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MISCELLANEOUS MEMOS INCLUDING INORGANICS IN GROUNDWATER DATED 28 MAY
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ENSAFE

MISCELLANEOUS MEMOS

PART X
ADDENDUM
BINDER 3



M e m o r a n d u m

INORGANICS IN GROUNDWATER

1.0 Introduction

Various inorganics in groundwater at the Charleston Naval Complex (CNC) have proven to be problematic with respect to detected concentrations from one or more sampling events exceeding maximum contaminant levels (MCLs). Identifying the source of these inorganics is complicated by the fact that a large portion of CNC was marsh that has been filled with dredge spoil and subsequently developed. Many of the shallow monitoring wells at CNC are screened in these sediments and it is unclear what contribution these materials have made to the inorganic concentrations which exceed MCLs. Background levels were established during the RFI on a zone by zone basis in an effort to differentiate between ambient conditions and site specific impacts. The calculated background values are a valuable tool in helping make this distinction but in some instances the values raised additional questions because the geographic boundaries of fill areas versus non-fill areas was not considered. The only consideration given to geographic areas were the zone boundaries that were established as a management tool for the RFI. As a result background values vary from zone to zone and, in several instances, the background concentrations for various metals exceed MCLs. Rather than continuing to solely evaluate groundwater on a zone by zone basis, the Project Team agreed it would be prudent to perform a "base wide evaluation" of the groundwater data with the purpose of trying to identify trends in groundwater quality that would further help differentiate between ambient conditions and site specific impacts. The process for conducting the base wide evaluation, which is outlined below, was discussed by team members at a meeting on 29 October 1998 at SCDHEC's office in Columbia, SC.

2.0 Groundwater Sampling

The initial step of the evaluation was designed to assess the representativeness of the data collected over previous quarters of sampling. An overall review of the data revealed inconsistencies in the inorganic sample results over time and few instances where the results exceeded MCLs consistently over all quarters of sampling. Possible causes of this can be well construction (this term will be used generically to refer to everything from the physical construction of the well to well development), sampling techniques, temporal variations (for some wells in this study the time difference between the first sampling event and the most recent is nearly 3.5 years), and analytical methods. To assess potential biases introduced by well construction and sampling techniques, the Project Team agreed to select at least 15 wells which had been singled out during the RFI process as potentially problematic and re-sample them. A total of 26 wells were sampled including several

wells that well being evaluated in the CMS even though inorganics detected at those locations did not exceed MCLs. The wells selected are illustrated in Figure 1 (Attachment A contains all figures) and are listed in Table 1 along with a brief explanation of why each was chosen. Also included are the metals study results tables and the groundwater sampling forms.

Table 1
Selection Criteria for Monitoring Wells
Selected for the Base Wide Evaluation

Zone C	
044-001	Antimony, beryllium, and thallium routinely exceeded MCLs
044-007	Antimony and arsenic frequently exceeded MCLs
047-001	Elevated lead detection in first round of sampling
047-011	Arsenic frequently exceeded MCL
Zone E	
070-01D	Antimony, chromium, and thallium routinely exceeded MCLs
549-003	Chromium routinely exceeded MCL
GDE-09D	Arsenic routinely exceeded MCL
Zone G	
FDS-16B	Arsenic routinely exceeded MCL
FDS-17B	Arsenic routinely exceeded MCL
Zone H	
653-003	Arsenic concerns prior to interim measure
655-001	CMS site due to SCDHEC concerns about arsenic
655-002	CMS site due to SCDHEC concerns about arsenic
655-003	CMS site due to SCDHEC concerns about arsenic
656-001	Single detection of thallium exceeded MCL
GDH-003	Arsenic concerns due to proximity to AOC 653
GDH-03D	Arsenic concerns due to proximity to AOC 653
GDH-006	Arsenic and thallium detected at varying concentrations
GDH-06D	Deep well paired with GDH-006
Zone I	

Table 1
Selection Criteria for Monitoring Wells
Selected for the Base Wide Evaluation

012-002	Arsenic routinely exceeded MCL
671-003	Mercury and thallium detections in third round of sampling
GDI-17D	Thallium occasionally exceeded MCL
GDI-18D	Thallium occasionally exceeded MCL
Zone K	
694-005	Interest was dioxins which are not addressed in this memo
694-006	Interest was dioxins which are not addressed in this memo
694-007	Interest was dioxins which are not addressed in this memo
GDK-CL1	Interest was dioxins which are not addressed in this memo

One of the biggest challenges the project team has faced in trying to make decisions regarding the concentrations of inorganics in groundwater is dealing with variability in the data sets. It is beyond the scope of this study to assess the potential effects of all the sources of variability mentioned earlier, but it was necessary to reduce or eliminate the amount of variability associated with sampling methodology. The project team agreed that sampling using a low flow or low stress method (minimal draw down) was the most appropriate means of collecting groundwater samples to be analyzed for inorganics. Documents used as guidance for designing this sampling event were *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, Revision 2* (EPA Region 1, July 30, 1996), *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, (EPA Ground Water Issue, April 1996). The low flow method is very similar to the one currently described in the *Comprehensive Sampling and Analysis Plan* (CSAP) except the plan does not explicitly state the pumping rate should not exceed the recharge rate of the aquifer which will result in excessive draw down. Low flow purging is generally considered anything less than 0.5 L/min. For this study the purge rates typically averaged around 0.3 L/min. Certain hydrogeologic conditions may make a low flow method difficult to use but the method was followed as closely as possible at each well so that all the samples were collected in essentially the same manner. As an added measure of consistency only one sampling crew was used to collect samples during this study. Even though all sampling crews should have followed the same written procedures provided in the CSAP, it is unlikely that every well was sampled in exactly the same manner particularly when it comes to pumping/purge rates.

Unfiltered samples were collected with analyses being performed for antimony, arsenic, beryllium, chromium, lead, mercury, thallium, and total suspended solids (TSS). Additionally, a sample split

was collected and filtered in the field using a 0.45 micron filter with similar analyses performed with the exception of TSS. Although it is debatable whether comparing filtered and unfiltered samples provides a accurate, quantitative measure of total versus dissolved metals in groundwater, the procedure is a very good qualitative means of determining if artifacts are present as a result of well construction or sampling methods.

3.0 Data Evaluation

Since the primary purpose of this evaluation is to qualitatively assess the prevalence of various inorganics across the base, the frequency of detection for the various inorganics from all rounds of sampling preceding the low flow sampling event has been compared to the frequency of detection observed in the data set for the low flow sampling event. Data from individual wells was further evaluated in accordance with a set of decision rules designed to help the project team overcome difficulties associated with variability in the data sets. The decision rules that follow were originally developed by members of the Project Team in attendance at the October meeting.

1. Compare the unfiltered versus filtered results.
 - A. If the sample results are similar a "problem" exists. Proceed to Step 2. (Note that the term problem was simply intended to refer to the fact that inorganics are present at levels which exceed reference levels such as MCLs)
 - B. If the sample results are significantly different, the problem may be associated with suspended solids. Both the unfiltered and filtered results are to be compared to MCLs. Project team needs to make a risk management decision.

2. Perform a GIS analysis to evaluate spatial distribution/correlation.
 - A. If there is a clear correlation to a SWMU or AOC the problem must be addressed.
 - B. If there is not a clear correlation to a SWMU or AOC the Project Team needs to make a risk management decision.

After collecting the data and beginning the evaluation process, it became apparent that the decision rules which applied simply to the comparison of unfiltered and filtered results did not account for potential differences in the data set resulting from the sampling technique used during the most recent event versus previous rounds of sampling. For purposes of this memo the decision rules previously agreed upon have been modified as follows to allow a more thorough examination of the data over time.

- I. Evaluate trends in the data set for each well over all rounds of sampling.
 - A. If the sample results are similar over time, including the final event using the low flow sampling, then compare the unfiltered vs. filtered results.

1. If the unfiltered vs. filtered results are similar then all samples are considered to be representative of ambient conditions and the results from this most recent round of sampling should be compared to MCLs.

a. If the concentrations from one or more sampling events exceed MCLs a “problem” exists and the evaluation should proceed to Step II below. Note that the term problem was simply intended to refer to the fact that inorganics are present at levels which exceed MCLs and Step II will help determine a probable source which could be anthropogenic or it could be naturally occurring.

b. If the concentrations do not exceed MCLs no further evaluation is required.

2. If the unfiltered vs. filtered results are appreciably different, the problem may be associated with suspended solids and the unfiltered sample is likely not indicative of ambient conditions. Both the unfiltered and filtered results are to be compared to MCLs.

a. If both concentrations exceed MCLs a “problem” may exist but additional sampling should be considered before proceeding to Step II because of the question of sample representativeness.

b. If the filtered results are less than MCLs the Project Team needs to make a risk management decision.

c. If neither result exceeds MCLs, no further evaluation is required.

B. If the sample results are similar or decrease over time with the addition of a notable decrease during the final sampling event then compare the unfiltered vs. filtered results.

1. If the unfiltered vs. filtered results are similar then only the final samples are to be considered the most representative of ambient conditions. Both the unfiltered and filtered results should be compared to MCLs.

a. If the concentrations exceed MCLs then the data from surrounding wells should be reviewed. If other MCL exceedances are noted then additional sampling of wells in close proximity may be warranted so a comparable data set is attained prior to making a risk management decision or performing a GIS evaluation.

b. If concentrations are less than MCLs no further evaluation is required.

2. If the unfiltered vs. filtered results are appreciably different, the problem may be associated with suspended solids and the unfiltered sample is likely not indicative of ambient conditions. The unfiltered results from the final round of sampling should still be considered more reliable than previous rounds of sampling

and closer to representing ambient conditions Both the unfiltered and filtered results are to be compared to MCLs.

a. If either the unfiltered or both concentrations exceed MCLs, then the data from surrounding wells should be reviewed. If other MCL exceedances are noted then additional sampling of wells in close proximity may be warranted so a comparable data set is attained prior to making a risk management decision or performing a GIS evaluation.

b. If neither result exceeds MCLs, a risk management decision for no further evaluation may be appropriate. In some instances where results from one or more previous rounds of sampling exceed MCLs, an additional sampling event using the low flow method may be appropriate to verify a problem does not exist.

II. Perform a GIS analysis to evaluate spatial distribution/correlation.

A. If there is a clear correlation to a SWMU or AOC the problem must be addressed.

B. If there is not a clear correlation to a SWMU or AOC the Project Team needs to make a risk management decision.

4.0 Results

The discussions presented in this section focus primarily on the sampling results at individual monitoring wells where inorganic concentrations exceeded a MCL during one or more quarters of samples. Two basic evaluations were performed during this study. Trends in the analytical results were reviewed and field sampling logs were evaluated to help make a qualitative determination regarding sample representativeness. Attachment B contains the analytical data summary tables for each of the wells included in the study and Attachment C contains the field sampling forms.

4.1 Antimony

- Preceding the low flow sampling event, antimony was detected in samples from 8 of the 26 well locations included in this study.
- Antimony concentrations exceeded the MCL of 6 $\mu\text{g/L}$ during one or more sampling events at 4 of the 8 monitoring wells with detections.
- Using the low flow sampling method antimony was only detected in the unfiltered sample from 2 of the 26 well locations.
- Neither of the detections exceeded the MCL and the filtered samples were non-detect.

044-007

The concentrations of antimony have varied erratically from non-detect to levels 8 times the MCL. The antimony results should be used with discretion since, with the exception of the second sampling event, the detected concentrations are all estimated values which limits the value of attempting to quantitatively compare the results to those from other wells in this particular

evaluation. The field notes for each of the sampling events were reviewed in an effort to subjectively determine whether or not sampling methods may have influenced the results. Draw down for each of the 6 rounds of sampling ranged from 0.1 to approximately 7 feet indicating that the pumping rates during the various sampling events were not consistent. Water quality parameters measured to assess stability did not seem to be greatly affected regardless of the pumping rate so it is difficult to say sampling methodology is solely responsible for the variations. Groundwater quality parameters achieved stability during the most recent sampling event but turbidity exceeded the optimum sampling level of ≤ 10 NTU. The results for TSS were non-detect so the slightly elevated turbidity reading is considered insignificant. Antimony was detected at $3.4 \mu\text{g/l}$ in the unfiltered sample but was not detected in the filtered sample. For practical purposes the values are essentially equal when considering the analytical method has an acceptable error range of $\pm 15\%$. The samples collected under controlled conditions during the final sample event are believed to be the most representative of ambient conditions and indicate that antimony is not a concern at this location even though the former coal pile is a potential source of inorganics. No further evaluation for antimony is recommended at this location.

047-001

Antimony was only detected in well number 047-001 above the MCL during the first sampling event and it was not detected in the remaining five rounds which includes both the unfiltered and filtered samples collected during the low flow sampling event. The complete absence of antimony over five consecutive sampling events since January 1996 provides compelling evidence that the first round results are simply an anomaly and not representative of ambient conditions. The exact cause of the anomalous value will likely never be determined but a plausible explanation is the sample may have been biased by artifacts created during the subsurface disturbances caused by the drilling process. Regardless of the cause of the elevated concentration in the first round, the results have been remarkably consistent after that time and there is no apparent need for further evaluation of antimony at this location.

070-01D

Antimony concentrations were relatively consistent during 3 of the 4 sampling events performed between April 1996 and February 1997 ranging from 115 to $209 \mu\text{g/l}$. The lone exception was the December 1996 sampling event during which antimony was not detected. During the most recent sampling event in January 1999 antimony was detected in the unfiltered sample at $2.8 \mu\text{g/l}$ ("J" flagged as estimated) and was not detected in the filtered. The unfiltered vs. filtered results are not considered significantly different simply because the value for the unfiltered detection was essentially equal to the quantitation limit for the filtered sample. Groundwater stability parameters were reviewed for all rounds to determine if the sampling method could be a reason for the differences in concentrations over time. The parameters were remarkably comparable over time and the pumping rate/draw down during the low flow sampling event were not significantly different from the previous rounds of sampling. The reason for the substantial decrease in concentration during the final sampling event is not readily apparent in the information reviewed for this evaluation. Other inorganics exhibited a similar decrease in concentration as well. A

comparison of antimony results in well 070-01D to surrounding wells was not made since the results from the most recent round did not exceed the MCL and the result differed significantly from previous rounds. This study indicates that proper sampling technique may eliminate antimony as a concern but one additional round of sampling is recommended prior to ruling it out as a COC since it was detected relatively consistently at concentrations 50-100 times the MCL prior to this sampling event and SWMU 70 (a former dip tank used for treating wood with a fire retardant) may be an anthropogenic source of elevated concentrations of other inorganics evaluated in this study.

549-003

Antimony was detected at 549-003 once (7.7 $\mu\text{g/l}$ in April 1996) and that one detection happened to exceed the MCL. The quantitation limits used during two rounds of sampling exceeded the MCL but that does not affect the usability of the data since the method detection limits (MDLs) are typically around 10 times less than the quantitation limit. In both cases this would have resulted in a sufficiently low method detection limit to identify the presence of antimony with an estimated concentration. Antimony was not detected in either the unfiltered or filtered sample during the low flow sampling event. The results at this location are similar to 047-001 above and there is no apparent need for further evaluation of antimony at this location since the results have been remarkably consistent over time.

Conclusions

There is no reason to believe a widespread problem with antimony in groundwater exists based on the results this evaluation. The frequency of detection was sufficiently low that it would probably be more practical to evaluate antimony detections on a case by case basis rather than proceed with additional study to attempt to justify its presence across the base. The results of this study preliminarily indicate that the detections of antimony at concentrations above the MCL are most likely an artifact of the sampling methodology.

4.2 Arsenic

- Preceding the low flow sampling event, arsenic was detected in samples from 23 of the 26 well locations included in this study.
- Arsenic concentrations exceeded the MCL of 50 $\mu\text{g/L}$ during one or more sampling events at 6 of the 23 monitoring wells with detections.
- Using the low flow sampling method arsenic was detected in the unfiltered sample from 16 of the 26 locations.
- Concentrations of arsenic in the unfiltered samples exceeded the MCL at 3 of the 16 locations. Arsenic concentrations in the filtered samples from each of the 3 locations also exceeded the MCL.

044-007

Similar to the antimony concentrations at this well location, the arsenic concentrations have also varied somewhat erratically which may be attributable to the inconsistent pumping rates mentioned

earlier. Arsenic exceeded the MCL during 2 of the 5 sampling events prior to the round in which the low flow method was used. Concentrations from the low flow samples did not exceed the MCL and the unfiltered/filtered results are within the analytical method acceptable error range of $\pm 15\%$ so the results are considered equal for purposes of this evaluation. A comparison to the background reference value (BRV) revealed that concentrations from all 6 rounds exceeded the BRV suggesting that the arsenic is a "problem". However, the appropriateness of using the BRV to help determine whether or not arsenic is a problem at this location is questionable. The reason for this statement being the BRV was determined using only 2 grid well locations in Zone C. Neither of these locations is in an area that was identified as being hydraulically filled during development of the base. Monitoring well 044-007 is in an area that was filled. The surrounding wells (Figure 2) at SWMU 44 do not indicate that a widespread problem with arsenic exists and the most recent results from 044-007 indicate arsenic is not a concern at that particular location. Because the results have varied with time it is probably appropriate to review an additional round of sample results prior to making a risk management decision with respect to arsenic in groundwater. The additional round of samples are already being collected as part of the CMS and it is recommended that the samples be collected using a low flow method.

047-011

Arsenic was the only inorganic at well number 047-011 with concentrations detected above the MCL during one or more rounds of sampling. The arsenic concentration routinely exceeded the MCL during the 2nd through 4th rounds of sampling and the concentrations remained relatively constant. A notable decline in concentration is evident in the most recent round of sampling using the low flow method raising the possibility that the results from previous rounds of sampling may not have been indicative of ambient conditions. A comparison of the unfiltered vs. filtered results for the 5th round revealed a noteworthy ($\geq 15\%$) difference in the two further suggesting that the unfiltered results from the 5th round may not be truly indicative of ambient conditions either. The TSS concentration was non-detect but the final turbidity reading recorded prior to collecting the sample showed a turbidity level of 29 NTU which slightly exceeds the optimum level of ≤ 10 NTU leaving open the possibility suspended solids had some effect on the unfiltered sample analysis. A review of the other water quality indicator parameters showed that stability was achieved and that results from the unfiltered sample should be more reliable than previous rounds of sampling because of the controlled conditions under which the sample was collected. Since both the unfiltered and filtered results from the 5th round do not exceed the MCL there is a strong possibility that a problem with arsenic in groundwater does not exist at this location. An additional round of sampling under controlled conditions is recommended to determine if the results of the 5th round can be repeated. If the results are repeated then arsenic in groundwater should be dismissed as a concern at this location.

GDE-09D

Arsenic was detected in all sampling rounds including the filtered and unfiltered low flow sampling event with results routinely exceeding the MCL in all rounds and the concentrations remaining relatively constant. A comparison of the unfiltered and filtered sample results indicates

that for practical purposes the values are essentially equal, especially when considering the analytical method has an acceptable error range of $\pm 15\%$. Groundwater quality parameters were stabilized prior to sampling during the first four sampling events with final turbidity readings taken within the optimum range of ≤ 10 NTU. The fifth sampling event, however, produced a final turbidity value of 50 NTU with a TSS value of 27 mg/l. This evidence of additional suspended solids does not appear to affect the arsenic concentrations detected in the unfiltered sample from the final sampling event when compared to other arsenic concentrations. Based on these facts and the decision rule criteria, a "problem" exists for arsenic since the results for the final round exceed the MCL.

A preliminary GIS evaluation was performed for both shallow and deep monitoring wells in the vicinity of GDE-09D (Figure 3). Groundwater from this well flows north to the Cooper River. The nearest deep monitoring well down gradient along this flowpath is 583-02D which is 743 feet north-northwest of the site. Arsenic was not detected above its MCL in any of the four sampling events conducted at this well with detected concentrations ranging from non-detect to 16.5 $\mu\text{g/l}$. Two deep wells to the northwest of GDE-09D, 145-01D (786 feet) and 580-01D (11,143 feet) did exhibit detected concentrations of arsenic exceeding MCLs (98.6 and 84.4- 110. mg/l respectively) but these locations are parallel to the expected groundwater flow path from GDE-09D and would not be influenced by arsenic contamination found there. The upgradient deep well GDE-08D, southeast of GDE-09D, had only one detected arsenic concentration which was below the MCL.

There are no down gradient shallow wells of GDE-09D that have arsenic concentrations that exceed the MCL. One shallow upgradient well in the vicinity of GDE-09D, GDE-008, had detected concentrations of arsenic ranging from 17.3-160. $\mu\text{g/l}$, with three of the four rounds exceeding its MCL. There is no clear correlation between GDE-09D and another SWMU or AOC, therefore, based on the criteria rules the Project Team needs to make a risk management decision.

FDS-16B

Arsenic concentrations at FDS-16B exceeded the MCL in all rounds except the first. The filtered and unfiltered sample results in the low flow rate sampling event are virtually equal (considering the $\pm 15\%$ analytical method error) and are slightly less than the high of 254 $\mu\text{g/L}$ in April 1998. Ground water quality parameters taken in the final round show turbidity readings at 3 NTU and the low flow rate of 0.38 L/min before the sample was taken. It is unclear why the TSS results were 92 mg/L since the stability measurements indicated that the sample should be representative of ambient conditions. As a comparison, second round quality parameters showed turbidity readings at 9 NTU and a low flow rate of .19 L/min but the arsenic concentration still exceeded the MCL. Because the results over time are remarkable consistent with the sample collected from well FDS-16B under controlled conditions, arsenic remains concern in this area.

