N65928.AR.001394
NTC ORLANDO
5090.3a

TECHNICAL MEMORANDUM FOR ANALYSIS OF OFF SITE IMPACTS OPERABLE UNIT 2 (OU 2) REVISION 1 NTC ORLANDO FL

7/16/2003

TETRA TECH

TETRA TECH NUS, INC.
800 Oak Ridge Turnpike, A-600 ▪ Oak Ridge, Tennessee 37830
(865) 483-9900 ▪ FAX: (865) 483-2014 ▪ www.tetratech.com

00956

0703-A071

July 16, 2003

Commander, Southern Division
Naval Facilities Engineering Command
Attn: Ms. Barbara Nwokike, Code ES33
P.O. Box 190010
2155 Eagle Drive
North Charleston, SC 29419-9010

Reference: CLEAN Contract No. N62467-94-D-0888
Contract Task Order No. 0235

Subject: Operable Unit 2 Analysis of Off-site Impacts
McCoy Annex, Naval Training Center, Orlando

Dear Ms. Nwokike:

Please find enclosed a copy of the revised Technical Memorandum regarding our analysis of the off-site impacts at Operable Unit 2 (OU 2) at McCoy Annex. The original document, dated July 15, 2003, was revised to clarify that contaminants have been observed in monitoring wells located in the strip of GOAA property that lies along the west bank of the canal adjacent to the southern portion of OU 2. The report emphasizes that contaminants have not migrated beyond the canals onto GOAA property.

Per your request, I will submit an electronic version of the memorandum to you via email. If you have any questions, please contact me at (865) 220-4730.

Sincerely,

Allan T. Jenkins for SBM

Steven B. McCoy, P.E.
Task Order Manager

SBM:ckf

Enclosures

c: Ms. Barbara Nwokike, Southern Division (Orlando Office)
Wayne Hansel, Southern Division
Ms. Hope Oaks, Southern Division
Mr. David Grabka, FDEP
Mr. Gregory Fraley, USEPA Region 4
Mr. Steve Tsangaris, CH2M Hill
Mr. Mark Salvetti, MACTEC Engineering
Mr. Allan Jenkins, Tetra Tech NUS
Mr. J.E. Bentkowski, Gannett Fleming
Mr. James Young, Terraine
Mr. Mark Perry, Tetra Tech NUS (unbound)
Ms. Debbie Wroblewski, Tetra Tech NUS (cover letter only)
File/db

Subject: **ANALYSIS OF OFF-SITE IMPACTS, OPERABLE UNIT 2 (Revision 1)**
Naval Training Center, Orlando, Florida

To: Barbara Nwokike, SOUTHDIV

From: Allan Jenkins, TtNUS

Copies: Orlando Partnering Team
Steve McCoy, TtNUS
File

Date: July 15, 2003

Purpose

This technical memorandum address the potential for off-site impacts to occur as a result of contaminants migrating from environmental media located at Operable Unit 2 (OU 2) to adjacent properties. Based on the results and conclusions presented in the Remedial Investigation Report (TtNUS, 2001a), the primary pathway for contaminant migration consists of contaminants dissolved in groundwater flowing through the surficial aquifer and/or the discharge of contaminated groundwater to surface water bodies (i.e., drainage canals along the eastern and southern perimeters of the site). Because of the presence of the golf course over much of the former landfill area, the surface soils have been stabilized and a clean cover overlies the landfill material. And, for certain areas, Interim Remedial Actions have been completed that removed and/or covered contaminated surface soils, thereby preventing future exposure of humans or the environment to contaminated soils and mitigating overland or airborne transport of contaminated soils. Therefore, off-site impacts from soils are deemed negligible and they are not discussed further.

Background

Operable Unit 2 (OU2) is located in the southern portion of the McCoy Annex, Naval Training Center, Orlando, Florida, immediately west of the Orlando International Airport. The OU consists of approximately 114 acres and contains a former landfill that was operated by the Air Force and subsequently the Navy from 1960 to 1978. A nine-hole golf course now occupies the northern half of the site. The golf course is bounded on the east and south by manmade canals that drain to Lake Gillooly and eventually into Boggy Creek Swamp to the southeast. The golf course includes a number of water hazards and has several cypress swamps between fairways.

Reportedly, the western portion of the site was used as a landfill by the Air Force from about 1960 to 1972, while the eastern portion was used as a landfill by the Air Force and the Navy from 1972 until about 1978.

