells have been installed at the Site to characterize the extent of PCE in shallow groundwater. The locations of these wells and the defined extent of the PCE plume as represented by the 3rd quarter 2010 data are shown on Figure 2-1. The plume begins at the former APTC location at 3661 South Maryland Parkway and extends roughly 4,000 feet east to the area of the Las Vegas National Golf Course. Eight additional wells are proposed to define the lateral extent of the PCE plume to a concentration of 5 μg/L. The proposed locations for the new wells are shown on Figure 2-1.

2.1 PERMITS AND SITE PREPARATION

Prior to commencement of field work, the drilling contractor will file a *Notice of Intent* to drill along with an *Affidavit of Intent to Abandon (monitor well)* with NDWR. A Right-of-Way encroachment permit and traffic control approval will be obtained from Clark County Development Services Department – Civil Engineering Division (County). Also, Work Notices will be prepared and distributed to nearby residences two weeks in advance of the work to notify and explain to residents the scope of work and potential parking restrictions. A toll-free number for NDEP's public relations officer will also be provided for any questions the residents might have. "No Parking" signs will be placed in designated areas as specified in the approved traffic control plans at least 48 hours prior to the start of drilling. Work activities will comply with County standards for traffic control signage and will ensure that post-drilling street clean-up of the drilling location is adequate.

Proposed drilling locations in public right-of-way areas will be identified using paint or wooden survey stakes with colored flagging. Underground Services Alert will be given at least 48 hours notice prior to commencement of field activities to identify potential aboveground and underground utility and service lines in the vicinity of the drilling locations. Proposed drilling locations on privately owned land will be identified by using paint or wooden survey stakes with colored flagging.

Utility locations will be surveyed and identified by a contracted underground clearance company. All utilities will be marked in paint or pin flags on the surface by each responsible entity. Immediately before drilling begins, poly sheeting and sand bags will be placed in the drilling and sampling area to protect the street surface from cuttings and liquids, and poly sheeting and sand bags will be placed over all nearby manhole lids/storm drain openings to preclude fluids from entering the subgrade systems. All work will be conducted as required under Occupational Safety and Health Administration (OSHA) Standards *Code of Federal Regulations* Title 29, Labor, Part 1910.120.

2.2 WELL CONSTRUCTION

New groundwater monitoring wells will be installed using 8-inch-diameter hollow stem augers. Drilling equipment will be decontaminated by the contracted driller prior to arrival at the site and between holes. All borings will be drilled to a depth of approximately 37 feet bgs and continuously sampled using a split barrel or split spoon sampler. Core lithology will be recorded to document the geology of the well borehole.

Wells will be constructed using ASTM International (ASTM)-rated Schedule 40, 4-inch-diameter polyvinyl chloride (PVC) pipe (Type 1, Grade 1, NSF certified, threaded, flush joint TriLoc or similar material). Screens will be 20 feet of No. 10 slot (0.010 inch) 4-inch-diameter slotted pipe. A 1-foot sump will be placed on each well as a sediment trap. The wells will be completed at grade with traffic-rated well vaults.

Sand packs will be constructed using clean #0/30 grade (30/50 sieve) sand and will extend to 2 feet above the top of the well screen. After placement of the sand, the well will be pre-developed by gently surging across the screen interval to settle the sand pack. Additional sand will be added to bring the sand pack to design specifications. Bentonite pellets will be placed above the filter pack and hydrated to form a minimum 2-foot-thick well seal, and a bentonite/cement slurry grout will be placed in the annulus above the bentonite seal up to within 2 feet bgs. A tremie pipe is to be worked around the hole to make sure that the annular space is free of voids. A locking, expanding well cap will be installed on each well and secured with a Masterlock, or equivalent. For monitor wells completed at grade, the surface completion will include a bolted access cover on a traffic-rated vault. Traffic barriers will be placed about the well for at least 24 hours to allow the grout to cure. Each well will be surveyed for location and elevation by a registered professional surveyor.

All waste will be containerized in drums and transported to the fenced APTC site for temporary storage until waste characterization is complete and the waste can be transported for off-site disposal.

2.3 WELL DEVELOPMENT

The new wells will be developed no sooner than 24 hours following installation. Well development will remove the residual sediments remaining in the well and maximize flow of groundwater through the filter pack and well screen. Wells will be developed using a combination of bailing, surging, and pumping. The well will initially be bailed until most of the sediment has been removed. The depth to the bottom of the well will be measured using a water level meter to confirm the total depth of the well. After allowing adequate time for the water level to recharge in the well after bailing, the well will be surged using a surge block to flush fine-grained materials from the filter pack. Surging will be conducted across the entire saturated screen interval for at least 5 minutes per 10-foot section.

After surging of the screened interval, the fine-grained materials that accumulate inside the well casing will be bailed until most of the settleable solids are removed. The water level recharge rate will then be measured using a stopwatch and water level meter. A minimum of three surge and bailing cycles will be conducted in each well. After three surge and bailing cycles are completed, a submersible pump will be placed inside the well, and the well will be pumped at a sustained rate. Pumping rates will be measured using a stopwatch and a graduated container.

For wells installed in intervals where silt and clay strata are present, less vigorous surging will be employed to avoid introducing fine-grained materials from the formation into the filter pack material. During pumping, water level and water quality parameters consisting of pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), and turbidity will be monitored and recorded on a well development field data sheet. Water quality parameters should stabilize according to the following standards:

- pH: ± 0.1 pH units
- Electrical Conductance: ± 5 percent of previous readings
- Temperature: ±1 degree Celsius (°C)
- DO: ±0.3 mg/L
- Turbidity: ≤100 nephelometric turbidity units (NTU), although 25 NTUs will be attempted.

If turbidity goals have not been met, development will continue with surging, bailing, and pumping. After water quality parameters have stabilized, development will be considered complete. Well development will not exceed more than 4 hours per well. If a well bails or pumps dry, development will

be attempted by allowing the well to recharge to at least 80 percent of pre-development capacity before continuing with surging and bailing/pumping; no more than two recharge/development events will be attempted for a low production well. NDEP will be notified within 1 business day of wells that cannot be fully developed due to limited production capacity. The total volume (in gallons) produced during development will be calculated and recorded on each well development field data sheet.

All development water will be contained and transported to the fenced APTC site for temporary storage until waste characterization is complete and the waste can be transported for disposal.

2.4 SAMPLING OF THE NEW WELLS

Wells will be sampled no sooner than 1 week after completion of development. As per NDEP agreement, groundwater monitoring will be performed using low-flow micro-purge procedures established by the United States Environmental Protection Agency (EPA) and ASTM D 6771-02.

Groundwater samples will be collected from each well after field-measured water quality parameters of pH, temperature, EC, DO, oxidation-reduction potential (ORP) and turbidity stabilize. The samples will be analyzed for PCE, TCE, *cis*-1,2-DCE and vinyl chloride using EPA Method 8260B (EPA 1996c). One duplicate sample and one trip blank sample will be collected for quality assurance (QA)/quality control (QC). The samples will be packed and shipped for analyses to Advanced Technology Laboratories in Las Vegas under chain of custody and following EPA SW-846 protocols.

2.5 REPORTING

Copies of well logs for each of the newly installed monitoring wells will be submitted to NDWR by the drilling contractor within 30 days of completion.

Upon complete delineation of the lateral extent of the 5 μg/L PCE plume in groundwater, a report will be prepared documenting the installation and development of all monitoring wells that were installed during the investigation. If evaluation of the analytical results indicates that the extent of the 5 μg/L PCE plume is not delineated, the final report will be delayed and a letter addendum to this work plan will be submitted to NDEP requesting additional investigation to complete the delineation. The final investigation report will include the well boring and construction logs, the well development records, the analytical results of the initial sampling event, and a PCE contaminant plume map based on the sampling results and the most recent quarterly groundwater monitoring event.

The new wells will be incorporated into the Site groundwater monitoring program.

3.0 INDOOR AIR AND SOIL VAPOR SAMPLING PLAN

Homes located over groundwater containing PCE at a concentration of 100 µg/L or more will be assessed to evaluate whether PCE is present in indoor at concentrations over the Interim-Action Level of 32 µg/m^3. In addition to indoor air sampling, soil vapor sampling, including sub-slab sampling beneath homes and vadose zone sampling in the affected neighborhood, is recommended to assess the VI pathway. The following sections detail the work that will be performed to assess the VI pathway and associated impacts to indoor air in homes located over the PCE groundwater plume.

