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NSA MID SOUTH
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PROCEDURE TO OBTAIN CLOSURE BY TGD-015 NORTH FUEL FARM MILLINGTON SUPPACT TN
6/7/1999
ENSAFE/ALLEN & HOSHALL

(2)

PROCEDURE TO OBTAIN CLOSURE BY TGD-015
NORTH FUEL FARM
NAVAL SUPPORT ACTIVITY MID-SOUTH
MILLINGTON, TENNESSEE

Facility ID 0-791709
Revision: 0

CTO-134

Contract Number: N62467-89-D-0318

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901) 372-7962

The Contractor, EnSafe Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0318 is complete, accurate, and complies with all requirements of the contract.

Date:	June 7, 1999
Signature:	
Name:	John Stedman
Title:	Task Order Manager

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

5724 Summer Trees Drive • Memphis, Tennessee 38134 • Telephone 901-372-7962 • Facsimile 901-372-2454 • www.ensafe.com

June 7, 1999

Commanding Officer
ATTN: John Karlyk/1846
SOUTHNAVFACENGCOM
2155 Eagle Drive
P.O. Box 190010
North Charleston, SC 29419-9010

Subject: CTO-0134; NSA Mid-South, Millington, Tennessee
Document Transmittal — *Procedure to Obtain Closure by TGD-015 — North Fuel Farm (NFF), Revision: 0*

Reference: Contract N62467-89-D-0318 (CLEAN II)

Dear Sir:

EnSafe is pleased to submit the *Procedure to Obtain Closure by TGD-015 Report* for the North Fuel Farm. Three copies of this report have been sent to Randy Wilson at NSA Mid-South.

If you have any questions or comments of a technical nature, please contact me at 901/372-7962. Comments or questions of a contractual nature should be directed to Debra Blagg at the same number.

Sincerely,

EnSafe Inc.

By: John Stedman, Jr.
Task Order Manager

Attachments

cc: Contracts File: CTO-0134 (without enclosure)
Project File: 0134-12102 (without enclosure)
SOUTHDIV: Ms. Kim Reavis/Code 0233KR (without enclosure)
NSA Mid-South: Randy Wilson (three copies)

Procedure to Obtain Closure by TGD-015 — North Fuel Farm; Revision: 0
Naval Support Activity Mid-South — Millington, Tennessee

Procedure to Obtain Closure by TGD-015 — North Fuel Farm; Revision: 0
Naval Support Activity Mid-South — Millington, Tennessee

Procedure to Obtain Closure by TGD-015 — North Fuel Farm; Revision: 0
Naval Support Activity Mid-South — Millington, Tennessee

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1.0 INTRODUCTION

This report contains the procedure to obtain closure for underground storage tank (UST) systems 7, 303, 1241, 304, and 1239 at the North Fuel Farm (NFF) (Figure 1) of the Naval Support Activity (NSA) Mid-South in Millington, Tennessee. The report was prepared according to *Technical Guidance Document (TGD) — 015, Procedure to Obtain Closure for Sites in the Monitoring Only Program*, published August 1, 1996 by the State of Tennessee, Department of Underground Storage Tanks.