Reportedly, the western portion of the site was used as a landfill by the Air Force from about 1960 to 1972, while the eastern portion was used as a landfill by the Air Force and the Navy from 1972 until about 1978. Landfill operations consisted of excavating ditches (100 to 200 ft long by 20 to 25 ft wide by 10 to 15 ft deep) into which trucks disposed wastes. Occasional burning of the wastes took place in the ditches. Trenches were filled with waste to within 3 or 4 ft of the ground surface and then backfilled with topsoil and seeded. In the Initial Assessment Study (C.C. Johnson & Associates 1985) it was estimated that the volume of waste was more than 1,000,000 cubic yards. Landfill wastes reportedly included the following:

- paint and paint thinner;
- asbestos;
- transformers [possibly with transformer oil containing polychlorinated biphenyls (PCBs)];
- hospital wastes (including syringes, dressings, blood and urine samples);
- low-level radiological waste (from Air Force operations);
- automobile batteries;
- steel cable, scrap metal, and sections of pipe;
- airplane parts;
- bricks;
- fire hoses;
- parachutes;
- trees, leaves, and scrap wood;
- paper and plastic; and
- possibly waste oil.

OU 2 was investigated between 1998 and 2000 and a final Remedial Investigation Report (RI) was published in March 2001 (TtNUS, 2001a). Subsequently, a Draft Feasibility Study (FS) was published in August 2001 (TtNUS, 2001b) that evaluated the technologies and potential remedies that were applicable for the environmental conditions, contaminants of concern, and current and future land uses of the site. The Draft Proposed Plan issued in December 2001 and the Draft Record of Decision issued in February 2002 included a remedy of monitoring groundwater and surface water to assess the progress of natural attenuation of the contaminant plumes in addition to certain land use controls. The following sections summarize the groundwater flow conditions at the site, the interaction of groundwater with local surface water bodies, and the nature and extent and migration of groundwater plumes at OU 2. As indicated above, the migration of contaminants via groundwater and the discharge of contaminated groundwater to surface water are the only significant pathways for off-site impacts to occur.

Groundwater Flow

Groundwater flow at OU 2 occurs in the surficial aquifer that is unconfined. The aquifer consists primarily of fine to medium grained quartz sand that contains varying percentages, both laterally and vertically, of fines

(i.e. mostly silt). Recharge to the aquifer occurs primarily from precipitation, although a portion of recharge may result from irrigation of the golf course. A water table is generally encountered within 5 to 10 feet of the ground surface and the surficial aquifer extends to a depth of typically 30 feet below ground surface (bgs). The bottom of the surficial aquifer is well defined by a clay or silty, sandy-clay aquitard that is 10 to 20 feet thick. Sands below the clay aquitard support a confined aquifer that was determined to be essentially isolated from the surficial aquifer in the area of OU 2; therefore, this lower confined aquifer is not discussed further.

A system of 48 monitoring wells was installed at OU 2 during the RI to define the groundwater flow system and to monitor the presence of contaminant plumes at the site. Prior to monitoring well installation, 28 piezometers were installed and potentiometric data were collected and evaluated to aid the selection of locations for the monitoring wells. In addition, 11 surface water staff gages were installed in various surface water bodies (e.g., ponds, canals) and monitored to determine surface water elevations around the site. The locations of the piezometers, wells, and staff gages are shown in RI Figures 2-2H, I, and J. At each surficial aquifer monitoring well location a pair of wells was installed: a shallow well with a 10-foot well screen across the water table and a total depth usually 15 feet bgs or less, and an intermediate well with a 5-foot well screen located at the bottom of the surficial aquifer and a total depth of 30 feet bgs or less. The four deep monitoring wells installed in the lower confined aquifer (i.e., Hawthorn aquifer) were completed at depths of 50 feet bgs or greater. It should be noted that 5 piezometers, 22 surficial aquifer wells (i.e., 11 well pairs), and 1 deep well were installed on property owned by the Greater Orlando Airport Authority (GOAA), in order to fully investigate the groundwater flow patterns on both sides of the drainage canals that lie along the entire eastern perimeter of OU 2 and to investigate groundwater quality in the off-site area.

