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Alameda County
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March 19, 2008

CORRECTIVE ACTION PILOT TEST WORKPLAN

6310 Houston Place
Dublin, California

Project No. 261639
ACHCSA Toxics Case # RO0002862

Prepared On Behalf Of

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1.0 INTRODUCTION

AEI Consultants (AEI) has prepared this Corrective Action Pilot Test Work Plan on behalf of Mr. Cary Greyson of G&G International Holding Company for the property located at 6310 Houston Place in Dublin, California (Figure 1). This plan was prepared to present a summary of site conditions, a comparative evaluation of potentially appropriate remedial alternatives, and propose an approach for remediation of the release of diesel-range petroleum hydrocarbons. This plan has been requested by the Alameda County Health Care Services Agency (ACHCSA).

Analytical results confirm that the dissolved-phase diesel plume in groundwater is limited to diesel-range hydrocarbons. No significant soil source was identified, based on soil analytical data. This is consistent with a release from a tank partially submerged beneath the groundwater. AEI is recommending a pilot test using direct push injections of a chemical oxidant, RegenOx™ in particular, to evaluate whether this form of remediation is a feasible and cost-effective approach to mitigating the diesel release.

2.0 SITE DESCRIPTION AND BACKGROUND

The subject property is located in a commercial and light industrial area of Dublin, on the south side of Houston Place, just east of Dougherty Road. The subject property yard is currently vacant although the building is used for storage. Please refer to Figures 1 and 2 for the site location map and site plan details, respectively. According to records on file with the Dublin Building Department (DBD), four underground storage tanks (USTs) (two 12,000-gallon diesel USTs, one 7,500-gallon gasoline UST, and one 2,000-gallon gasoline UST) were installed on the subject property in 1968.

2.1 Previous Releases

According to a case closure summary report prepared by Alameda County Health Care Services Agency (ACHCSA), a piping leak and a localized surface spill of used motor oil were discovered at the site prior to 1984. Following the release, 156 cubic yards of contaminated soil was removed from the site to the satisfaction of San Francisco Bay Regional Water Quality Control Board (SFRWQCB). On March 31, 1989, four USTs (one 500-gallon waste oil, two 12,000-gallon and one 8,000-gallon diesel tanks) were excavated, three of which were removed. One 12,000-gallon diesel UST was refinished internally with "Glass Armor" coating and was reinstalled for continued use. Soil samples collected from the sidewalls of the excavation during tank removal activities had concentrations of Total Petroleum Hydrocarbons as diesel (TPH-d) to 190 milligrams per kilogram (mg/kg) and Total Oil and Grease (TOG) up to 240 mg/kg. No concentrations of TPH as gasoline; Benzene, Toluene, Ethylbenzene, and total Xylenes (BTEX); or chlorinated hydrocarbons were detected in these samples. One grab groundwater sample was collected from the diesel UST excavation, which had concentrations of TPH-d and TOG up to 380,000 micrograms per liter (µg/L) and 50,000 µg/l, respectively.

Following removal of the three USTs, three groundwater monitoring wells (MW-1 through MW-3) were installed on August 9, 1989, and quarterly groundwater monitoring and sampling commenced. To further define the extent of the groundwater contamination plume, three additional wells (MW-4 through MW-6) were installed between May 1990 and March 1991. TPH-d and TOG were detected up to 22,000 µg/L and 8,600 µg/L, respectively, during initial sampling of these wells. Intermittent monitoring and sampling of the wells continued between August 1989 and October 1994. During the last sampling episode conducted in October 1994 concentrations of TPH-d and TOG were detected up to 850 µg/L and 600 µg/L, respectively. Based on a recent site inspection, the former onsite monitoring wells had been decommissioned.

Based on the gradual decline of TPH-d and TOG in the groundwater, and the remaining low concentrations of these contaminants in groundwater and soil, the ACHCSA granted case closure in a letter dated February 28, 1995.

At the request of a prospective purchaser of the property, AEI collected samples from on-site monitoring wells MW-1, MW-2, and MW-5 on January 23, 2001. TPH-d was detected up to 5,200 µg/L in the samples. No concentrations of TOG were detected in these samples. Monitoring wells MW-1 through MW-6 have apparently been decommissioned, although no information has been available to AEI as to the date and methods of decommissioning.

2.2 12,000-gallon diesel UST Removal

On October 27, 2004, the remaining 12,000-gallon diesel UST, fuel dispensers, and product piping were removed from the subject property by Golden Gate Tank Removal, Inc. (GGTR). Following excavation, GGTR collected a total of seven soil and two groundwater samples from the UST excavation bottom and sidewall, overburden stockpile, and areas in the vicinity of the fuel dispensers and product piping. These samples were analyzed for TPH-d, methyl tertiary butyl ether (MTBE), and BTEX. TPH-d was detected at concentrations of 6 mg/kg and 197 mg/kg in stockpile soil samples and at a concentration of 1 mg/kg in a soil sample obtained from the UST excavation sidewall. TPH-d was detected in the water sample collected from the UST pit at 0.3 mg/L and at 23.8 mg/L in water that was present in the shallow excavation beneath the dispenser. Locations of the samples collected by GGTR are shown on Figure 2 and a summary of sample analytical data from the tank removal is presented in Tables 2 and 3. The excavation was backfilled with the stockpiled soil and imported fill.

Upon reviewing the GGTR Tank Closure Report, the ACHCSA issued a letter dated April 12, 2005 requesting additional investigation concerning the release of petroleum hydrocarbons from the 12,000-gallon UST. On March 14, 2006, AEI performed a soil and groundwater investigation consisting of the collection and analysis of soil and groundwater samples from the site. Five (5) soil borings were advanced in the areas of the former 12,000-gallon diesel UST, the former dispenser island and products lines, and down-gradient from the former diesel UST. TPH-d was detected in the soil up to a concentration of 53 mg/kg. TPH-d and MTBE were detected in the groundwater samples up to concentrations of 580,000 µg/L and 2.6 µg/L, respectively. The findings of this investigation concluded that the release of TPH-d originated from the 12,000-gallon diesel UST, as the diesel release post-dates the previous releases at the property.

Upon reviewing the *Soil and Groundwater Investigation Report*, the ACHCSA issued a letter, dated July 31, 2006, requesting the installation of monitoring wells. A *Monitoring Well Installation Workplan* for five (5) wells, dated September 19, 2006, was approved by the ACHCSA in a letter dated October 3, 2006. A request for two (2) additional off-site wells was subsequently approved by ACHCSA in November 2006.

A *Monitoring Well Installation Report* was prepared for the newly installed seven (7) wells (DW-1 through DW-7), dated June 19, 2007, and submitted to the ACHCSA. The findings of the well installation determined that the release to groundwater is limited in extent, and confirmed that the dissolved phase plume is limited to diesel range hydrocarbons. Concentrations of diesel near solubility which suggests LNAPL may be present, however it has not been present in measurable volume within the wells and is apparently localized to just around the former UST hold. No significant soil source was identified, based on the analyses of soil samples and field observations.

3.0 GEOLOGY AND HYDROLOGY

Based on a review of the United States Geological Survey (USGS) Dublin, California Quadrangle topographic map, the site is situated in the southeast end of the San Ramon Valley, and is located approximately ¾-mile south/southeast of the Dougherty Hills, which are foothills of Mount Diablo. The site is situated east of Dougherty Creek, which is located approximately ½-mile from the site. The site is relatively flat and at an elevation of approximately 335 feet above mean sea level (amsl). Any apparent slope throughout the surface of the site was likely produced to manage surface water drainage.

Based on the USGS Quaternary Geology of Alameda County, and Parts of Contra Costa, Santa Clara, San Mateo, San Francisco, Stanislaus, and San Joaquin Counties, California: A Digital Database, surface deposits in the vicinity of the site consist of Holocene Age Basin Deposits. These are identified as by very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans.

During previous soil boring investigations, saturated sediments have been encountered at depth of approximately 12 feet below ground surface (bgs). Depth to water data gathered during recent monitoring has been in the range of approximately 7 feet bgs to 9 feet bgs. Recent monitoring has identified a south-southwesterly groundwater flow direction with a hydraulic gradient on the order of 10^{-3} ft/ft. The Fence Diagram A – A' is presented as Figure 6.

4.0 SITE CONCEPTUAL MODEL (SCM)

The release consists primarily of diesel-range hydrocarbons that have impacted groundwater. No soil source was identified from several soil samples analyzed. BTEX and other fuel additives have not been detected at the site, with the exception of small amounts of MTBE and diisopropyl ether (DIPE) in groundwater. The low concentrations of TPH-g and TPH-mo detected onsite are likely the result of range overlap with the analytical method (EPA Method 8015).

Based on soil boring groundwater data and three groundwater monitoring events, the plume is limited in extent, as demonstrated by the two down-gradient, offsite wells (DW-6 and DW-7) which have not had detections of diesel or other contaminants that exceed standard laboratory reporting limits. Analyses of select samples for volatile and semi-volatile organic compounds have not identified other individual contaminants of concern. Following is a summary of the maximum concentrations of site contaminants detected in groundwater.

	Maximum Concentration (µg/L)	Well / Boring ID	Date Collected / Sample ID	Location
TPH-d	580,000	SB-5	3/14/2006 / SB-5-W	Down-gradient
MTBE	2.6	SB-4	3/14/2006 / SB-4-W	Cross-gradient

4.1. Distribution in Soil

Very little soil impact has been identified above the water table or within the capillary fringe. Concentrations of TPH-d detected in soil samples range from non-detect concentrations up to a maximum of 53 mg/kg. TPH-mo was detected in one soil sample at a concentration of 6.2 mg/kg. TPH-g, BTEX, and MTBE were not detected in any soil samples analyzed. Soil sample analytical data is presented in Table 2. Based on the depth of the former UST and shallow depth to groundwater, the diesel released would have migrated directly to the water table and resulted in minimal volumes of significantly impacted soil around and beneath the UST.

4.2. Distribution in Groundwater

The highest concentrations of dissolved phase diesel have been detected in groundwater samples collected from borings SB-1, SB-3, and SB-5, at a maximum of 580,000 µg/L (SB-5-W). The highest concentrations detected in onsite monitoring wells over the past three monitoring events have been in wells DW-1 through DW-3, the most recent concentrations in these wells ranging from 14,000 µg/L (DW-2) to 71,000 µg/L (DW-3). Lower concentrations have been detected in other wells onsite and no detectable concentrations have been detected in offsite wells DW-6 and DW-7.

Although measurable free product has not been observed during monitoring events, dissolved phase concentrations of contaminants in wells DW-1 through DW-3 are indicative of the possible presence of non-aqueous phase liquid petroleum product. Refer to Figure 4 for recent groundwater sample analytical data. A rough estimate of contaminant mass in groundwater is calculated by assuming two elliptical plumes, an assumed thickness of 15 feet, porosity of 0.3, and an average concentration of 50,000 µg/L. Based on this, a dissolved mass of approximately 110 kg is calculated. This corresponds to approximately 35 gallons of dissolved diesel. Groundwater sample analytical data is presented in Tables 3 and 5.

4.3. Migration Pathways and Receptors

A conduit study was performed and documented in AEI's *Monitoring Well Installation Workplan,* dated September 16, 2006. There are no utility conduits that are likely to provide preferential pathways for contaminant migration. It should be noted that the depth of the storm drain east of the former tank hold appears to be approximately 2 to 4 feet bgs, and based on this depth, it's expected that the storm drain will not act a preferential groundwater mitration pathway. Nor is it expected that this storm drain will affect the proposed injection pilot test, as the depth of the storm drain will be at least approximately 4 to 5 feet above the most shallow injection depth (approximately 8 feet bgs).

A receptor study using records from the California Department of Water Resources was presented in AEI's *Monitoring Well Installation Report*, dated June 19, 2007. More recently, a receptor study using records from the Alameda County Zone 7 Water Agency (Zone 7) was performed. The results of the Zone 7 receptor study contained a smaller amount of wells than those identified in the DWR study (the ones that were identified were also indentified in the DWR study), and thus the DWR study is considered more comprehensive. In summary, based on the well surveys and the magnitude of the release, none of the wells identified during the well survey appear to risk acting as preferential vertical conduits for migration of site contaminants, nor does there appear to be active use of groundwater in the area that would be threatened by this release. However, according to the San Francisco Bay Regional Water Quality Control Board (RWQCB) Basin Plan, groundwater in the area of the site is considered of beneficial or potential beneficial use for a variety of purposes.

5.0 CLEANUP TECHNOLOGY OVERVIEW

As outlined above, the contaminants of concern are diesel range hydrocarbons, primarily located in the dissolved phase with minimal residual sorbed phase. Therefore, evaluation of potential cleanup approaches has eliminated soil vapor extraction or soil excavation as they are not applicable to this site. The methods outlined below are an overview of broad catagories of treatment technologies screened for potential use at the site. Groundwater treatment can be broadly grouped into ex-situ or in-situ treatment. Primary factors for consideration include aquifer properties, source locations (soil and/or groundwater), groundwater chemistry, biology, and permitting issues. Aquifer testing, air acceptances tests, and chemical and/or biological testing are necessary for efficient system or approach design. Below is a discussion of commonly employed groundwater treatment approaches.

5.1 Pump and Treat

Pump and treat processes involve pumping the contaminated groundwater from the sub-surface and treatment of extracted water prior to discharge to a storm drain or sewer system or re-injection. Treatment is accomplished by passing the groundwater through granular activated carbon, destroying the hydrocarbons directly using UV, peroxide, ozone or some combination there-of; or volatilizing the contaminants from the water and treating the off-gas in a method similar to soil vapor extraction.

Pump and treat can be used to control the migration of hydrocarbon plumes and locally induce contaminant flow to pumping centers. However, treatment times may be long due to the need to pump large volumes of groundwater to effectively remove contaminants through the dissolved phase; this can be inefficient and ineffective when significant sorbed phase or free phase hydrocarbons are present. Treatment effectiveness can be reduced by variable flow from high and low flow zones. Furthermore, the treatment and discharge of large quantities of water can be costly. If residual contaminants remain, pumping may continue in perpetuity, as contaminants continue to migrate into the aquifer.

5.2 Enhanced Bioremediation

Enhanced bioremediation, also called bio-augmentation or biosparging, involves adding oxygen and other amendments to groundwater to affect pH, oxygen, nutrient content, and /or biological communities in the subsurface. Oxygen availability is commonly the limiting factor for biodegradation of petroleum hydrocarbons. Increasing oxygen levels can result in an increase in the biomass, which results in an increased rate of degradation of the hydrocarbons. Bio-sparging is similar to air sparging, however, in air sparging, hydrocarbons are removed through volatilization while biosparging is performed with much lower air flow rates to simply increase oxygen content. A variety of other methods have been developed to deliver oxygen to the subsurface including the use of propriety chemicals, molecular diffusion, and as a secondary advantage of chemical oxidation (discussed below). In addition to increasing oxygen content, other amendments can be added to adjust pH, increase necessary nutrient for aerobic degradation (nitrogen, phosphorous, potassium, etc.), or provide cultured bacteria directly into the subsurface.

5.3 Chemical Oxidation

A number of methods of directly degrading contaminants in the subsurface have been developed and implemented in recent years. Hydrocarbons can be directly oxidized by the injection of reactants such as Fenton's Reagent, persulfate, hydrogen peroxide, proprietary materials, or sparging of ozone and /or oxygen. Such methods have a significant advantage over pump and treat in that removal of groundwater is not required. These methods can also be employed in the vadose zone. Injectants are delivered to the subsurface through either temporary soil borings or permanent injection wells. The spacing and volume of injectants is determined by chemical analyses, stoichiometric evaluation, and soil conditions. Effectiveness is highly dependant on geochemistry and permeability of sediments. Direct oxidation methods also have the advantage of oxygenating the subsurface when oxygen is released as part of the oxidation process.

