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NAS PENSACOLA
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RESPONSE TO U S EPA REGION IV AND FLORIDA DEPARTMENT OF ENVRONMENTAL PROTECTION COMMENTS ON SAMPLING AND ANALYSIS PLAN GROUNDWATER SURFACE WATER INTERFACE OPERABLE UNIT 2 SITES 11 AND 30 NAS PENSACOLA FL
11/22/2011
NAVFAC SOUTHERN

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RESPONSE TO FDEP COMMENTS
(Dated December 13, 2010)
SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN) GROUNDWATER/SURFACEWATER INTERFACE, OPERABLE UNIT (OU 2) – SITES 11 AND 30

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Comment 1: On page 8, Section 10.2, Site 11, second paragraph, the language explaining the selected remedy regarding contaminated soil removal is contradictory and unclear. The paragraph should be reworded.

Response: The second paragraph on Page 28, Section 10.2, Site 11, will be reworded and read as follows (~~Strikethrough~~ text has been deleted and *bold italic* text has been added): ~~*Under the response action, associated with*~~ ~~t~~ The selected remedy for Site 11, as *described in detail in the ROD (Tetra Tech, 2008) and Remedial Design (Tetra Tech, 2010), includes the removal of contaminated soil* ~~*will be removed*~~ *such that the average soil contaminant concentrations based on the 95 percent upper confidence limit meet the state of Florida industrial direct exposure Soil Cleanup Target Levels (SCTLs). Additionally, the remedy includes the removal of soil in the vadose zone where* ~~*vadose zone soil with*~~ *contaminant concentrations* ~~*that exceed leachability SCTLs will be also be excavated. Also, surface soil areas identified as exceeding state of Florida industrial direct exposure and leachability to groundwater (SCTLs) will be*~~ *Soil removed* ~~*and*~~ *will be replaced with clean fill to prevent unacceptable exposure under the present and future site use.*

Comment 2: On page 39, Section 11.3, Site 11 and Site 30 Vertical Boundaries, it says the vertical boundary of groundwater associated with these sites ranges from ground surface at the edge of the wetland to a maximum depth of approximately 30 feet. On page 32, top of page, it says the shallow zone extends from the water table to 50 feet bgs or the dark green marine clay. In SAP Worksheet #18.1 on pages 62 and 63, several OPT points are identified as extending to 35 feet bgs. This different depth should be resolved for the extent of the shallow zone.

Response: Shallow zone has been defined for Site 11 and 30 as 20 feet below the water table, which corresponds to the upper 20 feet of the saturated shallow aquifer. According the previous investigations (EnSAFE, 1997 & 2005), there is no physical separation between the shallow and intermediate depths, other than the vertical positioning. Therefore, due to the elevation of the sites, the depth of the shallow zone ranges from 1 feet to 25 feet bgs and the intermediate zone ranges from 25 feet to 50 feet bgs. The UFP SAP will be revised with the definition of shallow and intermediate zone (deeper 20 feet of the saturated shallow aquifer) as described in this response.

Comment 3: In SAP Worksheet #15 on page 51 and SAP Worksheet #17 on pages 58 and 59, a very limited list of metals are identified for analyses. They include arsenic, barium, beryllium, cadmium, chromium and vanadium. As this project is to investigate the groundwater/ surface water interface, the inclusion of barium and vanadium, which have no promulgated surface water criteria is curious. Also, the inclusion of arsenic and beryllium as analytes to be investigated is also curious, as they do not appear to have been identified as chemicals of concern in groundwater per Figure 10-1 on page 34 and arsenic's surface water cleanup target level is greater than its groundwater cleanup target level. Lastly, two inorganics, lead and iron, are shown on Figure 10-1 as having been detected at concentrations above their groundwater cleanup target levels and surface water cleanup target levels in monitoring wells to be sampled as part of the groundwater/ surface water interface investigation, but these analytes are not identified as being part of the investigation.

Response: Figure 10-1 shows the most recent sampling event exceedances, which do not include arsenic and beryllium exceedances that were reported from previous sampling event. It should be noted that results from all the sampling events have been incorporated in the ROD and Proposed Plan documents. Additionally, lead and iron will be included to the list of metals to be analyzed.

Comment 4: In SAP Worksheet #18.1, the OPT screen intervals are specified as either 10 feet (5-15 feet bgs or 25-35 feet bgs) or 15 feet (20-35 feet bgs). Please ensure these OPT screen intervals are correct.

Response: Worksheet #18.1 will be revised to indicate that all screen intervals will be 10 feet.

RESPONSE TO USEPA COMMENTS
(Received September 23, 2011)
SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN) GROUNDWATER/SURFACEWATER INTERFACE, OPERABLE UNIT (OU 2) – SITES 11 AND 30

NAVAL AIR STATION PENSACOLA
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GENERAL COMMENTS

1. The Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) Groundwater/Surface Water Interface Operable Unit (OU) 2 – Sites 11 and 30 dated July 2010 (SAP) discusses that four of the six sites that comprise OU 2 are identified as sources of Radium 226 contamination. These sites include: Site 12 - Scrap Bins; Site 25 - Radium Spill Area; Site 27 – Radium Dial Shop Sewer; and Site 30 – Complex of Industrial Buildings and Industrial Wastewater Treatment Plant (IWTP) Sewer Line. The SAP states that environmental investigations at OU 2 began in 1976 with an investigation of the radium contamination in the sewer lines at Site 27. It is understood that the Navy is currently conducting soil removal at the four Radium 226 contaminated sites (i.e., Sites 12, 25, 27, and 30). However, Radium 226 is a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substance and it has not been explicitly addressed in the SAP. This data gap in the characterization of Radium 226 contamination in groundwater appears to be a shortcoming of the remedial investigation (RI) process (which addresses only the CERCLA wastes) that was carried forward through to the OU 2 record of decision (ROD). In order to manage the uncertainty regarding whether unacceptable Radium 226 groundwater to surface water impacts are occurring, it is recommended the groundwater to surface water pathway for contaminant migration investigation (GSI investigation) include the assessment of Radium 226. Revise all relevant SAP worksheets to include the assessment of Radium 226 as part of the GSI investigation.

RESPONSE: In 1984, during the Verification Study, Geraghty and Miller installed a monitoring well (027GG002) at Site 27. Analytical data showed gross alpha radiation below the Florida groundwater standard in effect at that time.

In 1991, a radiological study was conducted at Building 709 by Radian/ABB Environmental Services. No radioactivity was found and a cold storage area was conducted at the site in 1995.

In 1992, Ecology and Environment performed a Phase I study at Sites 25 and 27 that included geophysical screening of surface radiation, a soil headspace survey, drilling and sampling shallow soil borings, and installation of temporary monitoring wells. Analysis of soil samples found isolated areas of Radium-226 contamination, the main one near the south wall of Building 709. Groundwater was reported to exceed USEPA and Florida standard in effect at that time for in one well located south of Building 709 and in all five wells at Site 25.

In 1996, an assessment of radioactive materials was conducted during the RI for OU 2 (Ensafe, 1997). Appendix D or the RI contains the results of the radiological investigation. The radiological investigation was conducted to explore possible near-surface radiation at Sites 25 and 27 and a preliminary radiological screening survey was conducted at sites 12 and 26. The investigation at Site 25 revealed that a spill of radium-paint waste occurred at a loading dock. The contamination was confined to concrete pavement and cleaned up. The survey conducted for the RI found no evidence of the spill. The radiation survey at Site 27 revealed a small area south of Former Building 709. The area was reported in the RI to appear to be adjacent to an old stairway from building 709. Outside this limited area, no significant radiological contamination was found.

At Sites 12 and 26, a preliminary survey was conducted for Radium-226 using a radiation survey meter. The preliminary investigation revealed radiological contamination in two locations at Site 12; in the north-central portion of the Site, and the other a 30 by 50 foot area for to a depth of 15 inches below the ground surface near the southeastern corner of the Site. The soils in the 30 by 50 foot area appeared to be the only area that exceeded Department of Energy Guidelines in effect at that time. Groundwater samples were collected from 4 monitoring wells at Sites 25 and 27 (2 at each site). Groundwater samples from these wells did not contain radium at concentrations exceeding Florida groundwater standards, which indicates there is no significant radium contamination in groundwater at the sites.

In October 2011, groundwater samples were collected by the Navy from three monitoring wells at Site 25, two monitoring wells at Site 27, and a background location. The groundwater samples were analyzed for Radium-226 and Radium-228. Preliminary results (not validated) indicate that Radium-226 was detected at concentrations ranging from 0.340 to 1.640 picocuries per liter in four samples (111GI02, 11GS11, 12 GS13 and 27GSI04) but below the Federal and Florida MCL of 5 picocuries per liter for Radium-226 and Radium-228 combined. Radium-228 was not detected above detection limits in the groundwater samples. Radium-226 and Radium-228 were not detected in the groundwater sample from the background well. These draft analytical results were provided by the Navy's Radiological Affairs Support Office to the NAS Pensacola Partnering Team in a presentation 11/16/11.

Based on the above, there is not a data gap with respect to Radium-226 as part of the Groundwater to Surface Water Investigation.

2. Currently, a significant data gap exists in the characterization of CERCLA Radium 226 contamination in groundwater. The current magnitude and extent of Radium 226 contamination in groundwater is uncertain and therefore, is a problem warranting action. Figure 10-1, OU 2 GSI Investigation Extent of Groundwater Contamination and Proposed Sample Locations, depicts the chemicals of concern (COCs) that exceed their Florida groundwater cleanup target levels (GCTLs). However, it does not appear that Sites 12, 25, and 27 have adequate monitoring well coverage as very few to no wells are depicted at these locations where sources of Radium 226 contamination are known to exist. Because the SAP pertains to Sites 11 and 30 only, it is not clear if additional monitoring wells are located at Sites 12, 25, and 27 but were purposely omitted from the figure. Currently, Figure 10-1 shows no wells at Sites 12 and 25 and only one well located within the Site 27 boundary. As currently depicted, a data gap exists in the current monitoring well network regarding the determination of the magnitude and extent of Radium 226 contamination in groundwater, particularly at Sites 12 and 25. It is not clear if all monitoring wells installed at OU 2, particularly at the sites where Radium 226 contamination is known to exist, have been depicted on the relevant SAP figures. If no wells have been installed at the sites where known sources of Radium 226 contamination exist, additional well installation to adequately characterize the magnitude and extent of Radium 226 contamination in groundwater at OU 2 is warranted.