Groundwater and surface water levels were monitored during the RI in April and August of 1998, and again in December 2001. Based on these potentiometric data, the physical description of the subsurface materials provided by borehole logging and cone-penetrometer logging performed during the RI investigation, and in consideration of published descriptions of the regional and local hydrogeologic setting (Scott, 1992; Lichtler, Anderson, and Joyner, 1968), a conceptual model was developed for the surficial aquifer at OU 2 as demonstrated in Figure 1. The basis of the conceptual model was a shallow water-table aquifer, confined at the bottom, that is recharged by precipitation in the topographically higher areas. Flow in the aquifer is deemed to be essentially horizontal with slight downward gradients in areas of highest recharge and upward gradients adjacent to local surface water bodies (i.e., drainage canals) that act as discharge areas. Because of the relative thinness of the surficial aquifer (< 30 feet), the relative homogeneous nature of the aquifer materials (i.e., absence of significant interbeds with significantly different hydraulic properties), and the predominance of relatively horizontal flow, the drainage canals that receive groundwater discharge act as hydraulic barriers to underflow through the aquifer. Under normal conditions for this system, groundwater

flows to the canals from both sides of the canals and does not pass beneath the canals. As indicated by the conceptual model, deep groundwater in close vicinity to the canals must flow nearly vertically upward under the influence of the hydraulic head regime imposed by the flow system. Although the hydraulic gradient in this area of the flow system can be at its maximum, it is quite normal for sediments to display a one, two, or greater order of magnitude decrease in vertical hydraulic conductivity compared to horizontal conductivity. This may result in a much lower upward groundwater seepage velocity compared to the horizontal seepage velocity in the aquifer.

The groundwater elevations from the August 1998 water level measurements were presented in the RI and FS reports as potentiometric surface maps for the shallow and intermediate wells. These maps clearly show a groundwater flow pattern that is consistent with the conceptual model (RI Figures 2-2H and I). The surface water elevations in the canals were lower than the wells on either side of the canals demonstrating flow toward the canals from both sides. The potentiometric levels in shallow wells were higher than in the intermediate wells away from the canals where recharge occurs, and the potentiometric levels in shallow wells were lower than in the intermediate wells adjacent to the canals where discharge occurs, again consistent with the conceptual model.

Beginning in March 2002, four quarters of groundwater measurements were conducted at OU 2. These data sets include all on-site shallow/intermediate well pairs and selected off-site well pairs on the GOAA property each quarter. Surface water staff gages were also measured during the last three quarters to determine the elevation of water in the drainage canals. The data were used to construct potentiometric surface maps that were published in quarterly reports (TtNUS, 2002b, 2002c, 2002d, 2003) and show a consistent pattern of groundwater flow towards the canals from both sides of the canals. As predicted by the site conceptual model, the surface water elevations were observed to be lower than the potentiometric surface displayed in adjacent wells in the surficial aquifer on all dates when data were collected.

Groundwater Plumes

Direct push technology (DPT) sampling methods and the monitoring well network at OU 2 have been used to collect groundwater samples for chemical analyses during the RI site characterization (1998 to 2000) and once each quarter during 2002. Initially, during the early stages of the RI, DPT was used to conduct an intensive groundwater plume investigation around the entire perimeter of OU 2. DPT groundwater samples were collected at two depths, near the water table at about 15 to 20 feet bgs and near the bottom of the surficial aquifer at 25 to 30 feet bgs. From July 1997 to May 1998, 274 groundwater sample points were installed using DPT methods. Samples were collected around the entire perimeter of OU 2 to illuminate any areas of potential groundwater plumes (see RI Figure 5-3A). In areas were volatile organic compounds

(VOCs) were detected (i.e., groundwater contaminants with relatively high potential for migration), additional DPT samples were collected to investigate any off-site migration. Based on the DPT results, two areas on GOAA property were investigated during this activity, east of the canal in the northern portion of OU 2 near the bulk fuel farm, and east of the canal in the southern portion of OU 2 in the vicinity of the bunkers. No detections of VOCs were found east of the canal in the southern area of concern, and only low, estimated concentrations of benzene [maximum of 1.3 J micrograms per liter (µg/L)] were detected east of the canal in the northern area of concern. Because petroleum fuel contamination was known to be present in groundwater at the bulk fuel farm, and because the groundwater flow direction was suspected (and later confirmed) to be away from the bulk fuel tanks toward the canal, the discovery of low concentrations of benzene on GOAA property adjacent to the northern area of concern was not considered to be indicative of a release from OU 2. It was noted that relatively low concentrations of benzene and chlorobenzene were detected on OU 2 in this same area, therefore additional investigation was performed by installing permanent monitoring wells in that area to monitor groundwater.