5.4 Natural Attenuation (No Action)

Natural attenuation relies on naturally occurring processes to degrade and reduce contaminants present in the aquifer. These include biodegradation, which is generally considered to be the primary natural attenuation mechanism for petroleum hydrocarbons, along with sorption and dispersion. Controlling factors include those discussed above and sufficient evidence must be identified to show that timely attenuation will occur. With larger release, these processes can be slow or not effective at reaching site goals. Monitoring is generally required as part of this method to ensure protection of human health and groundwater resources and to ensure that reduction is occurring.

6.0 CLEANUP METHODOLOGY SELECTION AND DISCUSSION

Although the above discussion was not intended to be inclusive of all options or combinations thereof, chemical oxidation via temporary injections has been selected as suitable for further evaluation and pilot testing. Pump and treat is an expensive treatment method which is not considered cost-effective in light of other options, due to high capital and operating costs. Natural attenuation is not expected to occur in reasonable time frame, given the high concentrations of diesel present. Based on the high diesel concentrations, natural or enhanced aerobic biodegredation is not considered to be effective; typically concentrations of greater than 25,000 μg/L are considered too high for aerobic degradation. Given the relatively localized area of impact, a chemical oxidation approach has been selected. As with many treatment technologies, their effectiveness is highly depended on the intrinsic permeability and hydraulic conductivity of the soils. Given the fine grained matrix at the site, all approaches will face this problem.

RegenOx™, a chemical oxidant, has been selected to treat contaminants in the saturated and vadose zones via direct push injections. RegenOx™ uses a solid alkaline oxidant that employs a sodium percarbonate complex with a multi-part catalytic formula. The product is delivered as two parts that are combined and injected into the subsurface using common direct-push equipment. Once in the subsurface, the combined product produces an oxidation reaction comparable to that of Fenton's Reagent without the significant exothermic reaction. This reaction oxidizes organic matter, including petroleum hydrocarbons. RegenOx™ has been shown to destroy contaminants for periods of up to one month after which time the oxygen released promotes repopulation of the aquifer with aerobic bacteria which metabolize residual hydrocarbons. RegenOx™ in an 8% solution has the viscosity of water.

There are several concerns when using chemical oxidants to oxidize contaminants in groundwater. A low pH and oxidation can change the oxidation state of several metals, increasing their solubility, however this is generally observed to be a relatively short-lived phenomenon. The potential for gas generation/volatilization of contaminants is not expected to be significant due to the low volatile content of site contaminants.

A pilot test is outlined below to evaluate the effectiveness of this approach prior to proposing it under a formal corrective action plan. If successful, the pilot test report will include recommendations for larger scale injections. If unsuccessful, an alternative approach will be recommended for further evaluation.

7.0 PROPOSED PILOT TEST

The goal of the pilot test is to document feasibility of source area treatment using RegenOx™ injections. If successful, the goal of full-scale injections would be to sufficiently reduce source area contaminants thereby removing limiting the spread of the plume and promoting natural aerobic bioremediation.

Six (6) injection locations are proposed (IP-1 through IP-6). In each of the six injection locations, illustrated in Figure 5, a temporary injection rod will be installed to a depth of 20 feet bgs. During injections, the temporary rods will be raised slowly to a depth of approximately 8 feet bgs to target smear zone impact. Based on fine grain sediments of the site, a minimum ROI of approximately 5 feet could be expected. Injection points IP-1 through IP-3 would be located up and cross gradient of monitoring well DW-3 and injection points IP-4 through IP-6 would be up and cross gradient of DW-1. During the pilot test, the distance from the injection locations to their respective monitoring well will be approximately 5 feet, a constant distance. The variable to be evaluated during this pilot test will be the amount of oxidant injected into the two areas. The reduction in concentrations and groundwater chemistry changes in the two monitoring wells will be used to design injection point spacing and dosing if this method is selected for full scale treatment.

8.1 Baseline Sampling

Prior to injection activities, a groundwater monitoring event will be performed on wells DW-1, DW-3, DW-5, and DW-7. Water quality parameters [pH, temperature, specific conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP)] will be measured and samples collected for analysis for site COCs. This data, particularly DO, ORP, and COC concentrations, will be used as a baseline for short-term interpretation of ROI and effectiveness of COC destruction and oxidant ROI. In addition, to determine whether specific metals are being mobilized, analyses for arsenic, barium, cadmium, chromium (total and Hexavalent), copper, iron (total), lead, and selenium will be performed.

Groundwater samples will be collected from the above specified wells before the pilot test. The samples will be analyzed for:

- TPH as diesel by EPA Method 8015 and;
- Dissolved Arsenic, Barium, Cadmium, Total and Hexavalent Chromium (E218.6), Copper, Iron (total), Lead, and Selenium by EPA Method E200.8 and;
- MTBE by EPA Method 8260

8.2 Health and Safety Meeting

Prior to any injection events, a site safety meeting will be held at a designated command post near the working area to review the Health and Safety Plan (HASP). Working hazards and emergency procedures will be discussed at this meeting, including an explanation of the hazards of the known or suspected chemicals of interest as well as the location and route to the nearest hospital. The HASP will include the appropriate level of personal protection equipment (PPE) needed for those performing chemical handling and equipment operation. The HASP will include MSDS sheets and chemical manufacturer handling instructions and contingency procedures. A work area or "exclusion zone" will be established with orange cones and/or barricades and warning tape to delineate the zone where hard hats and steel-toed shoes must be worn and where unauthorized personnel will not be allowed. A site safety plan conforming to Part 1910.120 (i) (2) of 29 CFR will be available on site at all times during the project.

8.3 Chemical Reagent Mixing and Handling

As stated in Section 6.0, there are two parts to the RegenOx™ mixture, Part A being the RegenOx™ oxidant powder and Part B being the RegenOx™ activator liquid. The composition of Part A is a mixture of sodium percarbonate, sodium carbonate, sodium silicate, and silica gel. The composition of Part B is a mixture of sodium silicate solution, silica gel, and ferrous sulfate. RegenOx™ is typically injected as a 3% weight/weight solution. Thus, for example, 30 lbs of the oxidant and activator are added to 116 gallons of water. Following the injections of RegenOx™, or mixed with the RegenOx™, ORC will be added to the aquifer to polish the injections.

Using injection points IP-1 through IP-3 (Area 1), up-gradient of well DW-3, 480 lbs of RegenOx™ at a concentration of 3 – 5% will be injected into the aquifer at a rate of approximately 3 gallons per minute (gpm), although this will be dependant on how much liquid the aquifer will accept. Injection rates may be adjusted accordingly. Using injection points IP-4 through IP-6 (Area 2), up-gradient of well DW-1, 1,740 lbs of RegenOx™ at a concentration of 3 – 5% will be injected into the aquifer at the same rate. A total of approximately 2,220 lbs of 3 to 5% RegenOx™ will be injected into the treatment zone during the pilot test. MSDS information regarding the oxidant and activator are presented in Appendix C.

A staging area to store equipment and supplies will be located onsite in a secure location adjacent to the pilot test injection area. The staging area will be used as a mixing zone for chemical products. Products mixed or diluted on site will be either injected during the remediation program or removed from the site at the completion of the project. Once the prepared products are injected and therefore expended, the injection team will return to the staging area, and mobilize to the next injection location.

Investigation-derived waste (IDW) generated from the investigation, including drill cuttings, liquid waste, will be characterized by laboratory results received for samples taken from waste containers, the waste containers being U.S. DOT-approved 55-gallon drums or roll-off bins stated at the site. Following waste profiling, the drums or bins will be removed from the site by a waste disposal contractor and transported to an appropriate waste facility.

8.4 Direct Push Drilling and Injection

Prior to injection activities, appropriate soil boring permits will be obtained from the Alameda County Zone 7 Agency. A direct push drill rig will be used to install injection rods and screens to predetermined depths at six (6) injection locations across the site by a qualified C-57 licensed driller with experience with in-situ chemical delivery and RegenOx use. The direct push injection system is designed to allow for pressure injection and introduction of oxidants directly into the aquifer. A 1.5-inch injection tool will be driven into the subsurface via the drill rig. Solid sections of 5-foot long casing will be added behind the initial injection tool and advanced until the desired injection depth is reached at which time the injection tool will be extracted one foot to expose the injection screen (1 foot to 5 foot in length). Then the expendable tip can be dropped from the drive rods. Oxidant application equipment includes pneumatic double-diaphragm pumps, ¾-inch diameter high pressure injection hose, valves, and cam-lock connectors. After connecting the delivery hose to the pump outlet and the delivery sub-assembly, the RegenOx™ will be pumped through the delivery system to displace the water/fluid in the rods. Standard Operating Procedures for direct-push injections are presented in Appendix B.

8.5 Borehole Abandonment and Equipment Decontamination

Upon completion of the oxidant injection, direct push boreholes will be sealed to prevent the spread of contaminants with depth. Bentonite granules will be poured into the boreholes and hydrated. The drill locations will be resurfaced to appropriate conditions via tremie method.

Field equipment that may have been contaminated during field activities will be decontaminated. Decontamination is performed as a quality assurance measure and a safety precaution, preventing cross-contamination among samples and helping to maintain a clean working environment.

Small, reusable equipment will be decontaminated by rinsing with liquids that include soap or detergent solutions (e.g., Alconox), potable water, and distilled water. Gross contamination consisting of solid particles will be removed from the equipment by brushing and rinsing with potable water. Equipment will then be washed with a detergent solution and a brush, followed by a thorough rinse with potable water. A final triple rinse using distilled water will also be performed.

Drilling equipment including rigs, drill rods, auger, bits, casing, downhole logging equipment, and other large pieces of field equipment will be high-pressure steam cleaned before and after use. Cleaning will be performed at an appropriate designated decontamination area specified in the field. The decontamination area will be capable of containing decontamination fluids and solids.

8.6 Post Injection Monitoring

Groundwater sampling events to be conducted to monitor the performance of the pilot-scale treatment performance using wells DW-1, DW-3, DW-5, and DW-7 are listed below.

- Baseline event (quarterly sampling event prior to injection, see Section 8.1)
- Two weeks following final injection event
- One month following final injection event
- Two months following final injection event

The groundwater samples will be analyzed for the analytical suite presented in Section 8.1. In addition, water quality parameters pH, temperature, specific conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be measured. If a regular quarterly monitoring event is to coincide with any of the above, the remaining two wells will be sampled in accordance with the established groundwater monitoring program.

8.7 Pilot Test Reporting

Upon completion of the 2 month post-injection sampling, a pilot test report will be prepared for the ACHCSA within approximately 30 days of receipt of all relevant analytical data. The report will include site plans, logs of boring and wells, injection concentrations and rates, data obtained, and contaminant concentrations trends. Any alterations made to this plan will be documented.

Assuming adequate contaminant concentration reductions and effective ROI, scale-up of the system will be recommended in a formal corrective action plan (CAP). Such recommendations would include proposed injection point spacing, volume and concentrations of materials to be injected, and the data on which these decisions are made. The CAP will include proposed groundwater cleanup goals, an adequate discussion of method selection rationale, including a consideration of cost and likely effectiveness, and provisions for public notification.

9.0 REFERENCES

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Golden Gate Tank Removal, *Tank Closure Report*, dated December 2, 2004

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USGS, *Quaternary Geology of Contra Costa County And Surrounding Parts of Alameda, Marin, Sonoma, Solano, Sacramento, and San Joaquin Counties, California*, 1997, prepared by E.J. Helley, et al.

10.0 CLOSING STATEMENT AND SIGNATURES

This plan has been prepared by AEI on behalf of Mr. Cary Greyson to address the release of petroleum hydrocarbons from the former UST system on the property located at 6310 Houston Place in the City of Dublin, California. This document outlines potentially appropriate options for mitigating the release and recommends a scope of work. The recommendations rendered in this report were based on previous field investigations and laboratory testing of soil and groundwater samples. This document does not reflect subsurface variations that may exist between sampling points. These variations cannot be anticipated, nor could they be entirely accounted for, in spite of exhaustive additional testing. This plan should not be regarded as a guarantee that no further contamination, beyond that which could have been detected within the scope of past investigations is present beneath the said property or that all contamination present at the site will be treated or removed. Undocumented, unauthorized releases of hazardous materials, the remains of which are not readily identifiable by visual inspection and are of different chemical constituents, are difficult and often impossible to detect within the scope of a chemical specific investigation that may or may not become apparent at a later time. All specified work would be performed in accordance with generally accepted practices in geotechnical and environmental engineering, engineering geology, and hydrogeology and will be performed under the direction of appropriate registered professional(s).

We look forward to comment on the scope of work outlined herein. Should you have any questions or need additional information, please contact us at 800/801-3224.

Sincerely,
AEI Consultants

Peter J. McIntyre, PG
Senior Project Manager

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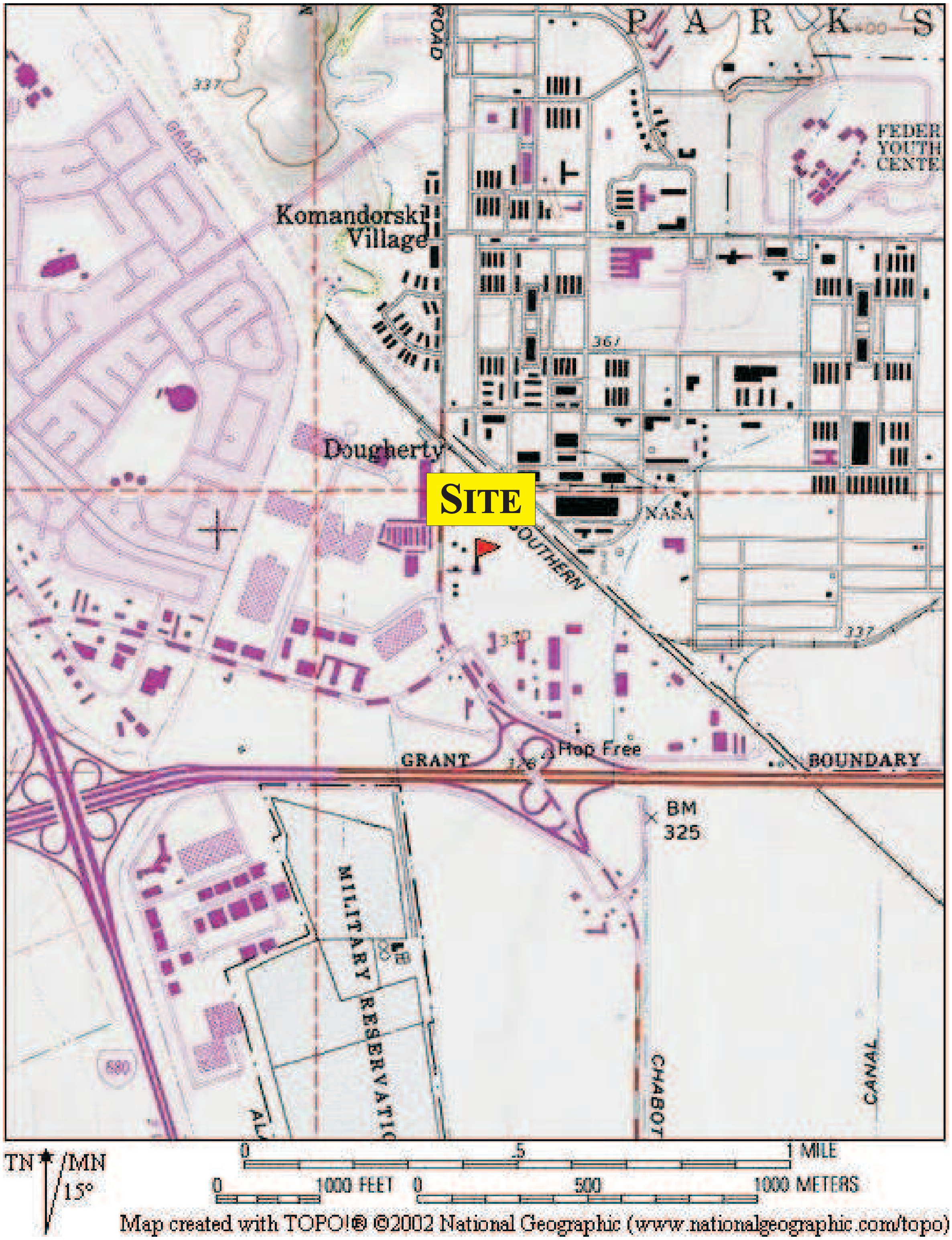
FIGURES



Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)

USGS DUBLIN, CALIFORNIA
QUADRANGLE TOPOGRAPHIC MAP
Created 1979, Revised 1980

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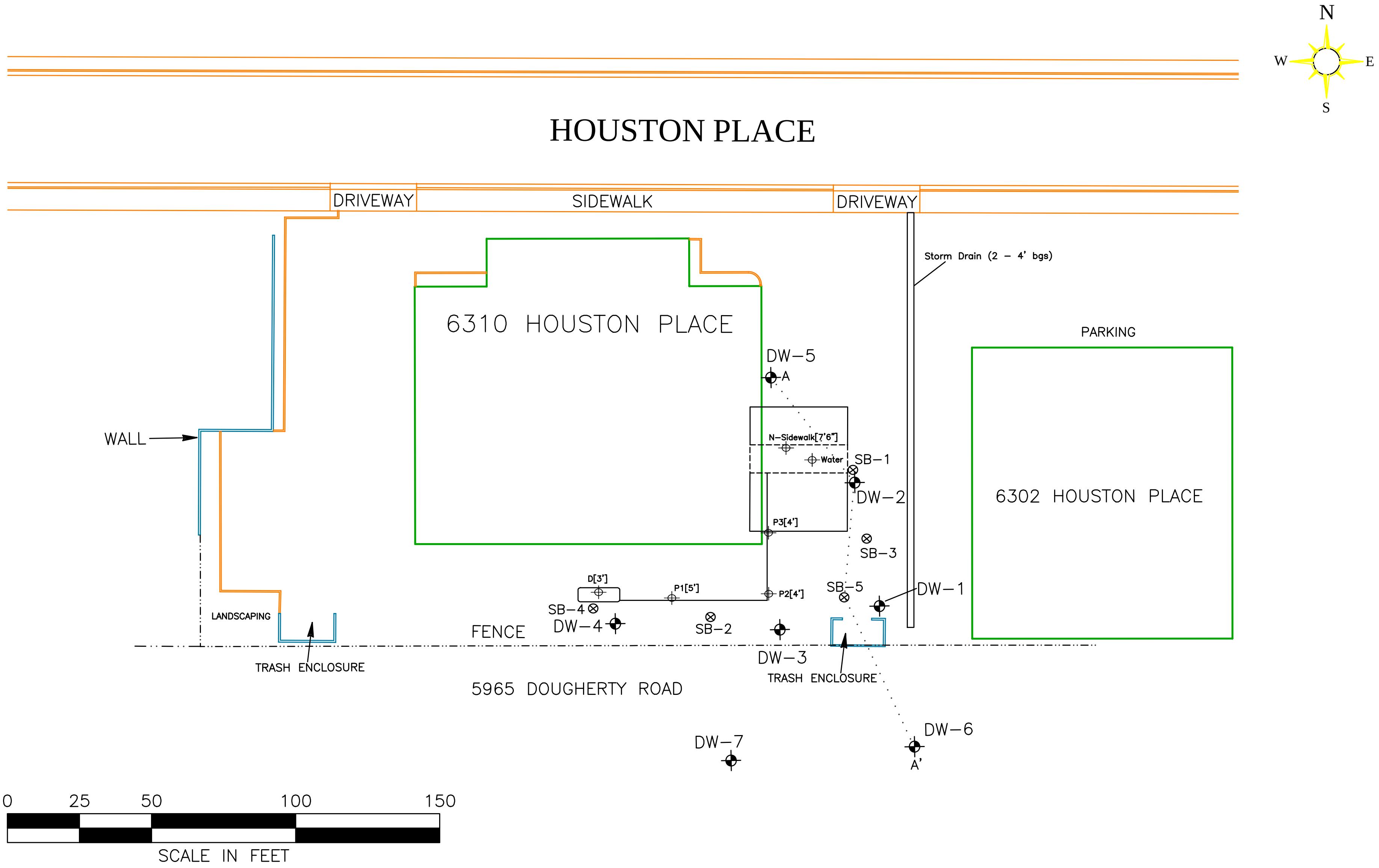
SITE LOCATION MAP

6310 HOUSTON PLACE
DUBLIN, CA 94568

FIGURE 1
PROJECT No. 261639



LEGEND

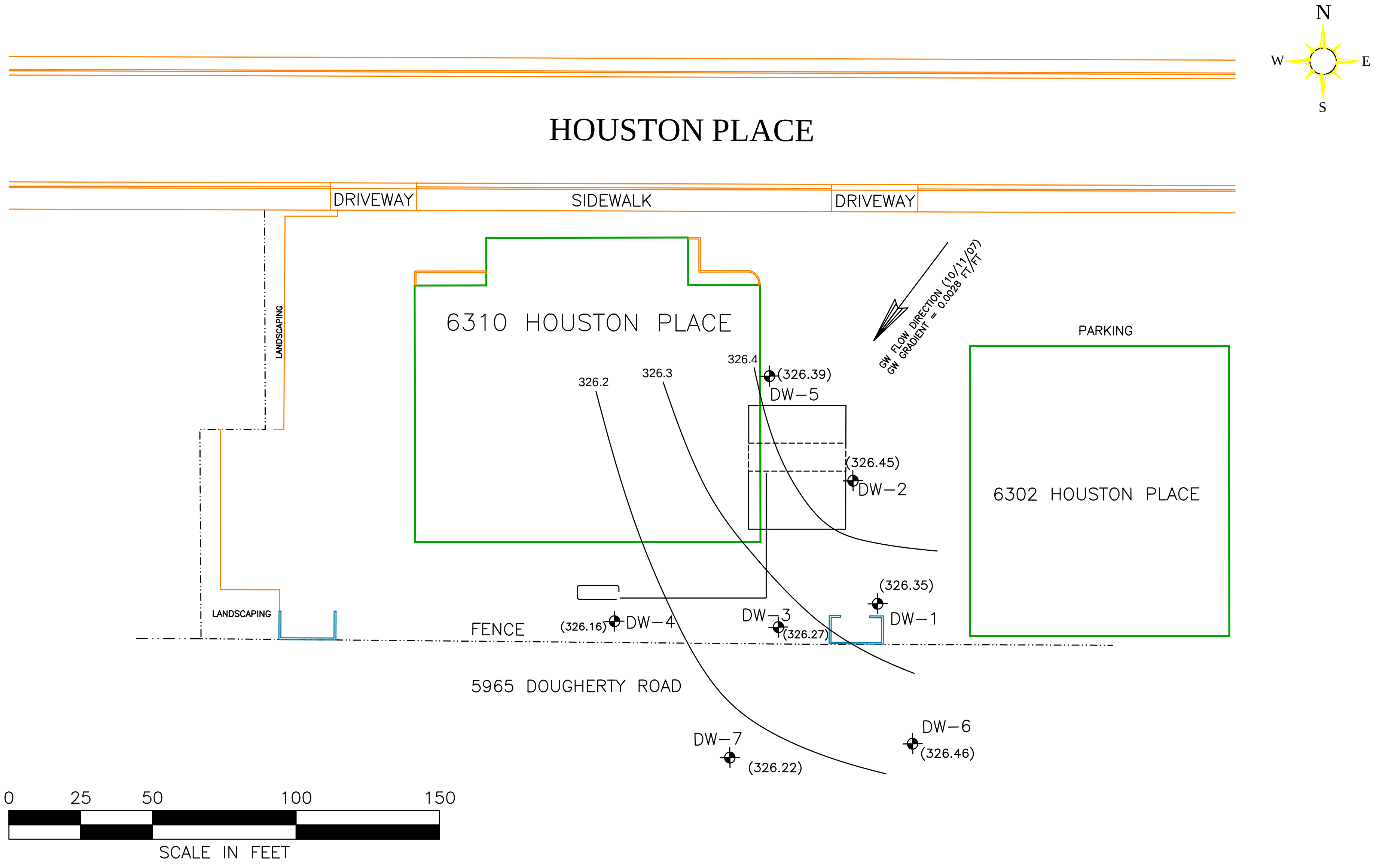
- ⊕ GROUNDWATER MONITORING WELL
- ⊗ BORING LOCATION (3/14/06)
- ⌖ TANK REMOVAL SAMPLE LOCATION
- ----- EXCAVATION BOUNDARY (12,000-GAL. DIESEL UST)
- · · · · FENCE DIAGRAM LINE

AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200, WALNUT CREEK

SITE PLAN

6310 HOUSTON PLACE
DUBLIN, CALIFORNIA

FIGURE 2
PROJECT NO. 261639



LEGEND

GROUNDWATER MONITORING WELL

***EVENT PERFORMED 10/11/07
DW-6 NOT USED IN CALCULATION

(326.51) = GROUNDWATER ELEVATION
ABOVE MEAN SEA LEVEL

326.4 = Contour Elevation

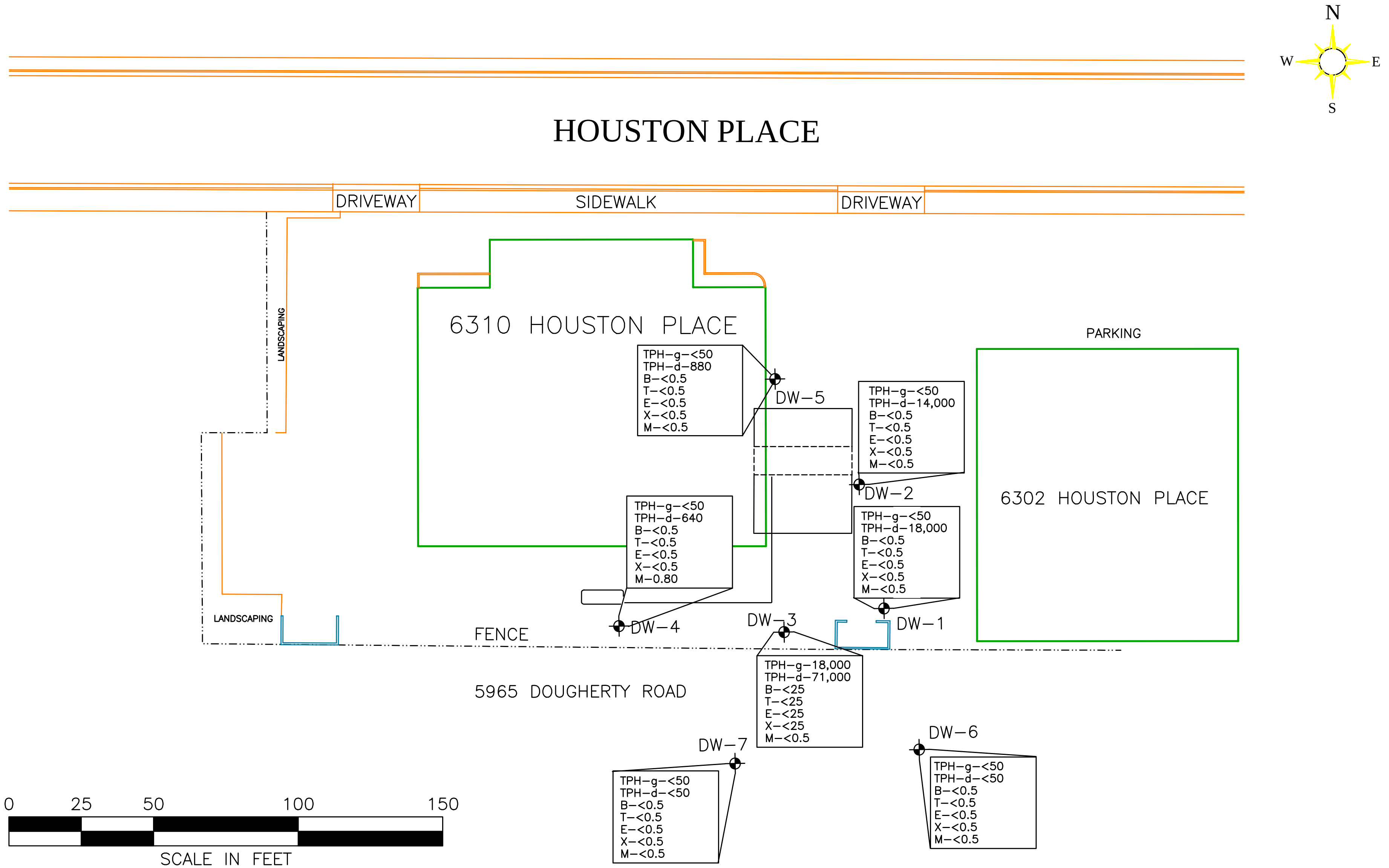
CONTOUR INTERVAL = 0.1 FT.

AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200, WALNUT CREEK

GROUNDWATER ELEVATION
(10/11/07)

6310 HOUSTON PLACE
DUBLIN, CALIFORNIA

FIGURE 3
PROJECT NO. 261639



LEGEND

⌖ GROUNDWATER MONITORING WELL

*EVENT PERFORMED 10/11/07

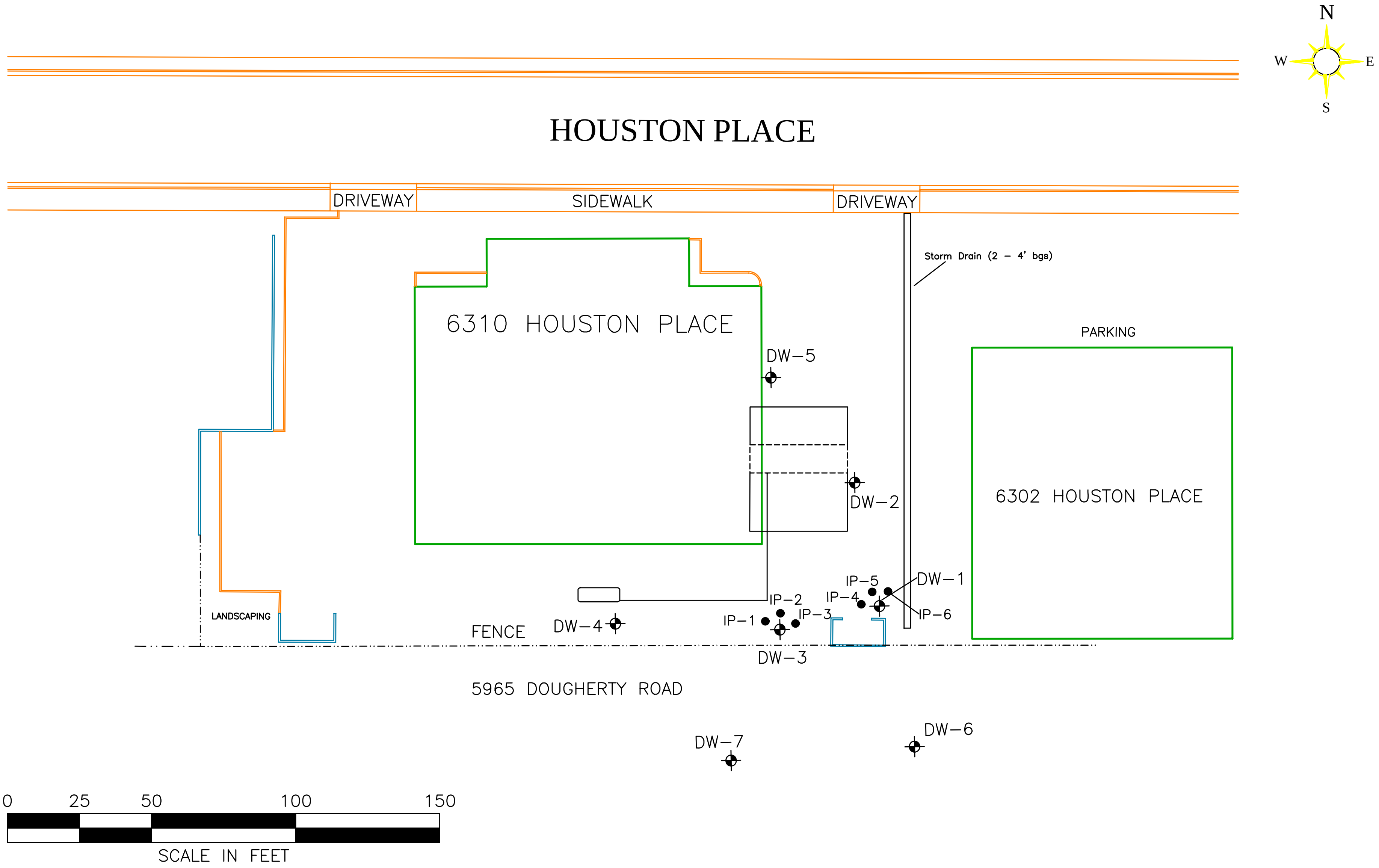
TPH-G-TOTAL PETROLEUM HYDROCARBONS AS GAS
TPH-D-TOTAL PETROLEUM HYDROCARBONS AS DIESEL
TPH-MO-TOTAL PETROLEUM HYDROCARBONS AS MOTOR OIL
B-BENZENE, T-TOLUENE, E-ETHYLBENZENE, X-XYLENES, M-MTBE
**SAMPLE CONCENTRATIONS IN MICROGRAMS PER LITER (uG/L)

AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200, WALNUT CREEK

GROUNDWATER ANALYTICAL DATA
(10/11/07)

6310 HOUSTON PLACE
DUBLIN, CALIFORNIA

FIGURE 4
PROJECT NO. 261639



LEGEND

⌖ GROUNDWATER MONITORING WELL

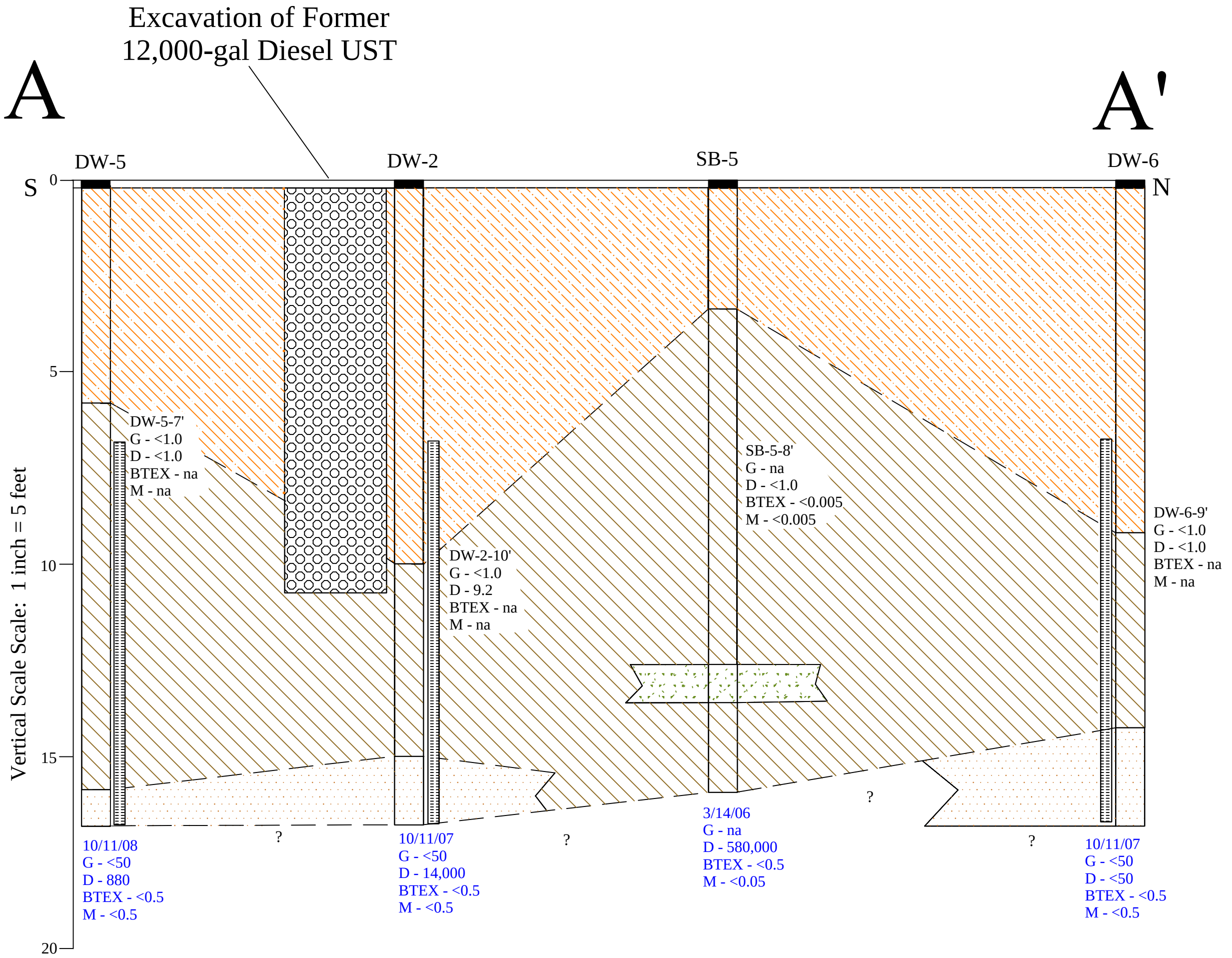
● PROPOSED INJECTION LOCATION

AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200, WALNUT CREEK

PROPOSED INJECTION LOCATIONS

6310 HOUSTON PLACE
DUBLIN, CALIFORNIA

FIGURE 5
PROJECT NO. 261639



▧ Silty Clay
▤ Clayey Silt
▨ Clayey Sand
░ Silty Sand
▒ Gravelly Clay
▦ Fill Material

▥ Well Screen Interval

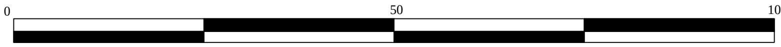
▼ Static Water Level

— — *Inferred Contact

Soil Analyses (mg/kg)	Water Analyses (ug/L)
10'	8/15/07
G - 150	G - 1,000
D - 650	D - 500
BTEX - 11	BTEX - <0.5
M - na	M - 7.1

*Based on discrete sampling during installation of wells via hollow stem auger

*G - Gasoline, D - Diesel, BTEX - Benzene, Toluene, Ethylbenzene, Xylenes
M - MTBE, na - not analyzed



Scale 1" = 25'

AEI CONSULTANTS
2500 CAMINO DIABLO, STE. 100, WALNUT CREEK, CA

A - A' Fence Diagram

6310 Houston Place
Dublin, CA

Figure 6
PROJECT NO. 261639

TABLES

Table 1, 6310 Houston Place, Dublin CA
Monitoring Well Construction Details

Well ID	Date Drilled	Top of Casing Elevation (ft amsl)	Well Box Rim Elevation (ft amsl)	Well Depth (ft)	Slotted Casing (ft)	Slot Size (in)	Blank Casing (ft)	Sand Interval (ft)	Sand Size	Bentonite Interval (ft)	Grout Interval (ft)
DW-1	03/14/07	334.23	334.44	17.00	7-17	0.010	0.2-5	4-17	# 2/12	3-4	0.75-2
DW-2	03/14/07	334.00	334.48	17.00	7-17	0.010	0.5-5	4-17	# 2/12	3-4	0.75-2
DW-3	03/14/07	334.56	334.99	17.00	7-17	0.010	0.4-5	4-17	# 2/12	3-4	0.75-2
DW-4	03/14/07	334.49	334.95	17.00	7-17	0.010	0.5-5	4-17	# 2/12	3-4	0.75-2
DW-5	03/15/07	333.91	334.5	17.00	7-17	0.010	0.6-5	4-17	# 2/12	3-4	0.75-2
DW-6	03/15/07	334.99	335.44	17.00	7-17	0.010	0.5-5	4-17	# 2/12	3-4	0.75-2
DW-7	03/15/07	335.18	335.62	17.00	7-17	0.010	0.4-5	4-17	# 2/12	3-4	0.75-2

Notes:
ft amsl = feet above mean sea level

Table 2, 6310 Houston Place, Dublin CA
Soil Sample Analytical Data

Sample ID	Sample Date	Sample Location	TPH-g mg/kg	TPH-d mg/kg	TPH-mo mg/kg	MTBE mg/kg	Benzene mg/kg	Toluene mg/kg	Ethylbenzene mg/kg	Xylenes mg/kg	MTBE mg/kg
				EPA Method 8015M				*EPA Methods 5030 / 8020F*			*EPA Method 8260B*
8559-SP1	10/27/2004	Stockpile	-	6	-	<0.005	<0.005	<0.005	<0.005	<0.01	-
8559-SP2	10/27/2004	Stockpile	-	<1	-	<0.005	<0.005	<0.005	<0.005	<0.01	-
8559-SP3	10/27/2004	Stockpile	-	197	-	<0.005	<0.005	<0.005	<0.005	<0.01	-
8559-P1[5']	10/27/2004	Product Piping	-	<1	-	<0.005	<0.005	<0.005	<0.005	<0.01	-
8559-P2[4']	10/27/2004	Product Piping	-	<1	-	<0.005	<0.005	<0.005	<0.005	<0.01	-
8559-P3[4']	10/27/2004	Product Piping	-	<1	-	<0.005	<0.005	<0.005	<0.005	<0.01	-
8559-N-Sidewall[7'6"]	10/27/2004	UST Excavation	-	1	-	<0.005	<0.005	<0.005	<0.005	<0.01	-
SB-1-8'	3/14/2006	Adjacent to Tank	-	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
SB-2-8'	3/14/2006	Product Piping	-	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
SB-3-8'	3/14/2006	Downgradient	-	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
SB-4-8'	3/14/2006	Dispenser	-	53	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
SB-5-8'	3/14/2006	Downgradient	-	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
DW-1-7'	3/14-15/2007	Upgradient	<1.0	2.0	<5.0	-	-	-	-	-	-
DW-2-10'	3/14-15/2007	Source Zone	<1.0	9.2	<5.0	-	-	-	-	-	-
DW-3-11'	3/14-15/2007	Downgradient	<1.0	12	6.2	-	-	-	-	-	-
DW-4-12'	3/14-15/2007	Crossgradient	<1.0	<1.0	<5.0	-	-	-	-	-	-
DW-5-7'	3/14-15/2007	Crossgradient	<1.0	<1.0	<5.0	-	-	-	-	-	-
DW-6-9'	3/14-15/2007	Downgradient	<1.0	<1.0	<5.0	-	-	-	-	-	-
DW-7-11'	3/14-15/2007	Downgradient	<1.0	<1.0	<5.0	-	-	-	-	-	-
Composite Sample #1	3/14-15/2007	Inv.-Derived Waste	<1.0	<1.0	<5.0	-	-	-	-	-	-
Composite Sample #2	3/14-15/2007	Inv.-Derived Waste	<1.0	<1.0	<5.0	-	-	-	-	-	-
RL	-	-	1.0	1.0	5.0	0.005	0.005	0.005	0.005	0.005	0.005

TPH-g = Total Petroleum Hydrocarbons as gas, TPH-d = TPH as diesel, TPH-mo = TPH as motor oil
MTBE = Methyl tertiary-Butyl Ether
RL = Laboratory reporting limit
UST excavation and sampling routine performed by Golden Gate Tank Removal, Inc., October 2004.

mg/kg = milligrams per kilogram (equivalent to parts per million)
µg/kg = micrograms per kilogram (equivalent to parts per billion)
UST = Underground Storage Tank

Table 3, 6310 Houston Place, Dublin, CA
Groundwater Sample Analytical Data - Soil Borings

Sample ID	Sample Date	Sample Location	TPH-d µg/L *EPA Method 8015M*	MTBE µg/L	Benzene µg/L	Toluene µg/L *EPA Methods 5030 / 8020F*	Ethylbenzene µg/L	Xylenes µg/L	MTBE µg/L *EPA Method 8260B*
8559-D[3']	10/27/2004	Dispenser	23,800	1.1	<0.5	<0.5	<0.5	1.8	-
8559-Water	10/27/2004	UST Excavation	300	3.8	<0.5	<0.5	<0.5	<1.0	-
SB-1-W	3/14/2006	Adjacent to tank	450,000	-	<0.5	<0.5	<0.5	<0.5	<0.5
SB-2-W	3/14/2006	Product Piping	4,100	-	<0.5	<0.5	<0.5	<0.5	<0.5
SB-3-W	3/14/2006	Downgradient	340,000	-	<0.5	<0.5	<0.5	<0.5	<0.5
SB-4-W	3/14/2006	Dispenser	17,000	-	<0.5	<0.5	<0.5	<0.5	<0.5
SB-5-W	3/14/2006	Downgradient	580,000	-	<0.5	<0.5	<0.5	<0.5	<0.5
RL	-	-	0.05	0.5	0.5	0.5	0.5	0.5	0.5

TPH-d = Total Petroleum Hydrocarbons as diesel
MtBE = Methyl tertiary-Butyl Ether
RL = Laboratory reporting limit
mg/L = milligrams per liter (equivalent to parts per million)
µg/L = micrograms per kilogram (equivalent to parts per billion)
UST = Underground Storage Tank

UST excavation and sampling routine performed by Golden Gate Tank Removal, Inc., October 2004.