RESPONSE: It is the Navy's opinion that a sufficient monitoring well network exists at the site to adequately assess the COCs at the sites. This opinion is supported by Figures 2 and 3 from the RI (Attachment 1) that shows monitoring well locations and the shallow and deep potentiometric surfaces for March 2003. The figures show the shallow and deep monitoring wells at the subject sites and those installed hydraulically downgradient (east) of the sites toward the wetlands. Data gaps do not exists in the current monitoring well network regarding the determination of the magnitude and extent of Radium 226 contamination (Please refer to the response to General Comment 1 and the Navy's 11/16/11 presentation).

3. According to the SAP, OU 2 has been investigated and a Record of Decision (ROD) was signed on September 29, 2008. Part of the remedy described in the ROD includes a GSI investigation. However, it is not clear from reviewing the SAP what the results will specifically be used for. It is stated in the executive summary that the information gained from this GSI investigation may be used to optimize the extent of the areas which would require land use controls (LUC). It is not clear whether human health and ecological risk assessments will be performed with the results, or how "the extent of the areas which would require LUCs" will be performed. Data Uses: The SAP should clearly state what the general uses of the data gathered would be. Please include in the document how the data gathered from the groundwater and pore water investigation will be used to determine impacts to surface water.

RESPONSE: The objective of the GSI Investigation is to use a phase approach to determine the influence between groundwater flow systems and surface-water bodies, both marine and freshwater. To achieve this objective, Phase I will consist of a direct push technology (DPT) boring investigation to determine plume extents at Sites 11 and 30. The Phase I DPT investigation at Sites 11 and 30 will include the collection of groundwater samples downgradient of existing monitoring wells. These samples will evaluate downgradient contaminant levels and natural attenuation processes within the flow path towards Wetlands 5A, 6, and 7. A nested monitoring well network will be installed along the edges of the wetlands and pore water samples will be collected to evaluate groundwater hydraulics, geochemistry, and natural attenuation processes proximal to the GSI. The information on plume extents would be used to determine the area requiring land use controls for groundwater.

Based on information collected from the Phase I investigation, a Phase II GSI investigation will be conducted in areas where the groundwater plumes at OU2 appear to discharge into Wetlands 5A, 5B, 7, and 64. The Phase II investigation will use tools such as those recently developed by the Navy's Space and Naval Warfare Command (SPAWAR) in San Diego, CA. SPAWAR has successfully demonstrated the use of the Trident Probe and the UltraSeep system through a research grant funded by the Department of Defense's Environmental Security Technology Certification Program. The Trident Probe measures temperature and chemical contrasts between groundwater and surface water to map areas of potential groundwater discharge. The UltraSeep system is an integrated ultrasonic seepage meter and water sampling system for quantifying discharge rates and chemical loading from groundwater flow to surface waters. The UltraSeep system is restricted to use in waters greater than one foot deep.

The Phase I and Phase II data will be used to determine if Federal and/or State Surface Water Cleanup Target Levels (SWCTLs) are relevant in the evaluation of long-term groundwater monitoring results. If contaminant concentrations in groundwater and/or pore water samples are less than detection limits, then SWCTLs are unlikely to be relevant. If contaminants are detected at low concentrations in groundwater and/or pore water samples, then SWCTLs may become important and surface water analyses may be needed.

4. Risk Assessment: Please include in the SAP if risk assessment will be performed with the current data. If human health and ecological risk assessments will be performed with the data, then the procedures used to perform the risk assessments should be included in the SAP. As it stands, the SAP does not address concerns regarding risks to ecological receptors. Details of the risk assessments, guidance documents, and the human health and ecological screening values to be used in the risk assessments should be provided in the QAPP. The ecological screening values (ESV) for soils were completely omitted from the tables.

RESPONSE: Human health and ecological risk assessments are not included in Phase I of the GSI.

5. Operable Unit 2: OU 2 has six sites but the decision was made to investigate only Site 11 and 30. It is not clear whether there have been any investigations at the other sites. Radium 226 spills have been documented at the other sites which could impact groundwater. Perhaps not all of the site contaminants were buried in the landfills.

RESPONSE: Please refer to the response to General Comment 1. In addition, RASO will re-examine all radium sites with the planned and upcoming Historical Radiological Assessment (HRA).

6. Bedsides FDEP's SCTL's, EPA's Water Quality Criteria (http://water.epa.gov/scitech/swguidance/standards/current/index.cfm) should also be used for screening purposes. For example, the PCB ambient water water quality criteria (AWQC) is 0.014 ug/L and all the PCB data detection limits for groundwater are 5 times the MCL of 0.5 ug/L and must be lowered for this GSI work.

RESPONSE: PCBs were not a COC for groundwater. The UFP SAP will be amended to include screening of the analytical data EPA's Water Quality Criteria.

7. The determination of the COC's was performed using data that had detection limits considerably above the MCL's for certain compounds (examples: PCBs, TCE, Vinyl Chloride, and others). Because of this, EPA would recommend that more wells than the 9 proposed be sampled and analyzed using proper detection limits so that the COC list can be adequately verified.

RESPONSE: The EPA approved the work plan, RI, PP and ROD for OU 2. The analytical results reflect the appropriate standard analytical methods and detection limits. The scope of work for the UFP SAP was developed in a scoping meeting held on January 8, 2010. The results of the Phase I sampling event will be used to determine if additional sampling locations are necessary during Phase II of the GSI. In addition it should be noted, that this UFP SAP only includes monitoring wells installed and associated with this groundwater to surface water investigation. Separate from this investigation is the OU 2 groundwater remedy of Monitored Natural Attenuation which will include additional wells being sampled near the individual source areas.

8. Please provide a potentiometric surface map of groundwater to ensure that the locations of the wells are correctly positioned. Also clarify the rationale for selecting the locations of the GW/pore water locations.

RESPONSE: Attachment 1 shows monitoring well locations and the shallow and deep potentiometric surfaces for March 2003.

9. Chemical Analyses: For the existing wells it may be okay to analyze for only the identified contaminants of concern (COC) because of available historical information. However, for the new monitoring wells and pore water samples full scan analyses are required because of lack of any historical data.

RESPONSE: There are no other known sites with potential releases to the environment located hydraulically downgradient from Sites 11 and 30, therefore, it is the Navy's opinion that the COCs listed in the ROD (September, 2008) represent a reasonable list of analytes for groundwater and pore water samples. Therefore, to be consistent with the CSM, laboratory analysis will be conducted only the COCs that have been documented for OU2. There are no plans to open each sampling location to a full suite of analytes.

10. Contaminants in Surface Water and Sediment: Pore water is intimately associated with sediment. Therefore if contaminants are detected in the pore water above FDEP and EPA risk benchmarks, then sediment collection and analyses may be required. This may also apply to any surface water in the wetlands.

RESPONSE: Please refer to the response to General Comment 3.

11. Background or Reference Stations: No background or reference stations were included in the SAP. Please indicate whether any background samples will be collected or there is already available background groundwater and pore water information.

RESPONSE: NAS Pensacola has established background concentrations for soil, groundwater and surface water. Background samples for pore water, if necessary, would be obtained during Phase II of the GSI.

12. Groundwater Analytical Results: Groundwater is usually not an exposure route for ecological receptors. However, if groundwater discharges to surface water, ecological receptors may be exposed to the chemicals. The results of the chemical analyses of groundwater, pore water, and possibly, sediment should be compared with ecological screening values in order to determine if ecological receptors are at potential risk.

RESPONSE: The analytical results for groundwater, pore water, and possibly, sediment samples will be compared to appropriate ecological screening values.

13. Quality Control (QC) Samples: The QC samples should include any field or preservative blanks. Also, it appears that the proposed number of trip blanks (six) should be reduced.

RESPONSE: The number of quality control samples will be reviewed and revised as necessary.

II. SPECIFIC COMMENTS

1. Page 3, last sentence: In addition to being used for determination of the LUC area, the investigation would inform a remedial alternative.

RESPONSE: The sentence will be change to: "The information gained from this GSI investigation may be used to optimize the extent of the areas which would require land use controls (LUCs), and provide additional information on the selected remedial alternative."

2. Pg 19, Responsibilities Section: Please note that EPA will also approve sampling and analysis plans ensuring that the UFP-QAPPs meet federal policies and guidance.

RESPONSE: The requested change was made to Worksheet #7; additionally, references to Greg Fraley were changed to Tim Woolheater on Worksheet #s 1, 3, 4, 5 and 9.

3. Pg 28, Second paragraph, last sentence: Please add that the soils removals will also protect groundwater.

RESPONSE: The sentence will be revised to state: "Additionally, to protect groundwater the remedy includes the removal of soil in the vadose zone where contaminant concentrations exceed leachability SCTLs."

4. Page 28, Soil Removal Criteria, second paragraph: Concentration data should be screened against EPA Remedial Screening Levels (RSLs) too. For the Leaching to Groundwater determination screening with the RSL's should also be performed.

RESPONSE: The cleanup goals for soil stated in the Record of Decision (September 2008) are the more stringent of Florida Soil Cleanup Target Levels per Chapter 62-777, Florida Administrative Code or NAS Pensacola background values.

5. Page 29, first paragraph: In this discussion the EPA RSL table should be consulted too.

RESPONSE: Please refer to the response to specific comment 4.

6. Section 10.3, History of Environmental Investigations and Actions, Page 29: The text in the third paragraph of Section 10.3 states that groundwater associated with Sites 11 and 30 appears to be more impacted than the groundwater quality at the other four OU 2 sites. The text references Figure 10-1, OU 2 GSI Investigation Extent of Groundwater Contamination and Proposed Sample Locations, and Figure ES-2, Site Area Map Operable Unit 2, for a depiction of the extent of groundwater contamination and a site area location map, respectively. While Figure 10-1 depicts the COCs with exceedances of the Florida GCTLs, it does not appear that Sites 12, 25, and 27 have adequate monitoring well coverage as very few to no wells are depicted at these locations, even though the sites are known sources of Radium 226 contamination. Currently, Figure 10-1 depicts one well located within the Site 27 boundary and no wells at Sites 12 and 25. Since the SAP pertains to Sites 11 and 30 only, it is not clear if additional monitoring wells located at Sites 12, 25, and 27 were purposely omitted from the figure. As such, the statement that Sites 11 and 30 appear to be more impacted than the groundwater quality at the other four OU 2 sites is not supported by the COC data presented in Figure 10-1. As currently depicted, data gaps exist in the current monitoring well network regarding the determination of the extent of Radium 226 contamination in groundwater, particularly at Sites 12 and 25. All monitoring wells that have been installed at OU 2, particularly at sites where Radium 226 contamination is known to exist, should be depicted in the relevant figures so the adequacy of the monitoring well network can be properly evaluated.