A multi-step approach to the indoor air sampling program is proposed. The first step will be identification of homes to be included in the sampling program based on refined groundwater isoconcentration contours (Section 2.0). Once a list of homes for inclusion in the program has been developed, the homes will be initially screened using indoor air grab samples and on-site analysis. This approach will provide a cost effective way to quickly eliminate from the program homes for which there is no evidence of significant impacts to indoor air. The screening level sampling will be followed up with collection of 24-hour time-composite SUMMA canister samples in homes that are not screened out during the initial sampling. Data from the SUMMA canister sampling will be used to develop a list of homes that have indoor air PCE concentrations above the NDEP Interim Action Level of 32 µg/m^3 and should be included in the long-term indoor air monitoring program (LTIAM). A flow chart of the decision process for inclusion/exclusion of homes in the LTIAM is provided in Figure 3-1 (note that the decision process illustrated in Figure 3-1 is valid only until the remediation standard for groundwater has been satisfied). The following sections detail the work to be performed for the indoor air and soil vapor sampling portions of this program.

3.1 SELECTION OF TARGET HOMES

3.1.1 Identification of Homes Within the 100 µg/L Isoconcentration Contour

In order to protect the privacy of individual homeowners, the locations and addresses of homes targeted for sampling will be kept confidential and not specified in this Work Plan or in any subsequent plans or reports. Each home will be assigned a randomly generated number and will be identified only by that number in plans and reports. Individual homeowners will be informed of the identification number assigned to their home and NDEP will be provided with a cross-reference table providing all of the identification numbers.

As discussed in Section 2.0, the extent of PCE in groundwater has not been fully delineated at the Site and one of the objectives of the proposed work is to better define the 100 and 5 µg/L PCE isoconcentration contours. Homes within the 100 µg/L PCE isoconcentration contour will be sampled for elevated indoor air concentrations; however, because this contour is not yet fully delineated, the number and location of homes that will be recommended for sampling is to be determined. Based on the results of the 3rd quarter 2010 groundwater monitoring event (Tetra Tech 2010), 60 to 100 homes may reside over portions of the plume exhibiting PCE concentrations of 100 µg/L or more (Figure 2-1).

Once the 100 µg/L PCE isoconcentration contour has been fully delineated, plume contours will be overlaid onto a map of residential property lots within the Site. Those homes located on lots that are within the 100 µg/L contour will be recommended for inclusion in the indoor air sampling program. Prior to residential notification and sampling activities, Tetra Tech will submit to NDEP (for review and concurrence) the overlay map illustrating the monitoring well locations and data used to define the isoconcentration contours, along with a list of addresses recommended for inclusion in the indoor air sampling program.

3.1.2 Requests to Conduct Indoor Air Sampling

Correspondence requesting permission to conduct indoor air sampling will be issued to those homes and homeowners recommended for inclusion in the initial sampling program. A release of liability form will be included in notification correspondence to be completed for purposes of documenting authorization to conduct subsequent indoor air sampling activities. It is assumed that notification and request efforts will be conducted in collaboration with NDEP and in conjunction with the Community Relations Plan.

Home for which permission to sample indoor air is denied will be monitored via the Site groundwater monitoring program. If groundwater PCE concentrations in the vicinity of a home are observed to be increasing, a second request to sample indoor air may be sent to the homeowner re-iterating Site conditions and relevant information that should be carefully reconsidered (Figure 3-1).

3.2 INDOOR AIR SAMPLING

The indoor air sampling program will consist of four primary elements: (1) home surveys to identify potential indoor and background sources of PCE, (2) grab sampling to screen out homes for which there is no evidence of significant VI, (3) SUMMA canister sampling to identify homes with PCE in indoor at a concentration above 32 µg/m^3, and (4) the LTIAM program.

Homes that are located within the 100 µg/L PCE groundwater contour and that have existing sub-slab depressurization (SSD) systems will be automatically included in the LTIAM program. Grab sampling may be conducted in these homes to identify potential indoor sources or preferential pathways for VI; however, these homes will be included in the LTIAM program regardless of grab sampling results.

Indoor air sampling can be regarded as a nuisance or disturbance to homeowners or occupants. Consequently, judicious efforts to thoughtfully coordinate with owners/occupants to conduct home surveys and gain access to indoor areas for sampling events will be needed. In an effort to impart credibility regarding the importance of this activity and to relieve potential concerns, NDEP participation with Tetra Tech while engaging sampling program participants is invited.

3.2.1 Home Surveys

Prior to collecting samples, each home included in the program will be inspected and the occupants interviewed in an effort to identify potential indoor or background sources of PCE. A draft version of the home-survey form that will be used is provided in Appendix A. Tetra Tech will conduct the home surveys; however, NDEP participation to assist in addressing questions or concerns that homeowners/occupants may have should be considered.

If potential indoor PCE sources are identified, reasonable steps will be taken to remove or otherwise mitigate interfering sources prior to sampling. Review and interpretation of indoor air sample results will be conducted in the context of identified potential indoor and/or background sources of PCE.

3.2.2 Phase I: Real-time Grab Sampling and Analysis

The initial phase of sampling will consist of grab sampling and on-site analysis using a mobile laboratory. Multiple grab samples will be collected from various locations in each home. Sampling locations will be home-specific and will be selected based on information obtained from the home survey. Samples will be collected from suspected vapor entry points (i.e., foundation cracks, utility penetrations, sumps) as well as regularly occupied areas such as living rooms, family rooms, and bedrooms. The objective of the

sampling will be to assess both "worst-case" indoor air concentrations (i.e., points of entry) and "likely exposure" concentrations that residents might experience in regularly occupied areas. In addition, grab samples may be collected at suspected indoor sources to assess relative contributions to indoor air concentrations.

Indoor air grab samples will be collected in ground glass syringes with vapor-tight lab-cocks or Tedlar bags. Glass syringes are preferred because the sample can be readily and directly introduced into the analytical instrument; however, the samples must be analyzed within 10 minutes of collection. If sample analysis cannot be completed within 10 minutes, samples will be collected in Tedlar bags, which have a holding time of up to 2 hours prior to analysis.

Duplicate indoor air samples will be collected at a rate of 5 percent (1 per 20) for quality assurance/quality control (QA/QC) purposes. At least one ambient (outdoor) air grab sample will be collected each day from a location upwind of the sampled homes to assess the presence of PCE and its daughter compounds in ambient air. If specific ambient sources of PCE are suspected (e.g., an upwind business that uses PCE), targeted grab samples of ambient air may also be collected.

Grab samples will be analyzed using a modified version of EPA SW-846 Method 8021 (EPA 1996b) for PCE and its daughter products trichloroethene (TCE), *cis*-1,2-dichloroethene (DCE), and *trans*-1,2-DCE. Method 8021 is a gas chromatography method that typically uses a photoionization detector (PID) and a Hall Detector (electrolytic conductivity detector). For this program, the instrumentation will be modified to use an electron capture detector (ECD) in place of the Hall Detector to achieve low reporting levels. Reporting levels for the target analytes will be:

- PCE 5 µg/m^3
- TCE 10 µg/m^3
- *cis*-1,2-DCE 50 µg/m^3
- *trans*-1,2-DCE 50 µg/m^3

Because the modified Method 8021 instrumentation completes sample quantification within 5 minutes, multiple samples from each home can be collected and analyzed to complete a robust VI profile of subject residences. This screening program will also enable the detection of indoor sources of target analytes. It is anticipated that two to five grab samples will be collected from each home depending upon house size and layout. Additional samples will be collected and quantified as necessary depending upon initial results. The analytical results will be used to evaluate analyte concentrations at potential points of entry, from indoor sources, and in typical breathing air. Analytical results representing typical breathing air (i.e., from regularly occupied rooms) will be used to determine whether a home is to be advanced to the next stage of sampling or if it should be dismissed from the indoor air sampling program.

A PCE screening level concentration of 16 µg/m^3 is recommended as the threshold to determine subsequent action. This concentration is equal to 50 percent of the NDEP Interim Action Level and provides a margin of error to account for potential temporal variability in indoor air concentrations. Supporting data compiled by EPA using the trace atmospheric gas analyzer (TAGA) mobile laboratory has demonstrated that grab samples tend to match 24-hour time-composite samples by less than a factor of two; therefore, the proposed screening level concentration of 16 µg/m^3 is consistent with this research and provides an adequate safety factor.

At the conclusion of screening sampling, Tetra Tech will prepare a brief report summarizing field sampling activities, sampling results, and recommended actions for each home. Based on the robust dataset generated from on-site analytical capabilities, homes exhibiting breathing air with PCE concentrations at or above 16 µg/m^3 will be advanced to the next stage of the sampling program. Homes where breathing air samples do not exceed 16 µg/m^3 will be dismissed from the indoor air sampling program (Figure 3-1).

Groundwater concentrations in the vicinity of homes that are dismissed will be monitored via the groundwater LTM program. If the groundwater PCE concentration near a home dismissed from the indoor air sampling program increases by more than 50% compared to the concentration known during the time of initial sampling, indoor air in the home will be resampled (Figure 3-1).

