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MEMORANDUM

DRAFT INTERNAL DRAFT

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MCAS EL TORO
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SUBJECT: MCAS El Toro RI/FS
CTO #0145
Response to Department of Toxic Substances Control Letter dated 27 August 1993 on Recommended Groundwater Sampling Procedures

This memorandum responds to the 27 August 1993 letter from Joe Zarnoch/California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) to Mr. Andy Piszkin/SOUTHWESTDIV. Mr. Zarnoch's letter comments on the impacts of submersible pumps and groundwater sampling procedures on sample quality during the second round of groundwater sampling at MCAS El Toro.

The memorandum summarizes the rationale for pumps selected during the Phase I RI field investigation, provides rationale for the use of 4-inch-diameter submersible pumps at specific locations, and provides recommendations to remedy the problem of air entrainment in groundwater samples at MCAS El Toro.

DTSC RECOMMENDATIONS

DTSC's letter recommends the following procedures for use in future groundwater sampling at MCAS El Toro.

1. Field blanks should be used as a check on ambient airborne contamination for those wells located at or near tarmacs with significant jet traffic.

2. The purge line should be closed during actual sampling of wells equipped with Grundfos 2-inch-diameter variable speed pumps.

3. For 4-inch-diameter constant speed pumps, the purge line valve should remain open during actual sampling to minimize aeration of the sample.

4. The 4-inch-diameter constant speed pumps should be replaced with 2-inch variable speed pumps. As an option, DTSC recommends a site-specific comparison to determine the degree of variation in VOC concentrations between the pump types. DTSC is concerned that the pumping rates obtained with the 4-inch submersible pumps results in entrained air in the groundwater sample, thus compromising the VOC analysis.

The Navy generally concurs with the first three recommendations.

- At well locations where jets are actively taxiing near a well, ambient field blanks will be collected.

- If possible, when sampling for volatile organic compounds (VOCs) with a 2-inch variable speed pump, the purge line will be closed. An exception would be if the discharge rate can not be adequately reduced by the speed control on the pump controller for sampling. Under these circumstances, water should flow from the purge line to ensure no backflushing or siphoning.

- For 4-inch pumps, if adequate head can be maintained above the pump, the purge line valve will remain open during actual sampling in an attempt to reduce aeration.

The remainder of this memorandum addresses Recommendation Number 4. Based on several lines of evidence, it is believed that the use of 4-inch-diameter pumps is appropriate for groundwater sampling at MCAS El Toro.

FACTORS SUPPORTING THE USE OF 4-INCH PUMPS

Concern has been expressed that 4-inch constant speed pumps may cause air bubbles in groundwater samples. Four lines of evidence that support the use of 4-inch-diameter pumps at MCAS El Toro are listed below:

1. Pump capabilities and limitations

2. Review of technical literature comparing the results of different sampling equipment

3. Poor correlation of entrained air in Phase I RI groundwater samples with pump type

Pump Capabilities

As stated above, DTSC suggests replacing the 4-inch constant speed pumps with 2-inch

variable speed pumps to reduce air bubbles in samples. However, 2-inch-diameter pumps do not provide enough lift to pump most of the wells installed with 4-inch-diameter pumps. Pump selection at MCAS El Toro was reexamined to evaluate which 4-inch pumps could potentially be replaced by 2-inch pumps. Factors considered for selecting the pump for each well were the depth to water, the well yield and drawdown observed during development, the maximum available drawdown, pipe friction head loss, and the purge volume required prior to sampling.

The following table summarizes the rationale for selection of each of the three pump types installed in monitoring wells during the Phase I RI field investigation:

PUMP	RATIONALE
4-inch-diameter 11-stage	Installed where relatively high purge volumes (up to 350 gallons) and lift distances in excess of 200 feet were required. Maximum pumping rate is 10 gpm at 200 feet of head.
4-inch-diameter 18-stage (high head)	Selected where pumping heads exceeded 300 feet or heads exceeded 200 feet with a flow rate of greater than 5 gpm. Pumping rate is 5 gpm at 300 feet of head.
Redi-Flo2	Selected in cases where pumping heads were less than 200 ft or pumping heads were less than 250 feet and pumping rates were less than about 0.5 gpm.

Phase I RI monitoring well and pump information is summarized in Table 1. Information includes well number, RI site, pump type, well depth, depth to water, pump intake depth, whether or not a packer is installed, approximate purge volumes, and pump selection comments. The monitoring wells were sorted by type of pump installed. Pumps were installed in 89 of the 93 monitoring wells (the 4 wells without pumps are multi-port wells). Of the 89 wells with pumps, 52 were equipped with Redi-Flo2 pumps; 12 were equipped with 4-inch, 18-stage pumps (high head); and 25 were equipped with 4-inch, 11-stage pumps. The locations of wells equipped with 4-inch pumps are displayed on Plate 1.

For each pump type, the wells were sorted by pump depth to reevaluate the pumping head requirements for each well. Based on the lift capabilities of 2-inch pumps (generally less than 200 feet), eight wells with 4-inch pumps (all are 11-stage) could potentially be replaced by 2-inch pumps (18_BGMW101, 18_BGMW05D, 12_UGMW31, 18_BGMW23, 09_DGMW75, 10_DGMW77, 18_BGMW19D, and 07_DBMW100). At

all other locations, a 4-inch pump is required to obtain samples, since the depth to water exceeds 200 feet.