RESPONSE: Figure 10-1 depicts only monitoring wells that had COCs that exceed Florida GCTLs and does not include those without exceedances. However, it is the Navy's opinion that a sufficient monitoring well network exists at the site to adequately assess the COCs at the sites. This opinion is supported by Figures 2 and 3 from the RI (Attachment 1) that shows monitoring well locations and the shallow and deep potentiometric surfaces for March 2003. The figures show the shallow and deep monitoring wells at the subject sites and those installed hydraulically downgradient (east) of the sites toward the wetlands.

The statement "that Sites 11 and 30 appear to be more impacted than the groundwater quality at the other four OU 2 sites is not supported by the COC data presented in Figure 10-1" will be replaced with the following description of the source and analytes detected at Sites 11, 12, 25, 26, 27 and 30 that exceed FDEP GCTLs.

<u>Site 11</u>: The source of groundwater contamination at Site 11 was identified as a former landfill, where trenching revealed evidence of a "seam" of blackened debris at the water table. This oily material contained corroded bits of metal and other debris. Organic compounds detected in groundwater at Site 11 in excess of FDEP GCTLs included benzene, 1,1-dichloroethene (DCE), 1,2-dichloroethane (DCA), cis-1,2-DCE, total 1,2-DCE, dieldrin, 1,1,2,2-tetrachloroethane, tetrachloroethene (PCE), TCE, and vinyl chloride, naphthalene, and aldrin. Inorganics detected in groundwater in excess of FDEP GCTLs included aluminum, arsenic, barium, beryllium, cadmium, chromium, manganese, and vanadium.

<u>Site 12</u>: Possible sources of groundwater contaminants at Site 12 include the storage of scrap metals, past storage of old transformers pending their disposal and residual fuels and oils from scrapped aircraft and vehicles stored at the site. The only organic compound detected in

groundwater at Site 12 in excess of FDEP GCTLs was dieldrin. Inorganics were not detected in groundwater in excess of FDEP GCTLs.

Site 25: Improper storage and disposal of materials, mostly metallic are the source of contaminants in groundwater at Site 25. The loading dock where the radium paint spill and cleanup occurred was investigated in the RI, but evidence of radium-226 contamination was not found. Organic compounds detected in groundwater at Site 25 in excess of FDEP GCTLs included PCE, TCE, and vinyl chloride. Mercury was detected in groundwater in excess of its FDEP GCTL.

Site 26: Possible sources of groundwater contamination include the storage of paints, fuels, and solvents. The only organic compound detected in groundwater at Site 26 in excess of FDEP GCTLs was dieldrin. The only inorganics detected in groundwater in excess of FDEP GCTLs was cadmium.

Site 27: This site was originally investigated because of the sewer from the Radium Dial Shop. The sources of organic and inorganic contaminants in groundwater are uncertain. Organic compounds detected in groundwater at Site 27 in excess of FDEP GCTLs included 1,1-DCA, 1,2-DCA, 1,1-DCE, total 1,2-DCE, PCE, 1,1,1-trichloroethane (TCA), TCE, vinyl chloride, 4-methylphenol, pentachlorophenol, and diedrin. Inorganics detected in groundwater in excess of FDEP GCTLs and NAS Pensacola background RCs included chromium and manganese. However, in more recently collected groundwater samples, manganese was not detected at concentrations in excess of the risk-based RSLs.

Site 30: Maintenance operations in the buildings at Site 30 such as painting, solvent use, and plating probably contributed to groundwater contamination at Site 30. The IWTP sewer line may also have been a source of groundwater contamination. Organic compounds detected in groundwater at Site 30 in excess of FDEP GCTLs included benzene, chloroform, 1,2-DCA, 1,1-DCE, PCE, 1,1,1-TCA, TCE, vinyl chloride, methylene chloride, 1,4-dichlorobenzene (DCB), and chlorobenzene. Inorganics detected in groundwater in excess of FDEP GCTLs included cadmium, chromium, and manganese.

Also, please refer to the response to General Comment 2 concerning Radium 226.

7. Section 10.3, History of Environmental Investigations and Actions, Page 30: The last paragraph in Section 10.3 states the Navy believes the Space and Naval Warfare Systems Command (SPAWAR) study on Wetland 64 meets the requirements of the OU 2 ROD for a GSI investigation at Wetland 64. Therefore, the Navy excluded Wetlands 64 from the GSI investigation that is the focus of this Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP). Section 10.3 indicates the Preliminary Data Report documenting the SPAWAR study had not been reviewed by the project team before the SAP was submitted for regulatory review. As such, it is not known if the assessment of Radium 226 as a hazardous substance contributing to the risk and hazards posed due to releases from past industrial activities was conducted for Wetlands 64. Therefore, the inclusion of Wetland 64 in the current GSI investigation may be warranted to investigate the potential for Radium 266 in groundwater to impact surface water. Revise the SAP to address this issue.

RESPONSE: Please refer to the response to General Comment 1.

8. Pg 30, Section 10.3: This section refers to a SPAWAR report that made specific determinations that the Navy used to remove Wetland 64 from the scope of the study without review by the team. EPA requests a copy of the study with a summary of the specific elements of the report which allowed the Navy to develop this conclusion. EPA will need to review this information along with the report to determine whether Wetlands 64 has been appropriately removed from the scope of this study. Ensafe

(2007) Results: It is stated in Section 10.3 that Ensafe used various techniques to analyze the data on benthic invertebrates and recommended no further action on the wetlands associated with OU 2. Please include what kind of techniques Ensafe used. Ecological risk assessment is usually based on a Triad approach (i.e., benthic survey, toxicity testing, and chemicals analyses) and risk decisions are based on different lines of evidence and not solely on macroinvertebrate survival.

RESPONSE: The requested draft SPAWAR report (SPAWAR, 2010) is provided in Attachment 2.

9. Section 10.4.1, Sources of Contamination, Page 31: Section 10.4.1 does not discuss the sources of known Radium 226 contamination. Revise the SAP as appropriate to include the assessment of the migration of Radium 226 contamination in groundwater to surface water. EPA is also concerned that COC's have been arrived at just based on FDEP GCTL's and not EPA criteria. In looking at the PCB and TCE and Vinyl Chloride groundwater data, the detection limits greatly exceed the MCL so screening them out with elevated detection limits is not acceptable.

RESPONSE: The site history will be amended to include a discussion on the assessment of Radium-226 (Please refer to the response to General Comment 1). The RI (Ensafe, 1997) and RI Addendum (Ensafe 2005) compared the analytical results for groundwater to Federal and State guidance and promulgated regulatory criteria. Groundwater and pore water samples will be compared to Federal and State groundwater and surface water quality criteria.

10. Pg 31, Section 10.4.1, last paragraph: There is an assumption in this paragraph regarding the steady state of the leaching of contaminants to the groundwater that needs to be verified with data from the site. Please ensure that this is addressed in the monitoring program.

RESPONSE: The last paragraph in Section 10.4.1 will be deleted and the following will be inserted into the text to provide a discussion on the potential of leaching of COCs from soil to groundwater that is supported by data in the 2003 RI Addendum.

Based on a review of Table 18 in the RI Addendum (2005) only groundwater samples from 22 monitoring well locations had COCs in 2003 at concentrations that exceed Florida GCTLs. Table 18 provides a review of analyte concentrations detected in 1993, 1995 and 2003 for the monitoring well locations in 2003 that had analytes at concentrations exceeding Florida GCTLs. The review suggests that at 14 locations the COCs concentrations were stable or decreasing and were increasing at 8 locations. This would suggest that because of the age of the sites, some source areas are not contributing to the leaching of COCs from soil to groundwater or are at a steady state with regard to the rate of leaching of COCs from soil to groundwater. The trends also suggest that the COCs at some source areas may not have decreased at the same rate and/or had higher original concentrations and continue to contribute COCs to groundwater at a higher rate than most of the other source areas.

11. Section 10.4.3: It is stated in Section 10.4.3 that COCs were not found to present unacceptable risk to human receptors. Please include the effects of the COCs on ecological receptors. Also, please indicate whether the sediment pore water will be used to perform aquatic toxicity tests and if so, what the tests are.

RESPONSE: The human health and ecological risk assessments for OU 2 are provided in the RI Report (Ensafe, 1997) and in an addendum (January 2000). Human health and ecological risk assessments for wetlands associated with OU2 were evaluated in the Final Site 41 Remedial Investigation Report (Ensafe, 2005). COCs for the Site 41 wetlands and those associated with OU2 were reevaluated and refined by Tetra Tech in a Technical Memorandum (October 2010) that was included in the Feasibility Study for Site 41 (December 2010).

The results of the Phase I GSI will be used to determine what additional data gaps need to be fill for the Phase II GSI investigation.

12. Figure 10-1: It would appear from this figure that there is no contamination in well 30GS123. If this is the case, EPA would like to understand the concern and the scope of the Wetland 5B study. An additional well and pore water wells are planned directly downgradient of a well that would not appear to be contaminated. Please explain.

RESPONSE: This location was selected because shallow and deep monitoring wells on the east side of Wetland 5B contained COCs. Shallow monitoring well 30GS111 contained benzene, chlorobenzene, chloroethane, naphthalene and manganese at concentrations exceeding their GCTLs and deep monitoring well 30GI111 contained benzene, chlorobenzene, vinyl chloride, 1,4-dichlorobenzene, 2,4-dichlorophenol, iron and manganese at concentrations exceeding their GCTLs. Other monitoring wells located in Wetland 6 to the north of monitoring wells 30GS111and 30GI111 did not contain any COCs.

13. Figure 10-2 and 10-3: Please explain the purpose of these figures and how they relate to the contaminants at the site. Conceptual Site Model: The preliminary conceptual site model (CSM) is too simplistic. If there are contaminants in the aquatic habitat both terrestrial (mammals, birds, reptiles and amphibians) and aquatic receptors (fish, benthic invertebrates, etc.) may be affected. The CSM should be based on available information on the waste sources, appropriate pathways, and receptors at the site. The CSM should include known and suspected sources of contamination, types of contaminants and affected media, known and potential routes of migration, and known or potential human and environmental receptors.