3.2.3 Phase II: 24-Hour Composite Sampling and Off-site Analysis

Homes that have indoor breathing air with PCE concentrations above 16 µg/m^3 based on the first phase of sampling will be advanced to the 24-hour composite indoor air sampling phase of the program. This phase will include collection of 24-hour SUMMA canister samples, which will be analyzed off-site at a fixed-facility laboratory using EPA Method TO-15 (EPA 1999).

The objective of this sampling is to determine, using conventional sampling and analytical methods, whether PCE is present in indoor air at concentrations exceeding the NDEP Interim Action Level of 32 µg/m^3. A minimum of one sample will be collected from each home. Additional samples may be collected depending on the size and configuration of the residence. Samples will be collected from rooms in which the residents spend the majority of time (i.e., living rooms, family rooms).

Indoor air samples will be collected in individually certified SUMMA canisters provided by the selected analytical laboratory. Canisters will be equipped with flow controllers calibrated to sample over a 24-hour period. Duplicate samples will be collected at a rate of 5 percent of field samples for QA/QC purposes.

SUMMA canisters must be placed in secure, stationary locations in order to accurately sample interior ambient conditions. Consequently, Tetra Tech, with support from NDEP, will coordinate with homeowners/occupants to arrange a convenient time to place and retrieve canisters, as well as educate residents regarding the necessary sampling protocol. While placing and retrieving the canisters, the indoor air will be scanned using a ppb RAE or similar high-sensitivity direct reading instrument to identify indoor sources of target analytes that may have been introduced since the screening level sampling. If indoor sources are identified, reasonable steps will be taken to remove them prior to sample collection.

Canisters will be positioned so that the intake port is approximately 2 to 6 feet above the floor (i.e., typical breathing level), and will be placed as near to the center of the room as possible and away from HVAC system registers. Steps will be taken to detect unauthorized tampering with the canisters (either deliberate or accidental). The start and finish times, date, and relative vacuum of each canister will be recorded in field notes, along with meteorological conditions including temperature, barometric pressure, and wind speed and direction.

At least one outdoor ambient air sample will be collected for each day of sampling to assess potential target analytes in background air. Ambient air samples will be collected from secure, outdoor locations, following the same procedures and within the same timeframe as the indoor air samples.

Sample details will be recorded on chain-of-custody forms and the samples submitted to the selected laboratory for analysis using EPA Method TO-15. TO-15 is the industry standard analytical methodology for the analysis of volatile chemicals, such as PCE, in ambient air. Samples will be analyzed for PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride.

At the conclusion of the Phase II sampling, Tetra Tech will prepare a brief report summarizing the field sampling activities and results, and providing the recommended action for each home. As illustrated on Figure 3-1, homes identified as having PCE concentrations in breathing air above 32 µg/m^3 will be included in the LTIAM program and will be recommended for design and installation of a SSD system.

Homes that do not have PCE concentrations in breathing air above 32 µg/m^3 will be dismissed from the indoor air sampling program. Groundwater concentrations in the vicinity of these homes will be monitored via the Site groundwater monitoring program. If groundwater PCE concentrations in the vicinity of a home increase by more than 50 percent above the concentrations measured in groundwater at the time of the Phase II indoor air sampling, indoor air in the home will be resampled to verify it remains below 32 µg/m^3 (Figure 3-1).

3.2.4 Phase III: Long-Term Indoor Air Monitoring

Homes that are determined during the Phase II sampling to have indoor air PCE concentrations above 32 µg/m^3 and homes within the 100 µg/L PCE groundwater contour that have existing SSD systems will be included in the LTIAM program (Figure 3-1). Sampling for the LTIAM program will be conducted on an annual basis. One sample will be collected from each home during each monitoring event using the method described for the Phase II sampling program. The LTIAM samples will provide data to verify that indoor air PCE concentrations remain below the Interim Action Level of 32 µg/m^3 and that the SSD systems work properly. An annual Indoor Air Monitoring Report will be prepared following each sampling event. The report will include a description of the sampling activities, a summary of the sampling results, data interpretation, and recommendations, as appropriate.

3.2.4.1 Exit Pathways

There are a variety of possible outcomes from the indoor air and groundwater monitoring program sampling events. Figure 3-1 illustrates the decision steps described below.

If a home is found to have PCE concentrations in indoor air above 32 µg/m^3, the SSD system (if installed) will be evaluated and adjustments made, as warranted, to lower the PCE concentrations. If a home has PCE concentrations above 32 µg/m^3, but the owner has declined to have a SSD system installed, NDEP may choose to reiterate the recommendation for installation of a system.

The most likely scenario is that the SSD systems will successfully lower PCE concentration below 32 µg/m^3. For homes where PCE concentrations in indoor air have been mitigated below 32 µg/m^3, the groundwater concentrations in the vicinity of the homes, as determined from the groundwater LTM program, will be used to guide the decision steps. If groundwater concentrations in the vicinity of the home fall below 100 µg/L (i.e., the home is no longer within the 100 µg/L isoconcentration contour), then the home will no longer meet the criterion for indoor air sampling and it will be dismissed from the LTIAM program and the SSD system will be disabled.

If the groundwater concentrations in the vicinity of the home remain above 100 µg/L, but have decreased by more than 50 percent relative to the concentrations measured at the time of the Phase II indoor air sampling, the SSD system will be temporarily shut off and unmitigated indoor air samples will be

collected. If PCE concentrations in the unmitigated indoor air exceed 32 µg/m3, the SSD system will be restarted, and the home will be retained in the LTIAM program. If PCE concentrations in indoor air remain below 32 µg/m^3 with the SSD system shut off, the home will be dismissed from the LTIAM program. Groundwater concentrations in the vicinity of these homes will be tracked and if the groundwater concentrations increase again by more than 50 percent, indoor air will be resampled and if PCE concentrations are above 32 µg/m^3, the SSD system will be restarted and the home will be re-enrolled in the LTIAM program.

3.3 SOIL VAPOR SAMPLING

3.3.1 Sub-slab Soil Vapor Sampling

Sub-slab soil vapor samples are collected to evaluate target analyte concentrations in gases occupying the pore space of engineered base material or natural soils immediately beneath a building foundation. Collection of sub-slab soil vapor samples can be useful in determining whether target analytes detected in indoor air are attributable to VI or not. Due to the multiple potential sources of target analytes in a home, the presence of target analytes in indoor air does not necessarily indicate that VI is occurring.

The presence of target analytes may result from indoor sources, such as chemicals used or stored in a home or brought inside on clothing or other items, or from background sources, such as industrial activities occurring upwind of a home. If target analytes detected in indoor air are not present in sub-slab vapor, it is unlikely that they are a result of VI. Thus, in order to develop a complete characterization of the contaminant conditions at target homes and to verify that VI is occurring, sub-slab vapor samples will be collected at some homes.

3.3.1.1 Selection of Homes for Sub-slab Sampling

Sub-slab sampling requires drilling a small hole through the foundation and installing a gas sampling probe. Homeowners are commonly resistant to this process; therefore, it is likely that the options for sub-slab sampling will be substantially limited by access.

Sub-slab probe installation and sampling will be conducted following the Phase I screening level indoor air sampling. The letters that are sent to homeowners requesting permission to collect indoor air samples (Section 3.1.2) will include a separate request for permission to conduct sub-slab sampling. The letters will explain that sub-slab sampling will not be conducted at each home, but that if the homeowner agrees to sub-slab sampling, Tetra Tech and NDEP will notify the individual homeowners if it is warranted based on the indoor air screening results.

The goal will be to collect sub-slab samples from 10 percent of the homes that are within the 100 µg/L groundwater contour and that have indoor air PCE concentrations above the Interim Action Level of 32 µg/m^3. An additional objective will be to collect sub-slab samples from homes located over the silty soils generally found between MW-23 and MW-25 and homes located over the gravelly sands found east of MW-25 and in the vicinity of MW-18 (URS 2007).

3.3.1.2 Probe Installation

At least one vapor probe will be installed in each home selected for sub-slab sampling. Depending on the size of the building footprint, the building layout, and concurrence from the homeowner, additional probes may be installed. Flooring material such as carpet will be rolled back during probe installation and then placed back over the probe after completion. The probes will be installed by drilling a 3/4-inch

diameter hole through the foundation using a hand held rotary hammer drill and inserting a length of 1/8-inch diameter Nylaflow tubing with a gas permeable tip to the bottom of the hole. A sand filter pack will be poured around the probe tip and then the hole will be filled to approximately 1 inch below the surface with hydrated bentonite. The top 1 inch of the hole will be sealed with plumber's putty. The top of the probes will be terminated with 2-way Luer valves.

Probe installation details, including the total depth and diameter of the hole, tubing length and diameter, time and date of completion, probe location, and any relevant observations will be recorded in field notes. The locations and identities of each probe will be recorded on a building floor plan. Probes will be allowed to equilibrate for a minimum of 1 day after installation prior to sampling.