A GIS review of adjacent wells to FDS-16B (Figure 4) show a shallow and deep well pair down gradient at GDE-008 with arsenic detections exceeding the MCL in the shallow well three out of

four rounds of sampling. There are no upgradient wells adjacent to FDS-16B. Wells SME-001 and 008 have flowpaths that go to the southeast away from FDS-16B. It is evident that the arsenic results from FDS-16B are higher than at GDE-008 and groundwater flow from FDS-16B may influence the results at GDE-008. This particular area should be discussed by the project team to determine an acceptable approach to dealing with this apparent problem that does not have a readily identifiable source.

FDS-17B

Arsenic concentrations at FDS-17B exceeded the MCL in all rounds including the filtered and unfiltered low flow sampling event. Quality assurance outliers were noted in the January 1999 final sampling results which led to the "J" qualifier being added to the filtered and unfiltered results. Arsenic concentrations actually increased from 51.5 $\mu\text{g/L}$ in the first round to 63.0 $\mu\text{g/L}$ in the final round sample. A comparison of the unfiltered and filtered sample results indicates that for practical purposes the values are essentially equal. A comparison of groundwater quality parameters from the final round to the previous rounds show results to be virtually the same meaning the controlled sampling conditions during the final round were representative to ambient conditions present in groundwater in other rounds. The arsenic results at FDS-17B appear to be a "problem".

A GIS evaluation of Figure 4 shows upgradient shallow well GEL-014 had two arsenic detections that exceeded the MCL. The nearest downgradient shallow well at GDE-003, next to the Cooper River, also had two arsenic detections that exceeded MCL. Well FDS-17B also happens to be in the same general geographic area as FDS-16B discussed above and it is recommended that the project team discuss the arsenic problem found in these wells concurrently since the concerns may be related.

012-002

Arsenic concentrations for the first four rounds exceeded the MCL but for the filtered and unfiltered low flow rate sampling round the results were below the MCL. Quality assurance outliers were noted in the September 1996 and January 1999 final sampling results which led to the "J" qualifier being added to the results. Arsenic concentrations had a five fold decrease between the fourth (253 $\mu\text{g/L}$) and final rounds (40.7 $\mu\text{g/L}$). A comparison of the unfiltered and filtered sample results indicates the values are essentially equal. Groundwater quality parameters for the final round show that the draw down (0.83 ft), low flow rate (0.37 L/min), and turbidity readings (2 NTU) were at their lowest when compared to other rounds. Low flow rates for other rounds ranged between 0.54 - .95 L/min with draw down ranging between 1.7 to 3.69 ft. Due to the fact that the filtered and unfiltered sample results are equal and below the MCL and seeing that the controlled sampling conditions were at the optimal ranges, the final round sample results are considered the most representative of ambient conditions. Therefore no further evaluation is necessary.

Conclusions

Arsenic can be found widespread in groundwater across as evidenced by the high frequency of detection in the unfiltered samples collected using the low flow method. The low frequency of detections at concentrations above the MCL suggests that, while it is expected to be present at many locations, arsenic isn't a problem except in localized areas. The results of this study suggest that simply using a low flow method of sampling to help ensure representative samples are collected will eliminate some of the problems since concentrations at 3 of the 6 problem wells were reduced to below the MCL. Because the frequency of detection above the MCL is so low it would probably be easier for the project team to address the significance of these localized areas on a case by case basis rather than proceed with a base wide study. It is recommended that the low flow sampling technique be used for any future sampling of wells FDS-16B, FDS-17B, and GDE-09D.

4.3 Beryllium

- Preceding the low flow sampling event, beryllium was detected in 10 of 26 samples from well locations included in this study.
- Beryllium concentrations exceeded the MCL of 4 $\mu\text{g/L}$ during one or more sampling events at 1 of the 10 monitoring wells with detections.
- Using the low flow sampling method beryllium was detected in the unfiltered sample from 5 of the 26 locations.
- Concentrations of arsenic in the unfiltered samples only exceeded the MCL at 1 of the 5 locations. Beryllium concentrations in the filtered sample from that one location also exceeded the MCL.

044-001

Beryllium detections remained relatively similar over the four rounds of sampling performed from June 1995 to July 1997. A noticeable decline in beryllium concentrations occurred during the latest round of sampling using the low flow sampling technique. A comparison of the unfiltered and filtered sample results shows the values are essentially equal, considering the analytical method has a method error range of $\pm 15\%$. Groundwater samples collected during the recent sampling event are representative of ambient groundwater conditions because the unfiltered vs. filtered results are similar, TSS were not detected, and field sampling notes indicate groundwater quality parameters were stabilized prior to sampling. Based on the decision rule criteria, beryllium should be regarded as a possible concern since the results from the final round are believed to be from a representative sample yet the MCL was still exceeded.

A comparison of the recent results from 044-001 to data from previous rounds of sampling at other nearby wells at the site to evaluate spatial distribution does not appear to be appropriate. The reason for this is the observed difference between the most recent samples from 044-001 and previous sampling events. If the basic assumption is made that the difference in results is attributed to the difference in sampling method, then one would have to assume that the results in surrounding wells may decrease as well under the more controlled sampling conditions. Other

potential sources of variability which also make this comparison inappropriate were mentioned earlier and should be considered in the planning of any future work.

Conclusions

Beryllium is a potential concern in the area of SWMU 44 which may be a source. Since SWMU 44 is undergoing a CMS and groundwater sampling is being performed anyway, at least one round of additional samples from all the wells at SWMU 44 analyzed for beryllium appears prudent to evaluate whether SWMU 44 is a likely source or if this is a localized anomaly.

3.4 Chromium

- Preceding the low flow sampling event, chromium was detected in samples from 19 of the 26 well locations included in this study.
- Chromium concentrations exceeded the MCL of 100 $\mu\text{g/L}$ during one or more sampling events at 2 of the 19 monitoring wells with detections.
- Using the low flow sampling method chromium was detected in the unfiltered sample from 11 of the 26 locations.
- Concentrations of chromium in the unfiltered samples exceeded the MCL at 2 of the 11 locations. Chromium concentrations in the filtered samples from both of those locations also exceeded the MCL.

070-01D

Chromium concentrations at 070-01D exceeded the MCL for all rounds including the filtered and unfiltered low flow sampling round with concentrations steadily decreasing from 52,500 $\mu\text{g/L}$ in the first round to 2,200 $\mu\text{g/L}$ in the final round. The analytical results for the filtered and unfiltered samples are essentially the same considering the $\pm 15\%$ laboratory analytical method error. The draw down for each of the five rounds of data ranged from 0.4 to 0.8 feet with the 0.4 feet draw down occurring in the filtered and unfiltered sampling event. The turbidity results for all sampling rounds were < 10 NTU, and as with the draw down results, the lowest turbidity reading occurred during the filtered and unfiltered sampling event. The low flow pumping rate for the final round was below the optimal rate of 0.5 L/min whereas the pumping rates for the previous rounds ranged between 0.63 - 0.79 L/min. Since the filtered and unfiltered sample results are virtually the same, the samples collected using the low flow method technique are considered representative of ambient conditions. Though final round chromium concentrations decreased significantly from earlier rounds, detections still exceeded the MCL and a "problem", according to the criteria rules, exists at 070-01D.

A data evaluation of adjacent wells to 070-01D (Figure 5) shows chromium detections above the MCL at shallow wells 025-002, 025-003, 025-004, 070-001, and 070-002. Building 44, an old plating operation is the likely source of the chromium contamination which the 025 wells border it. Review of geological and hydrological data shows that it is possible that contamination from the shallow wells at 025 migrated to the deep aquifer at 070-01D which is north of Building 44 since deep groundwater flows to the north. No wells down gradient of 070-01D had detections

of chromium in any of the rounds of sampling so it doesn't appear the contamination has migrated very far. Because of the significant drop in concentration in the sample collected during the low flow event it is unclear at this time how reliable the results are from the surrounding wells to which 070-01D is being compared. The project team should discuss this area further to reach an agreement on an appropriate course of action for future evaluation.

549-003

As with the chromium concentrations from 070-01D, the results at 549-003 show a significant decrease in concentrations over time. The exception to the above location is that the filtered and unfiltered results are greater than the $\pm 15\%$ laboratory error with the unfiltered result the greater of the two. In comparing groundwater quality parameters the pumping rate for the final round was 0.40 L/min which was the lowest of all rounds with the other rounds averaging 0.68 ft. The draw down rates for all rounds were virtually the same, averaging 0.12 ft and turbidity readings were all < 10 NTU. Because of the controlled sampling conditions in the final round the unfiltered sample is considered more reliable than previous rounds of sampling and is closer to representing ambient conditions.

As with groundwater at 070-01D above, 549-003, which is adjacent to 070-001 is also influenced by the old plating shop at Building 44. Well 549-002, east of 549-003 has not exceeded the MCL in any of the rounds sampled and appears to be on the fringe of the plume. No other downgradient wells of 549-003 have had exceedances of the MCL. Well 549-003 because it is in the same area as 070-0D should be included in the risk management decision made by the project team.

Conclusions

Prior to conducting this study there was no evidence to suggest that a wide spread chromium problem existed at the base but the levels in ground water around building 44 were a significant concern. The real question was whether or not the samples collected in this area were truly representative. It does not appear the samples were representative based on the marked decrease in concentrations of samples collected using the low flow method. Even so, a concern remains solely based on the results of the latest sampling event. The project team should consider the need to collect a complete, representative data set for this area prior to making any final risk management decisions.

4.5 Lead

- Preceding the low flow sampling event, lead was detected in samples from 11 of the 26 well locations included in this study.
- Lead concentrations exceeded the action level of $15 \mu\text{g/L}$ during one or more sampling events at 2 of the 11 monitoring wells with detections.
- Using the low flow sampling method lead was not detected in either the unfiltered or unfiltered samples at any of the 26 locations.

044-001

Lead concentrations exceeded the MCL in the first and third sampling rounds but lead was not detected in the final round for the filtered and unfiltered samples. A detection of lead was reported in the second round below the MCL. Quality assurance outliers were noted in the positive results for June 1995 and January 1996 and in the non-detect results for June 1996 and July 1997 which led to the "J" qualifier being added to the results.

047-001

Lead was only detected in well number 047-001 above the MCL during the first sampling event and it was not detected at all in the remaining five rounds which includes both the unfiltered and filtered samples collected during the low flow sampling event. The complete absence of lead over five consecutive sampling events since January 1996 provides compelling evidence that the first round results are simply an anomaly and not representative of ambient conditions. The exact cause of the anomalous value will likely never be determined but a plausible explanation is the sample may have been biased by artifacts created during the subsurface disturbances caused by the drilling process. Regardless of the cause of the elevated concentration in the first round, the results have been remarkably consistent after that time and there is no apparent need for further evaluation of lead at this location.

Conclusions

Similar to arsenic, lead is expected to be seen over a relatively widespread area simply on the basis that it has a moderate frequency of detection. It is unlikely however that a ubiquitous problem exists based on the results of this study. It is recommended that any future concerns that are raised simply be addressed on a site by site basis.

4.6 Mercury

- Preceding the low flow sampling event, mercury was detected in samples from 3 of the 26 well locations included in this study.
- Mercury concentrations exceeded the MCL of $2\mu\text{g/L}$ during one or more sampling events at 1 of the 3 monitoring wells with detections.
- Using the low flow sampling method mercury was not detected in any unfiltered sample and only detected in one filtered sample.

671-003

Prior to the final sampling round, mercury was detected in the August 1996 sampling event at a concentration exceeding the MCL. During the low flow sampling event mercury was detected at $0.1\mu\text{g/L}$ in the filtered sample but was not detected in unfiltered sample. Since the detection limit for the final round was at $0.1\mu\text{g/L}$, for purposes of this evaluation, both filtered and unfiltered results are considered the same with both results below the MCL. Quality assurance outliers were noted in the August 1996 and filtered sampling results which led to the "J" qualifier being added to results. The complete absence of mercury in the other rounds of data provides evidence that the fourth round results are an anomaly and are not representative of ambient conditions.

Regardless of the cause of the elevated concentration in the fourth round, the results are consistent between the other rounds and there is no apparent need for further evaluation of mercury at this location.

Mercury was not detected above the MCL in the final sampling round in any of the locations based on the evaluation results. There is no widespread problem for mercury in groundwater and any further evaluation of mercury should be conducted on a case by case basis.

Conclusions

Even though mercury was included as one of the potential inorganics of concern in the base wide study, there was no evidence to suggest that a wide spread problem existed and the real intent was to see if the low flow sampling method could resolve possible issues with data quality at 3 individual locations. Considering the random nature of the detections prior to this study and the results of this study, the Navy does not believe mercury is a concern at any of the 3 locations where it was detected.

4.7 Thallium

- Preceding the low flow sampling event, thallium was detected in samples from 13 of the 26 well locations included in this study.
- Thallium concentrations exceeded the MCL of 2 $\mu\text{g/L}$ during one or more sampling events at all 13 the monitoring wells with detections.
- Using the low flow sampling method thallium was detected in the unfiltered sample from only 1 of the 26 locations.
- Concentrations of thallium in both the unfiltered and filtered samples from that location exceeded the MCL.

044-001

Thallium concentrations have exceeded MCLs in the last three rounds of sampling performed since June 1996. Quality assurance outliers were noted in the January and May 1996 results which led to "J" qualifiers being added to the "U" (non-detect) qualifier indicating that the practical quantitation limits (PQLs). Due to the uncertainty of the data from those rounds of sampling, more emphasis was placed on reviewing data from the last three sampling events. Even though the concentrations show a declining trend, the levels detected in all three rounds exceed the MCL. The identical unfiltered and filtered results combined with the other ancillary data mentioned above support the belief that the final round of groundwater results are indicative of ambient conditions. Based on the decision rule criteria a "problem" exists for thallium since the results from the final round exceed the MCL.

At the present time a comparison of the most recent results from 044-001 to data from previous rounds of sampling at other nearby wells at the site to evaluate spatial distribution does not appear to be appropriate. The reason for this being the observed difference between the most recent samples from 044-001 and previous sampling events. If the basic assumption is made that the

difference in results is attributed to the difference in sampling method, then one would have to assume that the results in surrounding wells may decrease as well under the more controlled sampling conditions. Other potential sources of variability which also make this comparison inappropriate were mentioned earlier and should be considered in the planning of any future work.

044-007

Thallium was detected in well number 044-007 above the MCL during the third sampling round and was not detected at all in the other five rounds which includes the filtered and unfiltered samples collected during the low flow rate sampling event. The quantitation limits used during the analyses of thallium exceeded the MCL but that does not affect the usability of the data since the MDLs are typically around 10 times less than the quantitation limits. The complete absence of thallium in the other rounds of data provides evidence that the third round results are an anomaly and are not representative of ambient conditions. Regardless of the cause of the elevated concentration in the third round, the results are consistent between the other rounds and there is no apparent need for further evaluation of antimony at this location.

070-01D

Concentrations above the MCL were reported for thallium in the first and third rounds of sampling but thallium was not detected in the other rounds including the filtered and unfiltered sampling round. Quality assurance outliers were noted in the April and December 1996 results which led to the "J" qualifier being added to the results of 9.50 and 10.6 $\mu\text{g}/\text{L}$ respectively. Due to the uncertainty of the data in the first four rounds, the groundwater quality data collected from the filtered and unfiltered sampling event was compared to the previous rounds. The draw down for each of the five rounds of data ranged from 0.4 to 0.8 feet with the 0.4 feet draw down occurring in the filtered and unfiltered sampling event. The turbidity results for all sampling rounds were < 10 NTU, and as with the draw down results, the lowest turbidity reading occurred during the filtered and unfiltered sampling event. Further comparisons of the data show that water quality parameter data from the fourth round compare favorable to the filtered and unfiltered data in that draw down was 0.5 feet and turbidity was 1 NTU and results for thallium were non-detect. Since non-detect thallium results of samples collected under controlled conditions during the final sampling event validate results from previous rounds, thallium is not a concern at this location and no further evaluation for thallium is recommended.

549-003

Thallium was only detected in well number 549-003 above the MCL in the fourth round and it was not detected at all in the other rounds which includes the filtered and unfiltered samples collected during the low flow rate sampling event. The "J" qualifier was added to the fourth round result of 4.1 $\mu\text{g}/\text{L}$ indicating a quality assurance outlier was identified. The quantitation limits for thallium exceeded the MCL but MDLs are typically around 10 times less than the quantitation limits. The absence of thallium in the previous rounds, including the low flow sampling event, suggests that the fourth round results are an anomaly and not representative of ambient conditions.

Regardless of the elevated concentration in the fourth round, the other rounds have been consistent and there is no apparent need for further evaluation of thallium at 549-003.

GDE-09D

As was the case at the above location, thallium was detected above the MCL in only one round and was not detected in the other rounds including the filtered and unfiltered sampling event. The lone detection was 6.3 $\mu\text{g/L}$ in November 1996. The third round thallium detection noted a quality assurance outlier which lead to a "J" qualifier being added to the results. As with other samples the quantitation limits exceeded the MCL but it does not affect the usability of the data due to MDLs are 10 times less than quantitation limits. The results are similar to 549-003 above and there is no apparent need for further evaluation of thallium at this location since the results have been consistent over time.

FDS-16B

Thallium was detected only one time at FDS-16B and that detection exceeded the MCL. The detection was 6.4 $\mu\text{g/L}$ during the first round in January 1997. The quantitation limits used during the sampling rounds exceeded the MCL, but as stated previously, the usability of the data is not affected. Thallium was not detected in either the filtered or unfiltered sample during the low flow sampling event and the results at this location indicate there is no apparent need for further evaluation of thallium since the results have been remarkably consistent over time.

655-001

Thallium was detected only one time at 655-001 and that detection exceeded the MCL. The detection was 2.9 $\mu\text{g/L}$ during the fourth round in March 1996. The fourth round thallium detection noted a quality assurance outlier which lead to a "J" qualifier being added to the results. A possible explanation for the thallium detection is that the turbidity reading was at 37 NTU, above the optimal reading of 10 NTU. Since thallium was not detected in either the filtered or unfiltered sample and there was a complete absence of thallium in the previous rounds, the data suggests that the fourth round results are an anomaly and not representative of ambient conditions. Regardless of the cause of the elevated concentration in the fourth round, the other rounds have been consistent and there is no apparent need for further evaluation of thallium at this location.

656-001

Thallium was detected only one time at 656-001 and that detection exceeded the MCL. The detection was 4.2 $\mu\text{g/L}$ during the fourth round in March 1996. The fourth round thallium detection had a "J" qualifier added to the results. The usability of the data was not affected since the MDLs were 10 times less than the quantitation limits. Due to the absence of thallium in the previous rounds and during the low flow sampling event the fourth round results are an anomaly and not representative of ambient conditions. The results at this location are similar to 655-001 above and there is no apparent need for further evaluation of thallium at this location since the results are remarkably consistent over time.

GDH-003

Thallium was detected only one time at GDH-003 and that detection exceeded the MCL. The detection was 4.0 $\mu\text{g/L}$ during the fourth round in April 1996. A "J" qualifier was added to the fourth round thallium results and the quantitation limits exceeded the MCL but the MDL was 10 times less than the quantitation limits. Since thallium was not detected in either the filtered or unfiltered sample and there was an absence of thallium in the previous rounds the fourth round results are an anomaly and not representative of ambient conditions. The results at this location are similar to 656-001 above and there is no apparent need for further evaluation of thallium since the results are remarkably consistent over time.

GDH-006

Concentrations above the MCL were reported for thallium in the first and fourth rounds of sampling but thallium was not detected in the other rounds including the filtered and unfiltered sampling round. Quality assurance outliers were noted in the November 1994 and April 1996 results which led to the "J" qualifier being added to the results of 2.2 and 3.5 $\mu\text{g/L}$ respectively. Due to the uncertainty of the data in the first four rounds, the groundwater quality data collected from the filtered and unfiltered sampling event was compared to the previous rounds. The flow rate for purging in the first round was 0.57 L/min and the flow rate for the fourth round was 0.95 L/min as compared to 0.45 L/min in the filtered/unfiltered sampling event. The non-detect thallium results for the second and third rounds had flow rates of .76 and .83 L/min respectively. Turbidity results for all sampling rounds were <10 NTU. Due to the inconsistencies in the sampling procedures in previous rounds, the non-detect thallium results of samples collected under controlled conditions during the final sampling event validate results from two previous rounds. Therefore thallium is not a concern at this location and no further evaluation for thallium is recommended at this location.

671-003

Thallium was detected only one time at 671-003 and the result exceeded the MCL. The detection was 6.6 $\mu\text{g/L}$ during the fourth round in August 1996 and a "J" qualifier was added to the results. The quantitation limits used during the sampling rounds exceeded the MCL but that does not affect the usability of the data since MDLs were 10 times less than the quantitation limits. Thallium was not detected in either the unfiltered or unfiltered sample during the low flow sampling event. The complete absence of thallium in the previous rounds and during the low flow sampling event provides evidence that the fourth round results are an anomaly and not representative of ambient conditions. There is no apparent need for further evaluation of thallium at this location since the results are consistent over time.

GDI-17D

Thallium was detected twice at GDI-17D during the December 1995 and August 1996 sampling events and the detections exceeded the MCL. The second and fourth round thallium detections noted a quality assurance outlier which led to a "J" qualifier being added to the results. As stated previously the quantitation limits exceeded the MCL, but the MDLs were sufficiently low enough

so as not to affect the usability of the data. Thallium was not detected in either the filtered or unfiltered sample during the low flow sampling event. Due to the inconsistencies in the sampling procedures in previous rounds, the non-detect thallium results of samples collected under controlled conditions during the final sampling event validate the thallium results from previous rounds. Therefore thallium is not a concern at this location and no further evaluation for thallium is recommended at this location.