RESPONSE: The Conceptual Site Model will be revised as requested to show the relationship between the COCS and receptors.

14. Section 10.4.2, Potential Contaminant Migration Mechanisms, Page 32: The first paragraph on Page 32 states that "Groundwater flow at OU 2 is generally to the east toward Pensacola Bay, although locally, shallow groundwater flows towards wetlands." The SAP does not present a potentiometric surface map or provide water level data in order to verify that proposed sample locations designated as being down gradient of source of contamination are indeed down gradient. Revise the SAP to include this information so the appropriateness of the sample locations relative to groundwater flow direction can be properly evaluated.

RESPONSE: Please refer to the response to General Comment 2.

15. Pg 37, Sect 11.2, Point 4: Please explain why ecological criteria are not considered as the groundwater will be discharging to wetlands habitat. Please explain why sediment sampling is not considered as some COPC may have an affinity toward the sediments and not be detected in the pore water. Also include the Region 4 ecological screening benchmarks which will be used to address the effects of the site contaminants to ecological receptors.

RESPONSE: Please refer to the Response to General Comment 3.

16. Section 11.1, Problem Definition, Page 37: Section 11.1 states that in order to comply with part of the remedy described in the OU 2 ROD, the project team must evaluate through a GSI investigation whether the COCs that are associated with Sites 11 and 30 are migrating in groundwater to surface water at unacceptable levels. However, it was previously noted that a shortcoming of the ROD is that Radium 226 was never assessed during the CERCLA RI process. The resulting uncertainty surrounding the level of

impact of Radium 226 contamination in groundwater to surface water is a problem warranting action. Therefore, in order to manage this uncertainty, revise the SAP to include the assessment of Radium 226.

RESPONSE: Please refer to the Response to General Comment 1.

17. Section 11.2, Information Inputs, Page 37: The information obtained during the GSI investigation must include the assessment of Radium 226 contamination. As such, the input information regarding analytical methods, laboratory quality assurance (QA)/quality control (QC) limits, list of COCs, project action limits (PALs), sampling design and rational, and standard operating procedures (SOPs), etc., currently found in the various SAP worksheets needs to be revised as appropriate to demonstrate that assessment of Radium 226 contamination will be part of the GSI investigation.

RESPONSE: Please refer to the response to General Comment 1.

18. Pg 45, Section 14.5: Please clarify why tidal influence is not being considered with regard to groundwater flow patterns. The document states that only one round will be taken during a specific low tide. While EPA concurs that water levels must be taken during a set time to ensure that tides are minimized as a variable, it is also necessary to ensure that contaminant movement is understood with regard to tidal influence.

RESPONSE: There is not any tidal influence at Wetland 5, but tidal influence at Wetland 7 will be taken into consideration.

19. Pg 46, second paragraph: Purging and sampling should be continued until groundwater turbidity measurements reach 10 NTU or less. Difficulty reaching this value should be indicated within the reporting.

RESPONSE: Purging and sampling will be continued in accordance with USEPA and FDEP groundwater sampling protocols to obtain turbidity measurements below 10 NTUs or less.

20. Pg 49, Data Management: Please ensure that data is submitted using current electronic data deliverable guidance published by EPA in 2009, as well.

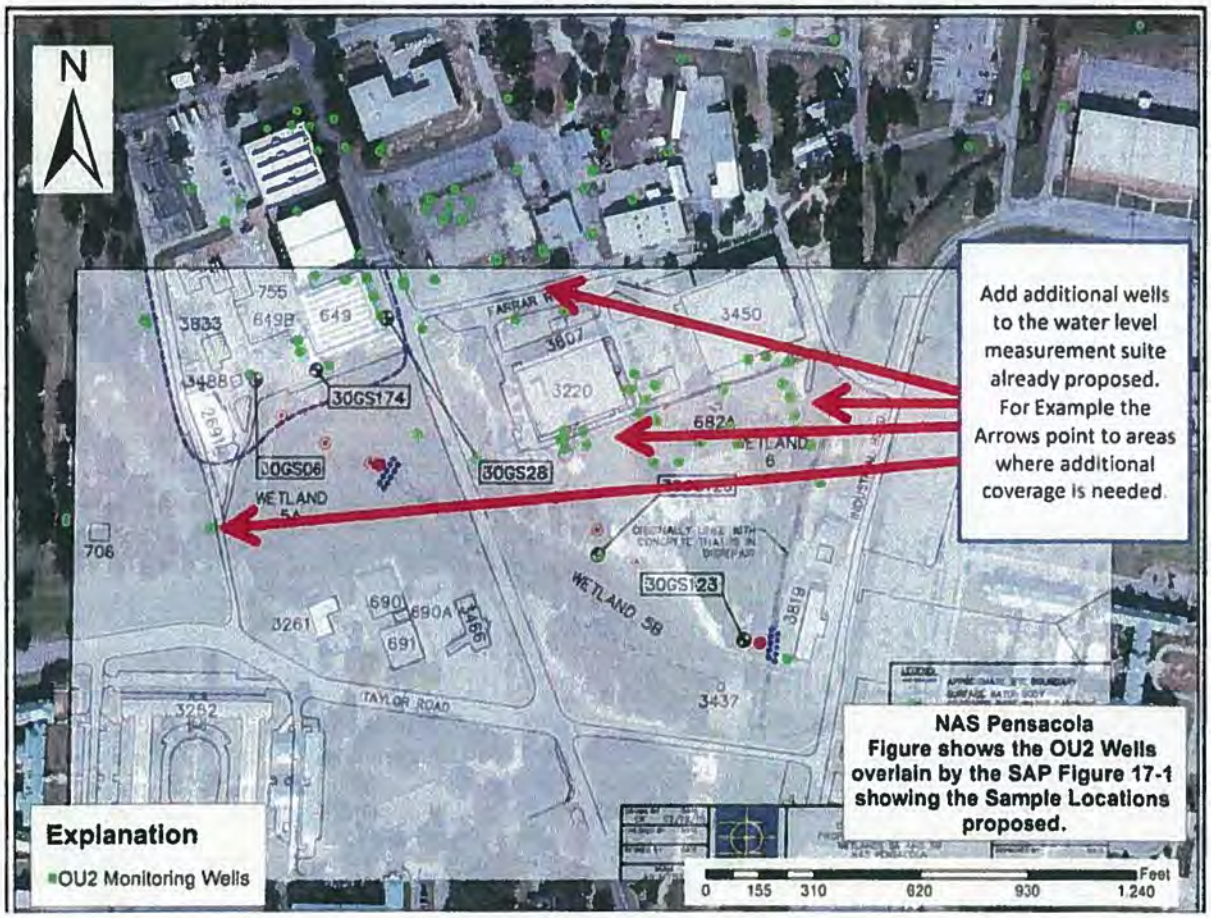
RESPONSE: The Navy will submit electronic data according to the Navy EDD format (NEDD).

21. Pg 55: Please revise the schedule, as appropriate, considering the delays.

RESPONSE: The schedule will be revised based on the delays. The current schedule projected for the site is provided in the Site Management Plan.

22. Page 57, SAP Worksheet #17, Water level discussion in first paragraph: Water levels should be taken in all wells in the area. The Figure below indicates the wells selected, in the transparent overlay, and the green dots are the wells available. EPA suggests other wells be added to give a more comprehensive water level map for evaluating groundwater discharge into the wetlands.

Figure 1: Depiction of the OU2 site and EPA's requested areas in which additional wells should be added for collecting water level data.



RESPONSE: One round of water levels will be taken in all wells associated with the OU 2 Sites.

23. Pg 57, Matrix and Sample numbers: The value is unclear from the description provided in the section above. There are 9 existing wells indicating 18 samples, 6 samples from DPT locations, and 3 duplicate samples. Please clarify.

RESPONSE: The 23 groundwater samples include shallow and intermediate samples from 14 DPT locations and 9 existing monitoring well locations.

24. Pg 57, third paragraph: Please indicate the rationale as to why sampling the 6 new wells is beyond the scope of the SAP.

RESPONSE: The text will be modified to indicate that the wells are to be sampled during monitoring activities which will occur after the GSI. Also, as previously noted, separate from this investigation is the OU 2 groundwater remedy of Monitored Natural Attenuation which will include additional wells being sampled near the individual source areas.

25. Worksheet #37: Please include any of the various equations for calculating the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, comparability)

RESPONSE: The UFP SAP template that was agreed to by USEPA and the Navy does not require including the calculations for PARCC parameters.

26. Figure ES-2, Site Area Map Operable Unit 2, Page 5; Figure 10-1, OU2 GSI Investigation Extent of Groundwater Contamination and Proposed Sample Locations, Page 34; Figure 17-1, OU 2 GSI Investigation Proposed Sample Locations Wetlands 5A and 5B, Page 60; and Figure 17-2, OU 2 GSI Investigation Proposed Sample Locations Wetlands 6 and 7, Page 61: In Figures ES-2, 10-1, 17-1 and 17-2, a portion of Wetland 6 is described as "originally lined with concrete that is in disrepair." However, the location of the portion of Wetland 6 described as "originally lined with concrete and in disrepair" depicted in Figure ES-2 is not consistent with the location depicted in Figure 10-1, or locations depicted in Figures 17-1 and 17-2. Figure ES-2 indicates the northern portion of Wetland 6 was originally lined with concrete that is in disrepair while Figure 10-1 indicates the southern portion of Wetland 6 fits this description. Figure 17-1 suggests both the northern and southern sections of Wetland 6 were originally lined with concrete that is now in disrepair while Figure 17-2 suggests that only the northern section fits this description. Revise the figures as appropriate so the actual location of the portion of Wetland 6 that was originally lined with concrete now in disrepair is clearly understood.

RESPONSE: Northern portions of Wetland 6 were lined with concrete plates that were not joined together. The concrete plates are in a state of disrepair (broken and misaligned). In the southern portion of where the concrete plates are present, they are only on the sides of the banks and in the northern portion of where they are present they line the banks and channel. The Figures will be revised to be consistent and show the areas where the concrete plates are preset in Wetland 6. Below are pictures that show the concrete plates in Wetland 6.