Table 4: 6310 Houston Place, Dublin, CA
Groundwater Elevation Data

Well ID (Screen Interval)	Date Collected	Well Elevation *(ft amsl)*	Depth to Water *(ft)*	Groundwater Elevation *(ft amsl)*
DW-1	4/10/2007	334.23	7.44	326.79
(7 - 17)	7/12/2007	334.23	7.72	326.51
	10/11/2007	**334.23**	**7.88**	**326.35**
DW-2	4/10/2007	334.00	7.09	326.91
(7 - 17)	7/12/2007	334.00	7.40	326.60
	10/11/2007	**334.00**	**7.55**	**326.45**
DW-3	4/10/2007	334.56	7.90	326.66
(7 - 17)	7/12/2007	334.56	8.19	326.37
	10/11/2007	**334.56**	**8.29**	**326.27**
DW-4	4/10/2007	334.49	7.99	326.50
(7 - 17)	7/12/2007	334.49	8.22	326.27
	10/11/2007	**334.49**	**8.33**	**326.16**
DW-5	4/10/2007	333.91	7.00	326.91
(7 - 17)	7/12/2007	333.91	7.36	326.55
	10/11/2007	**333.91**	**7.52**	**326.39**
DW-6	4/10/2007	334.99	8.62	326.37
(7 - 17)	7/12/2007	334.99	8.81	326.18
	10/11/2007	**334.99**	**8.53**	**326.46**
DW-7	4/10/2007	335.18	8.11	327.07
(7 - 17)	7/12/2007	335.18	8.34	326.84
	10/11/2007	**335.18**	**8.96**	**326.22**

Event #	Date	Average Water Table Elevation (ft amsl)	Change from Previous Episode (ft)	Flow Direction (gradient) (ft/ft)
1	3/9/2006	326.74	NA	S-SW / 0.005
2	7/12/2006	326.41	-0.33	S-SW/0.0036
3	**10/11/2007**	**326.33**	**-0.08**	**SW/0.0028**

ft amsl = feet above mean sea level
All water level depths are measured from the top of casing
***Average Water Table Elevation and Flow Direction do not include DW-7

Table 5: 6310 Houston Place, Dublin, CA

Groundwater Sample Analytical Data - TPH, BTEX, Fuel Additives

Sample ID	Date	TPH-g µg/L	TPH-d µg/L	TPH-mo µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes µg/L	MTBE µg/L	TAME µg/L	TBA µg/L	DIPE µg/L	ETBE µg/L	Ethanol µg/L	Methanol µg/L
DW-1	4/10/2007	100	8,000	2,800	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500
	7/12/2007	100	30,000	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-
	10/11/2007	**<50**	**18,000**	**-**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**-**	**-**	**-**	**-**	**-**	**-**
DW-2	4/10/2007	180	8,200	<5,000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500
	7/12/2007	120	34,000	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-
	10/11/2007	**<50**	**14,000**	**-**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**-**	**-**	**-**	**-**	**-**	**-**
DW-3	4/10/2007	220	27,000	9,200	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500
	7/12/2007	2,200	210,000	-	<0.5	<1.7	<1.7	<1.7	<1.7	-	-	-	-	-	-
	10/11/2007	**18,000**	**71,000**	**-**	**<25**	**<25**	**<25**	**<25**	**<0.5**	**-**	**-**	**-**	**-**	**-**	**-**
DW-4	4/10/2007	<50	65	<250	<0.5	<0.5	<0.5	<0.5	0.67	<0.5	<5.0	<0.5	<0.5	<50	<500
	7/12/2007	<50	300	-	<0.5	<0.5	<0.5	<0.5	0.87	-	-	-	-	-	-
	10/11/2007	**<50**	**640**	**-**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**0.80**	**-**	**-**	**-**	**-**	**-**	**-**
DW-5	4/10/2007	<50	800	320	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500
	7/12/2007	<50	990	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-
	10/11/2007	**<50**	**880**	**-**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**-**	**-**	**-**	**-**	**-**	**-**
DW-6	4/10/2007	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	0.81	<0.5	<50	<500
	7/12/2007	<50	<50	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-
	10/11/2007	**<50**	**<50**	**-**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**-**	**-**	**-**	**-**	**-**	**-**
DW-7	4/10/2007	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500
	7/12/2007	<50	<50	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-
	10/11/2007	**<50**	**<50**	**-**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**-**	**-**	**-**	**-**	**-**	**-**

Notes:
TPHmo = total petroleum hydrocarbons as motor oil (C18+) using EPA Method 8015
TPHd = total petroleum hydrocarbons as diesel (C10-C23) using EPA Method 8015
TPHg = total petroleum hydrocarbons as gasoline (C6-C12) using EPA Method 8015
Benzene, toluene, ethylbenzene, and xylenes using EPA Method 8021B
MTBE = methyl-tertiary butyl ether using EPA Method 8260B
TBA = tert-butyl alcohol using EPA Method 8260B
TAME = tert-amyl methyl ether using EPA Method 8260B
DIPE = diisopropyl ether using EPA Method 8260B
ETBE = ethyl tert-butyl ether using EPA Method 8260B
Methanol and Ethanol using EPA Method 8260B
SVOCs using EPA Method 8270C
µg/L= micrograms per liter
ND<50 = non detect at respective reporting limit

APPENDIX A

Boring/Well Logs

Project: G & G International
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 116304

Log of Boring SB-1

Sheet 1 of 1

Date(s) Drilled **March 14, 2006**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2 3/4 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **En-Prob**	Approximate Surface Elevation
Groundwater Level and Date Measured **13.5 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Neat Cement with Asphalt Patch**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Asphalt	■	Asphalt		
				SP	⠿	Silty Sand, bluish black, poorly graded, slightly loose, dry		
		☒	SB-1-4'		⠿		<1	
				CL	▨	Silty Clay, minor sand, bluish black to dark brown, low plasticity, soft, moist		
	5				▨			
					▨			DTW = 6.4 ft. bgs after 15 minutes
		☒	SB-1-8'		▨	color change to tannish brown	<1	
	10			SP	⠿	Sand, tannish brown, fine grained, slightly dense, poorly graded, moist		
		☒	SB-1-12'		⠿		<1	
					⠿	color change to greenish brown		
				SP	⠿	(ATD) ▽ Sand, greenish brown, fine grained, soft, poorly graded, wet to saturated		
	15			SP	⠿	Sand, minor clay, greenish brown, fine grained, soft, poorly graded, moist		
		☒	SB-1-16'		⠿		<1	
						Bottom of Boring at 16 feet bgs		
	20							

Figure

X:\PROJECTS\CHARACTERIZATION & REMEDIATION\CHARACTERIZATION\116304 SGWI (G&G - Greyson) Dublin\116304 SGWI\116304.bgs [AEI geoprobe 20.tpl]

Project: G & G International
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 116304

Log of Boring SB-2

Sheet 1 of 1

Date(s) Drilled	**March 14, 2006**	Logged By	**Adrian Angel**	Checked By	**Peter McIntyre**
Drilling Method	**Direct Push**	Drill Bit Size/Type	**2 3/4 inch**	Total Depth of Borehole	**16 feet bgs**
Drill Rig Type	**Geoprobe 5410**	Drilling Contractor	**En-Prob**	Approximate Surface Elevation	
Groundwater Level and Date Measured	**13.5 feet ATD**	Sampling Method(s)	**Tube**	Well Permit.	
Borehole Backfill	**Neat Cement with Asphalt Patch**	Location			

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Asphalt	■	Asphalt		
				SP	⁘	Silty Sand, bluish black, minor gravel clasts, poorly graded, slightly loose, dry		
		☒	SB-2-4'		⁘		<1	
	5			CL	▨	Silty Clay, minor sand, dark brown, low plasticity, moist		DTW = 5.5 ft. bgs after 20 minutes
		☒	SB-2-8'		▨		<1	
					▨	color change to tannish brown		
	10				▨			
		☒	SB-2-13'		▨		<1	
				SP	⁘	Sand, tannish brown, fine grained, soft, poorly graded, wet to saturated (ATD) ▽		
				SP	⁘	Sand, minor clay, tannish brown, fine grained, soft to slightly stiff, poorly graded, moist		
	15				⁘			
		☒	SB-2-16'		⁘		1.2	
						Bottom of Boring at 16 feet bgs		
	20							

Figure

X:\PROJECTS\CHARACTERIZATION & REMEDIATION\CHARACTERIZATION\116304 SGWI (G&G - Greyson) Dublin\116304 SGWI\116304.bgs [AEI geoprobe 20.tpl]

Project: G & G International
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 116304

Log of Boring SB-3

Sheet 1 of 1

Date(s) Drilled **March 14, 2006**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2 3/4 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **En-Prob**	Approximate Surface Elevation
Groundwater Level and Date Measured **13.5 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Neat Cement with Asphalt Patch**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Asphalt	■	Asphalt		
				SP	⁘	Silty Sand, bluish black, poorly graded, slightly loose, dry		
		☒	SB-3-4'		⁘		<1	
	5			CL	▨	Silty Clay, minor sand, bluish black to dark brown, low plasticity, soft, moist		
					▨			DTW = 6.8 ft. bgs after 15 minutes
		☒	SB-3-8'		▨		<1	
				CL	▨	color change to tannish brown		
	10				▨			
		☒	SB-3-12'		▨		<1	
					▨	color change to greenish brown		
						(ATD) ▽		
				SP	⁘	Sand, greenish brown, fine grained, soft, poorly graded, wet to saturated, slight petroleum odor		
				CL	▨	Silty Clay, greenish brown, low plasticity, slightly soft, moist, slight petroleum odor		
	15				▨			
		☒	SB-3-16'		▨		<1	
						Bottom of Boring at 16 feet bgs		
	20							

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Figure

Project: G & G International
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 116304

Log of Boring SB-4

Sheet 1 of 1

Date(s) Drilled **March 14, 2006**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2 3/4 inch**	Total Depth of Borehole **20 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **En-Prob**	Approximate Surface Elevation
Groundwater Level and Date Measured **13.5 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Neat Cement with Asphalt Patch**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Asphalt	■	Asphalt		
				SP	∴	Clayey Sand, dark brown, poorly graded, moderately dense, dry		
		☒	SB-4-4'	CL	▨	Silty Clay, minor sand, dark brown, occasional gravel, low plasticity, moist	<1	
	5				▨			
					▨			DTW = 8.3 ft. bgs after 15 minutes
		☒	SB-4-8'		▨		<1	
	10				▨			
		☒	SB-4-12'		▨		<1	
				SP	∴	(ATD) ▽ Gravelly Clay, dark brown, medium plasticity, saturated, sheen noted during groundwater collection		
				CL	▨	Silty Clay, dark brown, tight, medium plasticity, very moist		
	15				▨			
		☒	SB-4-16'		▨		<1	
		☒	SB-4-20'		▨		<1	
	20					Bottom of Boring at 20 feet bgs		

Figure

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Project: G & G International
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 116304

Log of Boring SB-5

Sheet 1 of 1

Date(s) Drilled **March 14, 2006**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2 3/4 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **En-Prob**	Approximate Surface Elevation
Groundwater Level and Date Measured **13.5 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Neat Cement with Asphalt Patch**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Asphalt	■	Asphalt		
				SP	⁘	Clayey Sand, dark brown, poorly graded, moderately dense, dry		
		☒	SB-5-4'	CL	▨	Silty Clay, minor sand and gravel, dark brown, medium plasticity, moist	<1	
	5							
								DTW = 6.5 ft. bgs after 10 minutes
		☒	SB-5-8'				<1	
	10							
		☒	SB-5-12'				<1	
				SP	⁘	Gravelly Clay, dark brown to greenish brown, medium plasticity, saturated, sheen noted during groundwater collection (ATD) ▽		
				CL	▨	Silty Clay, dark brown to greenish brown, tight, medium plasticity, very moist		
	15							
		☒	SB-5-16'				<1	
						Bottom of Boring at 16 feet bgs		
	20							

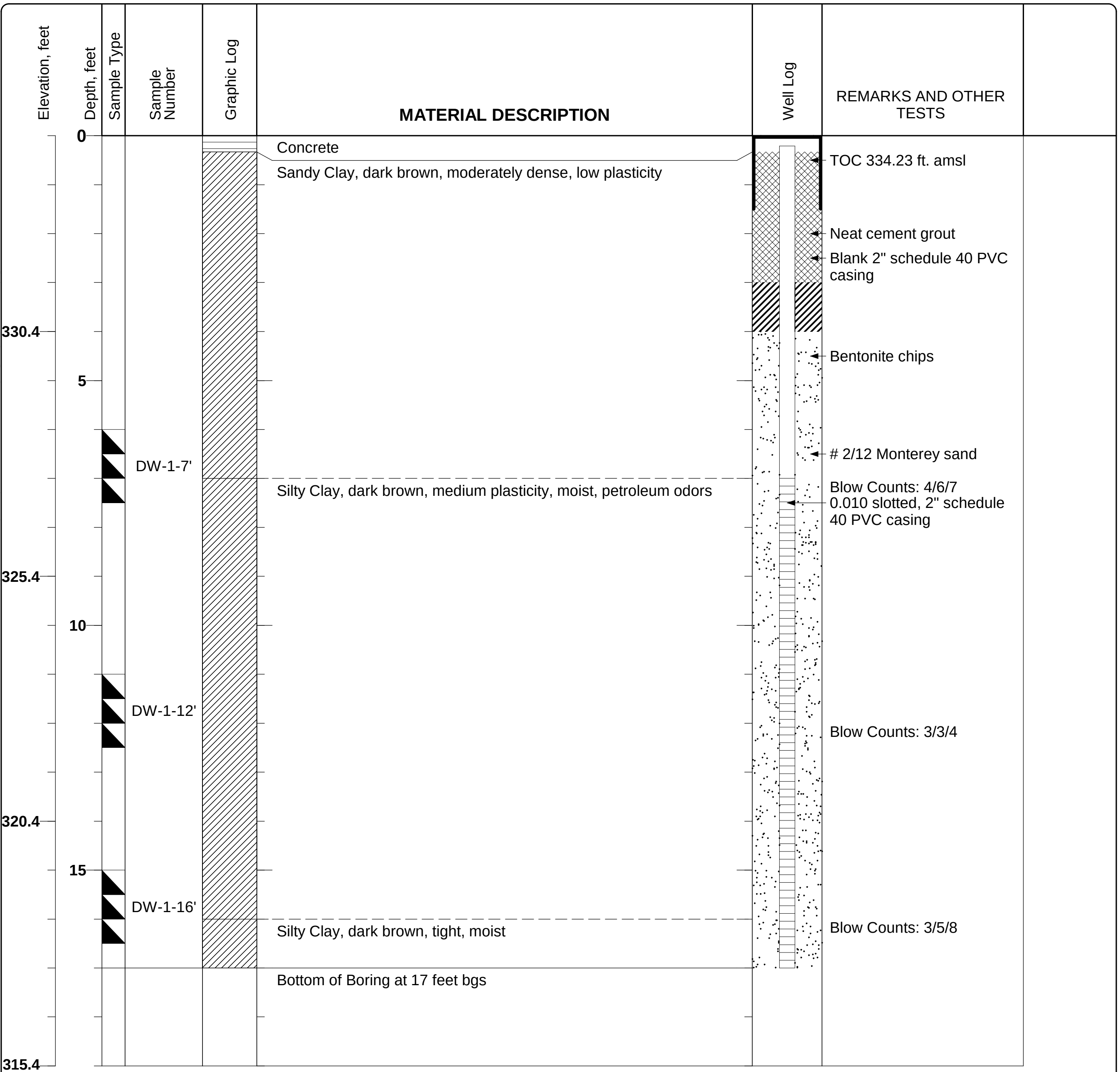
Figure

Project: G&G International Holding
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 261639

Log of Boring DW-1

Sheet 1 of 1

Date(s) Drilled **March 14, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Spectrum**	Approximate Surface Elevation **334.44 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **California**	Hammer Data
Borehole Backfill **See Below**	Location	