GDI-18D

Thallium was detected in three of the first four rounds of sampling at GDI-17D and the detections exceeded the MCL. The second, third and fourth round thallium results noted a quality assurance outlier which lead to a "J" qualifier being added. The quantitation limits used during the sampling rounds exceeded the MCL but that does not affect the usability of the data since MDLs were 10 times less than the quantitation limits. Thallium was not detected in either the filtered or unfiltered sample during the low flow sampling event. Due to the inconsistencies in the sampling procedures in previous rounds, the non-detect thallium results of samples collected under controlled conditions during the final sampling event are considered to be the most representative of ambient conditions. Therefore thallium is not a concern at this location and no further evaluation for thallium is recommended.

Conclusions

Even though the frequency of detection of thallium in the wells used in this study was only 50%, thallium seems to be the most problematic of the inorganics evaluated because of the very low MCL. This is evidenced by the fact that at all 13 of the 26 locations where it was detected it exceeded the MCL during one of more sampling events. The results of this study support that conclusion that thallium detections are more a problem associated with sampling technique than detections associated with groundwater contamination. Thallium was only detected at one location during this study and at that particular location, SWMU 44 - the former coal pile, a likely source exists.

5.0 Summary of Conclusions and Recommendations

When this study was first discussed by members of the project team the general opinion was the comparison of unfiltered sample results versus filtered sample results would provide the best evidence as to whether or not sample results were potentially being biased by turbidity or suspended solids problems. The decision to use a low stress sampling method was secondary in importance to collecting the filtered samples at the time, but the results of this study suggest the decision to use a low stress method had the greatest impact on the outcome of the study. In hindsight it seems obvious that using a method capable of obtaining representative samples should have been of primary importance and the collection filtered samples and analysis for suspended solids should mainly be used as verification steps. At most well locations the concentrations of the inorganics of concern declined during the final round of sampling and there were very few differences between the filtered and unfiltered results. Table 2 provides a summary of the wells and the various inorganics at each individual well location which the Navy believes may or may

not be a concern based on the results of this study. Further discussion of individual well results would probably be most appropriate within the context of ongoing studies at individual sites rather than to continue the discussions on a base wide scale. The only recommendation at this time that does have base wide implications is one use a low flow sampling method in the future for the collection of all groundwater samples intended for inorganics analysis.

Table 2
Wells Identified In Study That May Need Further Evaluation

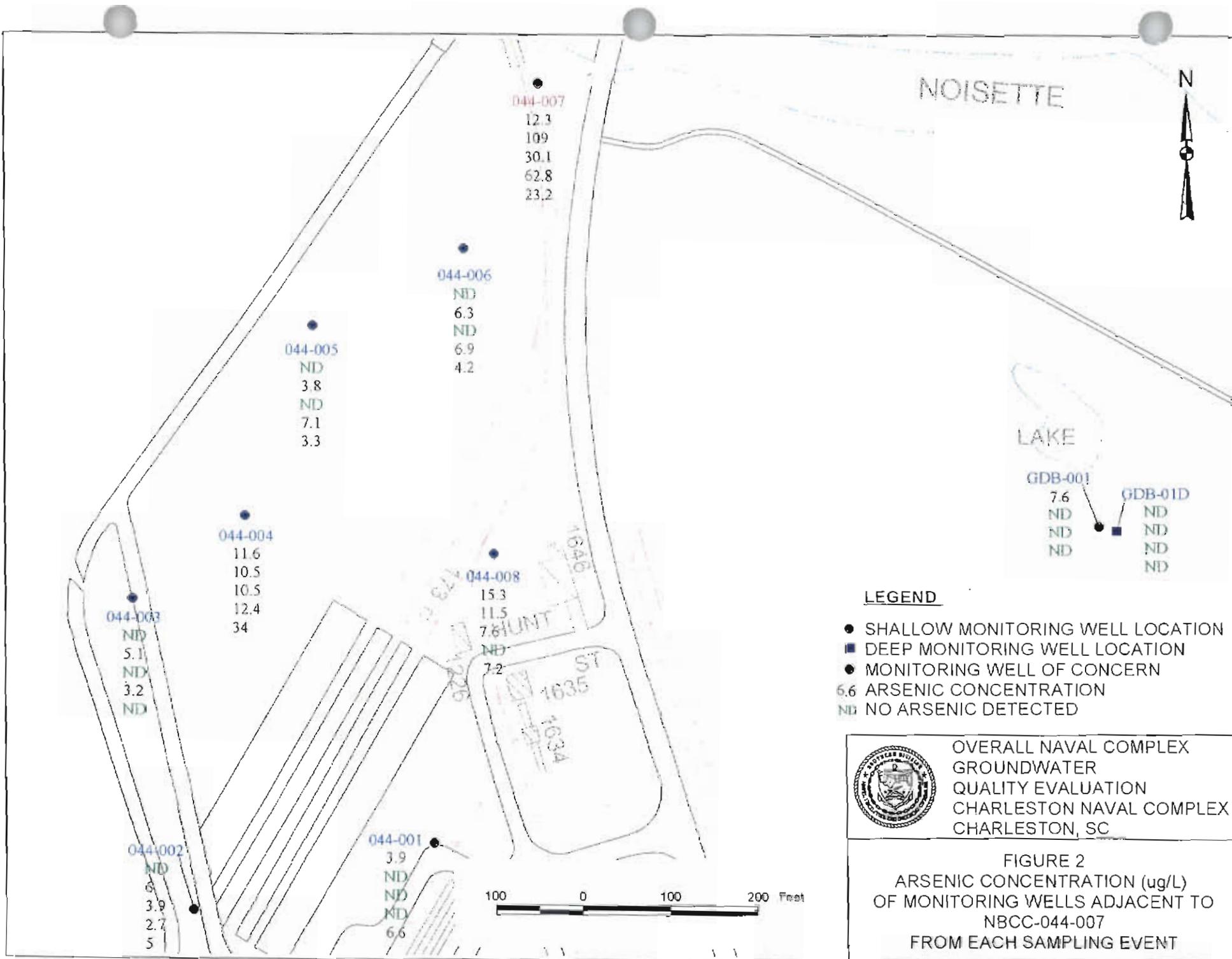
	Antimony	Arsenic	Beryllium	Chromium	Lead	Mercury	Thallium
Zone C							
044-001	No	No	Yes	No	No	No	Yes
044-007	No	Yes	No	No	No	No	No
047-001	No	No	No	No	No	No	No
047-011	No	Yes	No	No	No	No	No
Zone E							
070-01D	Yes	No	No	Yes	No	No	No
549-003	No	No	No	Yes	No	No	No
GDE-09D	No	Yes	No	No	No	No	No
Zone G							
FDS-16B	No	Yes	No	No	No	No	No
FDS-17B	No	Yes	No	No	No	No	No
Zone H							
653-003	No	No	No	No	No	No	No
655-001	No	No	No	No	No	No	No
655-002	No	No	No	No	No	No	No
655-003	No	No	No	No	No	No	No
656-001	No	No	No	No	No	No	No
GDH-003	No	No	No	No	No	No	No
GDH-03D	No	No	No	No	No	No	No
GDH-006	No	No	No	No	No	No	No
GDH-06D	No	No	No	No	No	No	No

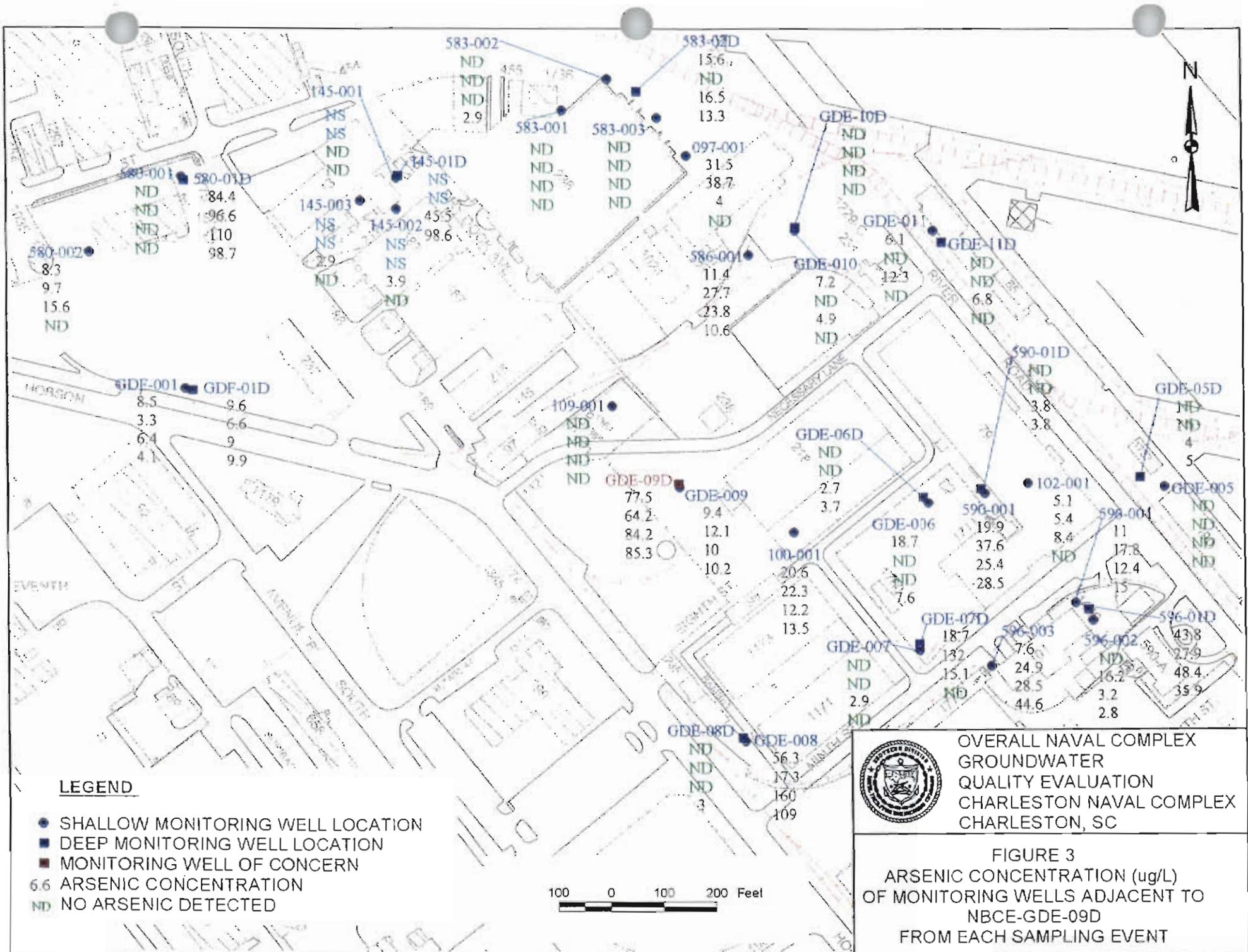
Table 2
Wells Identified In Study That May Need Further Evaluation

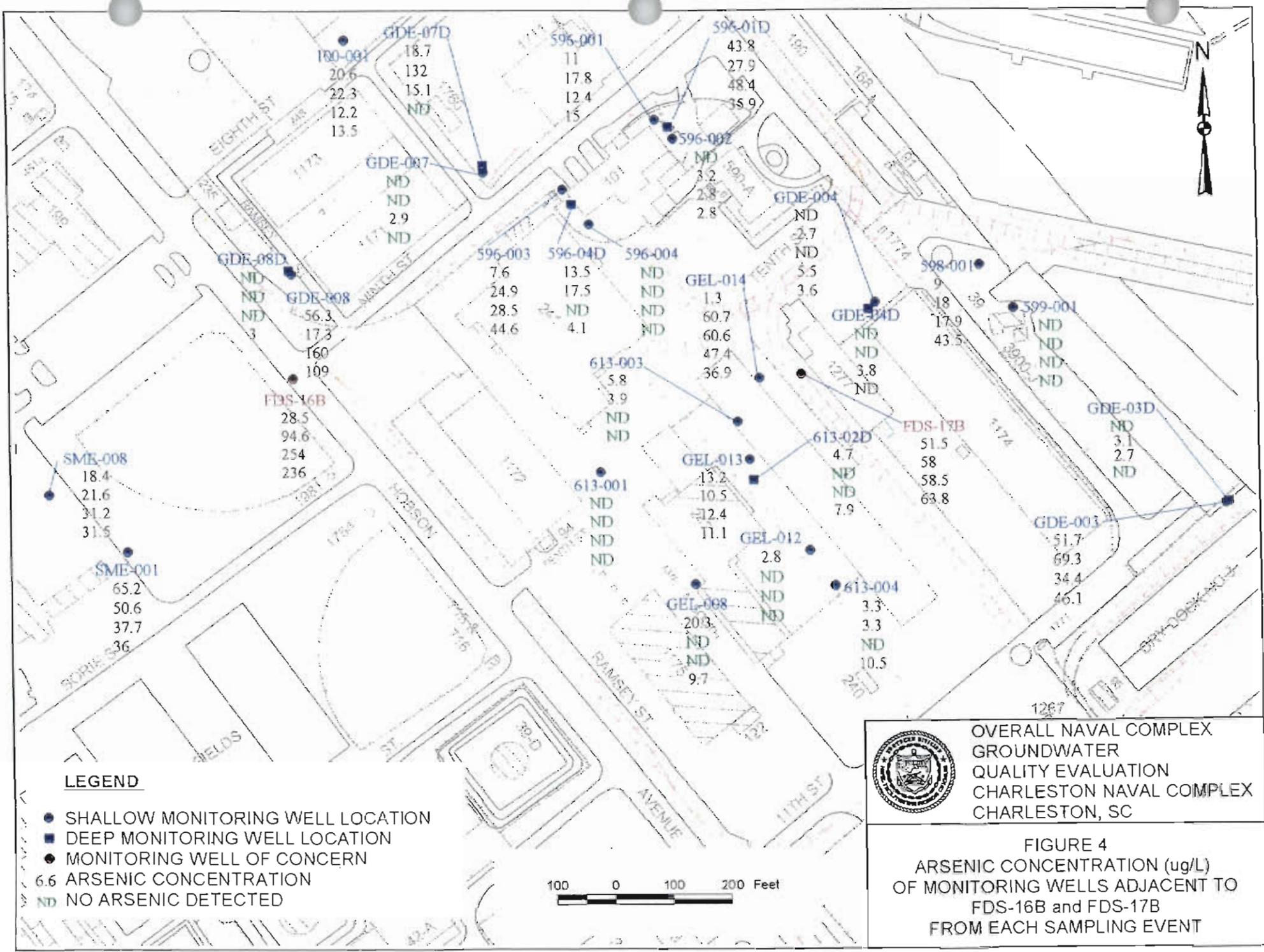
	Antimony	Arsenic	Beryllium	Chromium	Lead	Mercury	Thallium
Zone I							
012-002	No	No	No	No	No	No	No
671-003	No	No	No	No	No	No	No
GDI-17D	No	No	No	No	No	No	No
GDI-18D	No	No	No	No	No	No	No
Zone K							
694-005	No	No	No	No	No	No	No
GDK-CL1	No	No	No	No	No	No	No

Attachment A

Figures







100-001
18.7
132
20.6
17.8
22.3
15.1
12.2
12.4
13.5
15

GDE-07D
18.7
132
20.6
17.8
22.3
15.1
12.2
12.4
13.5
15

596-001
11
17.8
12.4
15

596-01D
43.8
27.9
48.4
35.9

596-002
ND
3.2
2.8
2.8

GDE-004
ND
2.7
ND
5.5
3.6

GDE-08D
ND
ND
ND
3

GDE-008
56.3
17.3
160
109

596-003
7.6
24.9
28.5
44.6

596-04D
13.5
17.5
ND
4.1

596-004
ND
ND
ND
ND

GEL-014
1.3
60.7
60.6
47.4
36.9

GDE-04D
ND
ND
3.8
ND

598-001
9
18
17.9
43.5

599-001
ND
ND
ND
ND

FDS-16B
28.5
94.6
254
236

SME-008
18.4
21.6
31.2
31.5

SME-001
65.2
50.6
37.7
36

613-003
5.8
3.9
ND
ND

GEL-013
13.2
10.5
12.4
11.1

613-02D
4.7
ND
ND
7.9

FDS-17B
51.5
58
58.5
63.8

GDE-03D
ND
3.1
2.7
ND

613-001
ND
ND
ND
ND

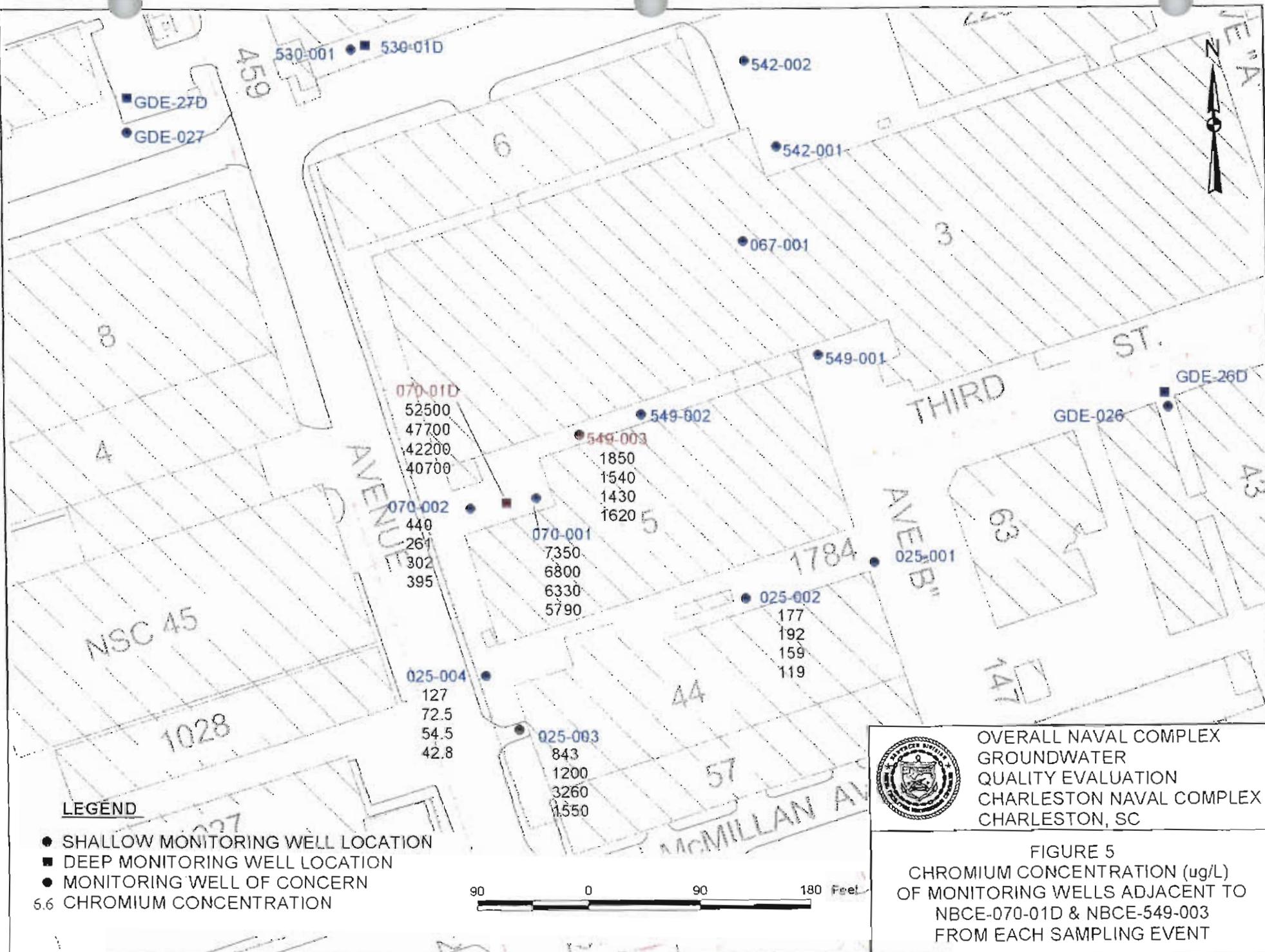
GEL-012
2.8
ND
ND
ND

GDE-003
51.7
69.3
34.4
46.1

GEL-008
20.3
ND
ND
9.7

613-004
3.3
3.3
ND
10.5

100 0 100 200 Feet



OVERALL NAVAL COMPLEX
GROUNDWATER
QUALITY EVALUATION
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE 5
CHROMIUM CONCENTRATION (ug/L)
OF MONITORING WELLS ADJACENT TO
NBCE-070-01D & NBCE-549-003
FROM EACH SAMPLING EVENT

Attachment B
Analytical Data

Ta
Naval Base Charleston - Zone C Metals Study

Well ID	Sampling Event	Sample Date	Antimony		Arsenic		Beryllium		Chromium		Lead		Mercury		Thallium	
BRV (µg/l)			NA		6.07		0.33		1.99		3.27		NA		NA	
MCL (µg/l)			6.00		50.00		4.00		100.00		15.00		2.00		2.00	
044-001	01	13-Jun-95	3.9000	J	3.9000	J	21.9000		1.3000	J	19.8000	J	0.2000	U	4.5000	U
	02	18-Jan-96	11.1000	U	2.5000	UJ	20.8000		1.6000	J	2.4000	J	0.1100	J	2.7000	UJ
	03	06-May-96	49.1000	U	2.5000	UJ	19.8000		2.2000	U	5.7000		0.1000	U	13.6000	UJ
	04	11-Jun-96	2.1000	U	2.5000	UJ	32.9000		0.8000	U	5.6000	UJ	0.1000	U	34.5000	J
	05	28-Jul-97	2.1000	J	6.6000	J	17.5000		5.5000	J	1.6000	UJ	0.1000	UJ	19.9000	
	F6	08-Jan-99	2.7000	U	2.9000	U	9.8000		0.7000	U	1.7000	U	0.1000	U	7.3000	J
	U6	08-Jan-99	2.7000	U	4.3000	J	10.0000		0.7000	U	1.5000	U	0.1000	U	7.3000	J
044-007	01	14-Jun-95	1.9000	U	12.3000		0.2400	U	4.5000	J	4.9000	J	0.2000	U	4.5000	U
	02	18-Jan-96	54.1000		109.0000		0.3000	U	1.1000	J	1.7000	U	0.1000	U	4.2000	U
	03	10-May-96	10.3000	J	30.1000		0.3000	U	2.2000	U	1.7000	U	0.1000	U	3.1000	J
	04	11-Jun-96	8.2000	U	62.8000		0.3000	U	0.8700	U	1.7000	U	0.1000	U	2.7000	UJ
	05	01-Aug-97	35.3000	J	23.2000		0.2500	J	1.0000	U	0.9000	U	0.1000	UJ	5.0000	U
	F6	07-Jan-99	2.7000	U	43.8000		0.1100	J	0.7000	U	1.5000	U	0.1000	U	3.1000	U
	U6	07-Jan-99	3.4000	J	45.9000		0.1000	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
047-001	01	14-Jun-95	53.1000	J	6.1000	J	0.2000	U	0.9000	U	467.0000		0.2000	U	4.5000	U
	02	25-Jan-96	2.1000	U	10.9000		0.3000	U	0.8000	U	1.7000	U	0.1000	U	2.7000	U
	03	09-May-96	2.1000	U	7.5000	J	0.3000	U	0.8000	U	1.7000	U	0.1000	U	2.7000	UJ
	04	07-Jun-96	3.1000	U	8.6000	J	0.3000	U	0.8000	U	1.7000	U	0.1000	U	2.7000	UJ
	F5	15-Jan-99	2.7000	U	25.3000	J	0.1000	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
	U5	15-Jan-99	2.7000	U	25.3000	J	0.1000	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
047-011	01	15-Jun-95	1.9000	U	46.3000		0.2000	U	0.9000	U	4.6000	J	0.2000	U	4.5000	U
	02	23-Jan-96	2.2000	U	164.0000		0.3000	U	1.3000	J	1.7000	U	0.1100	U	2.7000	U
	03	14-May-96	13.0000	UJ	159.0000		0.5000	U	2.2000	U	1.4000	U	0.1000	U	3.4000	U
	04	13-Jun-96	2.1000	U	120.0000		0.3000	U	0.8000	UJ	1.7000	U	0.1000	U	2.7000	UJ
	F5	19-Jan-99	2.7000	U	28.2000		0.1000	U	0.7000	U	1.5000	U	0.1000	*U	3.1000	U
	U5	19-Jan-99	2.7000	U	48.2000		0.1000	U	0.7000	U	1.5000	U	0.1000	*U	3.1000	U

Notes:

BRV (1) (µg/l) = Background Reference value

NA = BRV not available.

