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ENVIRONMENT

Ms. Barbara Jakub
Alameda County Environmental Health Department
1131 Harbor Bay Parkway
Alameda, CA 94502-6577

Subject:
Revised Remedial Action Plan Contingency Plan
Former 76 Service Station No. 0843 (2349)
1629 Webster Street
Alameda, California,

Date:
June 30, 2011

Contact:
Katherine Brandt

Phone:
510.596.9675

Email:
Katherine.Brandt@arcadis-us.com

Our ref:
B0047584

Dear Ms. Jakub:

This letter is in response to the request for additional information by Alameda County Environmental Health Department (ACEHD) in a letter to ConocoPhillips (COP) dated April 6, 2011 related to the Remedial Action Plan prepared by Antea Group on March 18, 2011. The additional information requested by ACEHD was a contingency plan to address the potential generation of Hexavalent Chromium (Cr(VI)) as a result of the addition of ozone into the subsurface to remediate petroleum hydrocarbon constituents.

ARCADIS has recently transitioned to lead consultant in support of remedial activities for the subject site. ARCADIS, on behalf of Union Oil of California, proposes the following actions to effectively implement an active remedy at the site while also addressing concerns associated with potential generation of Cr(VI). The proposed approach will be implemented in phases based on observations.

- Initial remedy to incorporate air sparging (biosparging) with monitoring of indicator parameters
- If biosparge treatment alone is ineffective after two quarters based on indicator parameters, ozone will gradually be introduced to the sparged air.
- Ozone sparging will be phased in pending observations following injections of air into sparge wells (biosparging).
- Remaining sparge wells TSP-2 through TSP-10 will be installed using slotted PVC well screen to allow for greater distribution of air in the subsurface, resulting in more effective distribution of air and ozone in the subsurface and subsequently more effective remedial treatment.

The remaining sections provide an explanation of chromium oxidation processes resulting from the addition of strong chemical oxidants such as ozone, but not typically generated from a biosparge system. Also, a biosparge remedial approach with the potential for phasing in ozone is discussed along with a Cr(VI) contingency plan. Lastly, updated well construction details are also included.

Chromium Chemistry in Presence of Ozone/Oxygen

Addition of strong chemical oxidants such as ozone can cause naturally occurring metals (chromium, barium, lead, e.g.) to enter the dissolved phase. For example, trivalent chromium (Cr(III)), typically in a solid state, can be oxidized to the more soluble Cr(VI) when in the presence of strongly oxidizing conditions caused by ozone. This can result in a temporal increase in Cr(VI) concentrations in the treatment zone. Alternatively, ferrous iron and manganese cations can be oxidized to form ferric oxide and manganese oxide precipitates, reducing dissolved concentrations of iron and manganese. Dissolved ferric iron can abiotically react with Cr(VI) to reduce Cr(VI) back to Cr(III). It is the combination of removing the dissolved iron and directly oxidizing Cr(III) to Cr(VI) that generates elevated Cr(VI) concentrations in groundwater.

Unlike oxygen, strong chemical oxidants are not typically present in natural systems, primarily because of their abiotic reactivity. Oxygen can only facilitate petroleum hydrocarbon oxidation when biologically mediated by naturally occurring aerobic bacteria. Biogeochemical site data shows that oxygen reduction is already occurring in site groundwater (depleted concentrations present in wells with elevated contaminants of concern (COC) concentrations such as MW-7 and MW-8). The proposed biosparge approach is consistent with ongoing biogeochemical processes at the site, so by only adding air to the system metals mobilization is not likely to occur.