Two phases of groundwater sampling were performed during the RI in the summers of 1998 and 1999. The results showed that a plume containing low concentrations of VOCs, iron, and manganese was present in the northern portion of OU 2 along the eastern portion of the golf course adjacent to the canal. A second plume area was found to exist in the mostly wooded, southern portion of OU 2 that contained only VOCs. Dissolved iron was also found in groundwater in the southern area above the previously published background for McCoy Annex. However, the upgradient and off-site distribution and concentration trends indicated that the dissolved iron was attributable to local geochemical conditions (low pH groundwater and reducing conditions) and was not strongly correlated to the former landfill in this area of OU 2. Most importantly, the data showed that there were no detections of VOCs above screening criteria (i.e., FDEP groundwater cleanup target levels) in any off-site well east of the canal on GOAA property. However, concentrations of VOCs above screening criteria were detected in wells located on the narrow strip of GOAA property that lies along the western bank of the canal. One semivolatile organic compound, naphthalene, was detected in an off-site well (OLD-OU2-15B) located east of the canal during both the 1998 and 1999 sampling, but this constituent was not detected in any wells in the same vicinity at OU 2.

Subsequent to the RI, four quarters of groundwater sampling were conducted in 2002. Five new surficial aquifer well pairs and four replacement wells were installed at OU 2 to support this effort (see TtNUS, 2002a, Figures 3-1 and 3-2). These sampling events included samples from selected wells on GOAA property during March and September 2002. The wells sampled on GOAA property were located adjacent to the southern portion of OU 2 where groundwater plumes at OU 2 impinge along the canal. All quarterly sampling results showed concentrations and plume areas at OU 2 consistent with those identified during the RI: benzene, iron, and manganese continue to exceed screening criteria and are the COCs in the northern

plume area, and VOCs (benzene, PCE, TCE, cis-DCE, and vinyl chloride) are the COCs in the southern plume area. The results also showed that none of the more mobile contaminants (i.e., benzene and VOCs) observed at OU 2 were detected in the wells east of the canal on GOAA property. Iron concentrations above screening criteria were detected in wells on GOAA property, but the concentrations were consistent with the concentrations of iron detected in non-plume areas at OU 2, and based on the groundwater setting the high iron is attributed to local geochemical conditions. All historical exceedances of the groundwater screening criteria for the shallow and intermediate monitoring wells are summarized in the fourth quarter 2002 groundwater monitoring report for OU 2 (TtNUS, 2003, Figures 3 and 4).

Surface Water

Three phases of surface water and sediment sampling were conducted at OU 2 during the RI. Phase I was conducted in July 1997 (10 locations) and Phase II in August 1998 (additional 12 locations). Because the canal was subsequently dredged and cleared during maintenance operations, Phase III sampling was conducted in August 1999 to re-characterize the surface water and sediment. Eleven of the original sample locations were re-sampled and six new upgradient locations were added in August 1999 to investigate the influence of upgradient, off-site sources on surface water quality in the canals. A total of 14 of the surface water samples were located in the canals that run along the eastern perimeter of OU 2 and are pertinent to this discussion.

During all phases of the RI sampling, relatively few detections of constituents above screening criteria were observed in the surface water/sediment samples collected in the canals along the eastern perimeter of OU 2. No VOCs were detected in surface water above the screening criteria (i.e., FDEP surface water cleanup target levels) indicating that the VOCs in groundwater at OU 2 are not impacting surface water. With the exception of iron, none of the other constituents detected above screening criteria in surface water (i.e., aluminum, lead, phthalate) are attributed to the groundwater plumes at OU 2. Iron exceed the screening criteria of 1000 ug/L at several sample locations, but the concentrations observed are consistent with concentrations observed in local, non-impacted groundwater and are not indicative of discharge of the plume into surface water (i.e., they are consistent with local background conditions). For example, iron concentrations detected at off-site, upgradient locations SW023 and SW024 were consistent with concentrations detected in surface water in the vicinity of the groundwater plumes. Downstream, off-site surface water samples (locations SW008, SW015, SW021, and SW022) did not demonstrate any iron exceedances and indicate that the high iron is a localized condition.

Similar conditions were observed for sediment samples collected in the vicinity of OU 2. Few constituents were detected above screening criteria, none are correlated with contaminants observed in the plumes at OU 2, and downstream samples demonstrate that there have not been any widespread or lasting impacts.