MCL = Maximum contaminant level

Table 2
Naval Base Charleston - Zone E Metals Study

Well ID	Sampling Event	Sample Date	Antimony	Arsenic	Beryllium	Chromium	Lead	Mercury	Thallium
Shallow BRV (µg/l)			NA	18.7	0.43	12.3	4.8	NA	5.4
Deep BRV (µg/l)			NA	16.4	1.2	15.5	NA	0.2	6.5
MCL (µg/L)			6.00	10.00 <i>SD.09</i>	4.00	100.00	15.00	2.00	2.00
070-01D	01	04/26/96	115.0000	12.5000	1.0000 U	52500.0000	3.0000 U	0.2000 U	9.5000 J
	02	07/29/96	149.0000	12.8000	0.3000 U	47700.0000	1.7000 U	0.1000 UJ	10.0000 UJ
	03	12/03/96	2.1000 U	5.0000 J	0.3000 U	42200.0000	1.7000 U	0.1000 U	10.6000 J
	04	02/18/97	209.0000	6.4000 J	0.2000 U	40700.0000	0.9000 UJ	0.1200 U	10.3000 U
	F5	01/19/99	2.7000 U	2.9000 U	0.1000 U	2200.0000	1.5000 U	0.1000 U	3.1000 U
	U5	01/19/99	2.8000 B	2.9000 U	0.1000 U	2190.0000	1.5000 U	0.1000 U	3.1000 U
549-003	01	04/24/96	7.7000 J	5.0000 U	1.0000 U	1850.0000	3.0000 U	0.2000 U	5.0000 U
	02	07/29/96	12.7000 U	2.5000 U	0.3200 J	1540.0000	5.2000 U	0.1000 UJ	3.0000 UJ
	03	11/25/96	2.1000 U	2.5000 U	0.3000 U	1430.0000	1.7000 UJ	0.2000 U	2.7000 U
	04	02/14/97	12.4000 U	2.5000 U	0.3000 U	1620.0000	1.7000 U	0.1000 U	4.1000 J
	F5	01/19/99	2.7000 U	2.9000 U	0.1000 U	426.0000	1.5000 U	0.1000 U	3.1000 U
	U5	01/19/99	2.7000 U	2.9000 U	0.1000 U	686.0000	1.5000 U	0.1000 U	3.1000 U
GDE-09D	01	04/05/96	4.0000 U	77.5000	1.0000 U	1.0000 U	3.0000 U	0.2000 U	5.0000 UJ
	02	07/19/96	2.5000 U	64.2000	1.2000 U	0.8000 UJ	2.1000 U	0.1000 U	2.7000 U
	03	11/01/96	2.1000 U	84.2000	0.6000 J	0.8100 J	1.7000 U	0.1000 U	6.3000 J
	04	01/10/97	2.1000 U	85.3000	0.4000 U	0.8000 U	1.7000 UJ	0.2100 U	2.7000 UJ
	F5	01/19/99	2.7000 U	75.1000 B	0.5000 B	0.7000 U	1.5000 U	0.1000 U	3.1000 U
	U5	01/19/99	2.7000 U	85.5000 B	0.4600 B	0.7000 U	1.5000 U	0.1000 U	3.1000 U

BRV = Background reference value (shown for shallow and deep MW)

NA = BRV not available

MCL = Maximum contaminant level

Table 3
Naval Base Charleston - Zone G Metals Study

Well ID	Sampling Event	Sample Date	Antimony		Arsenic		Beryllium		Chromium		Lead		Mercury		Thallium	
BRV (µg/L)			4.85		17.8		(2)		3.88		4.6		(2)		(2)	
MCL (µg/L)			6.00		50.00		4.00		100.00		15.00		2.00		2.00	
FDS-16B	01	01/29/97	4.2000	J	28.5000		0.5700	U	5.4000	J	2.9000	J	0.1000	U	6.4000	J
	02	06/16/97	3.3000	U	94.6000		0.3300	U	2.3000	J	1.7000	J	0.1000	U	5.0000	U
	03	04/20/98	5.0000	U	254.0000		0.2800	U	0.8600	U	1.7000	U	0.1000	U	5.5000	U
	04	10/28/98	2.7000	U	236.0000		0.1000	U	0.7000	U	1.5000	U	0.2900	U	3.9000	U
	F3	01/07/99	2.7000	U	214.0000		0.1000	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
	U3	01/07/99	2.7000	U	204.0000		0.1000	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
FDS-17B	01	01/28/97	3.0000	J	51.5000		0.4400	U	1.7000	J	1.7000	U	0.1000	U	2.7000	U
	02	06/17/97	1.6000	U	58.0000		0.3200	U	1.0000	U	0.9000	U	0.1000	U	5.4000	U
	03	04/24/98	5.0000	U	58.5000		0.3200	U	6.1000	J	1.7000	U	0.1000	U	5.5000	U
	04	10/20/98	18.0000	U	63.8000		0.3000	U	5.8000	U	1.2000	U	0.2000	U	1.6000	UJ
	F5	01/15/99	2.7000	U	63.0000	J	0.1000	U	0.7600	J	1.5000	U	0.1000	U	3.1000	U
	U5	01/15/99	2.7000	U	62.1000	J	0.1000	U	1.0000	J	1.5000	U	0.1000	U	3.1000	U

BRV = Background Reference Value

BRV not available

MCL = Maximum concentration limit

Table 4
Charleston Naval Complex - Airborne H Metals Study

Well ID	Sample Event	Sample Date	Antimony	Arsenic	Beryllium	Chromium	Lead	Mercury	Thallium	
BRV (µg/l)			NA	21.5	NA	NA	4.70	NA	5.3	
MCL (µg/l)			6.00	50.00	4.00	100.00	15.00	2.00	2.00	
653-003	02	11/12/98		9.2000 J						
	F3	01/20/99	3.2000 B	2.9000 U	0.1000 U	0.7000 U	1.5000 U	0.1000 U	3.1000 U	
	U3	01/20/99	2.7000 U	3.8000 B	0.1000 U	0.7000 U	1.5000 U	0.1000 U	3.1000 U	
655-001	01	10/28/94	16.0000 U	9.4000 U	0.3000 U	4.3000 U	1.0000 UJ	0.1000 U	4.0000 UJ	
	02	04/03/95	11.9000 U	6.8000 U	0.2000 U	3.5000 J	1.0000 U	0.1000 UJ	3.7000 UJ	
	03	09/21/95	10.5000 U	6.8000 J	0.3000 UJ	3.7000 U	1.2000 UJ	0.1000 U	6.4000 UJ	
	04	03/26/96	4.2000 U	3.3000 J	0.5800 J	1.1000 J	1.7000 U	0.1000 U	2.9000 J	
	05	06/01/98		2.9000 UJ	0.1600 U					
	06	11/11/98		6.1000 J						
	F7	01/12/99	2.7000 U	2.9000 U	0.2300 B	0.7000 U	1.5000 U	0.1000 U	3.1000 U	
	U7	01/12/99	2.7000 U	2.9000 U	0.2600 B	1.9000 B	1.5000 U	0.1000 U	3.1000 U	
655-002	01	10/27/94	16.0000 U	22.9000	0.3000 U	4.3000 U	1.5000 UJ	0.1000 U	5.8000 UJ	
	02	04/03/95	11.9000 U	9.6000 U	0.2000 U	2.0000 U	1.0000 U	0.1000 UJ	3.7000 UJ	
	03	09/20/95	10.5000 U	15.9000	0.3000 U	3.7000 U	1.6000 U	0.1000 UJ	2.5000 UJ	
	04	03/25/96	2.1000 U	12.6000	0.4600 U	0.8000 U	1.7000 U	0.1000 U	2.7000 U	
	05	06/01/98		9.2000 J	0.1900 U					
	06	11/11/98		10.6000						
	F7	01/14/99	2.7000 U	7.2000 J	0.1500 U	0.7000 U	1.5000 U	0.1000 U	3.1000 U	
	U7	01/14/99	2.7000 U	6.0000 J	0.1400 U	1.1000 J	1.5000 U	0.1000 U	4.0000 U	
655-003	01	10/27/94	16.0000 U	42.3000	0.3000 U	4.3000 U	1.0000 UJ	0.1000 U	4.0000 UJ	
	02	04/03/95	11.9000 U	27.9000	0.2000 U	4.0000 J	1.1000 U	0.1000 UJ	3.7000 UJ	
	03	09/20/95	10.5000 U	38.3000	0.3000 U	3.7000 U	1.2000 U	0.1000 UJ	2.5000 UJ	
	04	03/26/96	2.1000 U	32.7000	0.3200 J	1.3000 J	1.7000 U	0.1000 U	2.7000 U	
	05	06/01/98		10.0000 J	0.1000 U					
	F6	01/12/99	2.7000 U	14.2000 B	0.1000 U	0.7000 U	1.5000 U	0.1000 U	3.1000 U	
	U6	01/12/99	2.7000 U	23.5000 B	0.1000 U	1.3000 B	1.5000 U	0.1000 U	3.1000 U	
	656-001	01	10/27/94	16.0000 U	20.90 U	0.3000 U	4.3000 U	1.4000 UJ	0.1000 UJ	5.8000 UJ
02		04/03/95	11.9000 U	3.00 U	0.2000 U	2.0000 U	1.9000 U	0.1000 UJ	3.7000 UJ	
03		09/13/95	10.5000 U	10.70	0.3000 U	3.7000 U	1.2000 U	0.1000 UJ	2.5000 UJ	
04		03/19/96	2.1000 U	16.60 J	1.2000 U	1.1000 J	1.7000 UJ	0.1000 U	4.2000 J	
F7		01/12/99	2.7000 U	7.60 B	0.1000 U	0.7000 U	1.5000 U	0.1000 U	3.1000 U	
U7		01/12/99	2.7000 U	8.40 B	0.1000 U	2.6000 B	1.5000 U	0.1000 U	3.1000 U	
GDH-003		01	11/01/94	16.0000 U	26.6000 U	0.3000 U	4.3000 U	1.0000 UJ	0.1000 U	4.0000 UJ
		02	03/28/95	11.9000 U	24.8000	0.2000 U	2.0000 U	1.0000 U	0.1000 U	3.7000 U
	03	10/04/95	10.5000 U	41.0000 J	0.3000 U	3.7000 U	6.0000 U	0.1000 U	12.5000 U	
	04	04/08/96	2.2000 U	42.1000	0.5500 U	0.8000 U	1.7000 U	0.1000 U	4.0000 J	
	05	07/27/98		43.0000	0.2100 U					
	06	11/11/98		41.9000						
	F7	01/08/99	2.7000 U	32.0000	0.5000 U	0.7000 U	1.5000 U	0.1000 U	3.1000 U	
	U7	01/08/99	2.7000 U	36.5000	0.5000 U	0.7000 U	1.5000 U	0.1000 U	3.1000 U	

Table
Charleston Naval Complex - Site H Metals Study

Well ID	Sample Event	Sample Date	Antimony		Arsenic		Beryllium		Chromium		Lead		Mercury		Thallium	
BRV (µg/l)			NA		21.5		NA		NA		4.70		NA		5.3	
MCL (µg/l)			6.00		50.00		4.00		100.00		15.00		2.00		2.00	
GDH-03D	01	11/01/94	16.0000	U	3.8000	U	0.3000	U	4.3000	U	1.0000	U	0.1000	U	5.0000	U
	02	03/28/95	11.9000	U	2.6000	U	0.2000	U	2.0000	U	1.0000	U	0.1000	U	3.7000	U
	03	10/09/95	12.0000	U	2.6000	J	0.3000	U	3.0000	U	1.2000	U	0.1000	U	6.4000	U
	04	04/09/96	2.1000	U	4.6000	U	1.0000	J	3.5000	J	1.7000	U	0.1000	U	2.7000	U
	05	07/27/98			4.6000	U	0.6000	U								
	06	11/11/98			2.9000	U										
	F7	01/08/99	2.7000	U	2.9000	U	0.8500	J	0.7000	U	2.7000	U	0.1000	U	3.1000	U
	U7	01/08/99	2.7000	U	2.9000	U	0.8200	J	0.7600	J	1.5000	U	0.1000	U	3.1000	U
GDH-006	01	11/18/94	16.0000	U	7.2000	J	0.3000	U	4.3000	U	2.8000	J	0.1000	U	2.2000	J
	02	03/28/95	11.9000	U	7.3000		0.2000	U	2.0000	U	1.0000	U	0.1000	U	3.7000	U
	03	10/09/95	12.0000	U	42.7000		0.3000	U	2.4000	U	1.2000	UJ	0.1000	UJ	1.8000	UJ
	04	04/10/96	2.1000	U	27.8000		0.5900	U	0.8000	U	1.7000	U	0.1000	U	3.5000	J
	05	07/27/98			13.9000	U	0.2300	U								
	06	11/11/98			49.6000											
	F7	01/14/99	2.7000	U	29.6000	J	0.1700	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
	U7	01/14/99	2.7000	U	29.4000	J	0.1800	U	0.7000	U	1.5000	U	0.1000	U	3.3000	U
GDH-06D	01	11/18/94	16.0000	U	8.2000	J	0.3000	U	7.4000	J	2.4000	J	0.1000	U	10.0000	U
	02	03/28/95	11.9000	U	2.6000	U	0.2000	U	4.1000		1.0000	U	0.1000	U	3.7000	U
	03	10/09/95	12.0000	U	2.7000	J	0.3000	U	2.4000	U	1.2000	U	0.1000	U	6.4000	U
	04	04/10/96	2.1000	U	2.5000	U	0.9600	U	3.8000	J	1.7000	U	0.1000	U	2.7000	U
	05	07/27/98			4.5000	U	0.6100	U								
	06	11/12/98			2.9000	U										
	F7	01/15/99	2.7000	U	2.9000	U	0.5000	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
	U7	01/15/99	2.7000	U	2.9000	U	0.5000	U	0.7600	J	1.5000	U	0.1000	U	3.1000	U

Notes:

BRV = Background reference value.

NA = BRV not available.

MCL = Maximum contaminant level.

T
Naval Base Charleston - Zone I Metals Study

Well ID	Sample Event	Sample Date	Antimony		Arsenic		Beryllium		Chromium		Lead		Mercury		Thallium	
Shallow BRV (µg/l)*			NA		23.0		1.1		14.3		4.4		NA		6.6	
MCL (µg/l)			6.00		50.00		4.00		100.00		15.00		2.00		2.00	
012-002	01	06/08/95	1.9000	UJ	177.0000		0.3100	U	1.2000	J	4.9000	J	0.2000	U	4.5000	U
	02	01/16/96	4.0000	U	220.0000		1.0000	U	1.0000	U	3.0000	U	0.2000	U	5.0000	U
	03	05/31/96	4.0000	U	188.0000		1.0000	U	1.4000	J	3.9000	U	0.2000	UJ	5.0000	U
	04	09/04/96	2.1000	UJ	253.0000	J	0.8000	J	1.5000	UJ	1.7000	U	0.3200	U	2.7000	UJ
	F5	01/15/99	2.7000	U	40.5000	J	0.5800	U	0.9700	J	1.5000	U	0.1000	U	3.1000	U
	U5	01/15/99	2.7000	U	40.7000	J	0.5200	U	0.9600	J	1.5000	U	0.1000	U	3.1000	U
671-003	01	06/02/95	1.9000	U	31.4000		0.2000	U	0.9000	J	1.9000	U	0.2000	U	4.5000	U
	02	01/16/96	4.0000	U	42.0000		1.0000	U	1.0000	U	3.0000	U	0.2000	U	5.0000	U
	03	06/03/96	4.0000	U	28.8000		1.0000	U	1.2000	J	3.0000	U	0.2000	UJ	5.0000	U
	04	08/30/96	2.1000	UJ	38.9000		0.5400	U	1.0000	U	7.7000		37.9000		6.6000	J
	F5	01/15/99	2.7000	U	14.5000	J	0.2200	U	0.7000	U	1.5000	U	0.1000	J	3.1000	U
	U5	01/15/99	2.7000	U	17.0000	J	0.2100	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
GDI-17D	01	05/23/95	1.9000	U	3.2000	U	0.2000	U	3.8000	U	1.9000	U	0.2000	U	4.5000	U
	02	12/05/95	4.0000	U	5.0000	U	1.0000	U	1.0000	U	3.0000	U	0.2000	U	6.3000	J
	03	05/29/96	30.0000	U	5.0000	U	1.0000	U	5.0000	U	3.0000	U	0.2000	U	5.0000	UJ
	04	08/27/96	10.5000	U	24.8000	J	2.8000	U	6.4000	J	8.5000	U	0.1000	U	15.4000	J
	F5	01/18/99	2.7000	U	2.9000	U	0.5300	U	0.7000	U	1.5000	U	0.1000	U	3.1000	U
	U5	01/18/99	2.7000	U	2.9000	U	0.5700	U	0.8300	J	1.5000	U	0.1000	U	3.1000	U
GDI-18D	01	06/09/95	1.9000	UJ	3.2000	U	0.2600	U	2.5000	J	1.9000	UJ	0.2000	U	4.5000	U
	02	12/06/95	4.0000	U	5.0000	U	1.0000	U	1.8000	J	3.0000	U	1.9000		5.2000	J
	03	05/29/96	30.0000	U	5.0000	U	1.0000	U	5.0000	U	3.0000	U	0.2000	U	5.2000	J
	04	08/29/96	2.1000	UJ	4.7000	U	0.9500	U	6.7000	J	1.7000	U	0.1000	U	6.1000	J
	F5	01/18/99	3.5000	J	2.9000	U	0.5900	U	3.5000	J	1.5000	U	0.1000	U	3.1000	U
	U5	01/18/99	2.7000	U	2.9000	U	0.5900	U	4.0000	J	1.5000	U	0.1000	U	3.1000	U

Notes:

BRV = Background reference value

* = BRVs not available for deep monitoring wells

NA = BRV not available

MCL = Maximum contaminant level

Table 6
Naval Base Charleston - Zone K Metals Study

Well ID	Sampling Event	Sample Date	Antimony	Arsenic	Beryllium	Chromium	Lead	Mercury	Thallium
BRV (µg/l)			NA	18.8	NA	NA	NA	NA	NA
MCL (µg/l)			6.00	50.00	4.00	100.00	15.00	2.00	2.00
694-005	01	05/15/97	2.20 U	3.00 U	0.26 U	0.89 UJ	1.30 U	0.08 U	26.10 U
	02	07/17/97	2.00 U	3.20 J	0.22 U	4.40 UJ	2.70 J	0.20 U	3.90 U
	03	12/18/97	1.60 U	2.10 U	0.23	3.80 U	0.90 UJ	0.10 U	5.00 U
	04	03/19/98	2.50 U	2.40 J	0.24 U	1.00 U	0.90 U	1.40 UJ	5.00 U
	F5	01/13/99	2.70 U	2.90 U	0.10 U	0.70 U	1.50 U	0.10 U	3.10 U
	U5	01/13/99	2.70 U	2.90 U	0.10 U	0.70 U	1.50 U	0.10 U	3.10 U
694-006	01	05/15/97	2.30 U	3.40 J	0.62 U	0.89 UJ	1.30 U	0.08 U	52.20 U
	02	07/18/97	20.00 U	27.80 UJ	2.20 U	28.30 J	16.70 U	0.20 U	194.00 U
	03	12/19/97	2.40 U	2.10 U	0.40 J	4.70 U	0.90 UJ	0.10 U	5.00 U
	04	03/19/98	1.60 U	2.10 UJ	0.31 U	1.00 U	0.90 U	0.10 UJ	5.00 U
	F5	01/13/99	2.70 U	2.90 U	0.11 B	0.92 B	1.50 U	0.10 U	3.10 U
	U5	01/13/99	2.70 U	2.90 U	0.12 B	0.72 B	1.50 U	0.10 U	3.10 U
694-007	01	05/14/97	2.90 U	3.00 U	0.99 U	0.89 UJ	1.30 U	0.08 U	52.20 U
	02	07/17/97	20.00 U	27.80 UJ	2.20 U	15.70 J	16.70 U	0.20 U	38.90 U
	03	12/18/97	3.40 U	2.10 U	0.20 U	1.00 U	0.90 UJ	0.10 U	5.00 U
	04	03/18/98	1.60 U	2.10 UJ	0.28 U	1.00 U	1.20 J	0.10 UJ	5.00 U
	F5	01/11/99	2.70 U	2.90 U	0.10 U	0.70 U	1.50 U	0.10 U	3.10 U
	U5	01/11/99	2.70 U	2.90 U	0.10 U	0.70 U	1.50 U	0.10 U	3.10 U
GDK-CL1	01	05/16/97	2.20 U	9.40 J	0.11 U	0.89 UJ	1.30 U	0.08 U	52.20 U
	02	07/18/97	2.00 U	5.80 J	0.56 U	0.67 UJ	1.70 U	0.20 U	3.90 U
	03	12/17/97	1.70 U	6.80 J	0.20 U	4.20 U	0.90 UJ	0.10 U	5.00 U
	04	03/16/98	2.20 U	8.10 J	0.20 U	1.00 U	0.90 U	0.10 UJ	5.00 U
	F5	01/13/99	2.70 U	4.60 B	0.20 B	0.70 U	1.50 U	0.10 U	3.10 U
	U5	01/13/99	2.70 U	5.70 B	0.19 B	2.20 B	1.50 U	0.10 U	3.10 U

(1) BRV = Background Reference value calculated using 2-times the detected concentration from the single background well located on Clouter Island.