3.3.1.3 Sub-slab Sampling

Sub-slab probes will be sampled using disposable polypropylene syringes equipped with 3-way Luer valves. Three system volumes will be purged from the probes (a system volume is the volume of the tubing plus the filter pack volume) and the samples will then be collected in Tedlar bags. A fresh syringe will be used for each home and will be flushed with ambient air between each sample. A fresh Tedlar bag will be used for each sample. A leak check compound will be used to verify the samples are not being diluted by ambient air. The samples will be analyzed on-site in a mobile laboratory using either Method 8021 as discussed in Section 3.2.2 or Method 8260B. On-site analysis is advantageous as it eliminates concerns regarding holding times and allows for immediate re-sampling and analysis if a problem is encountered (for example if a leak is detected).

Sample collection data, including date and time, probe location and sample identification numbers, purge volume, and other pertinent information will be recorded in field notes along with meteorological data.

3.3.2 Vadose Zone Soil Vapor Sampling

Vadose zone soil vapor samples are samples collected a few feet or more below grade. They are important in characterizing the site as they provide data on vapor concentrations immediately above the groundwater source and on the rate of vertical attenuation. Like sub-slab samples, they can be useful in assessing whether chemicals detected in indoor air are a result of VI.

For this assessment, vadose zone soil vapor samples will be collected from the nine locations shown on Figure 3-2. URS (2007) previously installed 16 soil vapor borings at the site and designated them SVB-1 through SVB-16; therefore, the vapor probes proposed here will be designated as SVP-17 through SVP-21. These locations have been selected to assess vapor conditions in the gravelly-sand soils adjacent to wells MW-18, MW-26, and MW-27, and in the silty soils adjacent to wells MW-23 and MW-25, and to provide data across the aerial extent of the plume defined by the 100 µg/L groundwater contour. Placement of vapor probes near existing groundwater monitoring wells will facilitate evaluation of the vapor data with respect to corresponding groundwater quality and elevation data. The locations illustrated on Figure 3-2 are tentative and may be adjusted after the groundwater isoconcentration contours are refined based on data from the proposed new monitoring wells (Section 2.0).

3.3.2.1 Probe Installation

The sampling probes will be installed in boreholes drilled with a hollow-stem auger (HSA) rig using the smallest diameter auger flights available. To mitigate the effects of subsurface disturbance from HSA drilling, vapor probes will be allowed to equilibrate for at least 1 week after installation before sampling. Two vapor probes will be co-located within a single bore-hole at each location: a shallow probe

completed at approximately 5 feet below ground surface (bgs) and a deep probe completed approximately 3 feet above the water table. Recent groundwater elevation data (Tetra Tech 2010) indicate groundwater depths along the plume transect ranging from approximately 13 feet bgs (MW-18) to 21 feet bgs (MW-25); thus, the deep probes will be installed at depths of approximately 10 to 18 feet bgs.

Each probe will consist of a length of 1/8-inch Nylaflow tubing with a gas permeable probe tip at the terminus. Vapor probes will be completed with clean sand filter packs extending from 6-inches below to 6-inches above each probe tip, and will be sealed between and above the sand filter packs with hydrated bentonite. Vapor probes will be secured at the surface with 2-way Luer valves and each location will be finished at grade with a traffic rated well vault. Immediately after installation, three system volumes will be purged from each probe using a disposable syringe or portable pump to enhance equilibration with native soil vapor. These vadose zone probe construction specifications will allow additional sampling events, if warranted.

3.3.2.2 Vadose Zone Sampling

The probes will be allowed to equilibrate for at least 1 week after installation before sampling. Each probe will be sampled using disposable syringes equipped with 3-way Luer valves. Three tubing volumes will be purged from the probes prior to sample collection in Tedlar bags. A tubing volume is the volume of the tubing only and does not include the filter pack volume. Because of the large filter pack volume (due to using HSA drilling with 4- to 6-inch diameter augers) and because the filter pack will be purged immediately after installation, it is preferable to only purge the tubing volume prior to sampling. An unused, clean syringe will be used to sample each location, and will be flushed with ambient air between each sample. A fresh Tedlar bag will be used for each sample. A leak check compound will be used to verify the samples are not being diluted by ambient air. The samples will be analyzed on-site in a mobile laboratory. Vadose zone probes will be sampled concurrently with a groundwater sampling event, which will allow comparison of soil vapor concentrations to groundwater concentrations at adjacent wells. If logistics and scheduling permit, the vadose zone and groundwater sampling will be conducted concurrently with the Phase I indoor air sampling and the vapor samples will be analyzed using Method 8021 as discussed in Section 3.2.2, otherwise, Method 8260B may be used.

Sample collection data, including date and time, probe location and sample identification numbers, purge volume, and any other pertinent information will be recorded in the field notes along with meteorological data.

4.0 MONITORING SUB-SLAB DEPRESSURIZATION SYSTEMS

Monitoring of the SSD systems will be conducted as part of the annual LTIAM sampling rounds. The LTIAM sampling data will provide the primary means of monitoring the efficacy of the SSD systems by demonstrating whether or not indoor air PCE concentrations have been mitigated below the NDEP Interim Action Level of 32 $\mu g/m^3$. If indoor air PCE concentrations at a home are found to exceed 32 $\mu g/m^3$, the SSD system will be evaluated and optimized as necessary to bring the indoor air concentrations into compliance. If an SSD system is adjusted due to the detection of elevated PCE concentrations, indoor air in the home will be resampled after 1 month of making the adjustments to verify that it is back in compliance with Interim Action Level.

In addition, each SSD system will be inspected during every LTIAM sampling round to verify system integrity and proper function. The preferred approach to verifying proper function is to measure the vacuum in the suction pipe. Based on information available to Tetra Tech, the existing SSD systems do not have manometers. Manometers will be installed on the existing systems and will be included in any new systems that are to be installed. This will provide an added level of assurance and a cost-effective means to measure system performance. Homeowners/occupants will be requested to keep a log of monthly manometer readings during the first year of operation (or the first year after a manometer is installed on an existing system). The monthly readings will provide baseline data for future system inspections. In addition, residents will be requested to notify NDEP if they believe the system vacuum is significantly lower than normal.

Components that will be checked during the LTIAM sampling rounds include the manometer, exposed piping, the slab, and slab penetrations. An SSD System Inspection Checklist will be followed for each home (Appendix B). If problems are noted during the inspection, they will be promptly corrected. Indoor air in homes will be re-sampled after corrections only if PCE concentrations in indoor air were above 32 $\mu g/m^3$ prior to the corrections. The system will be allowed to operate for 1 month before re-sampling a home.

5.0 IDENTIFICATION AND SAMPLING OF DOMESTIC WELLS

A survey will be conducted to identify all domestic wells located within the 5 μg/L PCE plume. The extent of the area for the evaluation will be finalized after completion of the investigation presented in Section 2.0. Homes within 100 feet of the delineated extent of the 5 μg/L plume area will be included in the evaluation. Based on the results of the 2010 groundwater monitoring events, this survey may include 120 to 130 homes.

Initially, a record search will be conducted of the well log database of the NDWR to identify wells within the plume area. Letters will then be sent to each address within the area of concern to request information on any water wells on the property and requesting information on well construction and usage. It is assumed that NDEP and a legal representative of the homeowners will support Tetra Tech in developing and distributing the information request letters, and that the letters will be printed on NDEP letterhead. The letters will request a follow-up interview with the resident or property owner at a community meeting, by telephone, or through a direct visit with the homeowner or his/her representative to verify the information and collect any additional information that may be missed by the survey. It is assumed that an NDEP representative will be present at these interviews.

The information request letters will include a request for permission to sample the well at the wellhead, prior to any storage tank, and to sample the well water at a point of use (i.e., the water faucet). Whenever possible, the wells will be allowed to pump sufficiently to purge at least one volume of the water in the well bore prior to sampling; for point of use sampling, the water will be allowed to run long enough to flush the pipes. Whenever possible, sampling will be conducted at a low controlled flow to prevent or minimize turbulent flow and volatilization of dissolved organic compounds. The samples will be analyzed for PCE, TCE, *cis*-1,2-DCE and vinyl chloride using EPA Method 8260B. Duplicate samples will be collected at a rate of 10 percent (1 duplicate for 10 samples) and trip blanks will accompany each cooler used to transport samples. The samples will be packed and shipped for analyses to Advanced Technology Laboratories in Las Vegas under chain of custody and following EPA SW-846 protocols.

After completion of the domestic well survey and sampling events, a report will be provided to NDEP with the results. The report will include recommendations for mitigating risks associated with the domestic wells that produce water with greater than 5 μg/L PCE. The monthly status of the survey will be included in the project monthly status report.

6.0 SCHEDULE

Implementation of the work plan will begin within 30 days of NDEP's approval of the work plan. A schedule for implementation will be provided prior to the onset of work activities after discussions with NDEP and key stakeholders on logistics and coordination of activities.