MATERIAL DESCRIPTION

Concrete

Sandy Clay, dark brown, moderately dense, low plasticity

Silty Clay, dark brown, medium plasticity, moist, petroleum odors

Silty Clay, dark brown, tight, moist

Bottom of Boring at 17 feet bgs

REMARKS AND OTHER TESTS

TOC 334.23 ft. amsl

Neat cement grout

Blank 2" schedule 40 PVC casing

Bentonite chips

2/12 Monterey sand

Blow Counts: 4/6/7

0.010 slotted, 2" schedule 40 PVC casing

Blow Counts: 3/3/4

Blow Counts: 3/5/8

Figure

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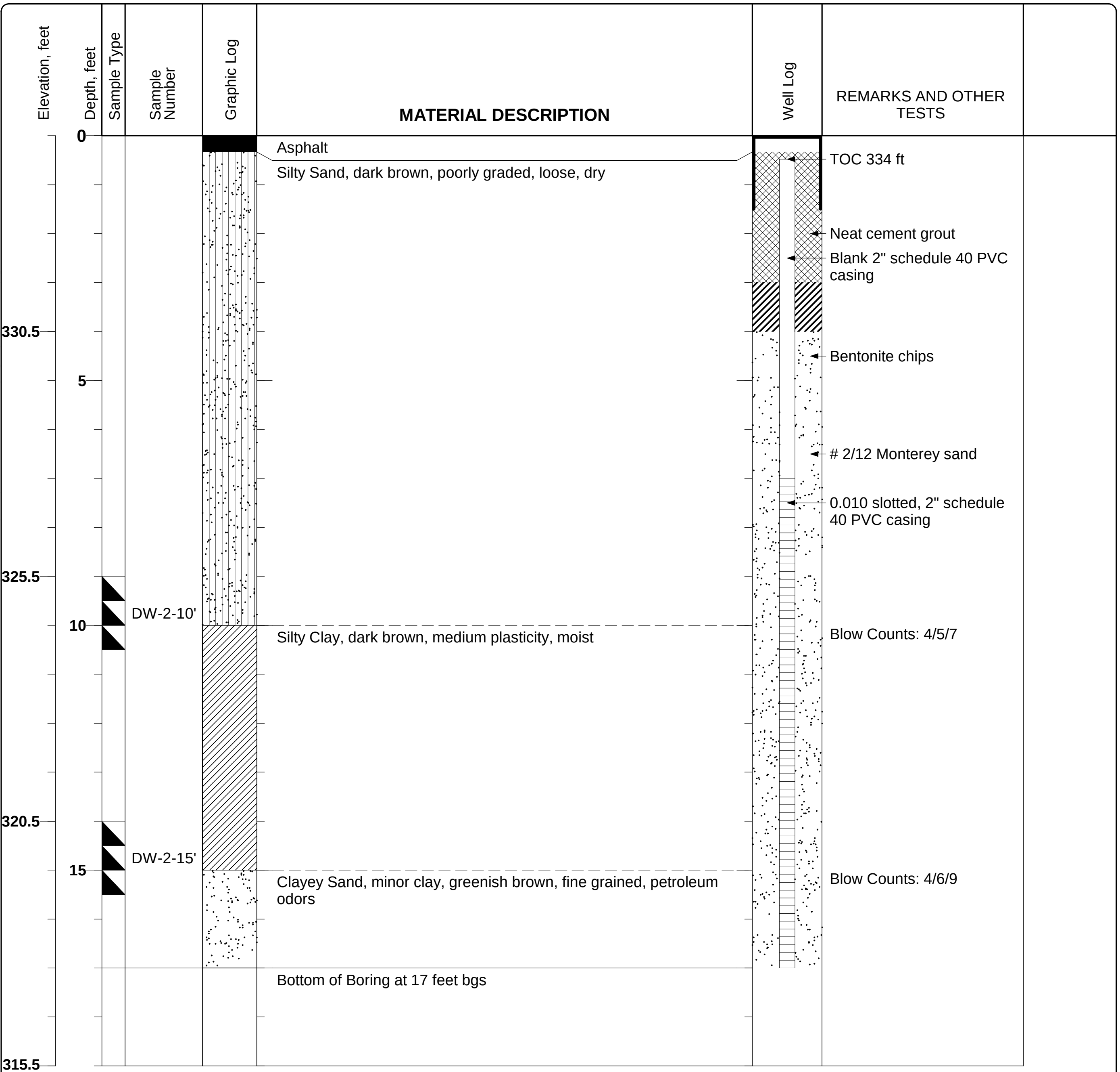
Project: G&G International Holding
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 261639

Log of Boring DW-2

Sheet 1 of 1

Date(s) Drilled **March 14, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Spectrum**	Approximate Surface Elevation **334.48 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **California**	Hammer Data
Borehole Backfill **See Below**	Location	



Asphalt

Silty Sand, dark brown, poorly graded, loose, dry

Silty Clay, dark brown, medium plasticity, moist

Clayey Sand, minor clay, greenish brown, fine grained, petroleum odors

Bottom of Boring at 17 feet bgs

TOC 334 ft

Neat cement grout

Blank 2" schedule 40 PVC casing

Bentonite chips

2/12 Monterey sand

0.010 slotted, 2" schedule 40 PVC casing

Blow Counts: 4/5/7

Blow Counts: 4/6/9

Figure

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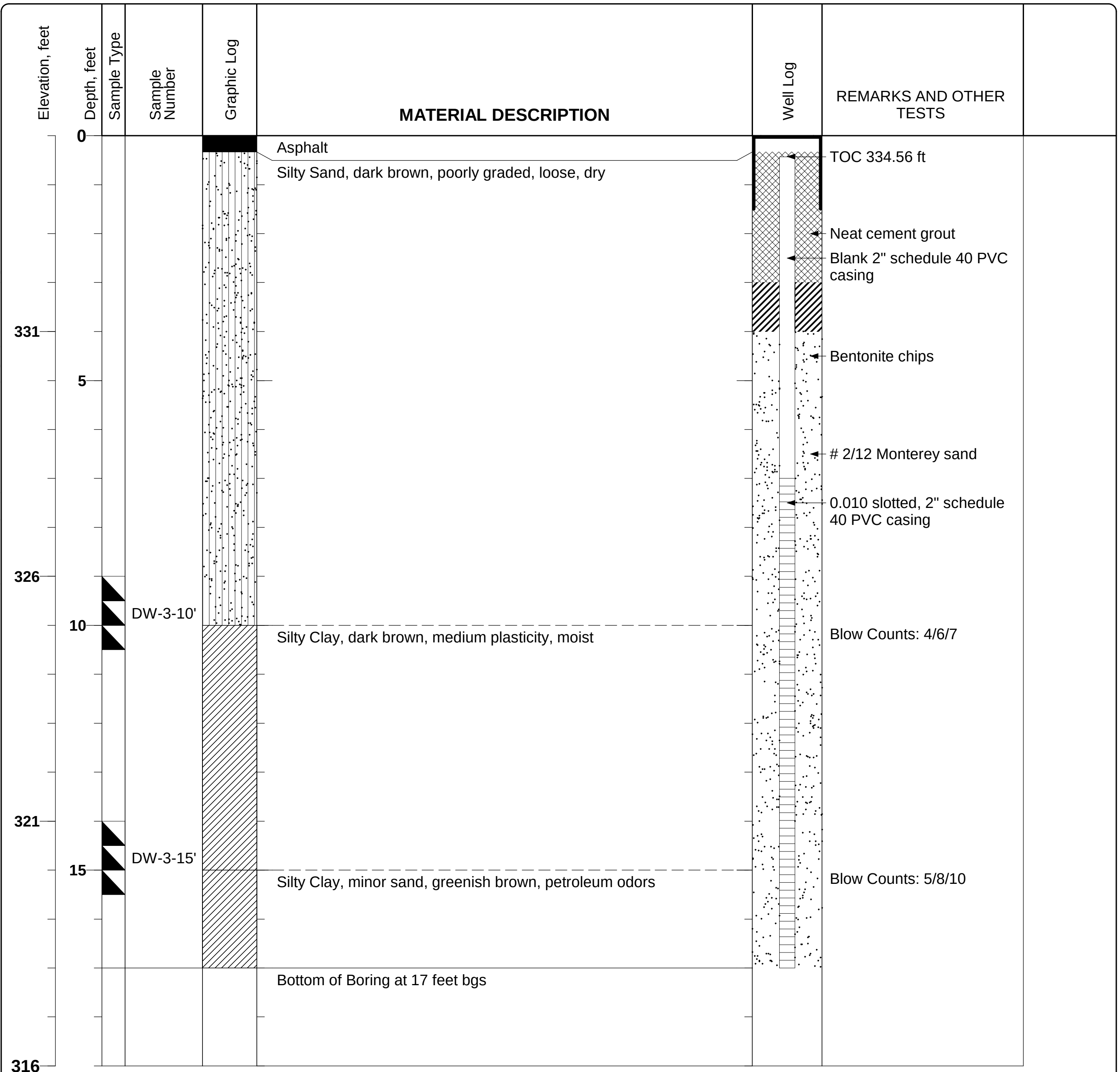
Project: G&G International Holding
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 261639

Log of Boring DW-3

Sheet 1 of 1

Date(s) Drilled **March 14, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Spectrum**	Approximate Surface Elevation **334.99 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **California**	Hammer Data
Borehole Backfill **See Below**	Location	



Asphalt

Silty Sand, dark brown, poorly graded, loose, dry

Silty Clay, dark brown, medium plasticity, moist

Silty Clay, minor sand, greenish brown, petroleum odors

Bottom of Boring at 17 feet bgs

TOC 334.56 ft

Neat cement grout

Blank 2" schedule 40 PVC casing

Bentonite chips

2/12 Monterey sand

0.010 slotted, 2" schedule 40 PVC casing

Blow Counts: 4/6/7

Blow Counts: 5/8/10

Figure

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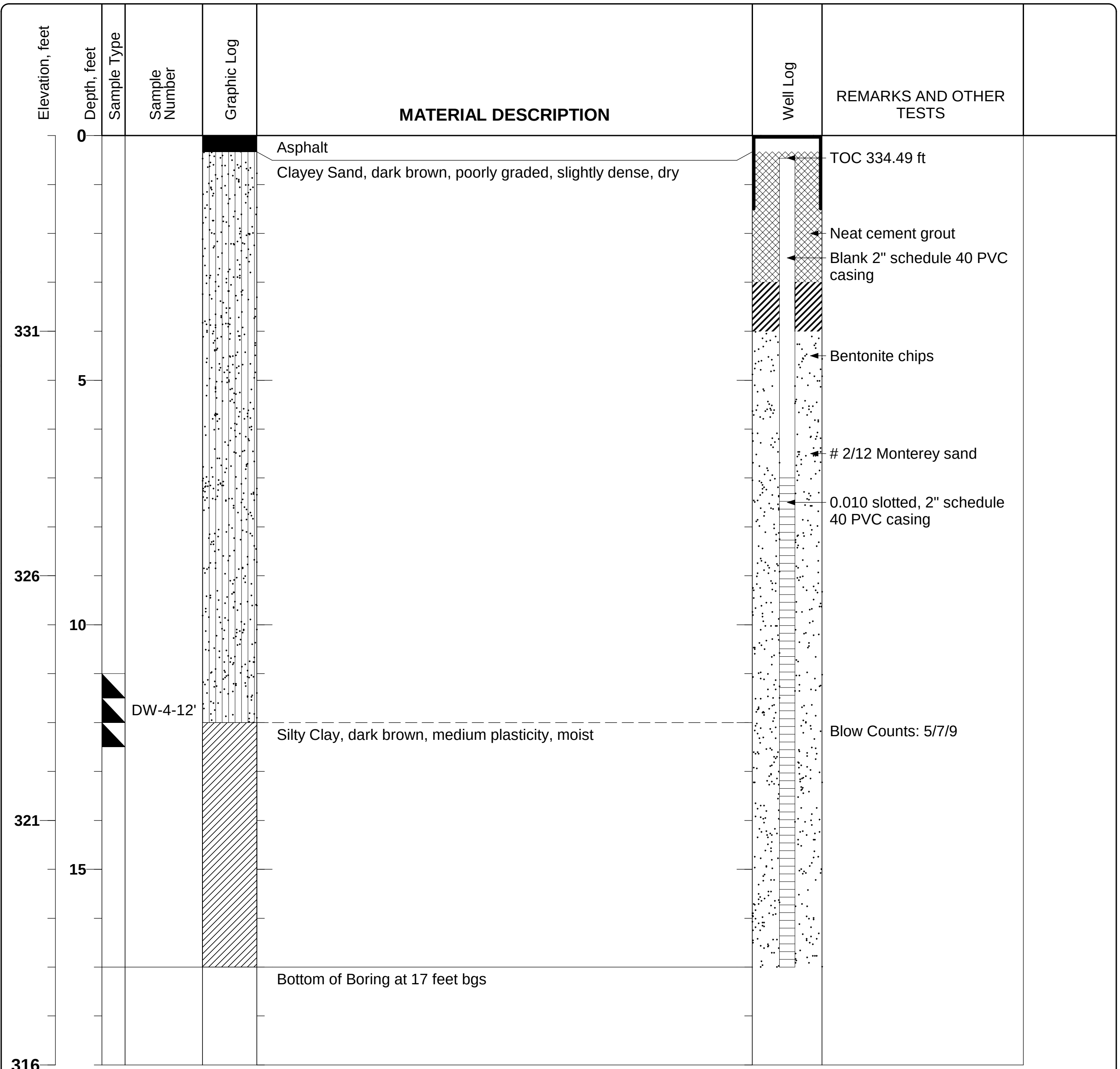
Project: G&G International Holding
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 261639

Log of Boring DW-4

Sheet 1 of 1

Date(s) Drilled **March 14, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Spectrum**	Approximate Surface Elevation **334.95 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **California**	Hammer Data
Borehole Backfill **See Below**	Location	



Depth, feet	Sample Number	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
0		Asphalt	TOC 334.49 ft
		Clayey Sand, dark brown, poorly graded, slightly dense, dry	Neat cement grout Blank 2" schedule 40 PVC casing Bentonite chips # 2/12 Monterey sand 0.010 slotted, 2" schedule 40 PVC casing
12	DW-4-12'	Silty Clay, dark brown, medium plasticity, moist	Blow Counts: 5/7/9
17		Bottom of Boring at 17 feet bgs	