(2) Analyte was not detected in background well.

Attachment C
Field Sampling Forms

Groundwater Sampling Form

Groundwater Sampling				Sample ID: <u>GDEGND9005</u> <small>PS</small>						
PROJECT NAME: <u>Naval Base Charleston</u>		JOB NO: <u>2708-001-08-014-00</u>		DATE: <u>1-17-99</u>						
WELL NO.: <u>GDE-09D</u>		LOCATION: <u>Zone E</u>								
WEATHER CONDITIONS: <u>Sunny, clear</u>		AMBIENT TEMP: <u>60°</u>								
REVIEWED BY: _____		PERSONNEL: <u>T. Temple</u>								
PURGING DEVICE			SAMPLING DEVICE							
Type device? <u>Geo Pump</u>			Type device? <u>Geo Pump</u>							
How was the device decontaminated? <u>Per CSAP</u>			How was the device decontaminated? <u>Per CSAP</u>							
How was the line decontaminated? <u>Per CSAP</u>			How was the line decontaminated? <u>Per CSAP</u>							
Which well was previously purged? _____			Which well was previously sampled? _____							
INITIAL WELL VOLUME			PURGING							
Well diameter (in.) <u>2"</u>			Time started <u>1605</u> Finished <u>1723</u>							
Stickup (ft.) <u>Flushmount</u>			Volume purged <u>13.25</u>							
Depth to bottom of well from TOC (ft.) <u>31.62</u>			Comments on Well Recovery _____							
Depth to water surface from TOC (ft.) <u>5.68</u>			Depth to water (ft.) <u>19.95</u>							
Length of water (ft.) <u>25.94</u>			Completion _____							
Volume of water (ft.) _____			Additional Comments _____							
(gal.) <u>4.40</u>			Sample Collected: Start <u>1730</u>							
Amount of sediment at bottom of well (ft.) _____			Finish <u>1735</u>							
3 Volumes of water (gal.) <u>13.20</u>										
IN-SITU TESTING		Time:		<u>1620</u>	<u>1637</u>	<u>1655</u>	<u>1710</u>	<u>1723</u>	_____	_____
				<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
Well Volume Purged (gal.)				<u>3</u>	<u>5</u>	<u>8</u>	<u>12</u>	<u>13.25</u>	_____	_____
Formation drawdown				<u>8.88</u>	<u>13.8</u>	<u>15.5</u>	<u>15.2</u>	<u>14.27</u>	_____	_____
or Turbidity				<u>164</u>	<u>81</u>	<u>67</u>	<u>56</u>	<u>50</u>	_____	_____
pH (units)				<u>6.38</u>	<u>6.42</u>	<u>6.39</u>	<u>6.34</u>	<u>6.41</u>	_____	_____
Conductivity (µmho)				<u>27.6</u>	<u>30.3</u>	<u>31.6</u>	<u>32.4</u>	<u>32.2</u>	_____	_____
Water Temperature (°C)				<u>23.2</u>	<u>23.1</u>	<u>23.5</u>	<u>23.2</u>	<u>22.5</u>	_____	_____
Depth to water (ft.)				<u>14.56</u>	<u>19.48</u>	<u>21.18</u>	<u>20.88</u>	<u>19.95</u>	_____	_____
NOTES:		1 ft. length of 4" Turbidity choices:		= 0.087 ft ³ or 0.65 gal. clear, turbid, opaque		1 ft. length 2" = 0.022 ft ³ or 0.16 gal. Revision Date: 8/5/92				

Groundwater Sampling Form

Groundwater Sampling		Sample ID: <u>FDSGW16803</u> <u>F3</u> <u>V3</u>																																																								
PROJECT NAME: <u>Naval Base Charleston</u>		JOB NO: _____ DATE: <u>1-7-99</u>																																																								
WELL NO.: <u>FDS-16B</u>	LOCATION: <u>Zone G (FDS)</u>																																																									
WEATHER CONDITIONS: <u>Sunny</u>		AMBIENT TEMP: <u>60°</u>																																																								
REVIEWED BY: _____	PERSONNEL: <u>J. Watson</u>																																																									
PURGING DEVICE Type device? <u>Geo Pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously purged? _____	SAMPLING DEVICE Type device? <u>Geo Pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously sampled? _____																																																									
INITIAL WELL VOLUME Well diameter (in.) <u>2"</u> Stickup (ft.) <u>Flush</u> Depth to bottom of well from TOC (ft.) <u>16.53</u> Depth to water surface from TOC (ft.) <u>3.10</u> Length of water (ft.) <u>13.43</u> Volume of water (ft.) _____ (gal.) <u>2.28</u> Amount of sediment at bottom of well (ft.): _____ 3 Volumes of water (gal.) <u>6.85</u>	PURGING Time started <u>1400</u> Finished <u>1505</u> Volume purged <u>6.85</u> Comments on Well Recovery _____ Depth to water (ft.) <u>7.19</u> Completion _____ Additional Comments _____ Sample Collected: Start <u>1510</u> Finish <u>1528</u>																																																									
IN-SITU TESTING	Time: <u>1407</u> <u>1417</u> <u>1430</u> <u>1447</u> <u>1505</u> _____																																																									
Well Volume Purged (gal.) Turbidity odor drawdown pH (units) Conductivity (µmho) Water Temperature (°C) Depth to water (ft.)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> <td style="text-align: center;">5</td> <td style="text-align: center;">6</td> <td style="text-align: center;">7</td> </tr> <tr> <td style="text-align: center;"><u>1</u></td> <td style="text-align: center;"><u>2</u></td> <td style="text-align: center;"><u>3</u></td> <td style="text-align: center;"><u>5</u></td> <td style="text-align: center;"><u>6.85</u></td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> <tr> <td style="text-align: center;"><u>13</u></td> <td style="text-align: center;"><u>12</u></td> <td style="text-align: center;"><u>4</u></td> <td style="text-align: center;"><u>3</u></td> <td style="text-align: center;"><u>3</u></td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> <tr> <td style="text-align: center;"><u>2.31</u></td> <td style="text-align: center;"><u>3.07</u></td> <td style="text-align: center;"><u>3.19</u></td> <td style="text-align: center;"><u>3.78</u></td> <td style="text-align: center;"><u>4.09</u></td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> <tr> <td style="text-align: center;"><u>6.30</u></td> <td style="text-align: center;"><u>6.72</u></td> <td style="text-align: center;"><u>6.76</u></td> <td style="text-align: center;"><u>6.79</u></td> <td style="text-align: center;"><u>6.75</u></td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> <tr> <td style="text-align: center;"><u>3.86</u></td> <td style="text-align: center;"><u>3.96</u></td> <td style="text-align: center;"><u>4.27</u></td> <td style="text-align: center;"><u>4.58</u></td> <td style="text-align: center;"><u>5.00</u></td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> <tr> <td style="text-align: center;"><u>22.5</u></td> <td style="text-align: center;"><u>22.1</u></td> <td style="text-align: center;"><u>22.0</u></td> <td style="text-align: center;"><u>21.8</u></td> <td style="text-align: center;"><u>22.0</u></td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> <tr> <td style="text-align: center;"><u>5.41</u></td> <td style="text-align: center;"><u>6.17</u></td> <td style="text-align: center;"><u>6.29</u></td> <td style="text-align: center;"><u>6.88</u></td> <td style="text-align: center;"><u>7.19</u></td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> </table>	1	2	3	4	5	6	7	<u>1</u>	<u>2</u>	<u>3</u>	<u>5</u>	<u>6.85</u>	_____	_____	<u>13</u>	<u>12</u>	<u>4</u>	<u>3</u>	<u>3</u>	_____	_____	<u>2.31</u>	<u>3.07</u>	<u>3.19</u>	<u>3.78</u>	<u>4.09</u>	_____	_____	<u>6.30</u>	<u>6.72</u>	<u>6.76</u>	<u>6.79</u>	<u>6.75</u>	_____	_____	<u>3.86</u>	<u>3.96</u>	<u>4.27</u>	<u>4.58</u>	<u>5.00</u>	_____	_____	<u>22.5</u>	<u>22.1</u>	<u>22.0</u>	<u>21.8</u>	<u>22.0</u>	_____	_____	<u>5.41</u>	<u>6.17</u>	<u>6.29</u>	<u>6.88</u>	<u>7.19</u>	_____	_____	_____ _____ _____ _____ _____ _____ _____
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Groundwater Sampling Form

Groundwater Sampling		Sample ID: <u>6716W00305</u>																																																																
PROJECT NAME: <u>Naval Base Charleston</u>		JOB NO: <u>2908001-08-014-00</u> DATE: <u>1-15-99</u>																																																																
WELL NO.: <u>671-003</u>	LOCATION: <u>Zone I</u>																																																																	
WEATHER CONDITIONS: <u>Sunny windy</u>		AMBIENT TEMP: <u>65° F</u>																																																																
REVIEWED BY: _____	PERSONNEL: <u>A. Wertz</u>																																																																	
PURGING DEVICE Type device? <u>Geo pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously purged? _____	SAMPLING DEVICE Type device? <u>Geo pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously sampled? _____																																																																	
INITIAL WELL VOLUME Well diameter (in) <u>2"</u> Stickup (ft.) _____ Depth to bottom of well from TOC (ft.) <u>12.32</u> Depth to water surface from TOC (ft.) <u>5.68</u> Length of water (ft.) <u>6.64</u> Volume of water (gal.) <u>1.13</u> Amount of sediment at bottom of well (ft.) _____ 3 Volumes of water (gal) <u>3.39</u>	PURGING Time started <u>1330</u> Finished <u>1406</u> Volume purged <u>3.39</u> Comments on Well Recovery _____ Depth to water (ft.) <u>5.83</u> Completion _____ Additional Comments _____ Sample Collected: Start <u>1409</u> Finish <u>1423</u>																																																																	
IN-SITU TESTING	Time: <u>1340</u> <u>1347</u> <u>1355</u> <u>1403</u> <u>1406</u> _____																																																																	
Well Volume Purged (gal.) Turbidity <u>Dir Draw Down</u> pH (units) Conductivity (µmho) Water Temperature (°C) Depth to water (ft.)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th><u>1</u></th> <th><u>2</u></th> <th><u>3</u></th> <th><u>4</u></th> <th><u>5</u></th> <th><u>6</u></th> <th><u>7</u></th> </tr> </thead> <tbody> <tr> <td>Well Volume Purged (gal.)</td> <td><u>.75</u></td> <td><u>1.5</u></td> <td><u>2.25</u></td> <td><u>3.0</u></td> <td><u>3.39</u></td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Turbidity</td> <td><u>5</u></td> <td><u>2</u></td> <td><u>2</u></td> <td><u>1</u></td> <td><u>0</u></td> <td>_____</td> <td>_____</td> </tr> <tr> <td><u>Dir Draw Down</u></td> <td><u>.13</u></td> <td><u>.15</u></td> <td><u>.14</u></td> <td><u>.15</u></td> <td><u>.15</u></td> <td>_____</td> <td>_____</td> </tr> <tr> <td>pH (units)</td> <td><u>6.47</u></td> <td><u>6.94</u></td> <td><u>7.02</u></td> <td><u>7.04</u></td> <td><u>7.03</u></td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Conductivity (µmho)</td> <td><u>1.61</u></td> <td><u>1.61</u></td> <td><u>1.58</u></td> <td><u>1.67</u></td> <td><u>1.69</u></td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Water Temperature (°C)</td> <td><u>23.4</u></td> <td><u>23.6</u></td> <td><u>23.5</u></td> <td><u>23.3</u></td> <td><u>23.4</u></td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Depth to water (ft.)</td> <td><u>5.81</u></td> <td><u>5.83</u></td> <td><u>5.82</u></td> <td><u>5.83</u></td> <td><u>5.83</u></td> <td>_____</td> <td>_____</td> </tr> </tbody> </table>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	Well Volume Purged (gal.)	<u>.75</u>	<u>1.5</u>	<u>2.25</u>	<u>3.0</u>	<u>3.39</u>	_____	_____	Turbidity	<u>5</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>0</u>	_____	_____	<u>Dir Draw Down</u>	<u>.13</u>	<u>.15</u>	<u>.14</u>	<u>.15</u>	<u>.15</u>	_____	_____	pH (units)	<u>6.47</u>	<u>6.94</u>	<u>7.02</u>	<u>7.04</u>	<u>7.03</u>	_____	_____	Conductivity (µmho)	<u>1.61</u>	<u>1.61</u>	<u>1.58</u>	<u>1.67</u>	<u>1.69</u>	_____	_____	Water Temperature (°C)	<u>23.4</u>	<u>23.6</u>	<u>23.5</u>	<u>23.3</u>	<u>23.4</u>	_____	_____	Depth to water (ft.)	<u>5.81</u>	<u>5.83</u>	<u>5.82</u>	<u>5.83</u>	<u>5.83</u>	_____	_____
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>																																																											
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Groundwater Sampling Form

Groundwater Sampling		Sample ID: <u>NBCK16946w00205</u> <small>05 FS</small>
PROJECT NAME: <u>Naval Base Charleston</u>		JOB NO: <u>208-001-08-014-00</u> DATE: <u>1-11-99</u>
WELL NO.: <u>694-007</u>	LOCATION: <u>Zone K</u>	
WEATHER CONDITIONS: <u>Sunny</u>		AMBIENT TEMP: <u>65°</u>
REVIEWED BY: _____	PERSONNEL: <u>A. Wertz</u>	
PURGING DEVICE Type device? <u>Geo Pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously purged? _____	SAMPLING DEVICE Type device? <u>Geo Pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously sampled? _____	
INITIAL WELL VOLUME Well diameter (in) <u>2"</u> Stickup (ft.) <u>Flush</u> Depth to bottom of well from TOC (ft.) <u>7.08</u> Depth to water surface from TOC (ft.) <u>1.71</u> Length of water (ft.) <u>5.37</u> Volume of water (ft.) _____ (gal.) <u>.91</u> Amount of sediment at bottom of well (ft.) _____ 3 Volumes of water (gal.) <u>2.74</u>	PURGING Time started <u>1450</u> Finished <u>1516</u> Volume purged <u>2.74 gallons</u> Comments on Well Recovery _____ Depth to water (ft.) <u>2.09</u> Completion _____ Additional Comments _____ Sample Collected: Start <u>1518</u> Finish <u>1534</u>	
IN-SITU TESTING	Time:	<u>1452</u> <u>1458</u> <u>1504</u> <u>1508</u> <u>1516</u> _____ _____
		<u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u>
Well Volume Purged (gal.)		<u>.5</u> <u>1</u> <u>1.5</u> <u>2</u> <u>2.74</u> _____ _____
Turbidity		<u>2</u> <u>4</u> <u>1</u> <u>1</u> <u>2</u> _____ _____
Draw down Draw down		<u>.36</u> <u>.35</u> <u>.37</u> <u>.36</u> <u>.39</u> _____ _____
pH (units)		<u>6.30</u> <u>7.15</u> <u>7.16</u> <u>7.14</u> <u>7.11</u> _____ _____
Conductivity (µmho)		<u>9.6</u> <u>10.6</u> <u>10.3</u> <u>10.3</u> <u>10.4</u> _____ _____
Water Temperature (°C)		<u>15.7</u> <u>16.0</u> <u>16.3</u> <u>16.4</u> <u>16.4</u> _____ _____
Depth to water (ft.)		<u>2.07</u> <u>2.06</u> <u>2.08</u> <u>2.07</u> <u>2.09</u> _____ _____
NOTES:	1 ft. length of 4" Turbidity choices: _____ = 0.087 ft ³ or 0.65 gal. clear, turbid, opaque	1 ft. length 2" = 0.022 ft ³ or 0.16 gal. Revision Date: 8/5/92



DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090/11
Code 18710
July 14, 1999

Mr. John Litton, P.E.
Director, Division of Hazardous and Infectious Waste Management
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Subj: SUBMITTAL OF AOC 506 TECHNICAL MEMORANDUM PROPOSING NFA
STATUS

Dear Mr. Litton:

The purpose of this letter is to submit the enclosed Technical Memorandum for AOC 506. This site was recommended for placement in the CMS process by the Zone A RFI conditional approval letter from SC DHEC. After EnSafe submitted a preliminary technical memorandum the project team visited the site and discussed the need for further action. Based on that discussion the Navy, SC DHEC, and EnSafe agreed that No Further Action was required for that site. The purpose of this letter and the attached technical memorandum is to formalize the decision for record purposes.

The Navy requests that the Department and the USEPA review and provide comment or approval whichever is appropriate. If you should have any questions please contact Billy Drawdy or myself at (843) 743-9985 and (843) 820-5543 respectively.

Sincerely,

DAVID P. DODDS
Remedial Project Manager
Installation Restoration III

Encl:

(1) Technical Memorandum for AOC 506, dated 12 July 1999

Copy to:

SCDHEC (Paul Bergstrand, Mihir Mehta), USEPA (Dann Spariosu)
CSO Naval Base Charleston (Billy Drawdy), SOUTHNAVFACENGCOM (Tony Hunt)



M e m o r a n d u m

Date: 12 July 1999

To: Mihir Mehta, David Dodds, Paul Bergstrand, Dann Spariosu

From: Todd Haverkost

Re: Zone A RFI Conditional Approval, AOC 506 Benzo(a)pyrene SSL Evaluation

AOC 506 is a former flammable storage shelter identified as Building 1629. This facility was used from 1942 to 1996 to store hazardous/flammable materials awaiting shipment for disposal. Building 1629 was an open-air storage shed composed of metal poles supporting a steel truss frame with sheet metal covering. The shed was constructed on a 21' x 30' concrete slab that was surrounded by wire fencing. The shed and fencing were removed sometime between the RFA site visit in 1994 when operations in 1996 at the facility ceased. This site was investigated during the RFI and was tentatively recommended for inclusion in the CMS solely based on leaching potential of semi-volatile organic compounds (SVOCs) as identified in the fate and transport evaluation. The intent of this memo is to re-visit existing data and present new data to provide the project team with an opportunity to make a risk management decision regarding the final recommendations for this site.

The Zone A RFI Report conditional approval letter issued by SCDHEC, dated 29 January 1999, recommended that a localized removal action be performed at AOC 506 due to the leaching potential of benzo(a)pyrene equivalents (BEQs). During the RFI, soil samples were collected at 6 locations from the 0-1' and 3-5' foot intervals. BEQs were detected at a concentration of 8377 $\mu\text{g}/\text{Kg}$ in surface soil at soil boring 506SB001, which exceeded the generic soil screening level (SSL) of 4000 $\mu\text{g}/\text{Kg}$. The only other detections of BEQs were in the subsurface samples collected from 506SB002 (362 $\mu\text{g}/\text{Kg}$) and 506SB004 (210 $\mu\text{g}/\text{Kg}$). Excerpts from the RFI report are included as Attachment A to provide additional background regarding the sampling results and the data screening process. Rather than proceed with the removal action, the Navy and EnSafe proposed to collect additional data to supplement the existing site data in an effort to demonstrate that the generic SSLs used in the fate and transport assessment are overly conservative for this site and that a leaching concern does not exist. The reason the Navy and EnSafe felt the generic SSL

was very conservative was that its derivation used a default dilution attenuation factor (DAF) of 10 rather than a DAF of 20 as suggested in the *USEPA Soil Screening Guidance: Technical Background Document*. The DAF of 10 was selected since it was presumed that the sandy soil at the site would have a low total organic carbon (TOC) value. This approach was agreed upon by members of the Project Team as documented in the response to SCDHEC comment #4 dated November 5, 1997 (the response document is dated August 7, 1998). Because of the SSL exceedance, a shallow monitoring well was installed at the location of 506SB001 to reduce the uncertainty of whether or not the BEQ concentrations in soil actually pose a threat to groundwater. The groundwater samples greatly reduce the uncertainty, but do not completely eliminate it since the age of the release and the travel time to groundwater are not really addressed unless samples are collected over time to account for temporal variation. The groundwater samples collected during two separate sampling events from this well were non-detect for BEQs, further suggesting the SSL used was appropriate for a preliminary screening value to determine if further assessment was warranted but should not be used as an action level.