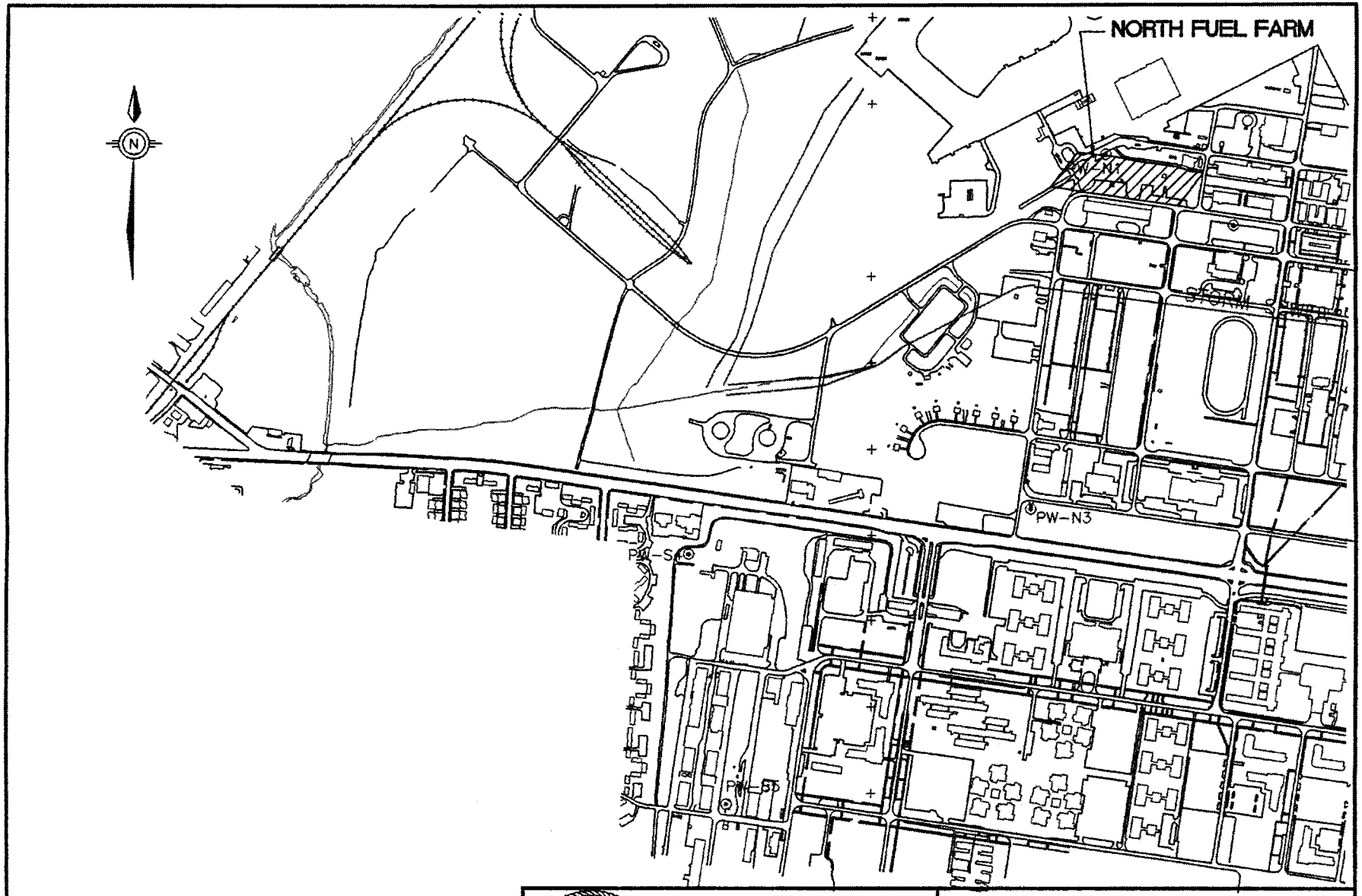
Site History

Five tanks have been onsite during the NFF's history:

- Tanks 304 and 1239 — Both 100,000-gallon heating oil tanks.
- Tank 7 — A 560-gallon aviation gasoline tank.
- Tanks 303 and 1241 — Both 25,000-gallon aviation gasoline tanks.

Tanks 7, 303, and 1241 were removed in 1992, and an Environmental Assessment Report (EAR) was subsequently completed on November 17,1993. Total petroleum hydrocarbon (TPH) concentrations in groundwater and soil were found as high as 17 parts per million (ppm) and 110 ppm, respectively.

A Site-Specific Standard (SSS) request was submitted for tanks 7, 303, and 1241 due to TPH in groundwater exceeding the non-drinking water cleanup standard. Quarterly monitoring and a 100- ppm action level were proposed in lieu of corrective action. The SSS was rescinded on November 18, 1994 due to the contamination identified at adjacent tanks 304 and 1239 and the scheduled site transfer to the City of Millington under the Base Closure and Realignment (BRAC) program.