Literature Review of Sample Collection Devices

In our review of the literature, the selection of Grundfos 4-inch submersible pumps is believed to be appropriate for use at MCAS El Toro. Several available journal articles (attached) indicate that submersible, constant speed pumps produce statistically accurate data for inorganic, organic, and VOC constituents in groundwater which are comparable to that obtained with other pump types. According to an EPA study (Yeskis, and others, 1988), the use of submersible pumps provided statistically higher and more consistent values of VOCs than bailers. There is also evidence that a high purge rate (i.e. about 10 gpm) provides more representative samples than lower purge rates (i.e. about 1 gpm) (Imbrigiotta, and others, 1988).

Correlation of Entrained Air and Pump Type

Entrained air was observed and noted in groundwater samples from 6 of the 119 wells sampled during the second round of groundwater sampling (includes wells installed prior to the Phase I RI field work). Entrained air was observed in groundwater from both 2-inch and 4-inch pumps. The presence of entrained air was not correlated with the 4-inch pumps.

Of the six wells, two were from monitoring wells with a 4-inch-diameter 18-stage pumps (03_BGMW26 and 18_BGMW01C), one was from a monitoring well with a 4-inch-diameter 11-stage pump (18_BGMW19B), and three were from monitoring wells with 2-inch-diameter pumps (18_PS3, 18_PS4, and 07_DBMW70). Monitoring wells 18_PS3 and 18_PS4 utilized temporary 2-inch pumps for purging and sampling.

Potential Factors Contributing to the Presence of Air Bubbles in Groundwater Samples

Potential factors contributing to the presence of air bubbles include:

- Air entrainment from backflow of water from the pump water column
- Sampling discharge turbulence
- Pumping water level too near the pump intake
- Cavitation during pumping due to excessive impeller pressures and

velocities

- The production of formation gases in the subsurface

Air entrainment due to the backflow of water from the pump water column is not likely, since all of the installed pumps have check valves.

Sampling discharge turbulence is minimized for the 2-inch diameter pumps by reducing the pumping rate to the minimum required. This is accomplished by reducing the pump speed. Nonetheless, very large speeds are required for the depths approaching 200 feet. At maximum speed, the 2-inch pumps are rotating at 23,000 rpm.

Sampling discharge turbulence for the 4-inch-diameter pumps is reduced by the use of EPA-approved stainless steel wellhead completions that include separate 1-inch discharge valves for purge water and 1/4-inch sampling valves that allow a sampling stream with a low fluid velocity.

A pumping water level too near the pump intake may potentially result in air entrainment by vortexing of air bubbles down the well, cascading of groundwater into the well, or reduction of the submergence head of the pump that may lead to cavitation. Pumping levels in future sampling activities will be closely monitored to evaluate if higher pumping water levels can reduce entrainment.

Cavitation occurs in a pump when the pressure of the water inside the pump falls below the vapor pressure and the liquid begins to vaporize. According to discussions with technicians at Grundfos Pump Corporation, it is unlikely that pump cavitation would occur under the circumstances present at the site.

Although formation gasses were observed during video logging of some wells, the gases do to not appear to be the source of entrained air in groundwater samples. During video logging of some wells, gas bubbles were observed emanating from some screened intervals or attached to well screens. There is, however, no correlation between the monitoring wells showing gas bubbles during video logging and those exhibiting entrained air during sampling. Of the 14 Phase I RI wells that were video logged, four (18_BGMW07, 05_UGMW27, 18_BGMP08, and 22_DBMW47) exhibited gas bubbles attached to the well screens. The gas bubbles were observed after development and are believed to emanate from the formation.

SUMMARY AND RECOMMENDATIONS

It is not clear if the use of 4-inch-diameter pumps is the cause of air bubbles in groundwater samples. However, DTSC has suggested replacing the 4-inch constant speed pumps with 2-inch variable speed pumps to reduce air bubbles in samples. Based on the lift capabilities of 2-inch pumps, eight wells presently equipped with 4-inch-diameter, 11-stage pumps could be replaced by 2-inch pumps (18_BGMW101, 18_BGMW05D, 12_UGMW31, 18_BGMW23, 09_DGMW75, 10_DGMW77, 18_BGMW19D, and 07_DBMW100).

It is recommended that a survey of these 8 wells for the presence of entrained air in discharge water be conducted. The survey would consist of a brief period of pump operation when the discharge water is observed for the presence of entrained air. If bubbles are present, the field personnel will vary the discharge rate and pumping water level to attempt to eliminate the air entrainment. If the bubbles can not be eliminated, a subcontractor will be hired to pull the riser pipe and pump out of the well. A temporary Redi-flo2 pump will be used for future groundwater samples.

Note that several of the eight identified wells (particularly 09_DBMW45 and 10_DGMW77) could potentially be used as extraction wells. If the 4-inch pumps are pulled for monitoring purposes, the 4-inch pumps may need to be reinstalled at a later date for remediation. The 4-inch pumps could also be used for Phase II RI monitoring wells where the depth to water exceeds 200 feet.