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FIGURES

Legend

- Monitoring Well Location
- Production Well Location
- 1100 PCE Concentration (ug/L)
- NS Not Sampled
- ND Non-detect
- ug/L Micrograms per Liter

PCE Contour (ug/L)

- 100
- 500
- 1000
- 1500
- 2000
- 2500

Notes:
1. Contours do not recognize unusually low PCE concentrations quantified at MW-19 and MW-20.
2. PCE data and contours are from the November 2010 monitoring event.

N W E S

0 250 500 Feet

Approximate Scale in Feet

MARYLAND SQUARE SHOPPING CENTER
3661 South Maryland Parkway
Las Vegas, Nevada

FIGURE 1-1
MARYLAND SQUARE PCE PLUME

TETRA TECH

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Summary of PCE Soil Vapor Concentrations

Sample Number	Sample Depth[1]	Soil Type	Soil Vapor Concentrations ug/L	ug/m[3]	ppbv
SVB-07-05	5	Silty Sand (Af)	11	11,000	1,623
SVB-08-05	5	Silty Sand (Af)	2.7	2,700	398
SVB-08-10	10	Silty Sand	7.1	7,100	1,047
SVB-08-910[2]	10	Silty Sand	15	15,000	2,213
SVB-09-05	5	Silty Sand (Af)	9.0	9,000	1,328
SVB-09-10	10	Gravelly Sand	23	23,000	3,393
SVB-10-05	5	Sand	42	42,000	6,196
SVB-10-10	10	Sand	27	27,000	3,983
SVB-11-10	10	Sandy Silt	0.5	500	74
SVB-11-910[2]	10	Sandy Silt	0.4	400	59
SVB-11-15	15	Sandy Silt	ND	ND	ND
SVB-12-05	5	Gravelly Sand (Af)	ND	ND	ND
SVB-12-10	10	Gravelly Sand	3.0	3,000	433
SVB-13-05	5	Gravelly Sand (Af)	24	24,000	3,541
SVB-13-10.5	10.5	Gravelly Sand (Af)	37	37,000	5,458
SVB-13-910.5[2]	10.5	Gravelly Sand (Af)	45	45,000	6,639
SVB-13-20	20	Sandy Silt	35	35,000	5,163
SVB-14-10	10	Silt	87	87,000	12,835
SVB-14-20	20	Silty Sand	170	170,000	25,079
SVB-15-15	15	Silt	ND	ND	ND
SVB-15-20	20	Silt	0.2	200	30
SVB-16-05	5	Gravelly Sand (Af)	ND	ND	ND
SVB-16-10	10	Gravelly Sand	ND	ND	ND
SVB-16.20.5	20.5	Silt	0.6	600	89

Legend

- Approximate Location of Monitoring Well Installed by Converse Showing Concentration (ug/L) of PCE in Groundwater. ND is Non-detect, NS is Not Sampled. Analytical Data from December 2006.
- Approximate Location of Monitoring Well Installed by URS Showing Concentration (ug/L) of PCE in Groundwater. Analytical Data from October and December 2006.
- Approximate Location of Soil Vapor Sampling Borehole Showing Concentration (ug/m^3 and ppbv) of PCE in Soil Vapor Collected from Shallow and Deeper Soil Above Groundwater.
- Approximate Concentration Contour of PCE in Groundwater

PCE tetrachloroethene

ND Analyte not detected at or above the reporting limit

ug/L Micrograms per liter

ug/m^3 Micrograms per cubic meter

ppbv Parts per billion by volume

(1) Depth in feet (ft) below ground surface

(2) Soil Samples SVB-08-910, SVB-11-910, and SVB-13-910.5 are duplicates for samples SVB-08-10, SVB-11-10, and SVB-13-10.5 respectively

N
W E
S

0 50 100 Feet

Approximate Scale in Feet

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Las Vegas, Nevada

FIGURE 1-2
SOIL VAPOR PCE CONCENTRATIONS ALONG OTTAWA DRIVE AND THE BOULEVARD MALL

TETRA TECH

Sources: Clark County Assessors Web Site, URS 2007

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Summary of PCE Soil Vapor Concentrations

Sample Number	Sample Depth[1]	Soil Type	Soil Vapor Concentrations ug/L	ug/m[3]	ppbv
SVB-01-05	5	Silty Sand (Af)	2.5	2,500	369
SVB-02-04	4	Silty Sand (Af)	3.0	3,000	443
SVB-02-10	10	Silty Sand	ND	ND	ND
SVB-03-05	5	Silty Sand (Af)	46	46,000	6,786
SVB-03-12	12	Silty Sand	0.8	800	118
SVB-04-05	5	Sand (Af)	0.4	400	59
SVB-04-12	12	Silty Sand	1.0	1,000	148
SVB-05-08	8	Silty Sand	25	25,000	3,688
SVB-05-98[2]	8	Silty Sand	17	17,000	2,508
SVB-05-13	13	Silty Sand	1.1	1,100	162
SVB-06-08	8	Silty Sand	ND	ND	ND
SVB-06-12	12	Silty Sand	12	12,000	1,770

Legend

- Approximate Location of Monitoring Well Installed by URS Showing Concentration (ug/L) of PCE in Groundwater. Analytical Data from October and December 2006.
- Approximate Location of Soil Vapor Sampling Borehole Showing Concentration (ug/m3 and ppbv) of PCE in Soil Vapor Collected from Shallow and Deeper Soil Above Groundwater.
- Approximate Concentration Contour of PCE in Groundwater
- PCE tetrachloroethene
- ND Analyte not detected at or above the reporting limit
- ug/L Micrograms per liter
- ug/m(3) Micrograms per cubic meter
- ppbv Parts per billion by volume
- (1) Depth in feet (ft) below ground surface
- (2) Soil Sample SVB-05-98 is a duplicate for sample SVB-05-08

N
W E
S

0 50 100 Feet

Approximate Scale in Feet

Sources: Clark County Assessors Web Site, URS 2007

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Las Vegas, Nevada

FIGURE 1-3
SOIL VAPOR PCE CONCENTRATIONS ALONG SPENCER STREET

TETRA TECH

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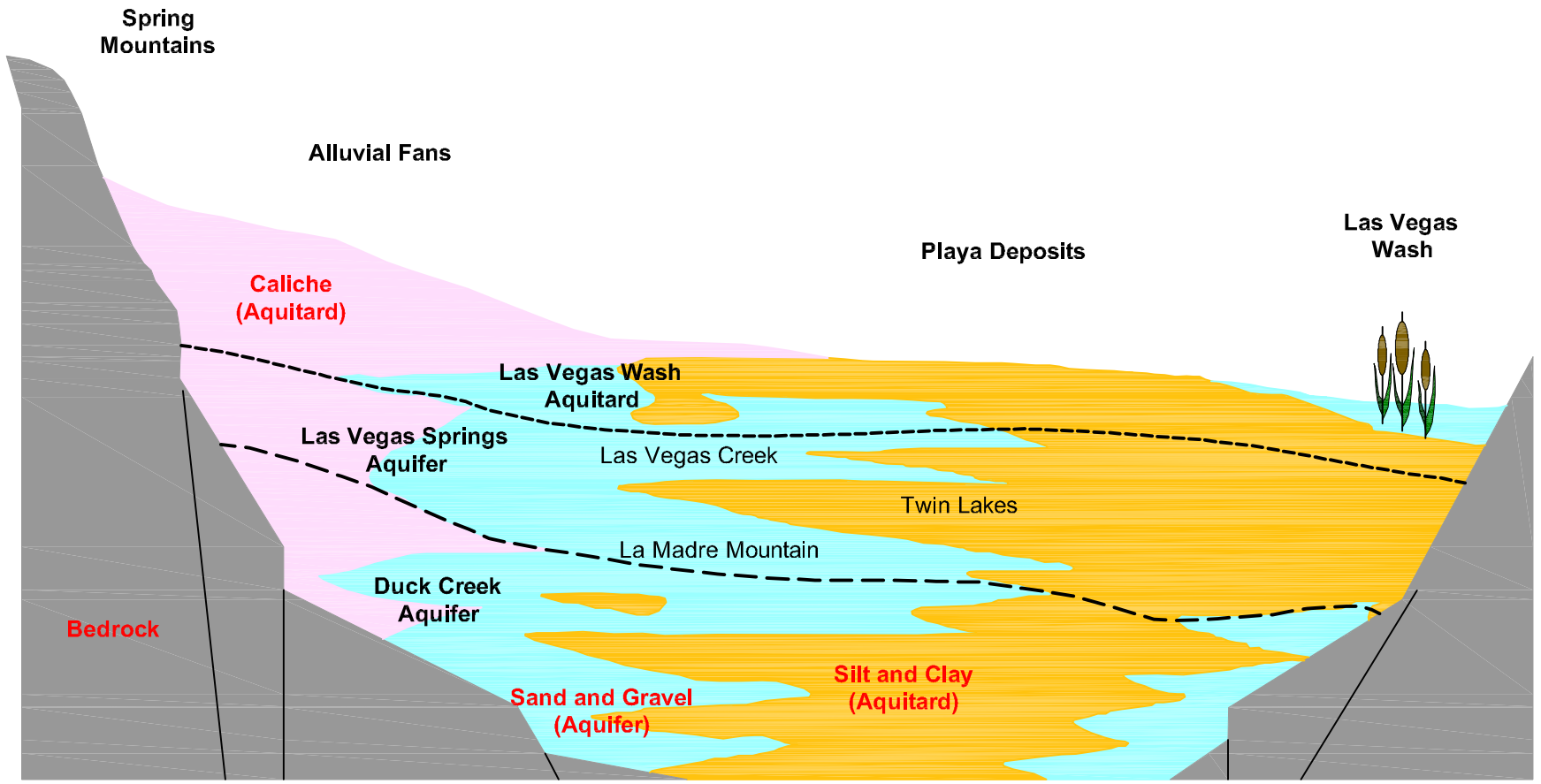