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TECHNICAL GUIDANCE
DOCUMENT 015
NSA MID-SOUTH
MILLINGTON, TN

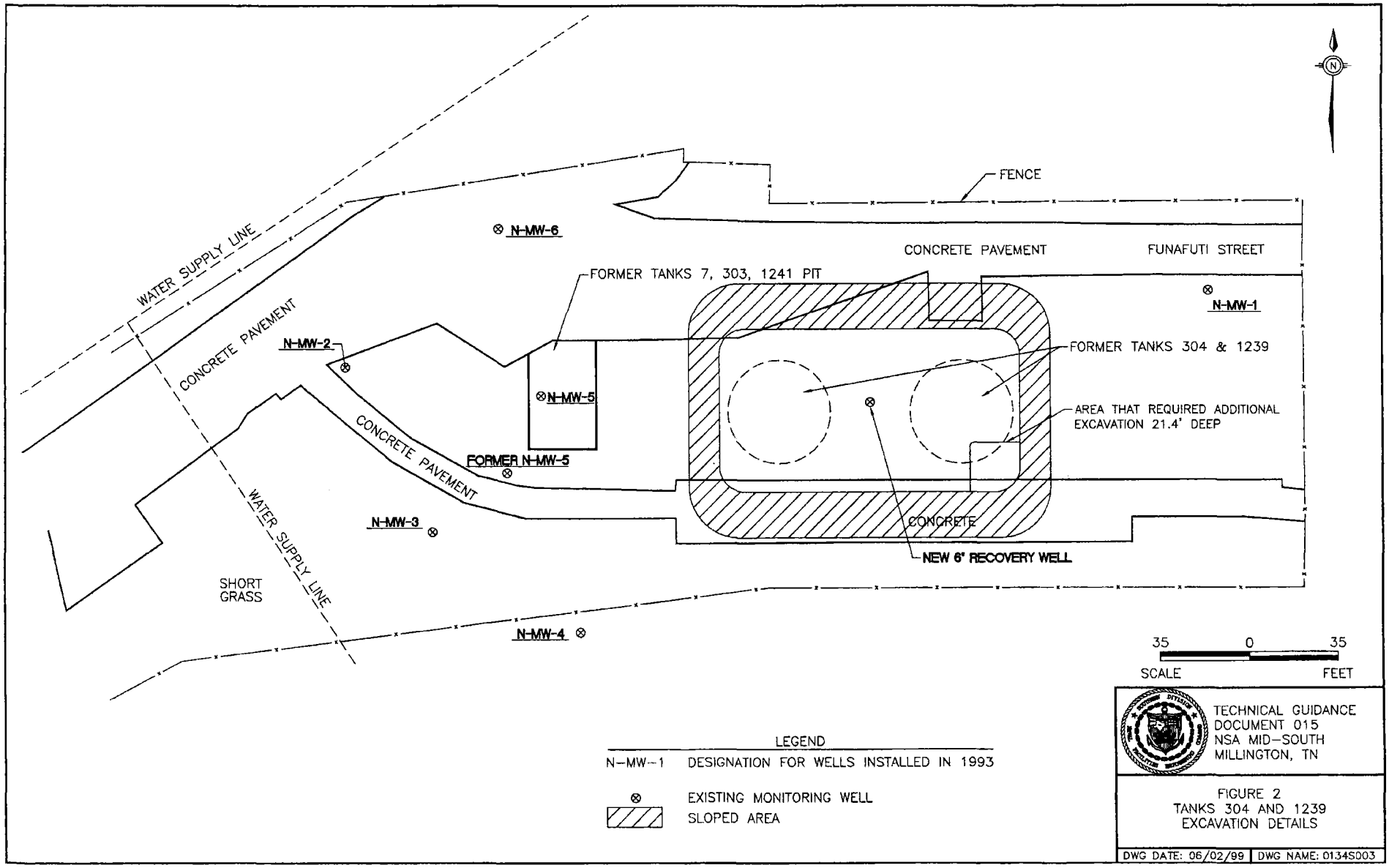
FIGURE 1
VICINITY MAP
NORTH FUEL FARM

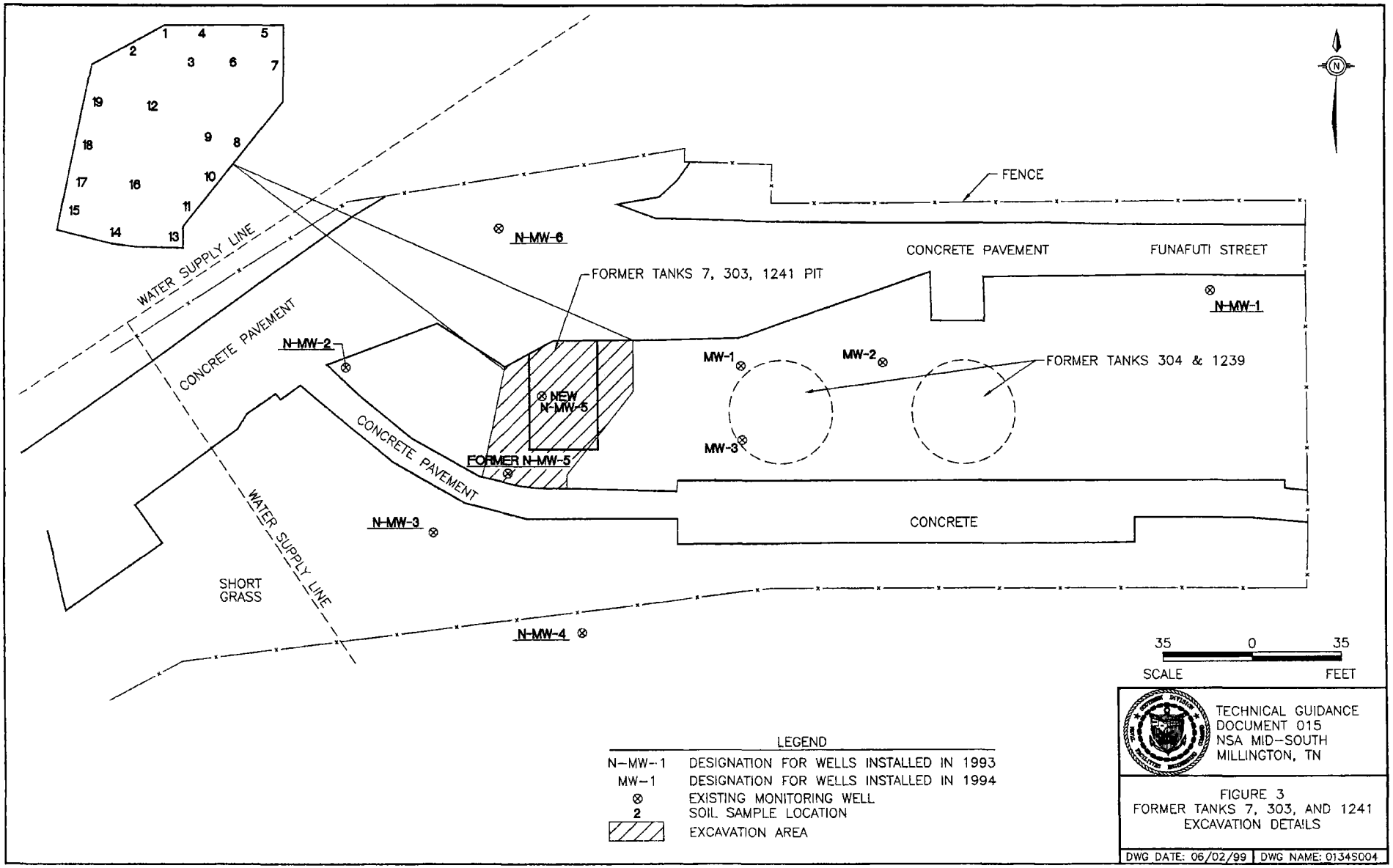
DWG DATE: 12/04/98 | DWG NAME: 0094G020

An EAR was submitted for tanks 304 and 1239 in 1994. TPH concentrations as high as 170 ppm and 2,300 ppm were found in groundwater and soil, respectively.

The former tank systems 7, 303, 1241, 304, and 1239 are currently regarded as one site. As referenced in the site Corrective Action Plan (CAP), the groundwater cleanup level for TPH is 1.0 ppm, and the soil cleanup level is 1,000 ppm *(Final Corrective Action Plan, Registered Tanks 7, 303, 1241 and Nonregistered Tanks 304 and 1239*, NAS Memphis, Millington, Tennessee, October 6, 1995). The CAP recommended excavation and source removal as a remediation method. Tanks 304 and 1239 were removed between May 1 and August 1, 1997, and TPH-contaminated soil was excavated to the cleanup level of 1,000 ppm. Figure 2 is a plan view of the excavation. Details of the removal of tanks 304 and 1239 can be found in the *Completion Report, Underground Storage Tank Removal (Tanks 304 and 1239)*, Naval Support Activity Memphis, Millington, Tennessee, October 21, 1997.