Hexavalent Chromium Attenuation

Hexavalent chromium liberated from the ozone sparge pilot study is attenuating; most likely resulting from the aquifer’s return to pre-pilot reducing conditions following ozone was consumption. As precipitated ferrous iron reduces to dissolved ferric iron it is available to convert Cr(VI) back to Cr(III). Total chromium is typically a measurement of both Cr(III) and Cr(VI) present in a groundwater sample while dissolved chromium represents the concentration of Cr(VI) in a groundwater sample. Attenuation is observed by comparing site monitoring wells MW-10 (20 feet from sparge point TSP-1 and TSP-2) and downgradient monitoring wells MW-7 and MW-8, approximately 60 to 65 feet downgradient of TSP-1. Increases in dissolved Cr(VI) concentrations were not observed at MW-10 during pilot activities, but instead were observed the next time samples were analyzed for Cr(VI) (approximately nine months following the termination of ozone sparge pilot activities). Assuming an average groundwater velocity of approximately 0.5 feet per day, an equivalent increase in Cr(VI)concentrations would have been observed at MW-7 or MW-8 three to four months following termination of pilot study activities. However, Cr(VI) concentrations have remained below the detection limit of 2 µg/L in both downgradient wells MW-7 and MW-8 (Antea, 2011b). The lack of detectable concentrations in downgradient monitoring wells indicate Cr(VI) is attenuating as redox conditions return to background conditions downgradient of the treatment area.

Phased Biosparge/Ozone Sparge Approach

The following provides a detailed summary of the proposed phased approach summarized above.

- Begin air injections (biosparge) into the installed sparge wells (Appendix A).
- If reductions in the concentrations of site COCs have not been demonstrated following two quarters of biosparge implementation, ozone sparging will gradually be phased in, starting at a rate of approximately 0.05 lbs/day (10-percent of ozone injection rate during pilot study implementation).
- After ozone sparging has begun, the initial startup sampling frequency will be reinstated. The system will be operated to mitigate Cr(VI) generation. If Cr(VI) is generated and persists in groundwater, ozone sparging will be stopped and if phased back in will be at lower dosing than when Cr(VI) was generated.

Chromium Contingency Plan

- If Cr(VI) persists above the environmental screening level (ESL) of 11.0 µg/L following treatment of site COCs, a soluble carbon source such as dilute molasses can be injected to promote reduction of oxidized metal species. The intent of adding an soluble carbon source would be to alter the redox conditions of the aquifer and dissolve the precipitated iron which, as discussed above, will provide assimilative capacity to treat Cr(VI).

- If chromium mitigation is necessary, a mitigation plan will be submitted, and will include details on the implementation of the technology and a proposed monitoring plan to prevent further migration of secondary impacts.

Proposed Groundwater Monitoring Plan

Prior to implementing biosparge activities, baseline groundwater samples and measurements will be collected from all site monitoring wells as proposed in the RAP.

Following biosparge system startup, dissolved oxygen (DO) will be closely measured at site monitoring wells to assess influence from nearby sparge wells. Monitors wells in which influence is observed (increases in DO of 3-4 mg/L) will be sampled for all parameters as proposed in the RAP at a frequency of weekly for the first month, monthly for the first quarter, and quarterly thereafter. Even though dissolved metal concentrations are not expected to increase using a biosparge remedy, monitoring for the full suite of parameters will continue for four quarters of sampling following implementation. At that time, sampling for metals other than those used as biogeochemical indicators (iron and manganese) will be reevaluated. The proposed schedule and parameters for groundwater sampling under both biosparging and ozone sparging conditions are included as Table 1.

Sparge Well Design

Existing sparge point (TSP-1) was constructed to a depth of 36 feet below ground surface (ft bgs) with a two-foot ceramic gas diffuser tip placed from 33 to 35 ft bgs. Ozone sparged into TSP-1 achieved limited distribution due to head loss encountered at the ceramic sparge tip. Short-circuiting of air through preferential pathways from TSP-1 likely led to observations of bubbling 20 feet away at MW-10. This observation was not indicative of influence, and cannot be correlated with a radius of influence equal to 20 feet. Other indications of influence, such as increases in dissolved oxygen, treatment of COCs and increases in dissolved chromium concentrations, were not observed until two quarterly sampling events following the ozone injection pilot study, in MW-10 directly downgradient of TSP-1. Therefore, these observations suggest groundwater influenced by the ozone pilot study has travelled downgradient from TSP-1 down to monitoring well MW-10.

Nine additional sparge wells (TSP-2 through TSP-10) will be installed at locations as proposed in the RAP using an assumed 20-foot radius of influence (Antea, 2011), but ceramic sparge tips will not be used. Influence of sparge wells around TSP-1, such as proposed wells TSP-2 through TSP-4, will be evaluated to assess the need for an additional sparge point in place of TSP-1.