27. Figure ES-2, Site Area Map Operable Unit 2, Page 5; and Figure 10-1, OU2 GSI Investigation Extent of Groundwater Contamination and Proposed Sample Locations, Page 34: The area labeled as Site 30 in Figure ES-2 is incorrectly labeled as Site 32 in Figure 10-1. Revise Figure 10-1 as appropriate.

RESPONSE: The typographical error will be corrected.

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ATTACHMENT 1

Site 11 YACHT BASIN

Site 12

Site 26

Site 25

Site 27

Site 30

GOLF COURSE

WETLAND 7

WETLAND 6

WETLAND 5A

WETLAND 5B

A. CUNNINGHAM ST.

MURRAY ROAD

PAGE ROAD

WAREHOUSE ROAD

PAT BELLINGER ROAD

COAT ROAD

INDUSTRIAL ROAD

FARRAR ROAD

TAYLOR ROAD

LEGEND

- SURFACE WATER BODY
- CLOSED LAGOON
- BUILDING
- TRENCH LOCATIONS/IDs
- FENCE LINE
- ROADS
- SIDEWALKS
- SHALLOW GROUNDWATER MONITORING WELL LOCATIONS/IDs AND GROUNDWATER ELEVATION (ABOVE MSL)
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER CONTOUR

NOTES

160 0 160
SCALE FEET

NAVFAC

REMEDIAL INVESTIGATION ADDENDUM
OPERABLE UNIT 2
NAS PENSACOLA
PENSACOLA, FLORIDA

FIGURE 2
SHALLOW PIEZOMETRIC SURFACE
MARCH 2003

Dr by: K. BRONSON	Proj. Code: 0059-00037	
Ck by: JPG	App by: H. BERO	Sheet 1
Date: 07/29/04	DWG Name: 0059037R001	Of 1

Site 11

YACHT BASIN

Site 12

Site 26

Site 25

Site 27

Site 30

GOLF COURSE

WETLAND 7

WETLAND 6

WETLAND 5A

WETLAND 5B

WAREHOUSE ROAD

MURRAY ROAD

A. CUNNINGHAM ST.

PAGE ROAD

FARRAR ROAD

PAT BELLINGER ROAD

CLAY ROAD

INDUSTRIAL ROAD

TAYLOR ROAD

LEGEND

- SURFACE WATER BODY
- CLOSED LAGOON
- BUILDING
- TRENCH LOCATIONS/IDs
- FENCE LINE
- ROADS
- SIDEWALKS
- SHALLOW GROUNDWATER MONITORING WELL LOCATIONS/IDs
- INTERMEDIATE GROUNDWATER MONITORING WELL LOCATIONS/IDs AND GROUNDWATER ELEVATION (IN FEET ABOUT MSL)
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER CONTOUR

NOTES

160 0 160
SCALE FEET

NAVFAC

REMEDIAL INVESTIGATION ADDENDUM
OPERABLE UNIT 2
NAS PENSACOLA
PENSACOLA, FLORIDA

FIGURE 3
INTERMEDIATE PIEZOMETRIC SURFACE
MARCH 2003

Dr by: K. BRONSON	Proj. Code: 0059-00037	
Ck by: JPG	App by: H. BERO	Sheet 1
Date: 07/29/04	DWG Name: 0059037R002	Of 1

ATTACHMENT 2

Preliminary Data Report

Wetland 64: Groundwater Discharge Zone & Integrated In Situ Sediment Assessments

19 January 2010

SPAWAR Systems Center Pacific
53560 Hull St.
San Diego, CA 92152

Background

As part of SERDP Project ER1550, Sediment Ecosystem Assessment Protocol (SEAP), integrated assessment strategies for contaminated sediment were tested at Naval Air Station (NAS) Pensacola, located in Pensacola, FL. The study focused on Wetland 64 (OU2), which was the subject of an extensive remedial investigation that revealed metals, PAHs, PCBs, DDTs, and VOCs to be of potential ecological risk, particularly at the south end of the water body. Primary components of the study included a groundwater discharge zone assessment for OU2 Site 11, and an integrated in-situ sediment assessment at four focus stations in Wetland 64.

Groundwater Discharge Zone Evaluation

Groundwater discharge was assessed using the Trident and UltraSeep systems. Potential discharge zones were mapped using the Trident conductivity/temperature probe (Figure 1). Trident sensor readings were taken at 3 ft below the sediment surface. Areas of potential discharge were identified based on low subsurface conductivity. Based on the sensor results, a subset of stations were selected for collection of subsurface porewater samples (annotated by gwd). Porewater samples were collected at 3 ft below the sediment surface. In addition, an UltraSeep was deployed at one station in the discharge zone to quantify discharge rates.

Trident Sensor Survey

Subsurface conductivity results from the Trident sensor survey indicated that the strongest evidence of groundwater discharge was along the near-shore areas adjacent to OU2 Site 11, particularly in the area of NASP5, NASP 25, and NASP 26 (Figure 2). An isolated instance of low conductivity was also observed further north along the marina shoreline at NASP 10, however this location was remote from known sources of groundwater contamination.

Trident Porewater Survey

Based on the sensor results, five stations (NASP5, NASP7, NASP25, NASP26, NASP27; Figure 1) were selected in proximity to OU2 Site 11 for collection of subsurface porewater samples. These samples were analyzed for VOCs and the results are shown in Table 1. VOCs were generally below reporting limits for all analytes at all stations. Hexachlorobutadiene was detected below the reporting limit at stations NASP 5 and NASP7, but was detected in water blanks at comparable levels. Naphthalene and 1,2,4-Trichlorobenzene were detected below reporting limits at station NASP 5.

UltraSeep Survey

An UltraSeep was deployed at station NASP25 to quantify the rate of groundwater seepage in the discharge zone identified by the Trident. Seepage rates were measured over a 24 hour period and results are shown in Figure 3 along with the tidal variation during the deployment period. The seepage rate varied from about -0.8 cm/day (recharge), to about +2.9 cm/day (discharge), with strongest discharge in phase with low

tide conditions. The mean discharge rate for the 24 hour period was 0.9 cm/day. No VOCs were detected in the discharge water collected by the UltraSeep.

Groundwater Discharge Zone Summary

In general, the groundwater discharge zone evaluation revealed shoreline areas with evidence of groundwater discharge which was quantified at one location with a mean rate of about 1 cm/day. Porewater and discharge water chemical characterization indicated that there was no VOC discharge associated with the groundwater discharge with the possible exception of trace levels of Naphthalene and 1,2,4-Trichlorobenzene in porewater at NASP5.

Integrated In-Situ Sediment Assessment

The integrated in-situ sediment assessment utilized a range of new and emerging technologies together with traditional measures to characterize exposure, uptake and response at four stations in Wetland 64. The stations were selected to represent a gradient of contamination primarily on the basis of historical data from the remedial investigation at the site and included NASP6B, NASP9, NASP11, and NASP25 (Figure 1). Multiple measures of exposure included bulk sediment chemistry (metals, PAHs, pesticides), porewater, discharge and interface water chemistry (metals, VOCs, PAHs, pesticides), and passive sampler chemistry (metals by DGT, PAHs by SPME). In-situ and laboratory uptake of PAHs was measured for two benthic organisms including *Leptocheirus plumulosus* (marine amphipod) and *Mercenaria mercenaria* (hard clam). In-situ toxicity tests were conducted for three species including *L. plumulosus, N. arenaceodentata* (polychaete), and *Americamysis bahia* (mysid shrimp) with parallel lab toxicity testing for *L. plumulosus*. The Sediment Ecotoxicity Assessment Ring (SEA Ring) system was used for passive sampler deployment, as well as in-situ uptake and in-situ toxicity test exposures. Porewater (one foot depth) and interface water samples were collected using the Trident probe. Seepage rates and discharge samples were collected using the UltraSeep. Surface sediment samples were collected by diver deployed cores.

Bulk Sediment Chemistry

Results for the bulk sediment analysis are shown in Table 2 – Table 4. The results confirm the expected concentration gradient, with generally higher chemical levels at NASP25 and NASP6B and lower levels at NASP11, and clean reference conditions at NASP9. Concentrations of selected individual PAHs,g-BHC, DDE, DDT, cadmium, chromium and lead exceeded ERM or PEL screening thresholds at NASP 6B. At NASP25, selected individual PAHs, g-BHC, cadmium, chromium, copper, lead, mercury, silver and zinc exceeded ERM or PEL screening thresholds. At NASP11 and NASP9 levels were always below ERM or PEL screening thresholds, with some exceedences of ERL or TEL screening thresholds.

Porewater, Discharge and Interface Water Chemistry

Results for porewater, discharge water and interface water samples are shown in Table 5 – Table 7. The only toxic metals above reporting limits were chromium and nickel in

porewater at NASP6B, and nickel in discharge water at NASP25. PAHs were not above reporting limits at any station. DDE and DDD were measured slightly above reporting limits at NASP6B.

Passive Sampler Chemistry

Results for porewater metal DGT measurements are shown in Table 8 and Figure 4. DGT copper concentrations were generally low, ranging from 0.38 to 2.15 ug/L with the maximum concentration measured in the near-surface 0-1 cm interval at NASP11. Zinc concentrations ranged from 0.87 to 16.55 ug/L with the maximum concentration measured in the 2-3 cm interval at NASP11. Nickel concentrations ranged from 0.32 to 2.34 ug/L with the maximum concentration measured in the near-surface 2-3 cm interval in the NASP6X sample, however the replicate samples for that station had levels generally <1 ug/L. Lead concentrations ranged from 0.03 to 0.41 ug/L with the maximum concentration measured in the overlying water measurement at NASP6B. Cadmium levels were near or below detection limits for deeper intervals, ranging from 0.008 to 0.18 ug/L with the maximum level in the overlying water at NASP6X and a comparable level in the shallow 0-1 cm interval at NASP11. Results generally indicate an increase in concentrations near the sediment interface. Results for the SPME sampler measurements of PAHs are not currently available.

In-Situ Bioaccumulation

Results for in-situ and laboratory PAH bioaccumulation measurements for *L. plumulosus* and *M. mercenaria* are shown in Table 9. In-situ measurements were conducted for 4-day exposures, and lab measurements were conducted for 4 and 28-day exposures (*L. plumulosus*), with survival and lipid content of the amphipods being substantially reduced in the latter. Therefore, 28-day *L. plumulosus* bioaccumulation data should be interpreted with caution. For the in-situ results, PAHs were only detected in the *L. plumulosus* tissues, all samples for *M. mercenaria* were below detection limits. For *L. plumulosus* tissues, PAHs were detected at stations NASP6B and NASP25. Lab results showed similar trends in the 4-day exposures with very low levels in *M. mercenaria*, and higher levels in *L. plumulosus* at NASP6B and NASP25. Interestingly, levels were generally lower in the longer term 28-day lab exposures versus the 4-day exposures.