Groundwater at the NFF is being monitored quarterly through six monitoring wells, and previous NFF groundwater sampling has indicated the presence of free product in monitoring well N-MW-5. In an effort to remove free product and remediate soils near this well, mobile enhanced multi-phase extraction (MEME) has been conducted at the NFF, specifically at N-MW-5. Results of the four most recent extractions indicated the presence of free product in N-MW-5. Previous investigations have indicated that the pit for former tanks 7, 303, and 1241 may be the source of contamination. Therefore, a soil removal was conducted in the vicinity of N-MW-5 in September, 1998 (Figure 3). During the excavation, N-MW-5 was properly abandoned and removed. Another monitoring well was installed to replace N-MW-5 (also called N-MW-5) inside the excavated area. Approximately 2,016 cubic yards of soil were excavated to the TPH cleanup level of 1,000 ppm. Excavation details for tanks 7, 303, and 1241 can be found in the *Final Soil Removal Report, Former Tanks 7, 303, and 1241, Facility I.D. #0-791709*, Naval Support Activity Mid-South, Millington, Tennessee, January 12, 1999.


FENCE
N-MW-6
CONCRETE PAVEMENT
FUNAFUTI STREET
WATER SUPPLY LINE
FORMER TANKS 7, 303, 1241 PIT
N-MW-1
CONCRETE PAVEMENT
N-MW-2
FORMER TANKS 304 & 1239
N-MW-5
AREA THAT REQUIRED ADDITIONAL EXCAVATION 21.4' DEEP
CONCRETE PAVEMENT
FORMER N-MW-5
WATER SUPPLY LINE
N-MW-3
CONCRETE
NEW 6" RECOVERY WELL
SHORT GRASS
N-MW-4
35 0 35
SCALE FEET
LEGEND
N-MW-1 DESIGNATION FOR WELLS INSTALLED IN 1993
EXISTING MONITORING WELL
SLOPED AREA
TECHNICAL GUIDANCE DOCUMENT 015
NSA MID-SOUTH
MILLINGTON, TN
FIGURE 2
TANKS 304 AND 1239
EXCAVATION DETAILS
DWG DATE: 06/02/99
DWG NAME: 0134S003