Eight new surface water sampling sites were established and monitored once each quarter in 2002 (TtNUS, 2002d, Figure 3). Three sample points (SW029-31) were located along the northern portion of the canal along the eastern perimeter of OU 2 adjacent to the northern plume area, and five sample points (SW032-36) were located in the southern canal along the eastern perimeter of OU 2 adjacent to the southern plume area. These locations allowed surface water monitoring upgradient of, adjacent to, and downgradient of the areas were the plumes at OU 2 impinge the canals. Samples from these locations were analyzed for VOCs, iron, manganese, chloride ion, and specific conductivity to investigate the potential discharge of the plumes into the canals. Iron was the only constituent detected in surface water that exceeded the screening criteria. However, as was observed during the RI investigation of surface water, with some exceptions, the concentrations of iron observed are consistent with the high background concentration of iron in non-impacted groundwater that discharges to surface water. Singularly high concentrations of iron observed at SW032 (13,200 µg/L in Mar-02) and SW031 (40,600 µg/L in Sep-02) are attributed to inclusion of particulates in the samples (i.e., acidification of the raw sample in the field and analysis for total iron would result in anomalously high results). Furthermore, SW032 and SW031 are not adjacent to high plume concentrations. Moderately high iron observed at SW029 (6,200 µg/L in Mar-02) and SW030 (3,070 µg/L in Mar-02) may be attributed to plume discharge since they are located in the vicinity of high iron plume concentrations (i.e., northern plume area of OU 2). However, both of these surface water sample points are located on Navy property and downstream sample point SW031 does not show off-site iron concentrations related to plume discharge.

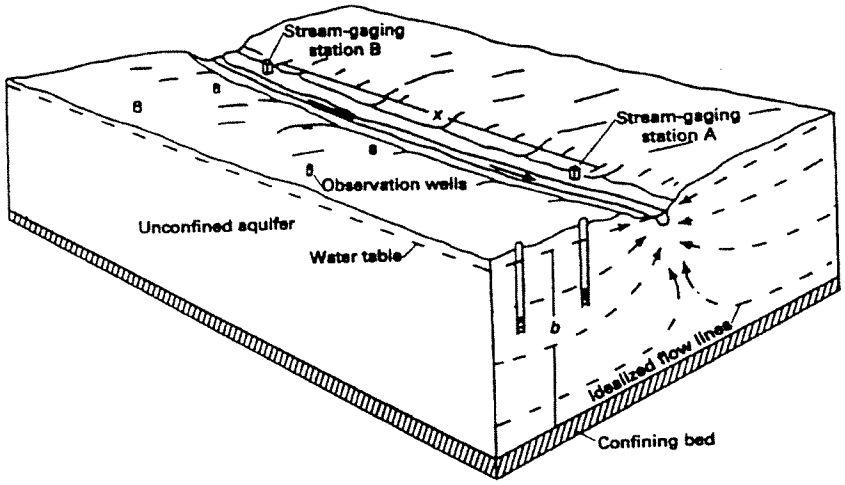
Low concentrations of some VOCs (benzene, toluene, PCE, TCE, and cis-DCE) were detected in the surface water samples adjacent to the southern plume area (SW032-36). The concentrations of these VOCs did not exceed the screening criteria. A maximum concentration 0.4J µg/L of cis-DCE was detected at SW036, the most downstream location, in only one of the four quarterly samples. These constituents are also found in the plume that is known to be discharging to the canal. The observance of these constituents in the surface water is consistent with and validates the groundwater flow conceptual model described for the site. The low concentrations observed over multiple sampling rounds spanning four years reflect that natural attenuation processes are effective at reducing plume concentrations and limiting the discharge of contaminants to surface water.