In-Situ Toxicity Testing

Results for in-situ and laboratory toxicity tests for *L. plumulosus, N. arenaceodentata*, and *A. bahia* are shown in Table 10. High control survival was observed in both short-term lab and *in situ* toxicity exposures. Toxicity was not observed in *in situ* tests conducted in the water column nor the sediment-water interface. Amphipod survival was significantly lower (t-tests, $p<0.05$) at one station (NASP 6B) relative to the controls in both the field and lab tests. *In situ* survival (50%) at NASP 6B, however, was considerably lower than in the lab (85%) from the 4-day toxicity exposures. Polychaetes (*N. arenaceodentata*) exhibited reduced feeding (based on mean) in the laboratory following 48 hour field exposure at NASP 6B, but the reduction was not statistically significant. Although pore water concentrations were low to non-detect for essentially all chemical classes, bulk sediment pesticides (e.g. DDx), PAH, and several metals were present in excess of ERM concentrations. The low pore water concentrations, and

apparently low bioavailability, at the two stations where some contaminants were elevated in the bulk chemistry, may be reflective of relatively high total organic carbon in those samples. Analysis of tissues revealed elevated TPAH at stations NASP 6B and 25, however, these concentrations do not alone explain toxicity based on critical body residue (CBR) theory. Body residues responsible for inducing mortality by PAH narcosis in *L. plumulosus* are substantially higher than those observed. VOCs were essentially non-detect in all samples, and are not believed to have contributed to any observed toxicity.

Water quality parameters measured in representative *in situ* sediment chambers (sensor positioned at sediment-water interface in sediment chamber) indicate that water quality was sufficient at station 6B (and all stations) to maintain organism health. Interestingly, salinity, pH, and ORP, however, were noticeably lower at 6B when compared to the other three *in situ* locations. Ammonia was not suspected to contribute to toxicity at station NASP 6B based on concentrations measured in discrete pore water samples that were below those expected to cause toxicity to *L. plumulosus.*

Integrated In-Situ Sediment Assessment Summary

The integrated in-situ sediment assessment generally reflects areas of low to moderate chemical loading in the bulk sediment with limited bioavailability, uptake or response. While bulk concentrations in sediment sometimes exceeded screening benchmarks, other measures of exposure including porewater, discharge water, interface water and passive samplers generally indicate a lack of mobility and bioavailability. This is supported by the lack or limited uptake in tissues of exposed organisms, and the general absence of toxicity in either laboratory or in-situ exposed organisms. The disparity between the lab and field data show that results from lab studies do not necessarily explain effects that may be observed in the field, highlighting the relevance of *in situ* studies. Subsequent toxicity identification evaluations (TIE) might help improve understanding of the toxicity observed at the one station.

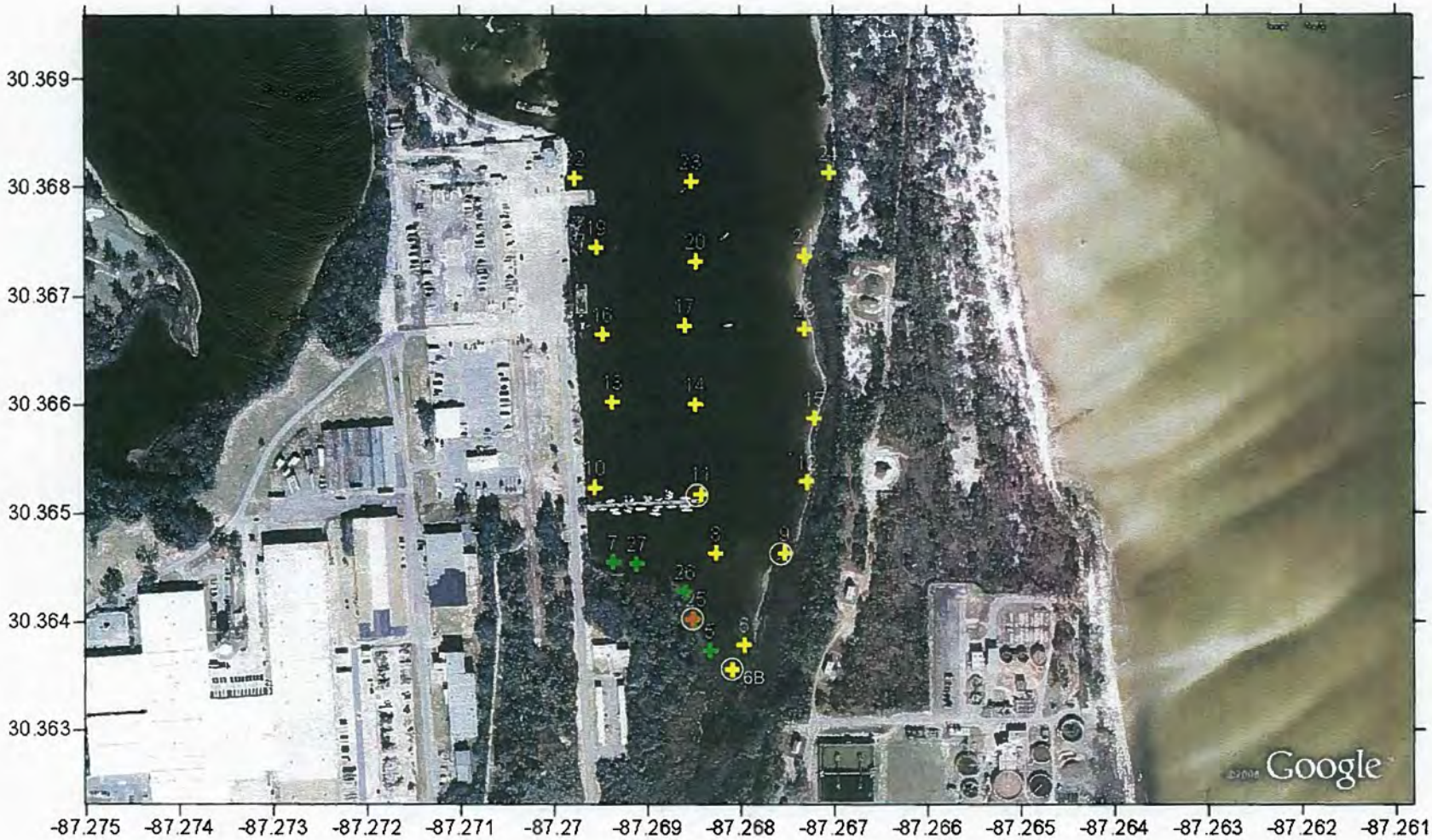
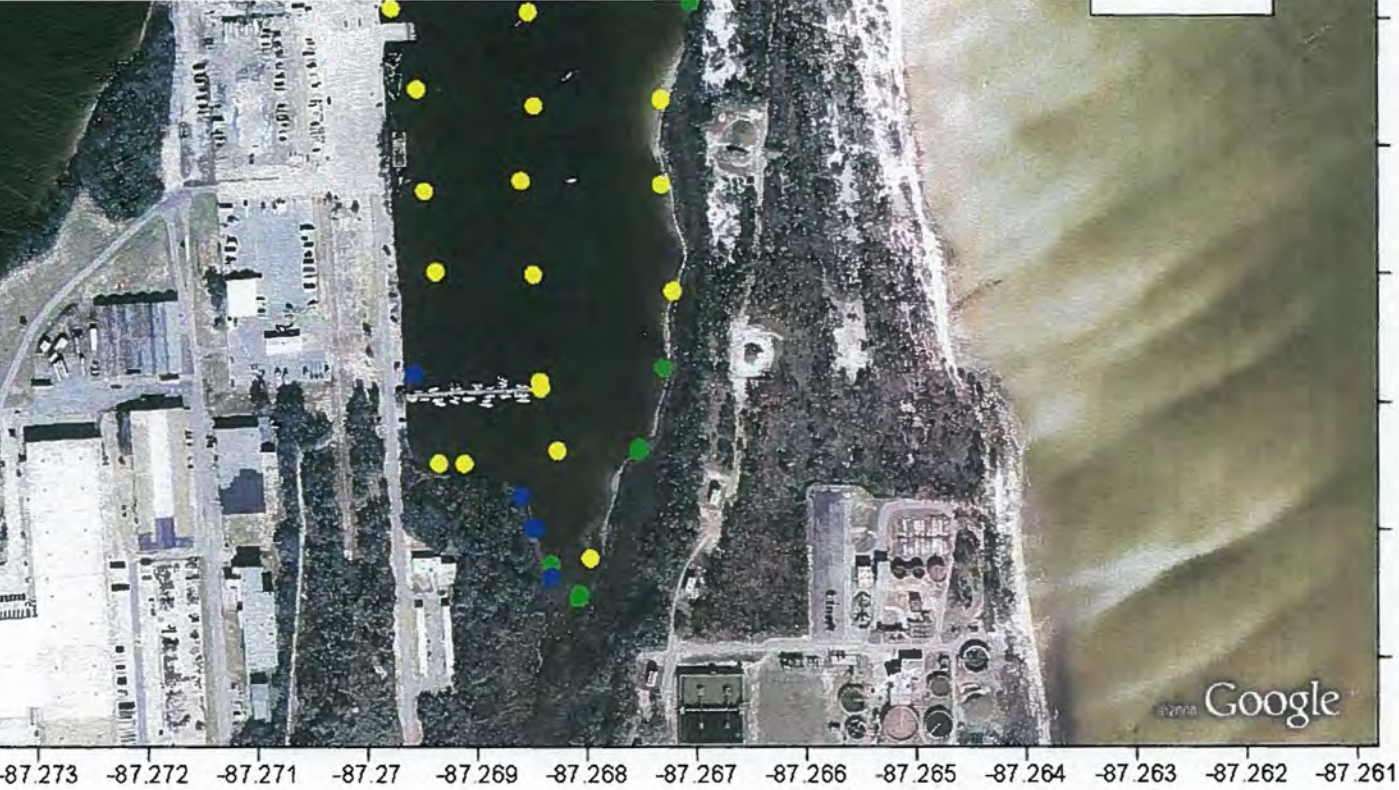
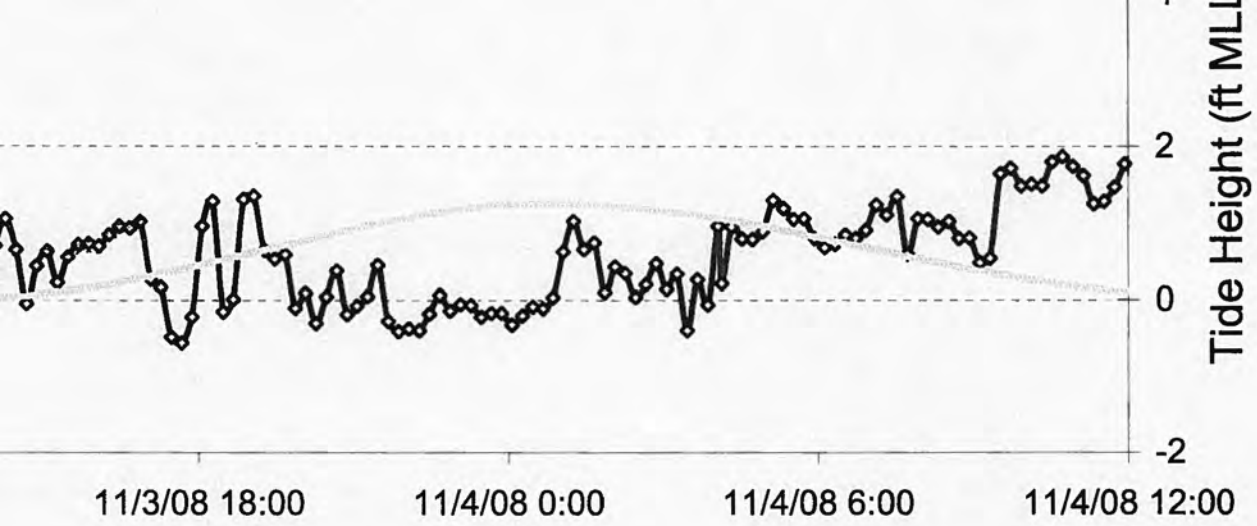