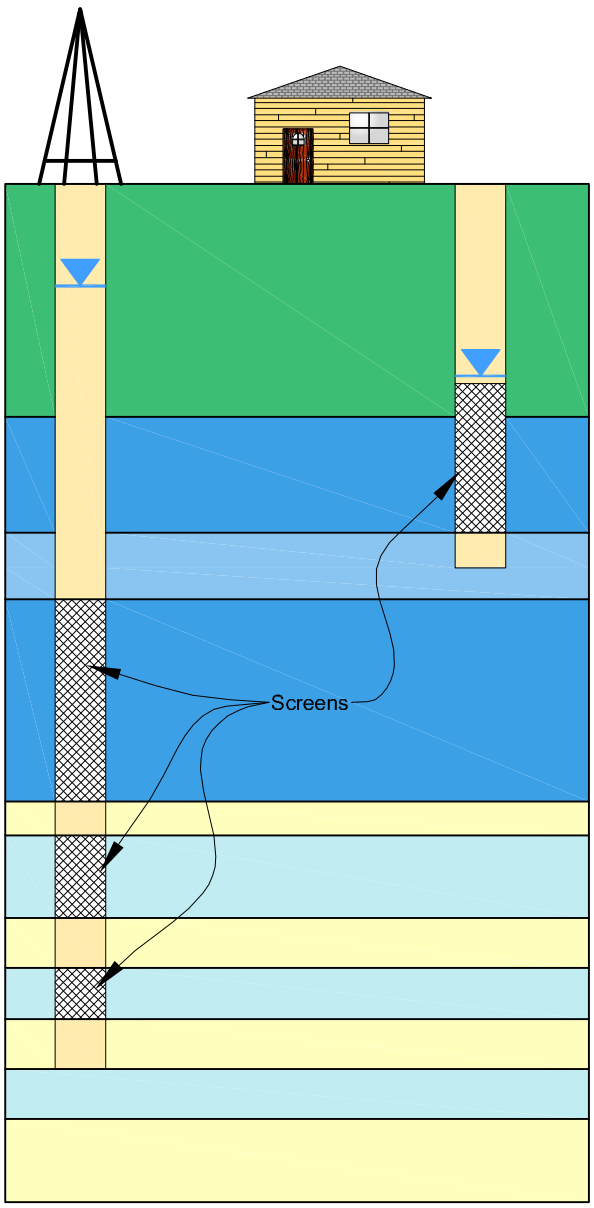
Not to Scale

MARYLAND SQUARE SHOPPING CENTER
3661 South Maryland Parkway
Las Vegas, Nevada

FIGURE 1-4
GENERALIZED CROSS SECTION
OF THE LAS VEGAS VALLEY

TETRA TECH

Source: Leising 2004



Mostly Aquitards
Tapped Rarely in its lower portions by domestic wells

Las Vegas Wash Aquitard

~90 - 450 feet below surface

Las Vegas Creek Aquifer
Primary supply for domestic wells

Twin Lakes Aquitard

Las Vegas Springs Aquifer

Las Madre Mountain Aquifer
Principal sourse for municipal wells

~630 - 950 feet below surface

Undivided Aquifers and Aquitards
Upper portions utilized by some municipal wells

Duck Creek Aquifer

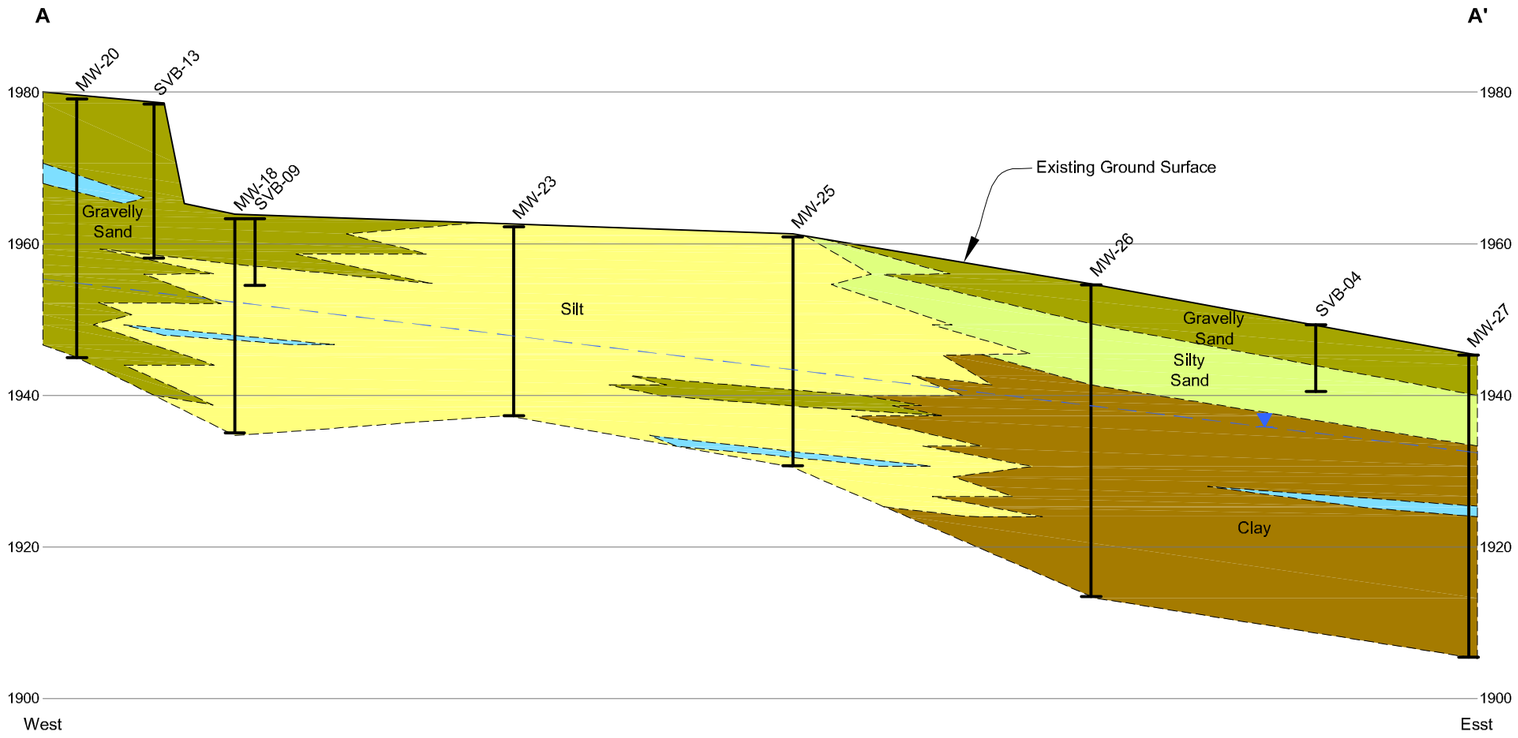
Not to Scale

MARYLAND SQUARE SHOPPING CENTER
3661 South Maryland Parkway
Las Vegas, Nevada

FIGURE 1-5
HYDROGEOLOGIC UNITS
OF THE LAS VEGAS VALLEY

TETRA TECH

Source: Modified from Leising 2004



Legend

- Approximate April 2007 Groundwater Surface
- Gravelly Sand
- Caliche
- Silty Sand
- Silt
- Clay

Source: URS 2007

0 100 200
Horizontal Scale in Feet

0 10 20
Vertical Scale in Feet

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Las Vegas, Nevada

FIGURE 1-6
GEOLOGIC CROSS SECTION A - A'