Sparge wells will be constructed using one-inch diameter, schedule 80 PVC casings set in the boreholes from ground surface to their respective screened intervals. The screened intervals will be two foot-long sections of two-inch diameter, 0.010-inch slotted pipe placed approximately 35 ft bgs. A bentonite filled sock will be placed above the well screen, hydrated by groundwater, and native material will be allowed to collapse around the riser pipe and well screen in the rest of the borehole. Proposed sparge well construction details are shown on Figure 1.

This improved sparge well design will allow for easier development of wells and will reduce head loss allowing for increased distribution of injected air or ozone. The resulting increase in distribution can reduce overall remedial timeframes by allowing for increased contact with COC mass during system operation.

Certification Statement

"I certify under penalty of law that this document, including all attachments and supplemental information, was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment."

Executed on the 30 day of June at 11:00 a.m.

_________________ (Signature)

Project Manager (Title)

If you have any questions or comments regarding the contents of this document, please contact Katherine Brandt of ARCADIS at 510.596.9675 or by e-mail at katherine.brandt@arcadis-us.com.

Sincerely,

ARCADIS U.S., Inc.

Katherine Brandt

Katherine Brandt
Project Manager

Kathleen Abbott
Senior Geologist

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NO. 8622
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Copies:
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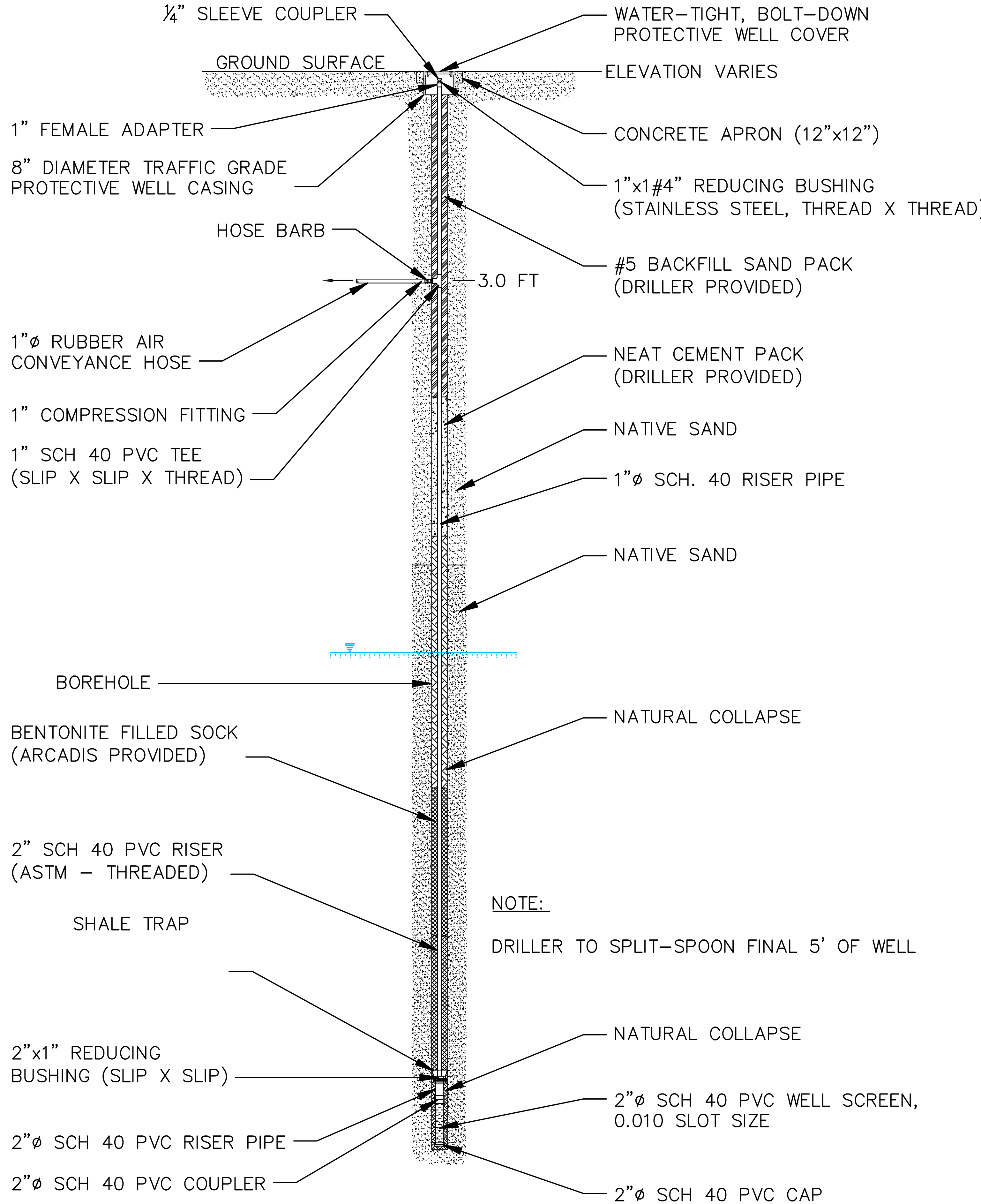
Shawn Burnell, ARCADIS
Roya Kambin, Union Oil of California