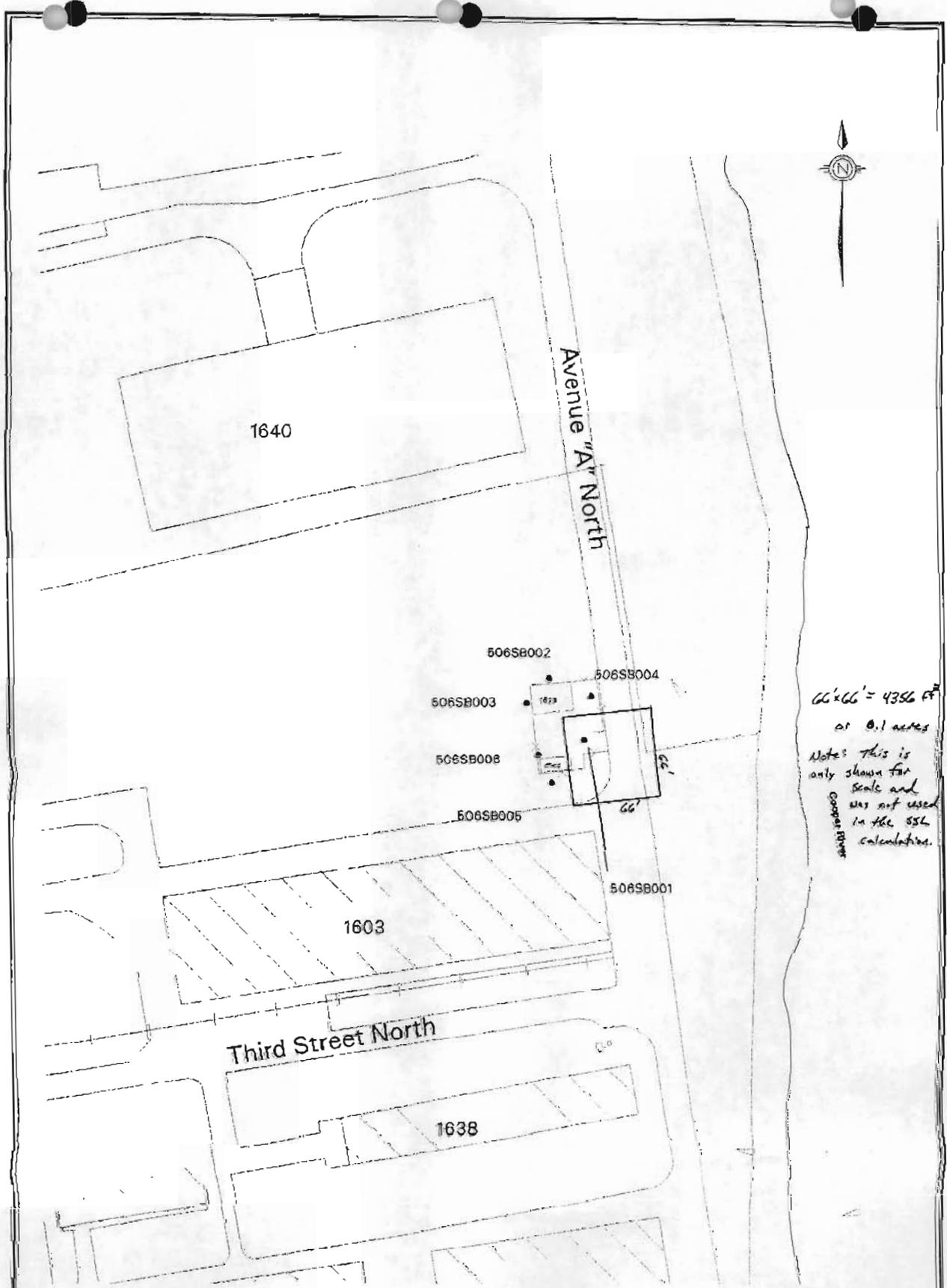
In discussions between the Navy, SCDHEC, and EnSafe, it was agreed that a site specific SSL should be calculated using the soil/water partitioning equation found in the *USEPA Soil Screening Guidance: Technical Background Document* and that a leach test be performed using the Synthetic Precipitation Leaching Procedure (SPLP) developed to model an acid rain leaching environment. The SPLP test is independent of the age of the release and was selected to help validate or invalidate the results of the site specific SSL calculations and the groundwater data. The SPLP method may not be entirely suitable for soils contaminated with oily constituents, but used in conjunction with other information such as the site specific SSL and site specific groundwater results, it does provide one more valuable piece of data to consider when making a weight of evidence decision. The key data gap identified for the completion of the SSL calculation was the absence of a site specific total organic carbon value. In February 1999, additional soil samples were collected at the 506SB001 location from the 3-5' interval. The samples were analyzed for SPLP and TOC.

The SPLP results (Attachment B) were non-detect for BEQs and for carbazole, which was not mentioned earlier, but also exceeded its generic SSL. Please note that the quantitation limits listed on the analytical reports are higher than the respective tap water RBCs and/or MCLs for these constituents. As a result, the laboratory's method detection limit (MDL) study has also been included for the reviewer's benefit. Had either constituent been detected above the MDL but below the quantitation limit, it would have been reported as a "J" flagged or estimated value. The detection limit for BEQs still exceeds the MCL and RBC because these values are extremely low and cannot be achieved with this particular analytical method. Even so the SPLP results indicate that, in the area of highest concentration, the BEQs were not detected above the MDL of 2.6 $\mu\text{g/L}$ which is only slightly above the MCL of 0.2 $\mu\text{g/L}$.

To calculate a site specific SSL, the default values for soil porosity, dry soil bulk density, fraction organic carbon, and hydraulic conductivity were replaced with data collected from AOC 506 or from nearby sites in Zone A which had a similar soil type. Following the procedures outlined in the EPA guidance, an SSL of 722.2 $\mu\text{g}/\text{Kg}$ was calculated for BEQs assuming no dilution or attenuation, and with a 0.5 acre source area with BEQ concentrations distributed uniformly from ground surface to the water table (Attachment C). Under the conservative assumptions made previously regarding sandy soil and applying a DAF of 10, the resulting SSL is 7222 $\mu\text{g}/\text{Kg}$. The decision to use a DAF of 10 was based on the assumption that most of the soil in Zone A is sandy. However, the site specific TOC result of 3540 mg/Kg is more characteristic of a heavier organic rich soil which adds justification to the argument that it may be more appropriate to use the EPA default DAF of 20. The calculated SSL with a DAF 20 is 14,444 $\mu\text{g}/\text{Kg}$. The BEQ level of 8,377 $\mu\text{g}/\text{Kg}$ at 506SB001 does exceed the lower SSL but is well below the higher value which EnSafe believes to be more applicable to this site. Another important factor that should be considered at this site is that the entire site is less than 0.1 acres and that the surface interval sample from 506SB001 was non-detect for BEQs. Conceivably, the SSL could even be higher at this site if the size of the site and distribution of the contaminants are considered.

In conclusion, the site specific SSL using a DAF of 10 indicates that BEQs have some potential to leach to groundwater at unacceptable levels. The exceedance of a SSL only means that further evaluation should be considered. As a result, groundwater samples were obtained and a leaching test was performed to collect the empirical data necessary to determine whether or not the BEQ concentrations actually pose a threat to groundwater. The SPLP results and 2 rounds of groundwater data, both of which were non-detect for BEQs (and carbazole), provide the most compelling evidence that the BEQs are not leaching. Considering the age of the unit and the depth to groundwater, one could reasonably assume that if groundwater were to be impacted, it would have occurred by now. The SSLs used during the RFI were appropriate for screening purposes but should not be used as an action level. The tentative recommendations made in the RFI report to include the site in the CMS and the SCDHEC recommendation to perform a removal action appear to be overly conservative. The Navy and EnSafe feel no further action is warranted at AOC 506.

Attachment A



66' x 66' = 4356 sq ft
 or 0.1 acres
 Note: This is only shown for scale and was not used in the SSL calculations.
 Cooper River

LEGEND
 • Soil Boring

Zone A RCRA Facility Investigation Report
 Naval Base Charleston
 Charleston, SC

FIGURE 10.7.1 - AOC 506
 Soil Sample Locations

The information on this page is derived from the following sources:

Table 10.7.2
 AOC 506
 Organic Compounds Detected in Soil

Compound	Sampling Interval	Frequency of Detection	Range of Detection (µg/kg)	Mean of Detections (µg/kg)	RBC (µg/kg)	Number of Samples Exceeding RBC
Volatile Organic Compounds						
(12 samples collected: 6 upper interval and 6 lower interval, 1 sample duplicated for Appendix IX analysis)						
Toluene	Upper	2/6	1.3 - 1.7	1.5	16,000,000	0
	Lower	4/6	2.4 - 9.2	4.8	NA	NA
Semivolatile Organic Compounds						
(12 samples collected: 6 upper interval and 6 lower interval, 1 sample duplicated for Appendix IX analysis)						
BEQ ^a	Upper	0/6	NA	NA	88	0
	Lower	3/6	210 - 8,377	3,008	NA	NA
Acenaphthene	Upper	0/6	NA	NA	4,700,000	0
	Lower	1/6	600	NA	NA	NA
Acenaphthylene	Upper	0/6	NA	NA	4,700,000	0
	Lower	1/6	970	NA	NA	NA
Anthracene	Upper	0/6	NA	NA	23,000,000	0
	Lower	1/6	1,800	NA	NA	NA
Benzo(a)anthracene	Upper	0/6	NA	NA	880	0
	Lower	2/6	300 - 5,700	3,000	NA	NA
Benzo(a)pyrene	Upper	0/6	NA	NA	88	0
	Lower	3/6	210 - 5,400	1,980	NA	NA
Benzo(b)fluoranthene	Upper	0/6	NA	NA	880	0
	Lower	2/6	370 - 8,000	4,190	NA	NA
Benzo(g,h,i)perylene	Upper	0/6	NA	NA	3,100,000 ^b	0
	Lower	2/6	270 - 3,100	1,690	NA	NA
Benzo(k)fluoranthene	Upper	0/6	NA	NA	8,800	0
	Lower	1/6	390	NA	NA	NA

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 NAVBASE Charleston
 Section 10 — Site-Specific Evaluations
 Revision: 0

Table 10.7.2
 AOC 506
 Organic Compounds Detected in Soil

Compound	Sampling Interval	Frequency of Detection	Range of Detection ($\mu\text{g}/\text{kg}$)	Mean of Detections ($\mu\text{g}/\text{kg}$)	RBC ($\mu\text{g}/\text{kg}$)	Number of Samples Exceeding RBC
Semivolatile Organic Compounds (12 samples collected: 6 upper interval and 6 lower interval, 1 sample duplicated for Appendix IX analysis)						
Carbazole	Upper	0/6	NA	NA	32,000	0
	Lower	1/6	1,200	NA	NA	NA
Chrysene	Upper	0/6	NA	NA	88,000	0
	Lower	3/6	250 - 6,500	2,390	NA	NA
Dibenzofuran	Upper	0/6	NA	NA	310,000	0
	Lower	1/6	1,200	NA	NA	NA
Dibenz(a,h)-anthracene	Upper	0/6	NA	NA	88	0
	Lower	1/6	1,300	NA	NA	NA
Fluoranthene	Upper	0/6	NA	NA	3,100,000	0
	Lower	2/6	350 - 750	550	NA	NA
Fluorene	Upper	0/6	NA	NA	3,100,000	0
	Lower	1/6	1,800	NA	NA	NA
Indeno(1,2,3-cd)-pyrene	Upper	0/6	NA	NA	880	0
	Lower	2/6	250 - 3,000	1,670	NA	NA
2-methylnaphthalene	Upper	0/6	NA	NA	3,100,000 ^c	0
	Lower	1/6	580	NA	NA	NA
Naphthalene	Upper	0/6	NA	NA	3,100,000	0
	Lower	2/6	350 - 550	450	NA	NA
Phenanthrene	Upper	0/6	NA	NA	3,100,000 ^b	0
	Lower	2/6	530 - 11,000	5,760	NA	NA
Pyrene	Upper	0/6	NA	NA	2,300,000	0
	Lower	1/6	690	NA	NA	NA

Notes:

- a = Calculated from method described in USEPA *Interim Supplemental Guidance to RAGS: Region IV Bulletins, Human Health Risk Assessment*, Bulletin No. 2, November 1995.
- b = RBC not available for this compound; fluoranthene RBC used as surrogate.
- c = RBC not available for this compound; naphthalene RBC used as surrogate.
- NA = Not applicable

Semivolatile Organic Compounds in Soil

No SVOCs were detected in any of the first-interval samples at AOC 506. Nineteen SVOCs were detected in the second-interval samples. Five exceeded their SSL: benzo(a)anthracene (730 $\mu\text{g}/\text{kg}$), benzo(a)pyrene (4,100 $\mu\text{g}/\text{kg}$), benzo(b)fluoranthene (2,300 $\mu\text{g}/\text{kg}$), carbazole (240 $\mu\text{g}/\text{kg}$), and dibenz(a,h)anthracene (700 $\mu\text{g}/\text{kg}$). Also, the resulting BEQ calculation exceeds the SSL for benzo(a)pyrene.

All of the exceedances were in one second-interval sample, 506SB00102. The concentrations detected in this sample were benzo(a)anthracene (5,700 $\mu\text{g}/\text{kg}$), benzo(a)pyrene (5,400 $\mu\text{g}/\text{kg}$), benzo(b)fluoranthene (8,000 $\mu\text{g}/\text{kg}$), carbazole (1,200 $\mu\text{g}/\text{kg}$), and dibenz(a,h)anthracene (1,300 $\mu\text{g}/\text{kg}$). The only other second-interval samples in which cPAHs were detected were 506SB00202 and 506SB00402, but these detections were below the respective SSLs.

Inorganics in Soil

Twenty metals were detected in soil at AOC 506. Three warrant further evaluation: cobalt, manganese, and tin.

Cobalt was detected above the RC (1.7 mg/kg) in both of the detections in six lower-interval samples. These detections do not exceed the SSL (990 mg/kg) for cobalt.

Manganese was detected above the RC (85.5 mg/kg) in two second-interval samples – 506SB00102 and 506SB00202. This detection does not exceed the SSL (550 mg/kg) for manganese.

Tin does not have an RC or RBC for comparison of the second-interval detection. This detection does not exceed the SSL (5,500 mg/kg) for tin.

10.7.5.1 AOC 506 — Soil to Groundwater Cross-Media Transport

Tables 10.7.7 and 10.7.8 compare the maximum detected concentrations of organic and inorganic chemicals reported in soil to risk-based soil screening levels considered protective of groundwater. As shown on Table 10.7.7, five organics — benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, and dibenzo(a,h)anthracene — were identified for further evaluation of soil to groundwater migration based on the screening process presented in Section 6. None of these organic chemicals were reported in shallow groundwater (including four rounds of groundwater sampling). As shown on Table 10.7.8, two inorganics — chromium and mercury — were identified for further evaluation of soil to groundwater migration. Chromium was detected in groundwater at a concentration less than its groundwater screening values; mercury was not detected in groundwater (including four rounds of groundwater sampling).

All of the organic exceedences were reported in a single subsurface soil sample (506SB00102). Soil concentrations reported for these organic chemicals are not likely to present a widespread threat to AOC 506 groundwater based on their limited areal extent at concentrations above their SSLs. Mercury was reported in a single surface soil sample (506SB00201) at a concentration of 1.3 mg/kg which marginally exceeds its SSL of 1 mg/kg. Although chromium was reported in one surface soil sample and four subsurface soil samples at concentrations exceeding its SSL, it was not reported in any soil sample at a concentration exceeding its background reference value. For screening purposes, chromium was conservatively assumed to exist in its soluble hexavalent state. Hexachrome analyses at AOC 506 and elsewhere in Zone A suggest that chromium in soil exists predominantly in less soluble valence states. These findings suggest that concentrations of inorganic soil constituents do not appreciably threaten AOC 506 groundwater.

10.7.5.2 AOC 506 — Groundwater to Surface Water Cross-Media Transport

As shown on Table 10.7.7, no organic constituents were detected in AOC 506 shallow groundwater above tap water RBCs or surface water saltwater AWQCs. Therefore, it has been

Organic Compounds Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
 Comparison to Cross-media SSLs, Tap Water RBCs, and Saltwater Surface Water Chronic Screening Levels
 NAVBASE-Charleston, Zone A - AOC 506
 Charleston, South Carolina

Parameter	Maximum Concentration				Screening Concentration *				Soil Units	Water Units	Leaching Potential	Volatilization Potential	Ground-Water Migration Concern	Surface Water Migration Concern
	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW	Soil to Air	Tap Water RBC	Saltwater Surf Wtr Chronic						
Volatile Organic Compounds														
Acetone	60	56	ND	NA	8000	1E+08	3700	NDA	UG/KG	UG/L	NO	NO	NO	NO
2-Butanone	ND	4.75	ND	NA	3900 c	NDA	1900	NDA	UG/KG	UG/L	NO	NO	NO	NO
Carbon disulfide	ND	3.6	1.6	NA	16000	720000	1000	NDA	UG/KG	UG/L	NO	NO	NO	NO
1,1-Dichloroethane	ND	ND	5.1	NA	12000	1300000	810	NDA	UG/KG	UG/L	NO	NO	NO	NO
Methylene chloride	ND	1.2	ND	NA	10	13000	4.1	2560	UG/KG	UG/L	NO	NO	NO	NO
Toluene	1.7	9.2	ND	NA	6000	650000	750	37	UG/KG	UG/L	NO	NO	NO	NO
Trichlorofluoromethane	ND	ND	33	NA	10000 c	790000	1300	NDA	UG/KG	UG/L	NO	NO	NO	NO
Semivolatile Organic Compounds														
Acenaphthene	ND	600	ND	NA	290000	NDA	2200	9.7	UG/KG	UG/L	NO	NO	NO	NO
Acenaphthylene	ND	970	ND	NA	95000 c	NDA	1500	NDA	UG/KG	UG/L	NO	NO	NO	NO
Anthracene	ND	1800	ND	NA	5900000	NDA	11000	NDA	UG/KG	UG/L	NO	NO	NO	NO
Benzo(g,h,i)perylene	ND	3100	ND	NA	1.2E+08 c	NDA	1500	NDA	UG/KG	UG/L	NO	NO	NO	NO
Benzo(a)pyrene equivalents														
Benzo(a)anthracene	ND	5700	ND	NA	800	NDA	0.092	NDA	UG/KG	UG/L	YES	NO	NO	NO
Benzo(a)pyrene	ND	5400	ND	NA	4000	NDA	0.0092	NDA	UG/KG	UG/L	YES	NO	NO	NO
Benzo(b)fluoranthene	ND	8000	ND	NA	2500	NDA	0.092	NDA	UG/KG	UG/L	YES	NO	NO	NO
Benzo(k)fluoranthene	ND	390	ND	NA	25000	NDA	0.92	NDA	UG/KG	UG/L	NO	NO	NO	NO
Chrysene	ND	6500	ND	NA	80000	NDA	9.2	NDA	UG/KG	UG/L	NO	NO	NO	NO
Dibenzo(a,h)anthracene	ND	1300	ND	NA	800	NDA	0.0092	NDA	UG/KG	UG/L	YES	NO	NO	NO
Indeno(1,2,3-cd)pyrene	ND	3000	ND	NA	7000	NDA	0.092	NDA	UG/KG	UG/L	NO	NO	NO	NO
Carbazole	ND	1200	ND	NA	300	NDA	3.4	NDA	UG/KG	UG/L	YES	NO	NO	NO
Dibenzofuran	ND	1200	ND	NA	42000 c	120000	150	NDA	UG/KG	UG/L	NO	NO	NO	NO
Fluoranthene	ND	750	ND	NA	2200000	NDA	1500	1.6	UG/KG	UG/L	NO	NO	NO	NO
Fluorene	ND	1800	ND	NA	280000	NDA	1500	NDA	UG/KG	UG/L	NO	NO	NO	NO
2-Methylnaphthalene	ND	580	ND	NA	230000 c	NDA	1500	NDA	UG/KG	UG/L	NO	NO	NO	NO
Naphthalene	ND	550	ND	NA	42000	NDA	1500	23.5	UG/KG	UG/L	NO	NO	NO	NO
Phenanthrene	ND	11000	ND	NA	900000 c	NDA	1500	NDA	UG/KG	UG/L	NO	NO	NO	NO
Pyrene	ND	690	ND	NA	2100000	NDA	1100	NDA	UG/KG	UG/L	NO	NO	NO	NO

Explanations of screening procedures appear in Section 6.2.