Figure

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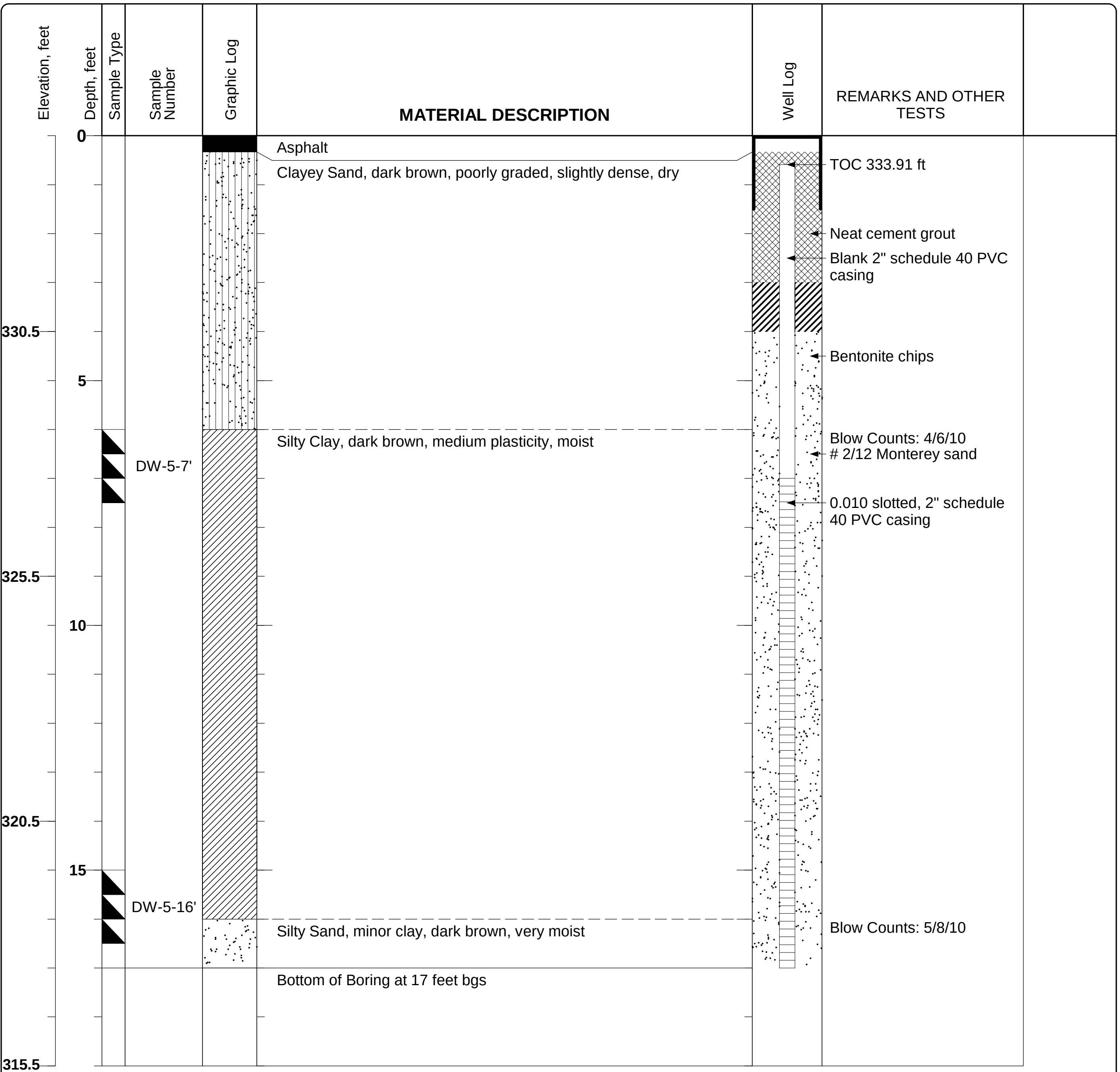
Project: G&G International Holding
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 261639

Log of Boring DW-5

Sheet 1 of 1

Date(s) Drilled **March 15, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Spectrum**	Approximate Surface Elevation **334.5 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **California**	Hammer Data
Borehole Backfill **See Below**	Location	



MATERIAL DESCRIPTION

Asphalt

Clayey Sand, dark brown, poorly graded, slightly dense, dry

Silty Clay, dark brown, medium plasticity, moist

Silty Sand, minor clay, dark brown, very moist

Bottom of Boring at 17 feet bgs

REMARKS AND OTHER TESTS

TOC 333.91 ft

Neat cement grout

Blank 2" schedule 40 PVC casing

Bentonite chips

Blow Counts: 4/6/10

2/12 Monterey sand

0.010 slotted, 2" schedule 40 PVC casing

Blow Counts: 5/8/10

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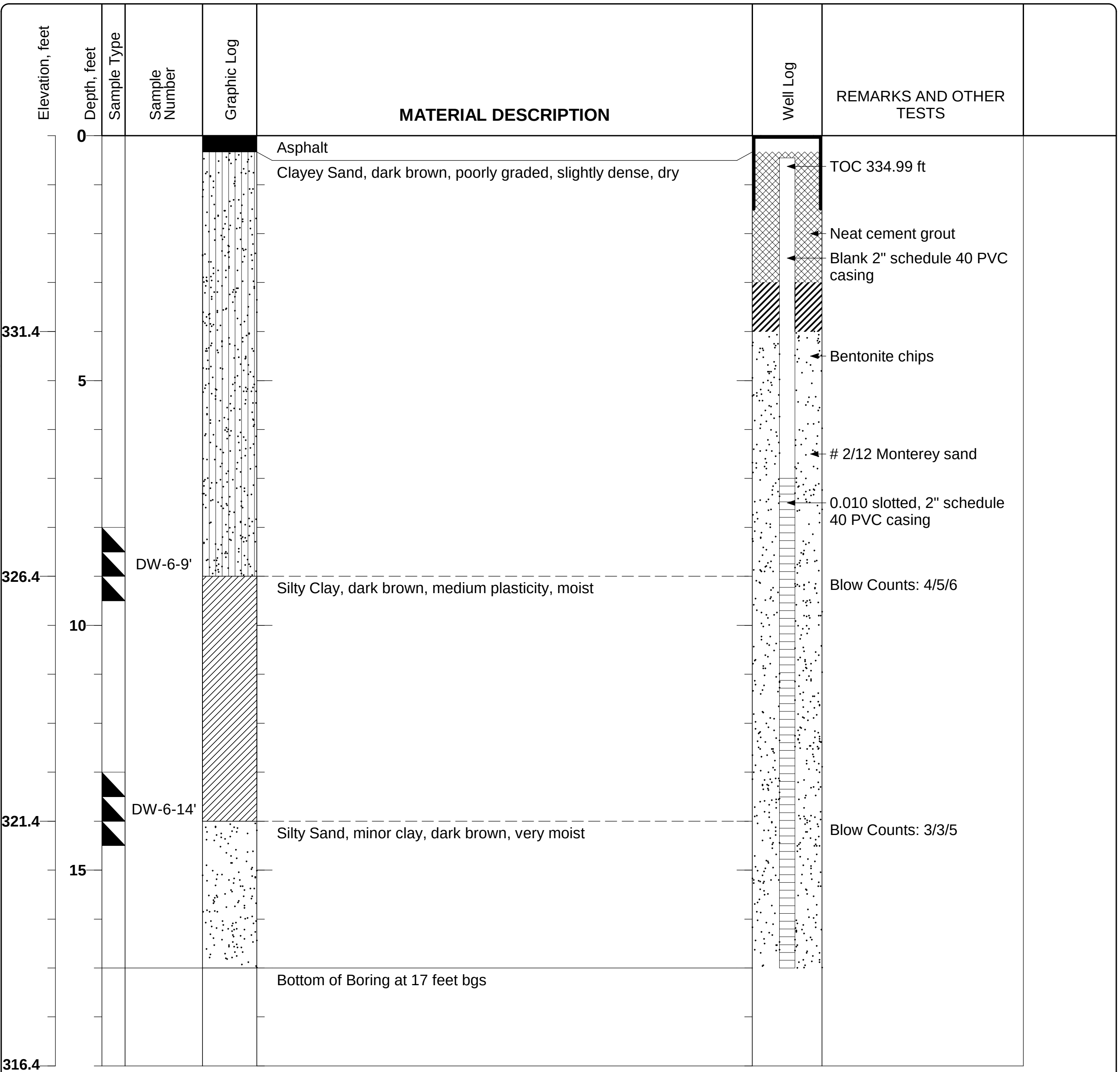
Figure

Project: G&G International Holding
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 261639

Log of Boring DW-6

Sheet 1 of 1

Date(s) Drilled **March 15, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Spectrum**	Approximate Surface Elevation **335.44 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **California**	Hammer Data
Borehole Backfill **See Below**	Location	



Elevation, feet	Depth, feet	Sample Number	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0		Asphalt	
			Clayey Sand, dark brown, poorly graded, slightly dense, dry	TOC 334.99 ft
				Neat cement grout
				Blank 2" schedule 40 PVC casing
331.4				Bentonite chips
	5			
				# 2/12 Monterey sand
				0.010 slotted, 2" schedule 40 PVC casing
326.4		DW-6-9'	Silty Clay, dark brown, medium plasticity, moist	Blow Counts: 4/5/6
	10			
321.4		DW-6-14'	Silty Sand, minor clay, dark brown, very moist	Blow Counts: 3/3/5
	15			
			Bottom of Boring at 17 feet bgs	
316.4				

Figure

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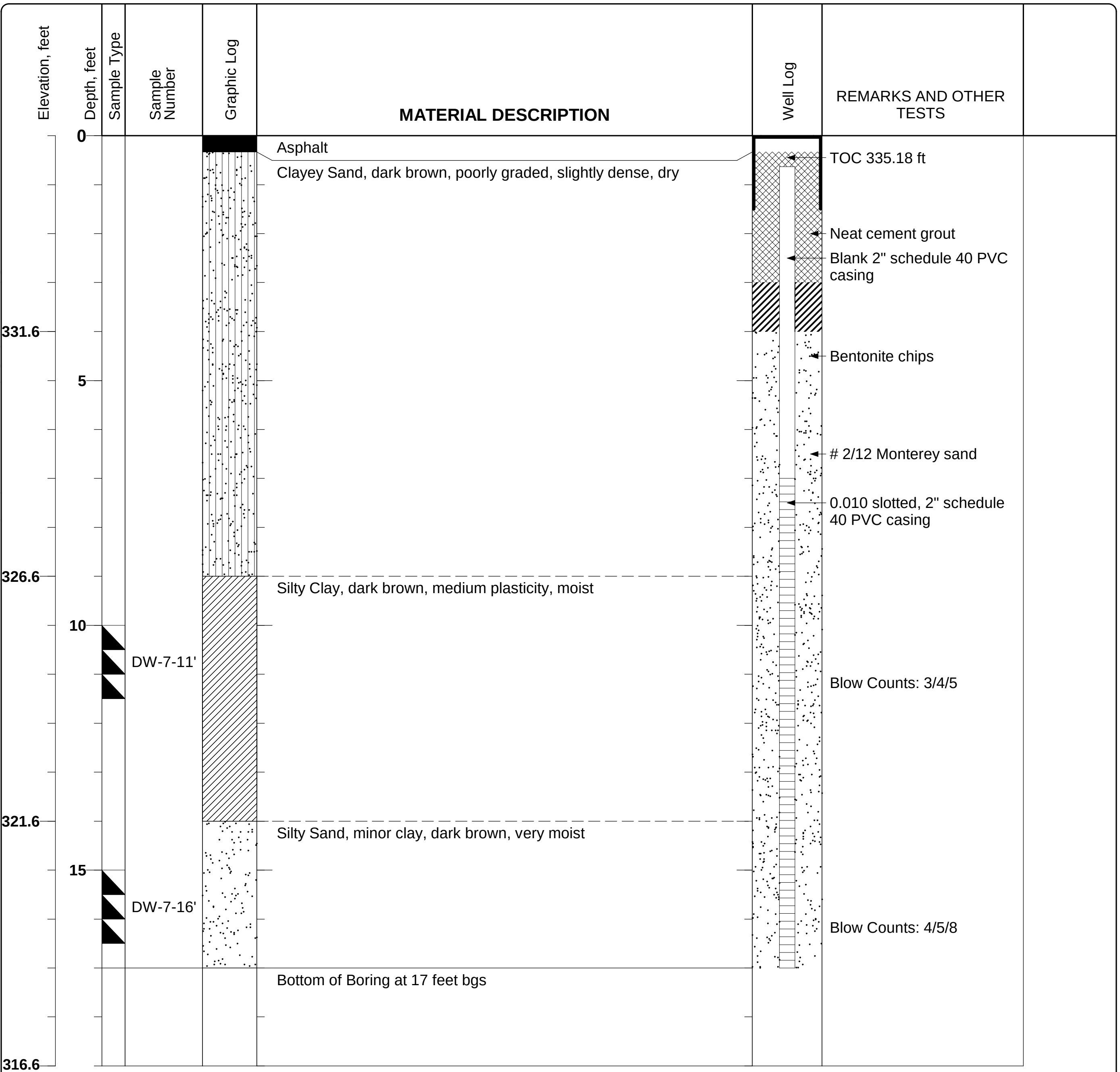
Project: G&G International Holding
Project Location: 6310 Houston Place, Dublin, CA
Project Number: 261639

Log of Boring DW-7

Sheet 1 of 1

Date(s) Drilled **March 15, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Spectrum**	Approximate Surface Elevation **335.62 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **California**	Hammer Data
Borehole Backfill **See Below**	Location	



Elevation, feet	Depth, feet	Sample Number	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0		Asphalt	TOC 335.18 ft
			Clayey Sand, dark brown, poorly graded, slightly dense, dry	Neat cement grout Blank 2" schedule 40 PVC casing
331.6				Bentonite chips
	5			# 2/12 Monterey sand 0.010 slotted, 2" schedule 40 PVC casing
326.6			Silty Clay, dark brown, medium plasticity, moist	
	10	DW-7-11'		Blow Counts: 3/4/5
321.6			Silty Sand, minor clay, dark brown, very moist	
	15	DW-7-16'		Blow Counts: 4/5/8
			Bottom of Boring at 17 feet bgs	
316.6				

Figure

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APPENDIX B

Direct Push Injection
Standard Operating Procedures (SOP)

REGENESIS

RegenOx™

CHEMICAL OXIDATION REDEFINED

RegenOx™ *In Situ* Chemical Oxidation Application Instructions

Using Direct-Push Injection (Step-by-Step Procedures)

RegenOx™ is the new generation of chemical oxidation. RegenOx™ is a proprietary (patent-applied-for) *in situ* chemical oxidation process using a solid oxidant complex (sodium percarbonate/catalytic formulation) and an activator complex (a composition of ferrous salt embedded in a micro-scale catalyst gel). RegenOx™ with its catalytic system has very high activity, capable of treating a very broad range of soil and groundwater contaminants including both petroleum hydrocarbons and chlorinated solvents.

Instructions

1) Prior to the installation of RegenOx™, any surface or overhead impediments should be identified as well as the location of all underground structures. Underground structures include but are not limited to utility lines; tanks; distribution piping; sewers; drains; and landscape irrigation systems. The planned installation locations should be adjusted to account for all impediments and obstacles. These considerations should be part of the SSHP or HASP.

2) Pre-mark the installation locations, noting any points that may have different vertical application requirements or total depth.

3) Set up the direct push unit over each point and follow the manufacturer standard operating procedures (SOP) for the direct push equipment. Care should be taken to assure that probe holes remain in the vertical.

4) For most applications, Regenesis suggests using 1.5-inch O.D./0.625-inch I.D drive rods. However, some applications may require the use of 2.125-inch O.D./1.5-inch I.D. or larger drive rods.

5) Advance drive rods through the surface pavement, as necessary, following SOP.

6) Push the drive rod assembly with an expendable tip to the desired maximum depth. Regenesis suggests pre-counting the number of drive rods needed to reach depth prior to starting injection activities.

7) After the drive rods have been pushed to the desired depth, the rod assembly should be withdrawn three to six inches. Then the expendable tip can be dropped from the drive rods, following SOP. If an injection tool was used instead of an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.

8) In some cases, introduction of a large column of air prior to RegenOx™ application may be problematic because the air can block water flow to the treatment area. This is particularly the case in deep injections (>50 ft) with large diameter rods (>1.5-inch O.D.). To prevent the injection of air into the aquifer during RegenOx™ application, as well as to prevent problems associated with heaving sands, fill the drive rods with water, or the RegenOx™ mixture prior dropping the expendable tip or exposing the injection tool.