1
2
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18
19
WATER SUPPLY LINE
CONCRETE PAVEMENT
N-MW-6
FENCE
CONCRETE PAVEMENT
FUNAFUTI STREET
FORMER TANKS 7, 303, 1241 PIT
N-MW-1
N-MW-2
MW-1
MW-2
FORMER TANKS 304 & 1239
NEW N-MW-5
MW-3
CONCRETE PAVEMENT
FORMER N-MW-5
WATER SUPPLY LINE
N-MW-3
CONCRETE
SHORT GRASS
N-MW-4
N
35
0
35
SCALE
FEET
LEGEND
N-MW-1 DESIGNATION FOR WELLS INSTALLED IN 1993
MW-1 DESIGNATION FOR WELLS INSTALLED IN 1994
EXISTING MONITORING WELL
2 SOIL SAMPLE LOCATION
EXCAVATION AREA
TECHNICAL GUIDANCE
DOCUMENT 015
NSA MID-SOUTH
MILLINGTON, TN
FIGURE 3
FORMER TANKS 7, 303, AND 1241
EXCAVATION DETAILS
DWG DATE: 06/02/99
DWG NAME: 0134S004

2.0 PROCEDURE TO OBTAIN CLOSURE

The purpose of TGD-015 is to provide the owner and/or operator with the minimum requirements to obtain closure at a UST site in the monitoring only program. The UST site may be eligible for closure after a minimum of 2 years of monitoring if groundwater concentrations at the point of compliance are at or below the established cleanup levels of 0.070 ppm benzene and 1.0 ppm TPH.

2.1 Distance to the Point of Compliance

TGD-015 defines the point of compliance as the offsite occupied building (residential or commercial) nearest to the monitoring well (MW) in the area specified below, with the highest level of contamination.

- A line drawn from the upgradient property line, through the MW with the highest level of contamination extending downgradient to the edge of the map indicates the predominant groundwater flow direction.

- Two additional lines, each 45 degrees in the downgradient direction, drawn off the groundwater flow direction line begin at the upgradient property line and extend to the edge of the map.

The point of compliance is approximately 187.5 feet downgradient of the new N-MW-5. Figure 4 depicts the site point of compliance using the methods described above.

2.2 Closure Report for Monitoring Only Sites

The site closure report in the following pages follows the format in TGD-015. Calculations for results found in the report were prepared in a spreadsheet format (Appendix A).

No soil has been monitored at the site, except confirmation soil sampling during the removal of tanks 304 and 1239, and the soil excavation at former tank locations 7, 303, and 1241. Therefore, the average soil concentration used in the calculations is the average of all confirmation soil sample results.

Figure 4 Point of Compliance

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF UNDERGROUND STORAGE TANKS
CLOSURE REPORT FOR MONITORING ONLY SITES

1. Facility ID #: *0-791709*

2. Facility Name: *North Fuel Farm (former tanks 7, 303, 1241, 304, and 1239)*

3. Date the site was approved for monitoring only: *Not Applicable.*

4. Provide a description of the point of compliance (i.e. residence, business). Attach a vicinity map showing its location and the distance to the monitoring well with the highest level of contamination. *The point of compliance is Building N-126, currently used as a hangar. It is approximately 187.5 feet from monitoring well N-MW-5. Figure 4 depicts the location of Building N-126 and N-MW-5.*

5. List the following parameters used in the calculations:

TGD-015 CALCULATION PARAMETERS		
Parameter	**Value**	**Units**
ρ_s, soil bulk density	1.7	g-soil/cm^3-soil
θ_{ws}, volumetric water content in vadose zone soils	0.12	cm^3-H_2O/cm^3-soil
f_{oc}, fractional organic carbon	0.01	percent
θ_{as}, volumetric air content in vadose zone soils	0.26	cm^3-air/cm^3-soil
U_{gw}, groundwater darcy velocity	49.80	cm/yr
S_w, width of source area parallel to groundwater flow direction	1500	cm
I_{cover}, percent of soil plume covered by impermeable surface	10	percent
x, distance to point of compliance	5,715	cm

6. List the benzene groundwater concentrations, in ppm, from the three most recent sampling events.

BENZENE GROUNDWATER CONCENTRATIONS (ppm)			
	Event 1	**Event 2**	**Event 3**
Date of Sampling Event →	***September 2, 1998***	***October 27, 1998***	***April 15, 1999***
Well Number ↓			
N-MW-1	<0.001	<0.001	<0.00014
N-MW-2	<0.001	<0.001	<0.00014
N-MW-3	<0.001	<0.001	<0.00014
N-MW-4	<0.001	<0.001	<0.00014
N-MW5	not sampled	<0.001	<0.00014
N-MW-6	<0.001	<0.001	<0.00014
N-RW-1	<0.001	<0.001	<0.00014