TETRA TECH

115.14° W
115.135° W
115.13° W
115.125° W
115.12° W
36.125° N
36.12° N

S MARYLAND PARKWAY
Boulevard Mall
Ruby S. Thompson Elementary School
Golf Course
E TWAIN AVENUE
William E. Orr Middle School
Orr Park
E KATIE AVENUE
FLAMINGO WASH

1970
1965
1960
1955
1950
1945
1940
1935
1930
1925
1920

MW-17 1971.27
MW-7 NM
MW-15 NM
MW-12 NM
MW-14 1968.18
MW-13 1965.46
MW-9 1972.15
MW-6 1968.65
MW-1 1972.03
MW-8 NM
MW-5 1969.94
MW-2 1964.89
MW-4 NM
MW-3 NM
BM
MW-10 NM
MW-21 NM
MW-20 1952.09
MW-19 1953.16
MW-18 1949.96
MW-16 NM
MW-11 NM
MW-22 NM
MW-23 1945.36
MW-24 NM
MW-25 1940.88
MW-26 1935.53
MW-33 1933.21
MW-32 1933.36
MW-31 1920.99
MW-30 1921.58
MW-27 1926.46
MW-28 1929.05
MW-29 1918.33

Legend

- Monitoring Well Location
- Groundwater Elevation Contour (5 ft Intervals)
- Direction of Groundwater Flow
- 1965.46 Groundwater Elevation (ft amsl)
- NM Not Measured
- ft amsl Feet Above Mean Sea Level

N
W E
S

0 250 500 Feet
Approximate Scale in Feet

MARYLAND SQUARE SHOPPING CENTER
3661 South Maryland Parkway
Las Vegas, Nevada

FIGURE 1-7
SHALLOW GROUNDWATER POTENTIOMETRIC MAP
OCTOBER 2010

TETRA TECH

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115.14° W
115.135° W
115.13° W
115.125° W
115.12° W
36.125° N
36.12° N

S MARYLAND PARKWAY
Ruby S. Thompson Elementary School
Boulevard Mall
Golf Course
E TWAIN AVENUE
William E. Orr Middle School
Orr Park
E KATIE AVENUE
FLAMINGO WASH

MW-33 ND
PW-2
MW-31 30
MW-32 660
PW-1
MW-30 62
MW-27 420
MW-25 760
MW-26 450
MW-22 NS
MW-21 NS
MW-20 340
MW-19 420
MW-18 1300
MW-23 1100
MW-15 NS
MW-17 270
MW-7 NS
MW-12 NS
MW-14 1500
MW-13 1600
MW-9 6.6
MW-6 2500
MW-1 400
MW-5 550
MW-2 570
MW-8 NS
MW-4 NS
MW-3 NS
MW-16 NS
MW-11 NS
MW-24 NS
MW-10 NS
BM NS
MW-28 0.94
MW-29 0.53

Legend

- Proposed Well Location
- Monitoring Well Location
- Production Well Location
- 1100 PCE Concentration (ug/L)
- NS Not Sampled
- ND Non-detect
- ug/L Micrograms per Liter

PCE Contour (ug/L)

- 100
- 500
- 1000
- 1500
- 2000
- 2500

Notes: 1. Contours do not recognize unusually low PCE concentrations quantified at MW-19 and MW-20.
2. PCE data and contours are from the November 2010 monitoring event.

N
W E
S

0 250 500 Feet
Approximate Scale in Feet

MARYLAND SQUARE SHOPPING CENTER
3661 South Maryland Parkway
Las Vegas, Nevada

FIGURE 2-1
Proposed Well Locations

TETRA TECH

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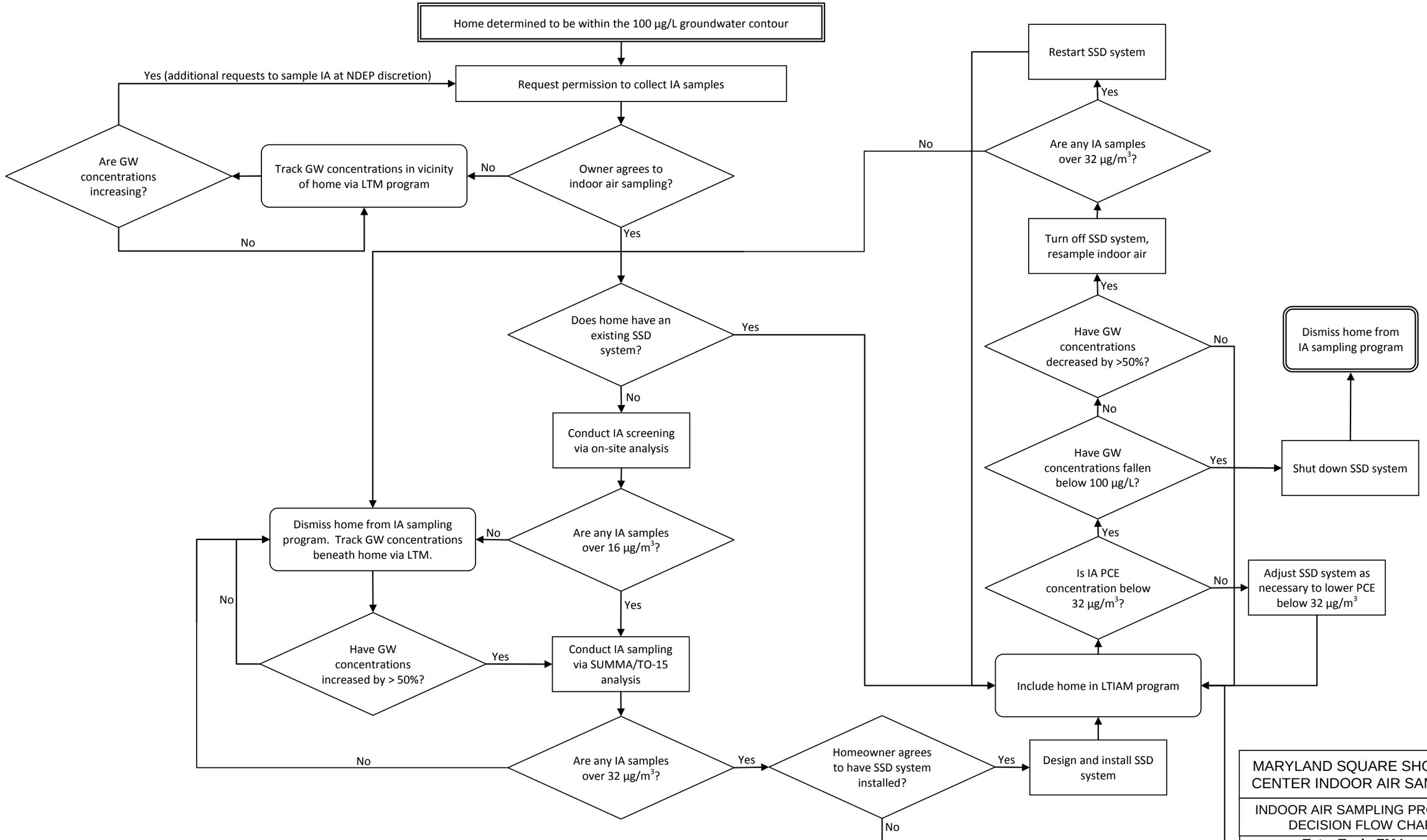

Note:
Decision path valid until remediation standard for groundwater is met. When remediation standard is met the indoor air sampling program will be terminated.

MARYLAND SQUARE SHOPPING CENTER INDOOR AIR SAMPLING

INDOOR AIR SAMPLING PROGRAM DECISION FLOW CHART

Tetra Tech, EM Inc.
1230 Columbia St., Suite 1000
San Diego, CA 92101

TASK NO.	DATE	FIGURE
27234-01	2/28/11	3-1

115.14° W
115.135° W
115.13° W
115.125° W
115.12° W
36.125° N
36.12° N

S MARYLAND PARKWAY
E TWAIN AVENUE
E KATIE AVENUE
FLAMINGO WASH

Approximate Location of Golf Course Pumping Well PW-2 (URS-2007)

Approximate Location of Golf Course Pumping Well PW-1 (URS-2007)

Golf Course
Ruby S. Thompson Elementary School
Boulevard Mall
William E. Orr Middle School
Orr Park

MW-33 <0.50
MW-22 <0.50
MW-21 13
MW-14 1500
MW-15 2.5
MW-17 240
MW-7 2.0
MW-12 0.76
MW-9 37
MW-8 4.0
MW-1 430
MW-4 ND
MW-3 5.8
MW-13 1900
MW-6 2300
MW-5 360
MW-2 560
MW-10 <0.50
BM NA
MW-16 <0.50
MW-11 NS
MW-20 890
MW-19 840
SVP-17
MW-18 1200
SVP-18
MW-23 970
MW-24 0.81
SVP-23
SVP-24
MW-32 740
SVP-25
SVP-19
MW-25 550
SVP-20
MW-26 750
SVP-22
MW-27 480
SVP-21
MW-31 27
MW-30 54
MW-28 0.66
MW-29 <0.50

Legend

- Monitoring Well Location
- Proposed Vadose Zone Soil Vapor Probe Location
- ug/L Micrograms Per Liter
- NA Not Analyzed
- NS Not Sampled
- PCE Tetrachloroethylene
- PQL Practical Quantitation Limit
- URS URS Corporation
- PCE PQL = 0.5 ug/L
- 2500 ug/L PCE Contour
- 2000 ug/L PCE Contour
- 1500 ug/L PCE Contour
- 1000 ug/L PCE Contour
- 500 ug/L PCE Contour
- 100 ug/L PCE Contour
- 5 ug/L PCE Contour (Dashed Where Inferred)

Note: Groundwater contours based on 4th Quarter 2010 sampling results.