Attachments:
Figure 1 – Typical Air Sparge Well Construction Detail
Table 1 – Performance Monitoring Parameters for Biosparging and Ozone Sparging
Appendix A - Antea Group – Figure 3 – Site Plan with Current Monitoring Wells, Sparge Points and Remedial System Locations

References:

Antea, 2011a. *Remedial Action Plan*, 76 Service Station No. 0843/2349 1629 Webster Street, Alameda, CA. March 18

Antea, 2011b. *Second Quarter 2011- Quarterly Groundwater Monitoring Report*,76 Service Station #0843, 1629 Webster Street, Alameda, CA. June 10.



NOTE:

DRILLER TO SPLIT-SPOON FINAL 5' OF WELL

NOT TO SCALE

FORMER 76 SERVICE STATION NO. 0843 (2349)
1629 WEBSTER STREET
ALAMEDA, CALIFORNIA
REVISED REMEDIAL ACTION PLAN ADDENDUM

SPARGE WELL CONSTRUCTION DETAIL

ARCADIS

FIGURE
1

Table 1
Performance Monitoring Parameters for Biosparging and Ozone Sparging
Revised Remedial Action Plan Contingency Plan
Former 76 Service Station No. 0843 (2349)
1629 Webster Street, Alameda, CA

		MONITORING PARAMETERS								
Remediation Technology	**Frequency**	**Dissolved Oxygen (DO)**	**pH**	**TPH-GRO by USEPA method 8260B**	**Total and Dissolved Iron (200.7/200.8)**	**Total and Dissolved Manganese (200.7/200.8)**	**BTEX by 8260B**	**MTBE and TBA by 8260B**	**Hexavalent Chromium by USEPA 7199**	**Total Chromium by USEPA 200.8/6010B**
Biosparge	Daily during first week of injections	X								
	Varies[1]	X	X	X	X	X	X	X		
Ozone	Daily during first week of injections	X								
	Varies[1]	X	X	X	X	X	X	X	X	X