Conclusions

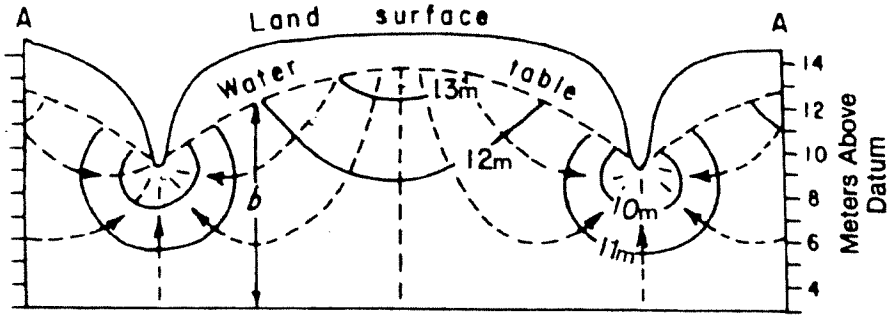
The Navy has identified two areas of shallow plumes at OU 2 that are migrating toward drainage canals along the eastern perimeter of the site. The site conceptual model predicts that plumes at OU 2 will migrate toward and discharge in the canals. A portion of those canals are located on GOAA property. Multiple rounds of hydraulic and chemical monitoring of both groundwater and surface water between August 1998 and December 2002 at OU 2 have confirmed these predictions. The absence of plume-related contaminants

beneath GOAA property east of the canal has been documented in the six rounds of monitoring well sampling. Concentrations of iron in surface water above the screening criteria in the canals both upstream of OU 2 and downstream of OU 2 are consistent with and attributed to local background conditions reflective of a highly reducing groundwater environment. The monitoring results have shown that concentrations of contaminants greater than the applicable screening criteria are present in groundwater beneath the narrow strip of GOAA property on the west side of the canal adjacent to the southern plume, but they are not migrating off-site east of the canal via either the groundwater or the surface water pathways. In summary, the Navy believes the pertinent conclusions are as follows:

- The canals along the eastern perimeter of OU 2 act as hydraulic barriers that prevent groundwater flow from crossing beneath the canals. This conceptual model has been verified through groundwater/surface water elevation monitoring.
- Accordingly, plume migration from OU 2 to GOAA property east of the canals is highly unlikely; this has been confirmed by sampling of multiple wells on GOAA property between July 1998 and December 2002. Only the narrow strip of GOAA property located along the west bank of the southern canal has been impacted by the groundwater plume at OU 2.
- No plume related VOCs have been detected in surface water above the screening criteria adjacent to either the northern plume or the southern plume at OU 2. Elevated iron detected at two surface water sample points located on Navy property adjacent to the northern plume appears to be associated with plume discharge; however, the downstream, off-site sample location has shown iron to be below the screening criteria and no off-site impacts are indicated.
- VOC breakdown products and geochemical parameters detected in groundwater indicate natural attenuation is occurring as expected.
- The remedy included in the draft Proposed Plan and draft Record of Decision (Monitored Natural Attenuation with certain Land Use Controls) would be protective of human health and the environment. However, the Navy will also implement a groundwater extraction and treatment remedial action to mitigate further contamination of GOAA property adjacent to the southern plume area.
- The location, design, and operation of storm water retention ponds proposed by GOAA, based on the Navy's current understanding, would not alter groundwater flow patterns or negatively impact future off-site migration of contaminants. Should this occur, the Navy would be responsible for addressing these issues.



A. Conceptual model of unconfined aquifer discharging to stream



B. Cross section through conceptual aquifer flow net

FIGURE 1

CONCEPTUAL MODEL OF SURFICIAL AQUIFER
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Source: EPA/625/4-85/016

tb-5x11v.dgn

REFERENCES:

Tetra Tech NUS, Inc. (TtNUS), 2001a, *Remedial Investigation Report for Operable Unit 2, McCoy Annex Landfill.* Naval Training Center, Orlando, Florida. Document No. R4712981, March.

TtNUS, 2001b, *Feasibility Study for Operable Unit 2, McCoy Annex Landfill.* Naval Training Center, Orlando, Florida. Document No. R470801005, August.

TtNUS, 2002a, *Work Plan for Well Installation and Groundwater Sampling, Operable Unit 2.* Naval Training Center, Orlando, Florida. Document No. 471201001, February.

TtNUS, 2002b, *Groundwater Sampling, March 2002 - Operable Unit 2.* Naval Training Center, Orlando, Florida. Document No. 470602003, June.

TtNUS, 2002c, *Groundwater Sampling, June 2002 - Operable Unit 2.* Naval Training Center, Orlando, Florida. Document No. 470802016, September.

TtNUS, 2002d, *Groundwater Sampling, September 2002 - Operable Unit 2.* Naval Training Center, Orlando, Florida. Document No. 471202006, December.

TtNUS, 2003, *Groundwater Sampling, December 2002 - Operable Unit 2.* Naval Training Center, Orlando, Florida. Document No. 470103005, March.