N
W E
S

0 250 500 Feet
Approximate Scale in Feet

MARYLAND SQUARE SHOPPING CENTER
3661 South Maryland Parkway
Las Vegas, Nevada

FIGURE 3-2
PROPOSED VADOSE ZONE SOIL VAPOR PROBE LOCATIONS

TETRA TECH

S:\Projects Directory\Private Sector - Other Offices\Maryland Square\Work Plan\Figure 3-2.mxd troy.fegter

APPENDICES

TETRA TECH

INDOOR AIR QUALITY ASSESSMENT
BUILDING SURVEY FORM

Project Information

Preparer's name: _____ Date: _____

Project Number: _____ Phone #: _____

Site Name: _____

Part I – Occupant Information

Building Address: _____

Property Contact:_____Owner / Renter / other: _____

Contact's Phone: home ( )_____ work ( )_____ cell ( )_____
(Check primary number if more than one supplied)

Number of building occupants: Children under age 13 _____ Children age 13-18 _____Adults _____

Part II – Building Characteristics

1) Building type:
residential / multi-family residential / mixed use residential / office / strip mall / commercial / industrial

2) Describe building: _____

_____

3) Building use:

Floor	**General use of each floor (e.g., family room, bedroom, workshop, storage)**
Basement:	
Ground floor:	
2nd Floor:	
3rd Floor:	
4th Floor:	

4) Municipal Zoning:_____ Year constructed: _____

5) Number of floors below grade:_____ (includes full basement / crawl space / slab on grade)

6) Number of floors at or above grade: _____

7) Depth of basement below grade surface: _____ft. Basement size: _____ ft^2

This questionnaire was prepared using guidelines published by the California Department of Toxic Substances Control, the New Jersey Department of Environmental Protection, the New York State Department of Health, and the Oregon Department of Environmental Quality (CADTSC 2005, NJDEP 1997; ORDEQ 2010; NYSDOH 2005)

8) Basement and Construction Characteristics (Circle all that apply):

Above Grade Construction:	Wood frame	Concrete	Brick	Other_____
Basement type:	Full	Crawlspace	Slab	Other_____
Basement Floor:	Bare earth	Concrete	Stone	Other:_____
Concrete floor (slab on grade):	Unsealed	Sealed	Seal Material:_____	
Foundation walls:	Poured	Block	Stone	Other:_____
Foundation wall finish	Unsealed	Sealed	Seal Material:_____	
The basement is:	Unfinished	Finished	Partially finished:_____	
The basement is :	Wet	Damp	Dry	Moldy
Sump present?	Yes	No	If yes is water present? Y/N/Not accessible	

9) If the basement is finished or partially finished does it include a bathroom or half-bath? Yes / No

10) Type of heating system(s) (circle all that apply):

hot air circulation	hot air radiation	subfloor radiant	steam radiation
heat pump	hot water radiation	kerosene heater	electric baseboard

other (specify): _____

11) Where is the furnace/boiler located?_____

12) Type of ventilation system(s) (circle all that apply):

central air conditioning	mechanical fans	bathroom ventilation fans	outside air intake
individual AC units	kitchen range hood fan	other (specify):_____	

_____

13) Are there whole house fans, kitchen fans, or bath fans? List each if present and where it is vented:_____

_____

_____

14) Types of heating / cooking fuel utilized (circle all that apply):

Natural gas / electric / fuel oil / wood / coal / kerosene / other:_____

15) Is a private irrigation or drinking water well on site? Yes / Yes (but not used) / No

16) Taste and/or odor problems noticed with water? Yes / No

If yes, describe taste/odor:_____

_____

If yes, how long has it been present?_____

17) Is the water chlorinated, brominated, or ozonated? Yes / No _____

18) Is there a septic system? Yes / Yes (but not used) / No

Distance of septic system from building/home:_____

Distance of septic system from site water well (if present): _____

19) Type of ground cover outside of building: grass / concrete / asphalt / other (specify)

_____

20) Is an existing subsurface depressurization (radon) system in place? Yes / No If yes: active / passive

21) Is a sub-slab vapor/moisture barrier in place? Yes / No
If yes, type of barrier: _____

Part III - Outside Contaminant Sources

22) Regulated contaminated site (1000-ft. radius): _____

23) Other stationary sources nearby (gas stations, emission stacks, etc.): _____

24) Heavy vehicular traffic nearby (or other mobile sources): _____

Part IV – Miscellaneous

25) Do any occupants of the building smoke? Yes / No How often? _____
Last time someone smoked in the building? _____hours / days ago

26) Does the building have an attached garage directly connected to living space? Yes / No
If so, is a car usually parked in the garage? Yes / No
Are gas-powered equipment/machines stored in the garage? Yes / No
If yes, what types (mower, ATV, PWC, etc.):_____
Are cans of gasoline/fuels stored in the garage? Yes / No
Are paints or chemicals stored in the garage? Yes / No
Does the garage have a separate heating system? Yes / No

27) Do the occupants of the building have their clothes dry cleaned? Yes / No
If yes, how often? weekly / monthly / 3-4 times a year

28) Do any of the occupants use solvents or volatile chemicals in their workplace? Yes / No
If yes, what types of solvents are used? _____
If yes, where are their clothes washed? At work At home Other:_____

29) Has the building/home been fumigated for termites/other pests within the last 12 months? Yes / No
If yes, when and which chemicals? _____
_____

30) Have any pesticides/herbicides been applied around the building or in the yard? Yes / No
If yes, when and which chemicals? _____
_____

31) Has there ever been a fire in the building? Yes / No If yes, when? _____

32) Has painting or staining been done in the building (including basement) within the last 6 months? Yes / No
If yes, when _____and where? _____

33) Are new carpets, drapes, other textiles, or upholstered furniture in the building? Yes / No
If yes, when _____and where? _____

34) Have cleaning chemicals been used in the building recently? Yes / No
If yes, what types? _____

35) Have cosmetic products been used in the building recently? Yes / No
If yes, what types? _____

36) Have air fresheners been used in the building recently (including basement)? Yes / No
If yes, what types? _____

37) Have any "hobby" chemicals (glues, paints) been used in the building recently (including basement)? Yes / No
If yes, what types? _____

38) Have any other chemicals been used in the building recently (including basement)? Yes / No
If yes, what types? _____

Part V – General Observations

Provide any additional information that may be pertinent to the survey and may assist in the data interpretation process below, and include floor plan(s) on a separate sheet.

Part VI – Indoor Contaminant Sources

Identify all potential indoor sources found in the building (including attached garages), the location of the source (floor and room), and whether the item was removed from the building 48 hours prior to indoor air sampling event. Any ventilation implemented after removal of the items should be completed at least 24 hours prior to commencement of the indoor air sampling event.

Potential Sources	Location(s)	Volatile Ingredients in Product, Container Type, and Size	Removed (Yes/No/NA)
Gasoline storage cans			
Gas-powered equipment			
Kerosene storage cans			
Paints / thinners / strippers			
Cleaning solvents			
Oven cleaners			
Carpet / upholstery cleaners			
Other house cleaning products			
Moth balls			
Polishes / waxes			
Insecticides			
Furniture / floor polish			
Nail polish / polish remover			
Hairspray			
Cologne / perfume			
Air fresheners			
Fuel tank (inside building)			NA
Wood stove or fireplace			NA
New furniture / upholstery			
New carpeting / flooring			NA
Hobbies - glues, paints, etc.			

Floor Plan

Building Address:_____Floor:_____

SUB-SLAB DEPRESSURIZATION SYSTEM INSPECTION CHECKLIST

Inspection Item	Yes	No	NA	Comment
System Operation				
Is the manometer or pressure gauge indicating a vacuum?				Vacuum:_____inH_2O
Pipe Integrity				
Is the piping free of any visible damage?				
Do pipe joints appear to be sealed?				
Slab-Integrity				
Is the seal around the pipe penetrating the slab intact?				
Is the slab free of visible cracks or other damage?				

Note:

NA Not applicable

If a leak is suspected, perform a smoke test to confirm.