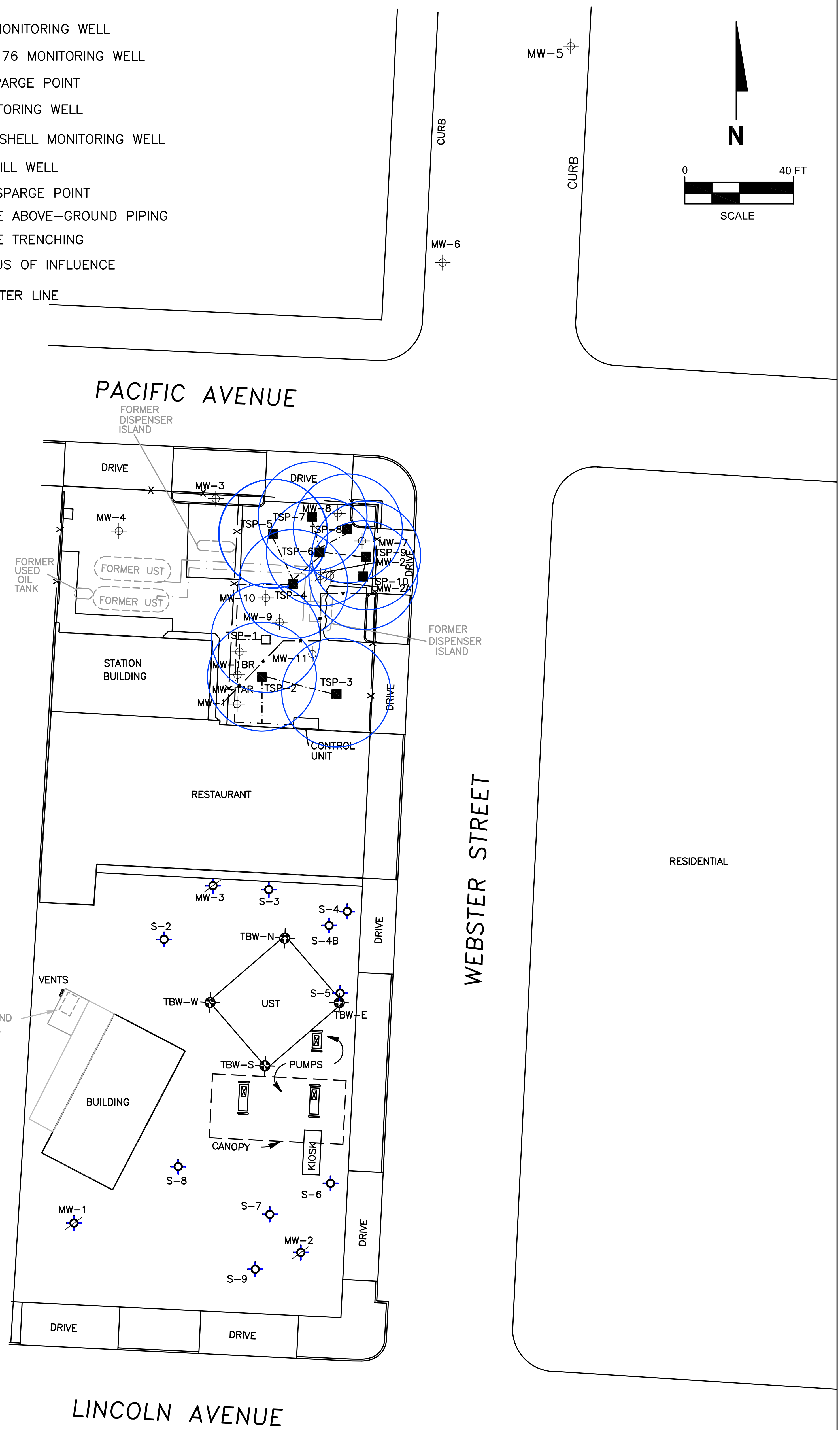
Notes:

1 Sampling frequency will vary after implementation of remedy. Sampling frequency will include weekly for the first month, monthly for the first quarter, and quarterly thereafter. Weekly and monthly sampling will only be conducted at wells in which influence is observed (increases in DO of 3-4 mg/L)

TPH-GRO	Total petroleum hydrocarbons as gasoline
BTEX	benzene, toluene, ethylbenzene, and xylenes
MTBE	methyl tert-butyl ether
TBA	tert-butyl ether

LEGEND:

- MW-1 — ACTIVE 76 MONITORING WELL
- MW-2A — ABANDONED 76 MONITORING WELL
- TSP-1 — CURRENT SPARGE POINT
- S-1 — SHELL MONITORING WELL
- MW-1 — DESTROYED SHELL MONITORING WELL
- TBW-N — TANK BACKFILL WELL
- TSP-2 — PROPOSED SPARGE POINT
- SPARGE LINE ABOVE-GROUND PIPING
- SPARGE LINE TRENCHING
- 20 FT RADIUS OF INFLUENCE
- EXISTING WATER LINE



PLAN ADAPTED FROM A SURVEY BY MORROW SURVEYING DATED FEBRUARY 2009.

FIGURE 3

SITE PLAN WITH CURRENT MONITORING WELLS, SPARGE POINTS & PROPOSED REMEDIAL SYSTEM LOCATIONS

FORMER 76 STATION NO. 0843
1629 WEBSTER ROAD
ALAMEDA, CALIFORNIA

PROJECT NO.	PREPARED BY	DRAWN BY
C102349217	AB	JH
DATE	REVIEWED BY	FILE NAME
02/25/11	JBB	76-0843-S

anteagroup