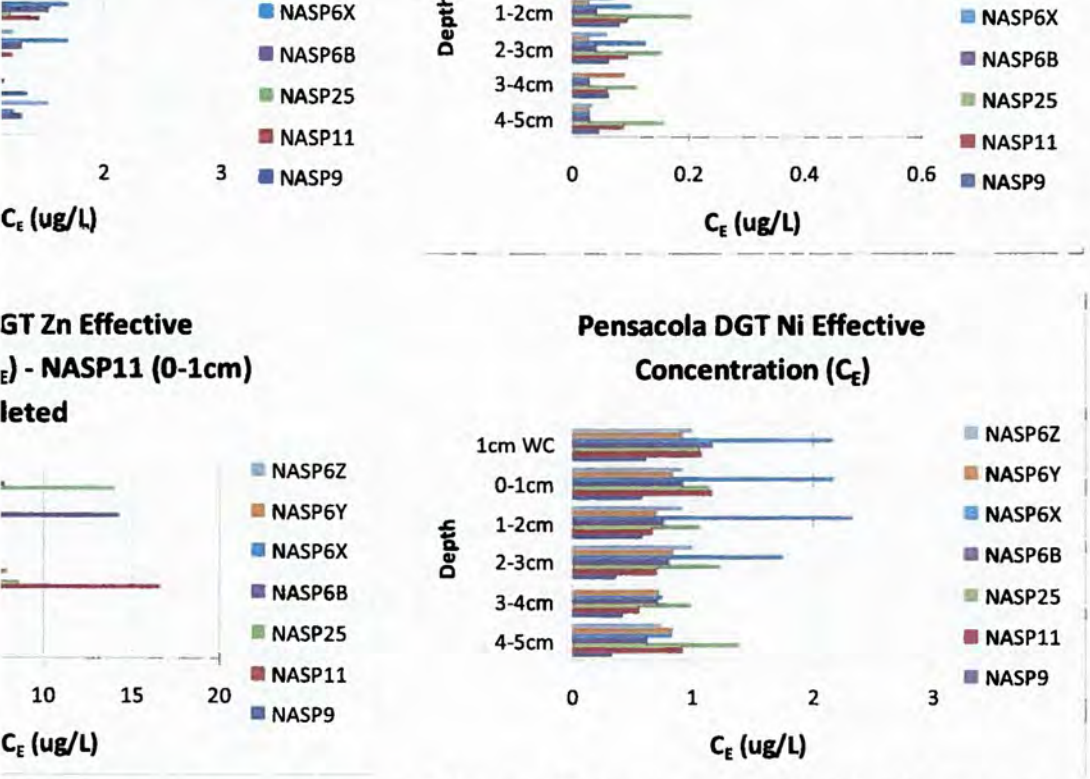
Figure 1. Station location map. Yellow stations indicate Trident sensor survey locations. Green stations indicate sensor and subsurface groundwater discharge sampling locations. The orange station indicates sensor, subsurface groundwater and seepage meter discharge sampling locations. Circles indicate focus stations for the in-situ sediment assessment.



survey results for subsurface conductivity (mS/cm).



harge and tide stage at station NASP25.



metal concentrations at different sediment depths, as measured with diffusive gradients in thin film (DGT).
presented by three replicate DGTs (X, Y, Z).

Sample Number	Water Blank B 111108-2		NASP-5-gwd		NASP-7-gwd		NASP-26-gwd		NASP-27-gwd	
Sample Location:			NAS Pensacola		NAS Pensacola		NAS Pensacola		NAS Pensacola	
Dilution Factor	1		1		1		1		1	
File:	BV9932.D		BV9938.D		BV9939.D		BV9940.D		BV9941.D	
Analyte	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L
Dichlorodifluoromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chloromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Vinyl Chloride	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromomethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Trichlorofluoromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Acetone	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0
1,1-Dichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Methylene Chloride	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Carbon Disulfide	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Methyl tert-Butyl Ether	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
trans-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1 Dichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2-Butanone	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2,2-Dichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
cis-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chloroform	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1-Dichloropropene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,1-Trichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Carbon Tetrachloride	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Benzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Trichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromodichloromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Dibromomethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
cis-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
trans-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,2-Trichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,3-Dichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Dibromochloromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dibromoethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromoform	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
4-Methyl-2-Pentanone	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Toluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2-Hexanone	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Tetrachloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,1,2-Tetrachloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Ethylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
p&m-Xylene	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0
o-Xylene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Styrene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Isopropylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,2,2-Tetrachloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2,3-Trichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
n-Propylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,3,5-Trimethylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2-Chlorotoluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
4-Chlorotoluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
tert-Butylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2,4-Trimethylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
sec-Butylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
p-Isopropyltoluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,3-Dichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,4-Dichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
n-Butylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dibromo-3-Chloropropane	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0
1,2,4-Trichlorobenzene	U	5.00	2.90 J	5.00	U	5.00	U	5.00	U	5.00
Hexachlorobutadiene	2.59 J	20.0	2.71 B	20.0	1.29 B	20.0	U	20.0	U	20.0
Naphthalene	U	20.0	3.86 J	20.0	U	20.0	U	20.0	U	20.0
1,2,3-Trichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00

Table 1. VOC results for the Trident and UltraSeep survey adjacent to OU2 Site 11. Note: gwd = 3 ft subsurface sample, sp = seepage meter sample.

Method: REAC SOP 1806

Sample Number	Water Blank B 111108-2		NASP-25-gwd		NASP-25-sp	
Sample Location:			NAS Pensacola		NAS Pensacola	
Dilution Factor	1		1		1	
File:	BV9932.D		BV9942.D		BV0036.D	
Analyte	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L
Dichlorodifluoromethane	U	5.00	U	5.00	U	5.00
Chloromethane	U	5.00	U	5.00	U	5.00
Vinyl Chloride	U	5.00	U	5.00	U	5.00
Bromomethane	U	5.00	U	5.00	U	20.0
Chloroethane	U	5.00	U	5.00	U	5.00
Trichlorofluoromethane	U	5.00	U	5.00	U	5.00
Acetone	U	20.0	U	20.0	U	20.0
1,1-Dichloroethene	U	5.00	U	5.00	U	5.00
Methylene Chloride	U	5.00	U	5.00	U	5.00
Carbon Disulfide	U	5.00	U	5.00	U	5.00
Methyl tert-Butyl Ether	U	5.00	U	5.00	U	5.00
trans-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00
1,1 Dichloroethane	U	5.00	U	5.00	U	5.00
2-Butanone	U	5.00	U	5.00	U	5.00
2,2-Dichloropropane	U	5.00	U	5.00	U	5.00
cis-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00
Chloroform	U	5.00	U	5.00	U	5.00
1,1-Dichloropropene	U	5.00	U	5.00	U	5.00
1,2-Dichloroethane	U	5.00	U	5.00	U	5.00
1,1,1-Trichloroethane	U	5.00	U	5.00	U	5.00
Carbon Tetrachloride	U	5.00	U	5.00	U	5.00
Benzene	U	5.00	U	5.00	U	5.00
Trichloroethene	U	5.00	U	5.00	U	5.00
1,2-Dichloropropane	U	5.00	U	5.00	U	5.00
Bromodichloromethane	U	5.00	U	5.00	U	5.00
Dibromomethane	U	5.00	U	5.00	U	5.00
cis-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00
trans-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00
1,1,2-Trichloroethane	U	5.00	U	5.00	U	5.00
1,3-Dichloropropane	U	5.00	U	5.00	U	5.00
Dibromochloromethane	U	5.00	U	5.00	U	20.0
1,2-Dibromoethane	U	5.00	U	5.00	U	5.00
Bromoform	U	5.00	U	5.00	U	20.0
4-Methyl-2-Pentanone	U	5.00	U	5.00	U	5.00
Toluene	U	5.00	U	5.00	U	5.00
2-Hexanone	U	5.00	U	5.00	U	5.00
Tetrachloroethene	U	5.00	U	5.00	U	5.00
Chlorobenzene	U	5.00	U	5.00	U	5.00
1,1,1,2-Tetrachloroethane	U	5.00	U	5.00	U	20.0
Ethylbenzene	U	5.00	U	5.00	U	5.00
p&m-Xylene	U	10.0	U	10.0	U	10.0
o-Xylene	U	5.00	U	5.00	U	5.00
Styrene	U	5.00	U	5.00	U	5.00
Isopropylbenzene	U	5.00	U	5.00	U	5.00
1,1,2,2-Tetrachloroethane	U	5.00	U	5.00	U	5.00
1,2,3-Trichloropropane	U	5.00	U	5.00	U	5.00
n-Propylbenzene	U	5.00	U	5.00	U	5.00
Bromobenzene	U	5.00	U	5.00	U	5.00
1,3,5-Trimethylbenzene	U	5.00	U	5.00	U	5.00
2-Chlorotoluene	U	5.00	U	5.00	U	5.00
4-Chlorotoluene	U	5.00	U	5.00	U	5.00
tert-Butylbenzene	U	5.00	U	5.00	U	5.00
1,2,4-Trimethylbenzene	U	5.00	U	5.00	U	5.00
sec-Butylbenzene	U	5.00	U	5.00	U	5.00
p-Isopropyltoluene	U	5.00	U	5.00	U	5.00
1,3-Dichlorobenzene	U	5.00	U	5.00	U	5.00
1,4-Dichlorobenzene	U	5.00	U	5.00	U	5.00
n-Butylbenzene	U	5.00	U	5.00	U	5.00
1,2-Dichlorobenzene	U	5.00	U	5.00	U	5.00
1,2-Dibromo-3-Chloropropane	U	20.0	U	20.0	U	5.00
1,2,4-Trichlorobenzene	U	5.00	U	5.00	U	5.00
Hexachlorobutadiene	2.59 J	20.0	U	20.0	U	5.00
Naphthalene	U	20.0	U	20.0	U	20.0
1,2,3-Trichlorobenzene	U	5.00	U	5.00	U	5.00