9) The RegenOx™ percent of the oxidizer in solution should range between 3% to 5%. Although solutions up to 8% may be used, this will likely increase the difficulty of injection due to reactivity.   Solutions with greater than 8% oxidizer in solution will result in excess reaction and flocculation prior to injection and are not typically recommended

   Measure the appropriate quantity of RegenOx™ Oxidizer for one to four vertical foot of injection into a 55 gallon drum or mixing tank. The volume of water per injection location can be calculated from the following formula:

$$\frac{\text{RegenOx Oxidizer lbs/foot}}{(8.34\text{ lbs/gal water})(\%\,\mathrm{R}egenOx\_Oxidizer\text{ solids})}\left[1-(\%\,\mathrm{R}egenOx\_Oxidizer\text{ solids})\right]$$

   Tighter formations (clays and silts), and even some fine sand formations will likely require higher oxidant percentages since less volume can be injected per location. The following are guides to various RegenOx™ mixing ratios based on the above equation.

   - to make a roughly 3% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 38 gallons of water.

   - to make a roughly 4% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 28 gallons of water.

   - to make a roughly 5% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 22 gallons of water.

10) Pour the pre-measured quantity of RegenOx™ Oxidizer into the pre-measured volume of water to make the desired target % oxidant in solution. NOTE: always pour the Oxidizer into water, do not pour water into the Oxidizer. Mix the water and oxidant with a power drill and paint stirrer or other mechanical mixing device to ensure that the Oxidizer has dissolved in the water.

11) Pour the applicable quantity of the pre-mixed RegenOx™ Activator into the oxidant:water solution. Mix the Oxidant and Activator using a power drill paint stirrer or other mechanical mixing device for at least 5 minutes until a homogenous mixture is formed. After mixing the RegenOx™ mixture should be injected into the subsurface as soon as possible.

12) Do not mix more RegenOx™ material than will be used over roughly 1 to 4 feet of injection so as to minimize potential above ground reaction/flocculation prior to injection.

    Transfer the contents of the mixing tank to the pump using gravity feed or appropriate transfer pump. (See Section 9.2: Pump Selection) For some types of pumps, it may be desirable to perform a volume check prior to injecting RegenOx™

13) Connect the delivery hose to the pump outlet and the delivery sub-assembly. Circulate RegenOx™ though the hose and the delivery sub-assembly to displace air in the hose. NOTE: an appropriately sized pressure gauge should be placed between the pump outlet and the delivery sub-assembly in order to monitor application pump pressure and detect changes in aquifer backpressures during application.

14) Connect the sub-assembly to the drive rod. After confirming that all of the connections are secure, pump the RegenOx™ through the delivery system to displace the water/fluid in the rods.

15) Slowly withdraw the drive rods. Commonly RegenOx™ injection progress at 1-foot intervals. However, continuous injection while slowly withdrawing single lengths of drive rod (3 or 4 feet) is an acceptable option. The pre-determined volume of RegenOx™ should be pumped into the aquifer across the desired treatment interval.

16) Remove one section of the drive rod. The drive rod may contain some residual RegenOx™. Place the RegenOx™-filled rod in a clean, empty bucket and allow the RegenOx to drain. Eventually, the RegenOx™ should be returned to the RegenOx™ pump hopper for reuse.

17) Monitor for any indications of aquifer refusal. This is typically indicated by a spike in pressure as indicated or (in the case of shallow applications) RegenOx™ “surfacing” around the injection rods or previously installed injection points. At times backpressure caused by reaction off-gassing will impede the pumps delivery volume. This can be corrected by bleeding the pressure off using a pressure relief/bypass valve (placed inline between the pump discharge and the delivery sub-assembly) and then resume pumping. If aquifer acceptance appears to be low, as indicated by high back pressure, allow sufficient time for the aquifer to equilibrate prior to removing the drive rod.

18) Repeat steps 13 through 23 until treatment of the entire contaminated vertical zone has been achieved. It is recommended that the procedure extend to the top of the capillary fringe/smear zone, or to the top of the targeted treatment interval.

19) Install an appropriate seal, such as bentonite, above the RegenOx™ material through the entire vadose zone. Prior to emplacing the borehole seal, we recommend placing clean sand in the hole to the top of the RegenOx™ treatment zone (especially important in holes that stay open). Bentonite chips or granular bentonite should be placed immediately above the treatment zone, followed by a cement/bentonite grout to roughly 0.5 feet below ground surface. Quick-set concrete should then be used as a surface seal.

20) Remove and clean the drive rods as necessary.

21) Finish the borehole at the surface as appropriate (concrete or asphalt cap, as needed). We recommend a quick set concrete to provide a good surface seal with minimal set up time.

22) A proper borehole and surface seal assures that the RegenOx™ remains properly placed and prevents contaminant migration from the subsurface. Each borehole should be sealed immediately following RegenOx™ application to minimize RegenOx™ surfacing during the injection process. If RegenOx™ continues to "surface" up the direct push borehole, an appropriately sized (oversized) disposable drive tip or wood plug/stake can be used to plug the hole until the aquifer pressures equilibrates and the RegenOx™ stops surfacing. If wells are used for RegenOx™ injection the RegenOx™ injection wells and all nearby groundwater monitoring wells should be tightly capped to reduce potential for surfacing through nearby wells.

23) Periodically compare the pre- and post-injection volumes of RegenOx™ in the holding tank or pump hopper using the pre-marked volume levels. Volume level may not be present on all tanks or pump hoppers. In this case, volume level markings can be temporarily added using known amounts of water and a carpenter's grease pencil (Kiel crayon).

24) Move to the next probe point, repeating steps 8 through 29. We recommend that the next RegenOx™ injection point be as far a distance as possible within the treatment zone from the previous RegenOx™ injection point. This will further minimize RegenOx™ surfacing and short circuiting up an adjacent borehole. When possible, due to the high volumes of liquid being injected, working from the outside of the injection area towards the center will limit expansion of the plume.

Pump Selection

Regenesis has evaluated a number of pumps and many are capable of delivering RegenOx™ to the subsurface at a sufficient pressure and volumetric rate. However, even though a number of the evaluated pumps may be capable of delivering the RegenOx™ to the subsurface based on adequate pressures and delivery rates, each pump has its own set of practical issues that may make it more or less difficult to manage in a field setting.

In general, Regenesis strongly recommends using a pump with a pressure rating of 200 pounds per square inch (psi) in sandy soil settings, and 800 psi in silt, clay or weathered bedrock settings. Any pump under consideration should have a minimum delivery rate of 5 gallons per minute (gpm). A lower gpm rated pump may be used; however, they are not recommended due to the amount of time required to inject the volume of liquids typically associated with a RegenOx™ injection (i.e. 1,000 lbs of RegenOx™ [500 lbs Oxidant/500 lbs Activator] require roughly 1,100 gallons of water to make a 5% Oxidant solution).

Quite often diaphragm pumps are used for the delivery of chemical oxidants. Generally, these pumps operate pressures from 50-150 psi. Some of these pumps do not have the pressure head necessary to overcome the back pressure encountered in silt and clay lenses. In these cases the chemical oxidant thus ends up being delivered to the surrounding sands (the path of least resistance) and is not delivered to soil with residual adsorbed contamination. The use of a positive displacement pump such as a piston pump or a progressing cavity pump is may be superior because these pumps have the pressure necessary to overcome the resistance of low permeability soils. NOTE: be aware that application at pressures that are too high may over-consolidate the soil and minimize the direct contact of the oxidant. The key is to inject at a rate and pressure that maximizes the radius of influence without causing preferential flow. This can be achieved by injecting at the minimum pressure necessary to overcome the particular pressures associated with your site soil conditions.

Whether direct injection or wells are used, it is best to start by injecting RegenOx™ outside the contaminated area and spiral laterally inwards toward the source. Similarly, RegenOx™ should be applied starting vertically at the bottom elevation of contamination, through the layer of contamination, and a couple of feet above the layer of contamination. The reagents can be pushed out from the well bore with some water.

Pump Cleaning

For best results, flush all moving parts and hoses with clean water at the end of the day; flush the injection system with a mixture of water and biodegradable cleaner such as Simple Green.

For more information or technical assistance please call Regenesis at 949-366-8000

APPENDIX C

Safety and Handling Information

Regen OX – Part A (Oxidizer Complex)

Material Safety Data Sheet (MSDS)

Last Revised: November 7, 2005

Section 1 – Supplier Information and Material Identification

Supplier:

REGENESIS
1011 Calle Sombra
San Clemente, CA 92673
Telephone: 949.366.8000
Fax: 949.366.8090
E-mail: info@regenesis.com

Chemical Description:	A mixture of sodium percarbonate [$2Na_2CO_3 \cdot 3H_2O_2$], sodium carbonate [Na_2CO_3], sodium silicate and silica gel.
Chemical Family:	Inorganic Chemicals
Trade Name:	Regen Ox – Part A (Oxidizer Complex)
Product Use:	Used to remediate contaminated soil and groundwater (environmental applications)

Section 2 – Chemical Information/Other Designations

CAS No.	**Chemical**
15630-89-4	Sodium Percarbonate
5968-11-6	Sodium Carbonate Monohydrate
1344-09-8	Silicic Acid, Sodium Salt, Sodium Silicate
63231-67-4	Silica Gel

Section 3 – Physical Data

Form:	Powder
Color:	White
Odor:	Odorless
Melting Point:	NA
Boiling Point:	NA

Section 3 – Physical Data (cont)

Flammability/Flash Point:	NA
Vapor Pressure:	NA
Bulk Density:	0.9 – 1.2 g/cm^3
Solubility:	Min 14.5g/100g water @ 20 ºC
Viscosity:	NA
pH (3% solution):	˜ 10.5
Decomposition Temperature:	Self-accelerating decomposition with oxygen release starts at 50 ºC.

Section 4 – Reactivity Data

Stability:	Stable under normal conditions
Conditions to Avoid/Incompatibility:	Acids, bases, salts of heavy metals, reducing agents, and flammable substances
Hazardous Decomposition Products:	Oxygen. Contamination with many substances will cause decomposition. The rate of decomposition increases with increasing temperature and may be very vigorous with rapid generation of oxygen and steam.

Section 5 – Regulations

TSCA Inventory Listed:	Yes

CERCLA Hazardous Substance (40 CFR Part 302)

Listed Substance:	*No*
Unlisted Substance:	*Yes*

SARA, Title III, Sections 313 (40 CFR Part 372) – Toxic Chemical Release Reporting: Community Right-To-Know

Extremely Hazardous Substance:	No
WHMIS Classification:	C, D2B
Canadian Domestic Substance List:	Appears

Section 6 – Protective Measures, Storage and Handling

Technical Protective Measures

Storage: Oxidizer. Store in a cool, well ventilated area away from all sources of ignition and out of the direct sunlight. Store in a dry location away from heat and in temperatures less than 40 ?C.

Keep away from incompatible materials and keep lids tightly closed. Do not store in improperly labeled containers.

Protect from moisture. Do not store near combustible materials. Keep containers well sealed.

Store separately from reducing materials. Avoid contamination which may lead to decomposition.

Handling: Avoid contact with eyes, skin and clothing. Use with adequate ventilation.

Do not swallow. Avoid breathing vapors, mists or dust. Do not eat, drink or smoke in the work area.

Label containers and keep them tightly closed when not in use.

Wash hands thoroughly after handling.

Personal Protective Equipment (PPE)

Engineering Controls: General room ventilation is required if used indoors. Local exhaust ventilation, process enclosures or other engineering controls may be needed to maintain airborne levels below recommended exposure limits. Avoid creating dust or mists. Maintain adequate ventilation at all times. Do not use in confined areas. Keep levels below recommended exposure limits. To determine actual exposure limits, monitoring should be performed on a routine basis.

Respiratory Protection: For many conditions, no respiratory protection is necessary; however, in dusty or unknown conditions or when exposures exceed limit values a NIOSH approved respirator should be used.

Hand Protection: Wear chemical resistant gloves (neoprene, rubber, or PVC).

Section 6 – Protective Measures, Storage and Handling (cont)

Eye Protection:	Wear chemical safety goggles. A full face shield may be worn in lieu of safety goggles.
Skin Protection:	Try to avoid skin contact with this product. Chemical resistant gloves (neoprene, PVC or rubber) and protective clothing should be worn during use.
Other:	Eye wash station.
Protection Against Fire & Explosion:	Product is non-explosive. In case of fire, evacuate all non-essential personnel, wear protective clothing and a self-contained breathing apparatus, stay upwind of fire, and use water to spray cool fire-exposed containers.

Section 7 – Hazards Identification

Potential Health Effects

Inhalation:	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath, and irritations to mucous membranes, nose and throat.
Eye Contact:	Causes irritation, redness and pain.
Skin Contact:	Causes slight irritation.
Ingestion:	May be harmful if swallowed (vomiting and diarrhea).

Section 8 – Measures in Case of Accidents and Fire

After Spillage/Leakage:	Eliminate all ignition sources. Evacuate unprotected personnel and never exceed any occupational exposure limit. Shovel or sweep spilt material into plastic bags or vented containers for disposal. Do not return spilled or contaminated material to the inventory.
Extinguishing Media:	Water

First Aid

Eye Contact:	Flush eyes with running water for at least 15 minutes with eyelids held open. Seek a specialist.
Inhalation:	Remove affected person to fresh air. Seek medical attention if the effects persist.
Ingestion:	If the individual is conscious and not convulsing, give two-four cups of water to dilute the chemical and seek medical attention immediately. **<u>Do Not</u>** induce vomiting.

Section 8 – Measures in Case of Accidents and Fire (cont)

Skin Contact:	Wash affected areas with soap and a mild detergent and large amounts of water.

Section 9 – Accidental Release Measures

Precautions:	
Cleanup Methods:	Shovel or sweep spilt material into plastic bags or vented containers for disposal. Do not return spilled or contaminated material to the inventory.

Section 10 – Information on Toxicology

Toxicity Data

LD50 Oral (rat):	2,400 mg/kg
LD50 Dermal (rabbit):	Min 2,000 mg/kg
LD50 Inhalation (rat):	Min 4,580 mg/kg

Section 11 – Information on Ecology

Ecology Data

Ecotoxicological Information:	NA

Section 12 – Disposal Considerations

Waste Disposal Method

Waste Treatment:	Dispose of in an approved waste facility operated by an authorized contactor in compliance with local regulations.
Package (Pail) Treatment:	The empty and clean containers are to be recycled or disposed of in conformity with local regulations.

Section 13 – Shipping/Transport Information

D.O.T. Shipping Name:	Oxidizing Solid, N.O.S. [A mixture of sodium percarbonate [$2Na_2CO_3 \cdot 3H2O_2$], sodium carbonate [Na_2CO_3], sodium silicate and silica gel.]
UN Number:	1479
Hazard Class:	5.1
Labels:	5.1 (Oxidizer)
Packaging Group:	III

Section 14 – Other Information

HMIS® Rating	Health – 1 (slight)	Reactivity – 1 (slight)
	Flammability – 0 (none)	Lab PPE – goggles, gloves, and lab coat

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Section 15 – Further Information

The information contained in this document is the best available to the supplier at the time of writing, but is provided without warranty of any kind. Some possible hazards have been determined by analogy to similar classes of material. The items in this document are subject to change and clarification as more information become available. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must exercise their independent judgment in determining its appropriateness for a particular purpose.