Frequency and range of detections, average detected concentrations, and number of screening concentration exceedances appear in Table 10.7.2 and 10.7.5

* Screening Concentrations:

Soil to GW - Generic SSLs based on DAF = 10, adapted from USEPA Soil Screening Guidance: Technical Background Document, May 1996 (first preference), or calculated using values from Table 6.2

Soil to Air - From USEPA Soil Screening Guidance: Technical Background Document, May 1996 (first preference), or USEPA Region III Risk-Based Concentration Table, June 1996

Tap Water RBC - From USEPA Region III Risk-Based Concentration Table, October 1997

Salt Water Surface Water Chronic - From USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November 1995, Table 2

c - Calculated soil to groundwater SSL value (See Table 6.2)

GW - Groundwater

NA - Not applicable

ND - Not detected

NDA - No data available

RBC - Risk-based concentration

SSL - Soil screening level

UG/KG - Micrograms per kilogram

UG/L - Micrograms per liter

CHARLESTON - ZONE A
NAVAL BASE CHARLESTON ZONE A (NBCH)
AOC 506 - SVOCs in Soil

SV846-SVDA		SAMPLE ID ----->	506-S-B001-01	506-S-B001-02	506-S-B002-01	506-S-B002-02	506-S-B003-01	506-S-B003-02			
		ORIGINAL ID ----->	506S800101	506S800102	506S800201	506S800202	506S800301	506S800302			
		LAB SAMPLE ID ---->	L5586-23	L5586-24	L5586-21	L5586-22	L5586-19	L5586-20			
		ID FROM REPORT -->	506S800101	506S800102	506S800201	506S800202	506S800301	506S800302			
		SAMPLE DATE ----->	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95			
		DATE EXTRACTED -->	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95			
		DATE ANALYZED ---->	11/06/95	11/03/95	11/02/95	11/02/95	11/02/95	11/06/95			
		MATRIX ----->	Soil	Soil	Soil	Soil	Soil	Soil			
		UNITS ----->	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG			
CAS #	Parameter	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL
108-95-2	Phenol	710.	U	730.	U	790.	U	780.	U	760.	U
111-44-4	bis(2-Chloroethyl)ether	710.	U	730.	U	790.	U	780.	U	760.	U
95-57-8	2-Chlorophenol	710.	U	730.	U	790.	U	780.	U	760.	U
541-73-1	1,3-Dichlorobenzene	710.	U	730.	U	790.	U	780.	U	760.	U
106-46-7	1,4-Dichlorobenzene	710.	U	730.	U	790.	U	780.	U	760.	U
100-51-6	Benzyl alcohol	1400.	U	1400.	U	1600.	U	1500.	U	1500.	U
95-50-1	1,2-Dichlorobenzene	710.	U	730.	U	790.	U	780.	U	760.	U
95-48-7	2-Methylphenol (o-Cresol)	710.	U	730.	U	790.	U	780.	U	760.	U
39638-32-9	Bis(2-Chloroisopropyl)Ether	710.	U	730.	U	790.	U	780.	U	760.	U
621-64-7	N-Nitroso-di-n-propylamine	710.	U	730.	U	790.	U	780.	U	760.	U
67-72-1	Hexachloroethane	710.	U	730.	U	790.	U	780.	U	760.	U
98-95-3	Nitrobenzene	710.	U	730.	U	790.	U	780.	U	760.	U
78-59-1	Isophorone	710.	U	730.	U	790.	U	780.	U	760.	U
88-75-5	2-Nitrophenol	710.	U	730.	U	790.	U	780.	U	760.	U
105-67-9	2,4-Dimethylphenol	710.	U	730.	U	790.	U	780.	U	760.	U
65-85-0	Benzoic acid	3600.	U	3700.	U	4000.	U	3900.	U	3800.	U
111-91-1	bis(2-Chloroethoxy)methane	710.	U	730.	U	790.	U	780.	U	760.	U
120-83-2	2,4-Dichlorophenol	710.	U	730.	U	790.	U	780.	U	760.	U
120-82-1	1,2,4-Trichlorobenzene	710.	U	730.	U	790.	U	780.	U	760.	U
91-20-3	Naphthalene	710.	U	550.	J	790.	U	320.	J	760.	U
106-47-8	4-Chloroaniline	1400.	U	1400.	U	1600.	U	1500.	U	1500.	U
87-68-3	Hexachlorobutadiene	710.	U	730.	U	790.	U	780.	U	760.	U
59-50-7	4-Chloro-3-methylphenol	1400.	U	1400.	U	1600.	U	1500.	U	1500.	U
91-57-6	2-Methylnaphthalene	710.	U	580.	J	790.	U	780.	U	760.	U
77-47-4	Hexachlorocyclopentadiene	710.	U	730.	UJ	790.	U	780.	U	760.	U
88-06-2	2,4,6-Trichlorophenol	710.	U	730.	UJ	790.	U	780.	U	760.	U
95-95-4	2,4,5-Trichlorophenol	710.	U	730.	UJ	790.	U	780.	U	760.	U
91-58-7	2-Chloronaphthalene	710.	U	730.	UJ	790.	U	780.	U	760.	U
88-74-4	2-Nitroaniline	3600.	U	3700.	UJ	4000.	U	3900.	U	3800.	U
131-11-3	Dimethyl phthalate	710.	U	730.	UJ	790.	U	780.	U	760.	U
208-96-8	Acenaphthylene	710.	U	970.	J	790.	U	780.	U	760.	U
606-20-2	2,6-Dinitrotoluene	710.	U	730.	UJ	790.	U	780.	U	760.	U
99-09-2	3-Nitroaniline	3600.	U	3700.	UJ	4000.	U	3900.	U	3800.	U
83-32-9	Acenaphthene	710.	U	600.	J	790.	U	780.	U	760.	U
51-28-5	2,4-Dinitrophenol	3600.	U	3700.	UJ	4000.	U	3900.	U	3800.	U
100-02-7	4-Nitrophenol	3600.	U	3700.	UJ	4000.	U	3900.	U	3800.	U

CHARLESTON - ZONE A
NAVAL BASE CHARLESTON ZONE A (NBCH)
AOC 506 - SVOCs in Soil

SV846-SV0A		SAMPLE ID ----->	506-S-8001-01	506-S-8001-02	506-S-8002-01	506-S-8002-02	506-S-8003-01	506-S-8003-02			
		ORIGINAL ID ----->	506S800101	506S800102	506S800201	506S800202	506S800301	506S800302			
		LAB SAMPLE ID ---->	L5586-23	L5586-24	L5586-21	L5586-22	L5586-19	L5586-20			
		ID FROM REPORT ---->	506S800101	506S800102	506S800201	506S800202	506S800301	506S800302			
		SAMPLE DATE ----->	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95			
		DATE EXTRACTED -->	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95			
		DATE ANALYZED ---->	11/06/95	11/03/95	11/02/95	11/02/95	11/02/95	11/06/95			
		MATRIX ----->	Soil	Soil	Soil	Soil	Soil	Soil			
		UNITS ----->	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG			
CAS #	Parameter	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL
132-64-9	Dibenzofuran	710.	U	1200.	J	790.	U	780.	U	760.	U
121-14-2	2,4-Dinitrotoluene	710.	U	730.	UJ	790.	U	780.	U	760.	U
84-66-2	Diethylphthalate	710.	U	730.	UJ	790.	U	780.	U	760.	U
7005-72-3	4-Chlorophenylphenylether	710.	U	730.	UJ	790.	U	780.	U	760.	U
86-73-7	Fluorene	710.	U	1800.	J	790.	U	780.	U	760.	U
100-01-6	4-Nitroaniline	3600.	U	3700.	U	4000.	U	3900.	U	3800.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	3600.	U	3700.	U	4000.	U	3900.	U	3800.	U
86-30-6	N-Nitrosodiphenylamine	710.	U	730.	U	790.	U	780.	U	760.	U
101-55-3	4-Bromophenyl-phenylether	710.	U	730.	U	790.	U	780.	U	760.	U
118-74-1	Hexachlorobenzene	710.	U	730.	U	790.	U	780.	U	760.	U
87-86-5	Pentachlorophenol	3600.	U	3700.	U	4000.	U	3900.	U	3800.	U
85-01-8	Phenanthrene	710.	U	11000.		790.	U	430.	J	760.	U
120-12-7	Anthracene	710.	U	1800.		790.	U	780.	U	760.	U
86-74-8	Carbazole	710.	U	1200.		790.	U	780.	U	760.	U
84-74-2	Di-n-butylphthalate	710.	U	730.	U	790.	U	780.	U	760.	U
206-44-0	Fluoranthene	710.	U	39000.	UR	790.	U	660.	J	760.	U
129-00-0	Pyrene	710.	U	19000.	UR	790.	U	520.	J	760.	U
85-68-7	Butylbenzylphthalate	710.	U	730.	U	790.	U	780.	U	760.	U
91-94-1	3,3'-Dichlorobenzidine	1400.	U	1400.	U	1600.	U	1500.	U	1500.	U
56-55-3	Benzo(a)anthracene	710.	U	5700.		790.	U	230.	J	760.	U
218-01-9	Chrysene	710.	U	6500.		790.	U	340.	J	760.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BERP)	710.	U	730.	U	790.	U	780.	U	760.	U
117-84-0	Di-n-octyl phthalate	710.	U	730.	U	790.	U	780.	U	760.	U
205-99-2	Benzo(b)fluoranthene	710.	U	8000.		790.	U	430.	J	760.	U
207-08-9	Benzo(k)fluoranthene	710.	U	730.	U	790.	U	780.	U	760.	U
50-32-8	Benzo(a)pyrene	710.	U	5400.		790.	U	280.	J	760.	U
193-39-5	Indeno(1,2,3-cd)pyrene	710.	U	3000.		790.	U	160.	J	760.	U
53-70-3	Dibenz(a,h)anthracene	710.	U	1300.		790.	U	780.	U	760.	U
191-24-2	Benzo(g,h,i)perylene	710.	U	3100.		790.	U	190.	J	760.	U
106-44-5	4-Methylphenol (p-Cresol)	710.	U	730.	U	790.	U	780.	U	760.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	NR		NR		NR		NR		NR	

CHARLESTON - ZONE A
NAVAL BASE CHARLESTON ZONE A (NBCH)
AOC 506 - SVOCs in Soil

SVOCs-SVOC		SAMPLE ID ----->	506-S-B004-01	506-S-B004-02	506-S-B005-01	506-S-B005-02	506-S-B006-01	506-S-B006-02			
		ORIGINAL ID ----->	506S800401	506S800402	506S800501	506S800502	506S800601	506S800602			
		LAB SAMPLE ID ---->	L5586-25	L5586-26	L5586-27	L5586-28	L5586-15	L5586-16			
		ID FROM REPORT -->	506S800401	506S800402	506S800501	506S800502	506S800601	506S800602			
		SAMPLE DATE ----->	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95			
		DATE EXTRACTED -->	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95			
		DATE ANALYZED ---->	11/02/95	11/03/95	11/06/95	11/02/95	11/02/95	11/02/95			
		MATRIX ----->	Soil	Soil	Soil	Soil	Soil	Soil			
		UNITS ----->	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG			
CAS #	Parameter	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL
108-95-2	Phenol	740.	U	900.	U	790.	U	790.	U	750.	U
111-44-4	bis(2-Chloroethyl)ether	740.	U	900.	U	790.	U	790.	U	750.	U
95-57-8	2-Chlorophenol	740.	U	900.	U	790.	U	790.	U	750.	U
541-73-1	1,3-Dichlorobenzene	740.	U	900.	U	790.	U	790.	U	750.	U
106-46-7	1,4-Dichlorobenzene	740.	U	900.	U	790.	U	790.	U	750.	U
100-51-6	Benzyl alcohol	1500.	U	1800.	U	1500.	U	1600.	U	1500.	U
95-50-1	1,2-Dichlorobenzene	740.	U	900.	U	790.	U	790.	U	750.	U
95-48-7	2-Methylphenol (o-Cresol)	740.	U	900.	U	790.	U	790.	U	750.	U
39638-32-9	Bis(2-Chloroisopropyl)Ether	740.	U	900.	U	790.	U	790.	U	750.	U
621-64-7	N-Nitroso-di-n-propylamine	740.	U	900.	U	790.	U	790.	U	750.	U
67-72-1	Hexachloroethane	740.	U	900.	U	790.	U	790.	U	750.	U
98-95-3	Nitrobenzene	740.	U	900.	U	790.	U	790.	U	750.	U
78-59-1	Isophorone	740.	U	900.	U	790.	U	790.	U	750.	U
88-75-5	2-Nitrophenol	740.	U	900.	U	790.	U	790.	U	750.	U
105-67-9	2,4-Dimethylphenol	740.	U	900.	U	790.	U	790.	U	750.	U
65-85-0	Benzoic acid	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U
111-91-1	bis(2-Chloroethoxy)methane	740.	U	900.	U	790.	U	790.	U	750.	U
120-83-2	2,4-Dichlorophenol	740.	U	900.	U	790.	U	790.	U	750.	U
120-82-1	1,2,4-Trichlorobenzene	740.	U	900.	U	790.	U	790.	U	750.	U
91-20-3	Naphthalene	740.	U	900.	U	790.	U	790.	U	750.	U
106-47-8	4-Chloroaniline	1500.	U	1800.	U	1500.	U	1600.	U	1500.	U
87-68-3	Hexachlorobutadiene	740.	U	900.	U	790.	U	790.	U	750.	U
59-50-7	4-Chloro-3-methylphenol	1500.	U	1800.	U	1500.	U	1600.	U	1500.	U
91-57-6	2-Methylnaphthalene	740.	U	900.	U	790.	U	790.	U	750.	U
77-47-4	Hexachlorocyclopentadiene	740.	U	900.	U	790.	U	790.	U	750.	U
88-06-2	2,4,6-Trichlorophenol	740.	U	900.	U	790.	U	790.	U	750.	U
95-95-4	2,4,5-Trichlorophenol	740.	U	900.	U	790.	U	790.	U	750.	U
91-58-7	2-Chloronaphthalene	740.	U	900.	U	790.	U	790.	U	750.	U
88-74-4	2-Nitroaniline	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U
131-11-3	Dimethyl phthalate	740.	U	900.	U	790.	U	790.	U	750.	U
208-96-8	Acenaphthylene	740.	U	900.	U	790.	U	790.	U	750.	U
606-20-2	2,6-Dinitrotoluene	740.	U	900.	U	790.	U	790.	U	750.	U
99-09-2	3-Nitroaniline	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U
83-32-9	Acenaphthene	740.	U	900.	U	790.	U	790.	U	750.	U
51-28-5	2,4-Dinitrophenol	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U
100-02-7	4-Nitrophenol	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U

CHARLESTON - ZONE A
NAVAL BASE CHARLESTON ZONE A (NBCH)
AOC 506 - SVOCs in Soil

SVOCs-SVOC		SAMPLE ID ----->	506-S-8004-01	506-S-8004-02	506-S-8005-01	506-S-8005-02	506-S-8006-01	506-S-8006-02			
		ORIGINAL ID ----->	506S800401	506S800402	506S800501	506S800502	506S800601	506S800602			
		LAB SAMPLE ID ---->	L5586-25	L5586-26	L5586-27	L5586-28	L5586-15	L5586-16			
		ID FROM REPORT -->	506S800401	506S800402	506S800501	506S800502	506S800601	506S800602			
		SAMPLE DATE ----->	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95	10/11/95			
		DATE EXTRACTED -->	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95			
		DATE ANALYZED -->	11/02/95	11/03/95	11/06/95	11/02/95	11/02/95	11/02/95			
		MATRIX ----->	Soil	Soil	Soil	Soil	Soil	Soil			
		UNITS ----->	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG			
CAS #	Parameter	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL	L5586	VAL
132-64-9	Dibenzofuran	740.	U	900.	U	790.	U	790.	U	750.	U
121-14-2	2,4-Dinitrotoluene	740.	U	900.	U	790.	U	790.	U	750.	U
84-66-2	Diethylphthalate	740.	U	900.	U	790.	U	790.	U	750.	U
7005-72-3	4-Chlorophenylphenylether	740.	U	900.	U	790.	U	790.	U	750.	U
86-73-7	Fluorene	740.	U	900.	U	790.	U	790.	U	750.	U
100-01-6	4-Nitroaniline	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U
86-30-6	N-Nitrosodiphenylamine	740.	U	900.	U	790.	U	790.	U	750.	U
101-55-3	4-Bromophenyl-phenylether	740.	U	900.	U	790.	U	790.	U	750.	U
118-74-1	Hexachlorobenzene	740.	U	900.	U	790.	U	790.	U	750.	U
87-86-5	Pentachlorophenol	3700.	U	4500.	U	3900.	U	4000.	U	3700.	U
85-01-8	Phenanthrene	740.	U	900.	U	790.	U	790.	U	750.	U
120-12-7	Anthracene	740.	U	900.	U	790.	U	790.	U	750.	U
86-74-8	Carbazole	740.	U	900.	U	790.	U	790.	U	750.	U
84-74-2	Di-n-butylphthalate	740.	U	900.	U	790.	U	790.	U	750.	U
206-44-0	Fluoranthene	740.	U	350.	J	790.	U	790.	U	750.	U
129-00-0	Pyrene	740.	U	900.	U	790.	U	790.	U	750.	U
85-68-7	Butylbenzylphthalate	740.	U	900.	U	790.	U	790.	U	750.	U
91-94-1	3,3'-Dichlorobenzidine	1500.	U	1800.	U	1500.	U	1600.	U	1500.	U
56-55-3	Benzo(a)anthracene	740.	U	900.	U	790.	U	790.	U	750.	U
218-01-9	Chrysene	740.	U	250.	J	790.	U	790.	U	750.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	740.	U	900.	U	790.	U	790.	U	750.	U
117-84-0	Di-n-octyl phthalate	740.	U	900.	U	790.	U	790.	U	750.	U
205-99-2	Benzo(b)fluoranthene	740.	U	900.	U	790.	U	790.	U	750.	U
207-08-9	Benzo(k)fluoranthene	740.	U	900.	U	790.	U	790.	U	750.	U
50-32-8	Benzo(a)pyrene	740.	U	210.	J	790.	U	790.	U	750.	U
193-39-5	Indeno(1,2,3-cd)pyrene	740.	U	900.	U	790.	U	790.	U	750.	U
53-70-3	Dibenz(a,h)anthracene	740.	U	900.	U	790.	U	790.	U	750.	U
191-24-2	Benzo(g,h,i)perylene	740.	U	900.	U	790.	U	790.	U	750.	U
106-44-5	4-Methylphenol (p-Cresol)	740.	U	900.	U	790.	U	790.	U	750.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	NR		NR		NR		NR		NR	

CHARLESTON - ZONE A
NAVAL BASE CHARLESTON ZONE A (NBCH)
AOC 506 - SVOCs in Groundwater

SM846-SV0A

SAMPLE ID -----> 506-G-W001-01
ORIGINAL ID -----> 506GW00101
LAB SAMPLE ID ----> L5997-36
ID FROM REPORT ---> 506GW00101
SAMPLE DATE -----> 12/07/95
DATE EXTRACTED ---> 12/14/95
DATE ANALYZED ----> 12/21/95
MATRIX -----> Water
UNITS -----> UG/L

CAS #	Parameter	LS997	VAL				
108-95-2	Phenol	10.	U				
111-44-4	bis(2-Chloroethyl)ether	10.	U				
95-57-8	2-Chlorophenol	10.	U				
541-73-1	1,3-Dichlorobenzene	10.	U				
106-46-7	1,4-Dichlorobenzene	10.	U				
100-51-6	Benzyl alcohol	21.	U				
95-50-1	1,2-Dichlorobenzene	10.	U				
95-48-7	2-Methylphenol (o-Cresol)	10.	U				
39638-32-9	Bis(2-Chloroisopropyl)Ether	10.	U				
621-64-7	N-Nitroso-di-n-propylamine	10.	U				
67-72-1	Hexachloroethane	10.	U				
98-95-3	Nitrobenzene	10.	U				
78-59-1	Isophorone	10.	U				
88-75-5	2-Nitrophenol	10.	U				
105-67-9	2,4-Dimethylphenol	10.	U				
65-85-0	Benzoic acid	52.	UJ				
111-91-1	bis(2-Chloroethoxy)methane	10.	U				
120-83-2	2,4-Dichlorophenol	10.	U				
120-82-1	1,2,4-Trichlorobenzene	10.	U				
91-20-3	Naphthalene	10.	U				
106-47-8	4-Chloroaniline	21.	U				
87-68-3	Hexachlorobutadiene	10.	U				
59-50-7	4-Chloro-3-methylphenol	21.	U				
91-57-6	2-Methylnaphthalene	10.	U				
77-47-4	Hexachlorocyclopentadiene	10.	U				
88-06-2	2,4,6-Trichlorophenol	10.	U				
95-95-4	2,4,5-Trichlorophenol	10.	U				
91-58-7	2-Chloronaphthalene	10.	U				
88-74-4	2-Nitroaniline	52.	U				
131-11-3	Dimethyl phthalate	10.	U				
208-96-8	Acenaphthylene	10.	U				
606-20-2	2,6-Dinitrotoluene	10.	U				
99-09-2	3-Nitroaniline	52.	U				
83-32-9	Acenaphthene	10.	U				
51-28-5	2,4-Dinitrophenol	52.	U				
100-02-7	4-Nitrophenol	52.	U				

CHARLESTON - ZONE A
NAVAL BASE CHARLESTON ZONE A (NBCH)
AOC 506 - SVOCs in Groundwater