7. List the TPH groundwater concentrations, in ppm, from the three most recent sampling events.

TPH/EPH GROUNDWATER CONCENTRATIONS (ppm)			
	Event 1	**Event 2**	**Event 3**
Date of Sampling Event →	***September 2, 1998***	***October 27, 1998***	***April 15, 1999***
Well Number ↓			
N-MW-1	0.225	<0.1	0.183
N-MW-2	0.261	0.134	0.156
N-MW-3	<0.1	0.103	<0.01
N-MW-4	0.213	0.167	0.138
N-MW-5	not sampled	2.13	2.74
N-MW-6	0.902	0.660	0.729
N-RW-1	0.143	0.160	0.213

Note:
The above concentrations are for Extractable Petroleum Hydrocarbons (EPH), which replaced DRO on May 1, 1998 (required by TDEC Division of Underground Storage Tanks)

8. Provide average soil concentration ($©_{soil\ ave}$) for benzene, and diesel range organics (DRO), in ppm. Include document, date, and page number where information can be verified.

SOIL ANALYTICAL DATA					
Location	**Benzene (ppm)**	**DRO (ppm)[a]**	**GRO (ppm)**	**Date**	**Document**
304S000101	0.0040	10	4	9/29/98	b
304S000201	0.0044	67	2.3	9/29/98	b
304S000301	ND	8	1.2	9/29/98	b
304S000401	0.04	ND	4.7	9/29/98	b
304S000501	0.0045	ND	3.2	9/29/98	b
304S000601	ND	30	0.67	9/29/98	b
304S000701	ND	17	12	9/29/98	b
304S000801	0.0030	5.3	1	9/29/98	b
304S000901	0.01	4.1	1.4	9/29/98	b
304S001001	0.032	99	14	9/29/98	b
304S001101	ND	460	15	9/29/98	b
304S001201	ND	110	ND	9/29/98	b
304S001301	ND	740	25	9/29/98	b
304S001401	ND	680	38	9/29/98	b
304S001501	ND	44	ND	9/29/98	b
304S001601	ND	12	ND	9/29/98	b
304S001701	ND	18	0.64	9/29/98	b
304S001801	ND	17	ND	9/29/98	b
304S001901	ND	7.7	ND	9/29/98	b
1239CS343	NS	ND	ND	6/17/97	c
1239CS345	NS	16.8	0.0627	6/17/97	c
1239CB346	NS	20	0.51	6/17/97	c
1239CB347	NS	ND	0.0271	6/17/97	c
1239CS348	NS	ND	ND	6/17/97	c
1239CS349	NS	7.98	0.0092	6/17/97	c

SOIL ANALYTICAL DATA					
Location	**Benzene (ppm)**	**DRO (ppm)[a]**	**GRO (ppm)**	**Date**	**Document**
1239CB350	NS	157	2.31	6/17/97	c
1239CB351	NS	ND	0.014	6/17/97	c
1239CS352	NS	ND	0.0665	6/17/97	c
1239CS353	NS	ND	0.0301	6/17/97	c
1239CS354	NS	9.35	0.572	6/17/97	c
1239CB355	NS	26.3	0.0276	6/17/97	c
1239CS356	NS	94.9	ND	6/17/97	c
0304CS357	NS	2.6	196	6/17/97	c
0304CB358	NS	163	7.17	6/17/97	c
0304CB359	NS	53.5	193	6/17/97	c
0304CS360	NS	15.6	ND	6/17/97	c
0304CS361	NS	267	228	6/17/97	c
0304CB362	NS	36.2	0.0338	6/17/97	c
0304CB363	NS	37.5	0.25	6/17/97	c
0304CS364	NS	13.7	0.0174	6/17/97	c
0304CS365	NS	25.9	83.6	6/17/97	c
0304CS366	NS	ND	ND	6/17/97	c
0304CS367	NS	18.6	0.151	6/17/97	c
0304CB368	NS	349	12.8	6/17/97	c
1239CB369	NS	ND	0.14	6/17/97	c
1239CB370	NS	5.34	23	6/17/97	c
1239CS371	NS	ND	0.25	6/17/97	c
AVERAGES	0.014 ppm	101.4 ppm	23.5 ppm		

Notes:

a = Effective May 1, 1998, TDEC now requires the use of the EPH Method 8100M to replace the DRO Method 8015M.

b = *Final Soil Removal Report, Former Tanks 7, 303, and 1241.*

c = *Completion Report, Underground Storage Tank Removal, Tanks 304 and 1239.*

ND = Not detected above method detection limit.
NS = Compound not sampled for.
GRO = Gasoline range organics.