Table 1. (cont.)

		NASP-6B-Sed		NASP-9-Sed		NASP-11-Sed		NASP-25-Sed	
Analyte		Conc. µg/kg	RL µg/kg	Conc. µg/kg	RL µg/kg	Conc. µg/kg	RL µg/kg	Conc. µg/kg	RL µg/kg
Acenaphthene	ug/kg	282		45	U	55	U	84.7	J
Acenaphthylene	ug/kg	82	U	45	U	55	U	99.5	J
Anthracene	ug/kg	440		45	U	55	U	226	
Benzo(a)anthracene	ug/kg	981		29.2	J	54.3	J	798	
Benzo(a)pyrene	ug/kg	886		32.6	J	72.3		967	
Benzo(b)fluoranthene	ug/kg	1080		42.8	J	105		1320	
Benzo(g,h,i)perylene	ug/kg	475		24.9	J	52.2	J	556	
Benzo(k)fluoranthene	ug/kg	573		25.8	J	37.1	J	685	
Chrysene	ug/kg	959		35.7	J	57.9		899	
Dibenzo(a,h)anthracene	ug/kg	155		45	U	55	U	157	
Fluoranthene	ug/kg	2820		65		99.4		1600	
Fluorene	ug/kg	262		45	U	55	U	69.9	J
Indeno(1,2,3-cd)pyrene	ug/kg	505		45	U	55	U	515	
Naphthalene	ug/kg	182		45	U	55	U	120	U
Phenanthrene	ug/kg	1990		45	U	30.6	J	697	
Pyrene	ug/kg	1720		51.3		79.1		1320	
TPAH	ug/kg	13392		**667.3**		**972.9**		10114.1	
TPAH	mg/kg	13.392		**0.6673**		**0.9729**		10.1141	
TPAH OC norm	**ug/kg OC**	**225076**		**106427**		**66637**		**132557**	
TPAH OC norm	**mg/kg OC**	**225**		**106**		**67**		**133**	
#>TEL/ERL		**2**		**0**		**0**		**4**	
#>PEL/ERM		**10**		**0**		**0**		**7**	
General Chemistry									
TOC	%	5.95		0.627		1.46		7.63	
Total Organic Carbon	mg/kg	59500		6270		14600		76300	
Solids, Percent	%	40.5		73.6		60.5		27.9	
% Gravel	%	0.32		0.63		1.4		0.79	
% Sand	%	79.9		87.7		78.8		46.1	
% Silt, Clay, Colloids	%	19.8		11.7		19.7		53.1	

Blue exceeds TEL or ERL
Red exceeds PEL or ERM

Table 2. Bulk sediment PAH concentrations at the four focus stations (dry weight).

	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	3.74	J	7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	49.5		7.75	U	4.69	2.24	J	5.46	26.7	12.3
	U	3.33	23.7		7.75	U	4.69	U		5.46	U	12.3
	U	3.33	U		7.75	U	4.69	U		5.46	U	12.3
g OC			1230.3			0.0		153.4			349.9	
Kg OC			1.23			0.00		0.15			0.35	
g			**73.2**			**0**		**2.24**			**26.7**	
			0			0		1			1	
			3			0		0			1	
			5.95			0.627		1.46			7.63	

pesticide concentrations at the four focus stations (dry weight).

U	0.400	11.4	0.61	2.49	0.384	6.61	0.420	71.3	0.988					
U	0.300	U	0.46	U	0.288	U	0.315	U	0.741					
U	0.400	15.9	0.61	0.936	0.384	2.72	0.420	18.2	0.988	0.68	4.21	1.2	9.6	:
U	9.90	1780	15.1	308	9.50	1720	10.4	10400	24.4					
U	0.500	520	0.77	32.9	0.480	90.7	0.526	523	1.23	52.3	160	81	370	6:
U	0.400	2.22	0.61	U	0.384	1.05	0.420	4.80	0.988					
U	0.400	66.7	0.61	9.64	0.384	25.6	0.420	230	0.988	18.7	108	34	270	39(
U	15.0	9920	22.9	2040	14.4	5810	15.8	27200	37.0					
U	1.00	226	1.53	15.0	0.959	35.7	1.05	326	2.47	30.2	94	46.7	218	40(
U	20.0	2550	30.6	605	19.2	1500	21.0	5620	49.4					
U	0.400	44.2	0.61	8.70	0.384	38.4	0.420	127	0.988					
U	0.040	0.232	0.07	U	0.044	0.451	0.045	0.969	0.0914	0.13	0.7	0.15	0.71	0.4
U	0.600	8.41	0.92	1.11	0.576	2.96	0.631	17.0	1.48	15.9	42.8	20.9	51.6	11(
U	25.0	730	38.2	215	24.0	521	26.3	1790	61.7					
U	1.30	U	1.99	U	1.25	U	1.37	U	3.21					
U	0.500	1.67	0.77	U	0.480	U	0.526	5.20	1.23	0.73	1.77	1	3.7	3.
U	100	9470	153	2340	95.9	4760	105	17200	247					
U	1.80	U	2.75	U	1.73	U	1.89	U	4.44					
U	0.400	12.4	0.61	2.77	0.384	7.09	0.420	31.8	0.988					
U	3.10	229	4.74	21.8	2.97	62.1	3.26	396	7.65	124	271	150	410	41(
		4		1		4		2						
		3		0		0		7						

metal concentrations at the four focus stations (dry weight).

U	100	U	100	U	300	U	300	U	100	U
U	14.0	U	14.0	U	14.0	U	14.0	U	14.0	U
U	17.0	U	17.0	U	17.0	U	17.0	U	17.0	U
U	2.00	87.2	2.00	23.9	2.00	34.4	2.00	6.49	2.00	15.1
U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U
U	60.0	93600	60.0	239000	60.0	270000	60.0	35400	60.0	257000
U	3.00	76.4	3.00	U	3.00	U	3.00	U	3.00	U
U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U
U	4.00	U	4.00	U	4.00	U	4.00	U	4.00	U
U	60.0	U	60.0	U	300	U	600	14600	60.0	U
U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
U	160	242000	160	824000	800	918000	800	13200	160	880000
U	2.00	37.7	2.00	24.4	2.00	39.0	2.00	126	2.00	6.76
U	0.200	U	0.200	U	0.200	U	0.200	U	0.200	U
U	5.00	8.65	5.00	U	5.00	U	5.00	U	5.00	U
U	200	124000	1000	271000	2000	310000	2000	7190	200	294000
U	15.0	U	15.0	U	15.0	U	15.0	U	15.0	U
U	4.00	U	4.00	U	4.00	U	4.00	U	4.00	U
U	1200	2500000	60000	6320000	120000	7120000	120000	105000	6000	6780000
U	18.0	U	18.0	U	18.0	U	18.0	U	18.0	U
U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U
U	6.00	U	300	U	600	U	600	U	6.00	U

ations in porewater (pw), interface (swi), and discharge (sp) water samples.

U	500	U	500	U	500	U	500
U	14.0	U	14.0	U	14.0	U	14.0
U	17.0	U	17.0	U	17.0	U	17.0
13.5	2.00	22.3	2.00	17.9	2.00	27.6	2.00
U	2.00	U	2.00	U	2.00	U	2.00
U	3.00	U	3.00	U	3.00	U	3.00
256000	60.0	274000	60.0	266000	60.0	262000	60.0
U	3.00	U	3.00	U	3.00	U	3.00
U	3.00	U	3.00	U	3.00	U	3.00
U	4.00	U	4.00	U	4.00	U	4.00
U	600	U	600	U	600	U	600
U	10.0	U	10.0	U	10.0	U	10.0
876000	800	931000	800	882000	800	884000	800
5.49	2.00	8.22	2.00	5.50	2.00	172	2.00
U	0.200	U	0.200	U	0.200	U	0.200
U	5.00	U	5.00	U	5.00	15.0	5.00
297000	2000	316000	2000	296000	2000	296000	2000
U	15.0	U	15.0	U	15.0	U	15.0
U	4.00	U	4.00	U	4.00	U	4.00
6790000	120000	7110000	12000	6840000	120000	6750000	120000
U	18.0	U	18.0	U	18.0	U	18.0
U	3.00	U	3.00	U	3.00	U	3.00
U	600	U	6.00	U	600	U	600

	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.10	U	0.11	U	NA	NA	0.10	U	NA	0.10	U
	NA	0.10	U	0.11	U	NA	NA	0.10	U	NA	0.10	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
	NA	0.21	U	0.21	U	NA	NA	0.21	U	NA	0.21	U
l	15.8	NA		NA		11.3	15.9	NA		5.0	U	NA

concentrations in porewater (pw), interface (swi), and discharge (sp) water samples.