SW846-SVDA		SAMPLE ID ----->	506-G-W001-01				
		ORIGINAL ID ----->	506GW00101				
		LAB SAMPLE ID ---->	15997-36				
		ID FROM REPORT -->	506GW00101				
		SAMPLE DATE ----->	12/07/95				
		DATE EXTRACTED -->	12/14/95				
		DATE ANALYZED ---->	12/21/95				
		MATRIX ----->	Water				
		UNITS ----->	UG/L				
CAS #	Parameter	L5997	VAL				
132-64-9	Dibenzofuran	10.	U				
121-14-2	2,4-Dinitrotoluene	10.	U				
84-66-2	Diethylphthalate	10.	U				
7005-72-3	4-Chlorophenylphenylether	10.	U				
86-73-7	Fluorene	10.	U				
100-01-6	4-Nitroaniline	21.	UU				
534-52-1	2-Methyl-4,6-Dinitrophenol	52.	U				
86-30-6	N-Nitrosodiphenylamine	10.	U				
101-55-3	4-Bromophenyl-phenylether	10.	U				
118-74-1	Hexachlorobenzene	10.	U				
87-86-5	Pentachlorophenol	52.	U				
85-01-8	Phenanthrene	10.	U				
120-12-7	Anthracene	10.	U				
86-74-8	Carbazole	10.	U				
84-74-2	Di-n-butylphthalate	10.	U				
206-44-0	Fluoranthene	10.	U				
129-00-0	Pyrene	10.	U				
85-68-7	Butylbenzylphthalate	10.	U				
91-94-1	3,3'-Dichlorobenzidine	21.	U				
56-55-3	Benzo(a)anthracene	10.	U				
218-01-9	Chrysene	10.	U				
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U				
117-84-0	Di-n-octyl phthalate	10.	U				
205-99-2	Benzo(b)fluoranthene	10.	U				
207-08-9	Benzo(k)fluoranthene	10.	U				
50-32-8	Benzo(a)pyrene	10.	U				
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U				
53-70-3	Dibenz(a,h)anthracene	10.	U				
191-24-2	Benzo(g,h,i)perylene	10.	U				
106-44-5	4-Methylphenol (p-Cresol)	10.	U				
108-60-1	2,2'-oxybis(1-Chloropropane)	NR					

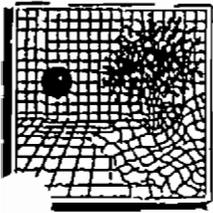
CHARLESTON - ZONE A
CHARLESTON ZONE A - QUARTERLY GW
AOC 506 - SVOCs in Groundwater

SW846-SVOC		SAMPLE ID -----> 506-G-W001-04					
		ORIGINAL ID -----> 506GW00104					
		LAB SAMPLE ID ----> 6434-02					
		ID FROM REPORT --> 506GW00104					
		SAMPLE DATE -----> 10/10/96					
		DATE EXTRACTED --> 10/14/96					
		DATE ANALYZED ----> 10/23/96					
		MATRIX -----> Water					
		UNITS -----> UG/L					
CAS #	Parameter	6434	VAL				
108-95-2	Phenol	10.	U				
111-44-4	bis(2-Chloroethyl)ether	10.	U				
95-57-8	2-Chlorophenol	10.	U				
541-73-1	1,3-Dichlorobenzene	10.	U				
106-46-7	1,4-Dichlorobenzene	10.	U				
100-51-6	Benzyl alcohol	10.	U				
95-50-1	1,2-Dichlorobenzene	10.	U				
95-48-7	2-Methylphenol (o-Cresol)	10.	U				
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	UJ				
106-44-5	4-Methylphenol (p-Cresol)	10.	U				
621-64-7	N-Nitroso-di-n-propylamine	10.	U				
67-72-1	Hexachloroethane	10.	U				
98-95-3	Nitrobenzene	10.	U				
78-59-1	Isophorone	10.	U				
88-75-5	2-Nitrophenol	10.	U				
105-67-9	2,4-Dimethylphenol	10.	U				
65-85-0	Benzoic acid	50.	UJ				
111-91-1	bis(2-Chloroethoxy)methane	10.	U				
120-83-2	2,4-Dichlorophenol	10.	U				
120-82-1	1,2,4-Trichlorobenzene	10.	U				
91-20-3	Naphthalene	10.	U				
106-47-8	4-Chloroaniline	10.	U				
87-68-3	Hexachlorobutadiene	10.	U				
59-50-7	4-Chloro-3-methylphenol	10.	U				
91-57-6	2-Methylnaphthalene	10.	U				
77-47-4	Hexachlorocyclopentadiene	10.	U				
88-06-2	2,4,6-Trichlorophenol	10.	U				
95-95-4	2,4,5-Trichlorophenol	25.	U				
91-58-7	2-Chloronaphthalene	10.	U				
88-74-4	2-Nitroaniline	25.	U				
131-11-3	Dimethyl phthalate	10.	U				
208-96-8	Acenaphthylene	10.	U				
606-20-2	2,6-Dinitrotoluene	10.	U				
99-09-2	3-Nitroaniline	25.	U				
83-32-9	Acenaphthene	10.	U				
51-28-5	2,4-Dinitrophenol	25.	UJ				

CHARLESTON - ZONE A
CHARLESTON ZONE A - QUARTERLY GW
AOC 506 - SVOCs in Groundwater

SW846-SVOC		SAMPLE ID ----->	506-G-W001-04				
		ORIGINAL ID ----->	506GW00104				
		LAB SAMPLE ID ---->	6434-02				
		ID FROM REPORT -->	506GW00104				
		SAMPLE DATE ----->	10/10/96				
		DATE EXTRACTED -->	10/14/96				
		DATE ANALYZED -->	10/23/96				
		MATRIX ----->	Water				
		UNITS ----->	UG/L				
CAS #	Parameter	6434	VAL				
100-02-7	4-Nitrophenol	25.	U				
132-66-9	Dibenzofuran	10.	U				
121-14-2	2,4-Dinitrotoluene	10.	U				
84-86-2	Diethylphthalate	10.	U				
7005-72-3	4-Chlorophenylphenylether	10.	U				
86-73-7	Fluorene	10.	U				
100-01-6	4-Nitroaniline	25.	U				
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U				
86-30-6	N-Nitrosodiphenylamine	10.	U				
101-55-3	4-Bromophenyl-phenylether	10.	U				
118-74-1	Hexachlorobenzene	10.	U				
87-86-5	Pentachlorophenol	25.	U				
85-01-8	Phenanthrene	10.	U				
120-12-7	Anthracene	10.	U				
86-74-8	Carbazole	10.	U				
84-74-2	Di-n-butylphthalate	10.	U				
206-44-0	Fluoranthene	10.	U				
129-00-0	Pyrene	10.	U				
85-68-7	Butylbenzylphthalate	10.	U				
91-94-1	3,3'-Dichlorobenzidine	10.	U				
56-55-3	Benzo(a)anthracene	10.	U				
218-01-9	Chrysene	10.	U				
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U				
117-84-0	Di-n-octyl phthalate	10.	U				
205-99-2	Benzo(b)fluoranthene	10.	U				
207-08-9	Benzo(k)fluoranthene	10.	U				
50-32-8	Benzo(a)pyrene	10.	U				
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U				
53-70-3	Dibenz(a,h)anthracene	10.	U				
191-24-2	Benzo(g,h,i)perylene	10.	U				
110-86-1	Pyridine	10.	U				
103-33-3	Azobenzene	10.	U				
62-53-3	Aniline		NR				
62-75-9	N-Nitrosodimethylamine		NR				

Attachment B



SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 West Albany Broken Arrow, Oklahoma 74012 Office (918) 251-2858 Fax (918) 251-2599

INSAFE INC.
5724 SUMMER TREES DRIVE
MEMPHIS, TN 38134

REPORT : 37527.01

REPORTED : 03/16/99

Attn: BLAKE COUTURE

PROJECT : ZONE A, RELEASE 87
LAB# : 37527.01
SAMPLE #: 506SB00102
LOCATION:
MATRIX : Soil

SAMPLED : 02/23/99
SUBMITTED: 02/24/99

MOISTURE: 13.2

MISCELLANEOUS REPORTED ON A DRY WEIGHT BASIS

PARAMETER	RESULTS**	UNITS	DATE PREPARED	DATE ANALYZED	REFERENCE METHOD
ORGANIC CARBON	3540	mg/kg		02/25/99	EPA 415.1/SW 9060

Data File: /chem/p.i/p990305a.b/p19861.d
 Report Date: 12-Mar-1999 10:11

Southwest Laboratory of Oklahoma

TARGET COMPOUNDS

Client Name: ENSAFE Client SDG: 37527
 Client Sample ID: 06SB00102 Sample Date:
 Sample Location: Sample Point:
 Lab Sample ID: 37527.01 Date Received: 02/24/99
 Sample Type: WATER Quant Type: ISTD
 Analysis Type: SV Level: LOW
 Data Type: MS DATA
 Misc Info: MS540*TB990225A1*INSTP*ENSAFE*37527.01*500ML/1ML/2UL*

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
108-95-2	Phenol	20.00	U
111-44-4	bis(2-Chloroethyl) ether	20.00	U
95-57-8	2-Chlorophenol	20.00	U
541-73-1	1,3-Dichlorobenzene	20.00	U
106-46-7	1,4-Dichlorobenzene	20.00	U
100-51-6	Benzyl alcohol	20.00	U
95-50-1	1,2-Dichlorobenzene	20.00	U
95-48-7	2-Methylphenol	20.00	U
108-60-1	bis(2-Chloroisopropyl) ether	20.00	U
106-44-5	4-Methylphenol	20.00	U
621-64-7	N-Nitroso-di-n-propylamine	20.00	U
67-72-1	Hexachloroethane	20.00	U
98-95-3	Nitrobenzene	20.00	U
78-59-1	Isophorone	20.00	U
88-75-5	2-Nitrophenol	20.00	U
105-67-9	2,4-Dimethylphenol	20.00	U
111-91-1	bis(2-Chloroethoxy)methane	20.00	U
65-85-0	Benzoic Acid	50.00	U
120-82-1	1,2,4-Trichlorobenzene	20.00	U
91-20-3	Naphthalene	20.00	U
106-47-8	4-Chloroaniline	20.00	U
87-68-3	Hexachlorobutadiene	20.00	U
59-50-7	4-Chloro-3-methylphenol	20.00	U
91-57-6	2-Methylnaphthalene	20.00	U
77-47-4	Hexachlorocyclopentadiene	20.00	U
88-06-2	2,4,6-Trichlorophenol	20.00	U
95-95-4	2,4,5-Trichlorophenol	50.00	U
120-83-2	2,4-Dichlorophenol	20.00	U
91-58-7	2-Chloronaphthalene	20.00	U
88-74-4	2-Nitroaniline	50.00	U
131-11-3	Dimethylphthalate	20.00	U
208-96-8	Acenaphthylene	20.00	U
606-20-2	2,6-Dinitrotoluene	20.00	U
121-14-2	2,4-Dinitrotoluene	20.00	U
99-09-2	3-Nitroaniline	50.00	U
83-32-9	Acenaphthene	20.00	U
51-28-5	2,4-Dinitrophenol	50.00	U
100-02-7	4-Nitrophenol	50.00	U
132-64-9	Dibenzofuran	20.00	U

Data File: /chem/p.i/p990305a.b/p19861.d
 R rt Date: 12-Mar-1999 10:11

Southwest Laboratory of Oklahoma

TARGET COMPOUNDS

Client Name: ENSAFE Client SDG: 37527
 Client Sample ID: 06SB00102 Sample Date:
 Sample Location: Sample Point:
 Lab Sample ID: 37527.01 Date Received: 02/24/99
 Sample Type: WATER Quant Type: ISTD
 Analysis Type: SV Level: LOW
 Data Type: MS DATA
 Misc Info: MS540*TB990225A1*INSTP*ENSAFE*37527.01*500ML/1ML/2UL*

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
84-66-2	Diethylphthalate	20.00	U
86-73-7	Fluorene	20.00	U
7005-72-3	4-Chlorophenyl-phenylether	20.00	U
100-01-6	4-Nitroaniline	50.00	U
86-30-6	N-Nitrosodiphenylamine	20.00	U
534-52-1	4,6-Dinitro-2-methylphenol	50.00	U
101-55-3	4-Bromophenylphenylether	20.00	U
118-74-1	Hexachlorobenzene	20.00	U
87-86-5	Pentachlorophenol	50.00	U
85-01-8	Phenanthrene	20.00	U
120-12-7	Anthracene	20.00	U
84-74-2	Di-n-butylphthalate	20.00	U
206-44-0	Fluoranthene	20.00	U
129-00-0	Pyrene	20.00	U
85-68-7	Butylbenzylphthalate	20.00	U
56-55-3	Benzo(a)anthracene	20.00	U
91-94-1	3,3'-Dichlorobenzidine	40.00	U
218-01-9	Chrysene	20.00	U
117-81-7	bis(2-Ethylhexyl)phthalate	17.67	J
117-84-0	Di-n-octylphthalate	20.00	U
205-99-2	Benzo(b)fluoranthene	20.00	U
207-08-9	Benzo(k)fluoranthene	20.00	U
50-32-8	Benzo(a)pyrene	20.00	U
53-70-3	Dibenz(a,h)anthracene	20.00	U
193-39-5	Indeno(1,2,3-cd)pyrene	20.00	U
191-24-2	Benzo(g,h,i)perylene	20.00	U
86-74-8	Carbazole	20.00	U
367-12-4	2-Fluorophenol	131.79	
4165-62-2	Phenol-d5	131.26	
4165-60-0	Nitrobenzene-d5	77.16	
321-60-8	2-Fluorobiphenyl	77.86	
118-79-6	2,4,6-Tribromophenol	86.45	
98904-43-9	Terphenyl-d14	70.78	
93951-73-6	2-Chlorophenol-d4	124.03	
2199-69-1	1,2-Dichlorobenzene-d4	64.47	

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

Semivolatile
 Test Code MS500
 Method SW846 8270C
 Matrix Water-Soil
 Extract Volume 1000 mL - 30g
 Initial Calibration 10, 20, 50, 80, 100 ng, %RSD for CCC compounds=30%, SPCC=RF >
 Continuing Calibration 50 ng, %D = 20% for CCC Compounds, SPCC = RF > 0.05
 PAGE 1 OF 2

COMPOUND	CAS NUMBE	PQL's		MDL's	
		WATER	SOIL	WATER	SOIL
		ug/L	ug/Kg	ug/L	ug/Kg
1,2,4-Trichlorobenzene	120-82-1	10	330	3.7	65
1,2-Dichlorobenzene	95-50-1	10	330	3.7	74
1,3-Dichlorobenzene	541-73-1	10	330	4.1	31
1,4-Dichlorobenzene	* 106-46-7	10	330	4.2	58
2,3,4,6-Tetrachlorophenol	58-90-2	10	330	8.2	71
2,4,5-Trichlorophenol	95-95-4	50	1600	6.1	120
2,4,6-Trichlorophenol	* 88-06-2	10	330	4.6	85
2,4-Dichlorophenol	* 120-83-2	10	330	4.7	70
2,4-Dimethylphenol	105-67-9	10	330	4.0	210
2,4-Dinitrophenol	** 51-28-5	50	1600	7.1	64
2,4-Dinitrotoluene	121-14-2	10	330	2.9	74
2,6-Dinitrotoluene	606-20-2	10	330	3.1	85
2-Chloronaphthalene	91-58-7	10	330	3.3	63
2-Chlorophenol	95-57-8	10	330	5.0	92
2-Methylnaphthalene	91-57-6	10	330	3.2	43
2-Methylphenol	95-48-7	10	330	5.1	170
2-Nitroaniline	88-74-4	10	1600	3.4	57
2-Nitrophenol	* 88-75-5	10	330	7.7	93
3,3'-Dichlorobenzidine	91-94-1	20	660	3.3	6.4
3-Nitroaniline	99-09-2	50	1600	5.7	3.6
4,6-Dinitro-2-methylphenol	534-52-1	50	1600	7.3	93
4-Bromophenyl-phenylether	101-55-3	10	330	3.1	72
4-Chloro-3-methylphenol	* 59-50-7	10	330	4.1	75
4-Chloroaniline	106-47-8	10	330	4.6	87
4-Chlorophenyl-phenylether	7005-72-3	10	330	4.1	49
4-Methylphenol	106-44-5	10	330	6.0	220
4-Nitroaniline	100-01-6	50	1600	2.5	62
4-Nitrophenol	** 100-02-7	50	1600	7.1	93
Acenaphthene	* 83-32-9	10	330	3.4	65
Acenaphthylene	208-96-8	10	330	3.5	69
Anthracene	120-12-7	10	330	2.7	47
Benzo(a)anthracene	56-55-3	10	330	2	56
Benzo(a)pyrene	* 50-32-8	10	330	2.6	38
Benzo(b)fluoranthene	205-99-2	10	330	2.8	160
Benzo(g,h,i)perylene	191-24-2	10	330	2.8	81
Benzo(k)fluoranthene	207-08-9	10	330	4.2	96
Benzoic acid	65-85-0	50	1600	7.9	440
Benzyl alcohol	100-51-6	10	330	5.2	98
Butylbenzylphthalate	85-68-7	10	330	0.3	87

WATER MDLS PERFORMED ON INST V <01/09/98>

SOIL MDL'S PERFORMED ON INST P <01/08/98>

NR = NonRoutine Compounds. Analyzed only upon request.

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

Test Code Semivolatile
 Method MS500
 Matrix SW846 8270C
 Extract Volume Water-Soil
 Initial Calibration 1000 mL - 30g
 Continuing Calibration 10, 20, 50, 80, 100 ng.%RSD for CCC compounds=30%, SPCC=RF > 50 ng, %D = 20% for CCC Compounds, SPCC = RF > 0.05
 PAGE 2 OF 2

COMPOUND	CAS NUMBE	PQL's		MDL's	
		WATER ug/L	SOIL ug/Kg	WATER ug/L	SOIL ug/Kg
Carbazole	86-74-8	10	330	2.3	89
Chrysene	218-1-9	10	330	2.5	51
Di-n-octylphthalate	* 117-84-0	10	330	1.8	46
Dibenz(a,h)anthracene	53-70-3	10	330	3.0	150
Dibenzofuran	132-64-9	10	330	3.3	50
Diethylphthalate	84-66-2	10	330	0.4	64
Fluoranthene	* 206-44-0	10	330	2.2	71
Fluorene	86-73-7	10	330	3.2	40
Hexachlorobenzene	118-74-1	10	330	2.8	59
Hexachlorobutadiene	* 87-68-3	10	333	3.3	56
Hexachlorocyclopentadiene	** 77-47-4	10	330	0.6	73
Hexachloroethane	67-72-1	10	330	3.6	120
Indeno(1,2,3-cd)pyrene	193-39-5	10	330	3.3	280
Isophorone	78-59-1	10	330	4.1	69
N-Nitroso-di-n-propylamine	** 621-64-7	10	330	4.1	110
N-Nitrosodiphenylamine	* 86-30-6	10	330	2.0	56
Naphthalene	91-20-3	10	330	3.7	30
Nitrobenzene	98-95-3	10	330	3.8	74
Pentachlorophenol	* 87-86-5	50	1600	8.4	130
Phenanthrene	85-01-8	10	330	2.9	42
Phenol	* 108-95-2	10	330	4.2	66
Pyrene	129-00-2	10	330	2.4	47
bis(2-Chloroethoxy)methane	111-91-1	10	330	4.0	69
bis(2-Chloroethyl)ether	111-44-4	10	330	3.5	61
bis(2-Chloroisopropyl)ether	108-60-1	10	330	4.5	73
bis(2-Ethylhexyl)phthalate	117-81-7	10	330	1.9	80

* CCC compounds **SPCC compounds

WATER MDLS PERFORMED ON INST. H <01/09/98>

SOIL MDLS PERFORMED ON INST. H <01/08/98>

Attachment C

SOIL SCREENING LEVEL PARTITIONING EQUATION FOR MIGRATION TO GROUNDWATER

ZONE A: AOC 506

SIMPLIFYING ASSUMPTIONS FOR SSL MIGRATION TO GW PATHWAY

- 1) Infinite source
- 2) Uniform contamination distribution from surface to top aquifer
- 3) No contamination attenuation (i.e., adsorption, biodegradation)
- 4) Instantaneous and linear equilibrium soil-water partitioning
- 5) Homogeneous, isotropic, unconfined aquifer
- 6) Receptor well at downgradient edge of source and screened in plume
- 7) No contaminant attenuation in aquifer
- 8) No NAPLs present.

$SSL_{(soil)} = C_w [K_d + (\theta_w + \theta_a H') / \rho_b]$ <p>where: SSL_(soil) = screening level in soil (mg/kg) C_w = target soil leachate conc. (mg/l) [MCL] K_d = soil-water partition coeff. θ_w = water filled soil porosity (L_{water}/L_{soil}) θ_a = air-filled soil porosity (L_{water}/L_{soil}) ρ_b = dry soil bulk density (kg/L) H' = Henry's law constant (dimensionless) other variables: f_{oc} = fraction organic carbon in soil (g/g) K_{oc} = soil organic carbon/water partition coeff (L/kg)</p>	<p>Site-Specific Input Data:</p> <p>n (Zone A)# = 0.35 K_h* (ft/d) = 1.1 convert to m/yr = 122.38 pb (sand/sty sd) lb/f 122.34 convert to kg/L = 1.959 f_{oc}^(mg/kg)= 3540 as % ≈ 0.00354</p> <p>* geomean of all Qs deposits regardless of depth # avg of 3 STs from sand <13.5 ft bgs</p>	<p>ZONE A Kh (ft/d)</p> <p>506001= 1.1 Qs* = 3.6</p>
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<p>1) Calc. avg. soil moist. content. Assume n represents avg. annual soil moisture conditions $\theta_w = n / (1/K_d)^{1/(2b+3)}$ I = infiltration rate (in/yr) = 1.2 convert to m/yr = 0.03048 1/(2b+3) = soil-specific exponential parameter (unitless) = 0.09 for sand θ_w = 0.166</p>	<p>Literature Data: Contaminant = benzo(a)pyrene C_w = 2.00E-04 MCL [mg/l] H' = 4.63E-05 K_{oc} = 1.02E+06</p>
<p>2) Calc. avg. air-filled soil porosity $n = \theta_w + \theta_a$ θ_a = 0.184</p>	<p>5) Apply dilution attenuation factor Assuming 0.5 acre source area: At DAF = 10 SSL = 7,222 ug/kg At DAF = 20 SSL = 14,444 ug/kg</p>
<p>3) Calc. Kd $K_d = K_{oc} * f_{oc}$ K_d = 3610.8</p>	
<p>4) Calc. SSL_(soil) SSL_(soil) = 0.722177 in ug/kg = 722.177</p>	