9. Worksheets for calculations are located in Appendix A.

10. Provide the results of the calculations in the following table.

TGD-015 CALCULATION RESULTS		
Parameter	**Value**	**Units**
I_{site}, infiltration rate of water through soil	27	cm/yr
α, leachate to gw dilution factor	1.25	unitless
$k_{s\ benzene}$, soil-water sorption coefficient	0.38	g-H_2O/g-soil
$k_{s\ GRO}$, soil-water sorption coefficient	4.79	g-H_2O/g-soil
$k_{s\ DRO}$, soil-water sorption coefficient	12.9	g-H_2O/g-soil
$K_{sw\ benzene}$, soil to leachate partition	2.07	unitless
$K_{sw\ GRO}$, soil to leachate partition	0.18	unitless
$K_{sw\ DRO}$, soil to leachate partition	0.08	unitless
$LF_{sw\ benzene}$, soil to groundwater leaching	1.66	(mg/L-H_2O)/(mg/kg-soil)
$LF_{sw\ GRO}$, soil to groundwater leaching	0.14	(mg/L-H_2O)/(mg/kg-soil)
$LF_{sw\ DRO}$, soil to groundwater leaching	0.06	(mg/L-H_2O)/(mg/kg-soil)
$C_{soil\ ave\ benzene}$, avg. benzene contamination in soil	0.014	ppm
$C_{soil\ ave\ GRO}$, avg. GRO contamination in soil	23.50	ppm
$C_{soil\ ave\ DRO}$, avg. DRO contamination in soil	101.40	ppm
$C_{leaching\ benzene}$, contamination in gw contributed by leaching	0.02	ppm
$C_{leaching\ GRO}$, contamination in gw contributed by leaching	3.35	ppm
$C_{leaching\ DRO}$, contamination in gw contributed by leaching	6.27	ppm
$C_{gw\ ave\ benzene}$, avg. benzene contamination in gw	0.00	ppm
$C_{gw\ ave\ TPH}$, avg. TPH contamination in gw (EPH+GRO)	1.454	ppm

TGD-015 CALCULATION RESULTS		
Parameter	**Value**	**Units**
$C_{source\ benzene}$, benzene concentration at source	0.02	ppm
$C_{source\ TPH}$, TPH concentration at source	11.07	ppm
α_x, longitudinal dispersivity	571.5	cm
α_y, transverse dispersivity	190.5	cm
α_z, vertical dispersivity	57.15	cm
$C_{x\ benzene}$, concentration of benzene at compliance point	0.001	ppm
$C_{x\ TPH}$, concentration of TPH at compliance point	0.436	ppm

Notes:

gw = Groundwater.
mg/L = Milligrams per liter.
mg/kg = Milligrams per kilogram.
cm = Centimeters.

11. Determine if the site is eligible for closure:

	Benzene (ppm)	**TPH (ppm)**
Calculated concentrations at the point of compliance	0.001	0.436
Applicable cleanup levels	0.07 ppm	1.0 ppm
Is the calculated concentration below the applicable cleanup level?	YES	YES

12. Determine target site cleanup goal(s) for benzene and TPH, if applicable:

Benzene target site cleanup goal (ppm)	Not applicable
TPH target site cleanup goal (ppm)	Not applicable

3.0 CONCLUSIONS AND RECOMMENDATIONS

As shown in Section 2.0, the point of compliance is approximately 187.5 feet downgradient of monitoring well N-MW-5. The calculated benzene and TPH concentrations at that point are 0.001 and 0.436 ppm, respectively, which are well below site cleanup levels.

A site ranking, per Technical Guidance Document — 014 has also been completed for the NFF. The site ranked below 500 which provides further evidence that the site is not a danger to human health or the environment. Previous groundwater monitoring at the NFF also indicate only one MW (N-MW-5) with TPH concentrations above 1.0 ppm (2.74 ppm on April 15, 1999 and 2.13 ppm on October 27, 1998). Prior to these two sampling events, TPH concentrations in N-MW-5 were as high as 48 ppm TPH. N-MW-5 is completed in the former tank pit area, and all other MWs at the NFF were below the cleanup level of 1.0 ppm TPH.

4.0 SIGNATURE PAGE

We, the undersigned, certify under penalty of law, including but not limited to penalties for perjury, that the information contained in this report form and on any attachments, is true, accurate and complete to the best of our knowledge, information, and belief. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for intentional violations.

Owner/Operator (Print)	Signature	Date
P.E. or P.G. (Print)	Signature TN Lic./Reg. #	Date

All signatures above must be notarized.

STATE OF_____

Sworn to and subscribed before me by_____ on this date_____

My commission expires_____

_____
Notary Public — Print Name

_____
Signature

Appendix A
TGD-015 Spreadsheet Calculations

North Fuel Farm NSA Mid-South

Procedure to Obtain Closure for Sites in the Monitoring Only Program - TGD-015

Site Groundwater Concentrations

	Benzene				
A	soil bulk density:		1.70	g soil/cubic cm soil	(default value)
B	volumetric water content in vadose zone soils:		0.12	cubic cm water/cubic cm soil	(default value)
C	carbon-water sorption coefficient:		38.00	square cm water/g carbon	(published value)
D	fractional organic carbon:		0.01	fraction	(default value)
E	soil-water sorption coefficient:	(CxD)	0.38	g water/g soil	(calculated)
F	henry's law constant:		0.22	unitless	(published value)
G	volumetric air content in vadose zone soils:		0.26	cubic cm air/cubic cm soil	(default value)
H	soil to leachate partition (Ksw):	[A / (B+(E x A)+(F x G)]	2.07	ppm water/ppm soil	(calculated)
I	groundwater darcy velocity:		49.80	cm/yr	(calculated)
J	groundwater mixing zone thickness:		200.00	cm	(default value)
K	infiltration rate of water through soil (I):		30.00	cm/yr	(default value)
L	width of source area parallel to gw flow direction (Sw):		1500.00	cm	(default value)
M	leachate to groundwater dilution factor:	[1+(I x J)/(P x L)]	1.25	unitless	(calculated)
N	leaching factor (LFsw), soil to groundwater:	(H/M)	1.66	ppm/ppm	(calculated)
O	percent of soil plume which is covered (Icover):		0.10		(calculated)
P	site specific infiltration rate (Isite):	[K x (1-O)]	27.00	cm/yr	(calculated)
R	avg. soil contamination (Csoil ave):		0.01	ppm	(calculated)
S	cont. in gw contributed by leaching (Cleaching):	(R x N)	0.02	ppm	(calculated)

			N-MW-1	N-MW-2	N-MW-3	N-MW-4	N-MW-5	N-MW-6	N-RW-1	
T	Avg. site gw contamination (Cgw ave): for benzene	3rd most recent event	nd	nd	nd	nd	nd	nd	nd	PPM
		2nd most recent event	nd	nd	nd	nd	nd	nd	nd	PPM
		1st most recent event	nd	nd	nd	nd	nd	nd	nd	PPM
		Cgw ave/well	NA	NA	NA	NA	NA	NA	NA	
		Cgw ave/site	0.000	PPM						

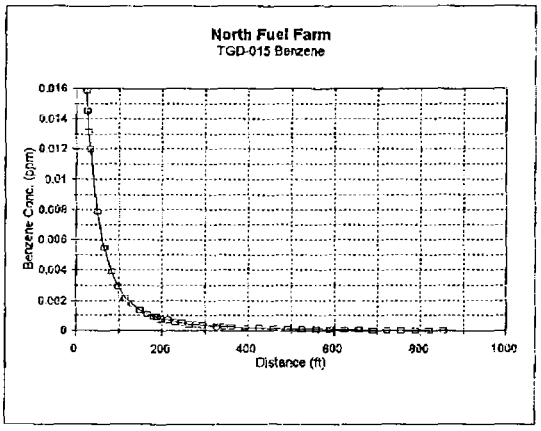
U	Concentration at the source (Csource)	(S + T)	0.02	ppm	benzene only	
V	Source depth, Sd		200.00	cm		(default value)

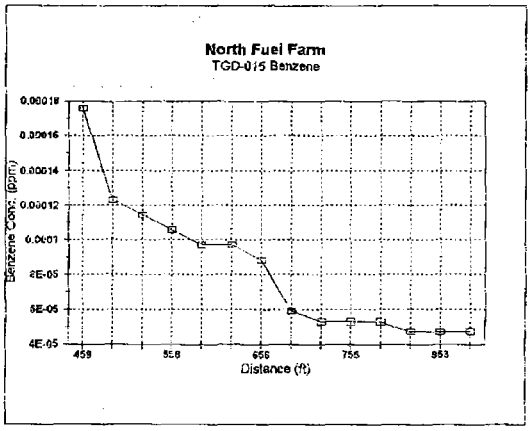
North Fuel Farm NSA Mid-South

Procedure to Obtain Closure for Sites in the Monitoring Only Program - TGD-015

Conc. at distance x (Cx) = Csource x erf[Sw/(4 x SQRT(trans. disp. x dist.))] x [erf[Sd/(4 x SQRT(vert. disp. x dist.))]

x (cm)	x (ft)	x longitudinal dispersivity (cm)	y transverse dispersivity (cm)	z vertical dispersivity (cm)	Beta1	erf	Beta2	erf	benzene (ppm)
100	3	10.00	3.33	1.00	20.54		5.00		0.000
200	7	20.00	6.67	2.00	10.27		2.50		0.000
300	10	30.00	10.00	3.00	6.85		1.67		0.000
400	13	40.00	13.33	4.00	5.13		1.25		0.000
500	16	50.00	16.67	5.00	4.11		1.00	0.842701	0.000
600	20	60.00	20.00	6.00	3.42		0.83	0.759240	0.000
700	23	70.00	23.33	7.00	2.93	0.999965	0.71	0.684470	0.016
800	26	80.00	26.67	8.00	2.57	0.999713	0.63	0.626760	0.015
900	30	90.00	30.00	9.00	2.28	0.990713	0.56	0.571430	0.013
1000	33	100.00	33.33	10.00	2.05	0.996172	0.50	0.520500	0.012
1500	49	150.00	50.00	15.00	1.37	0.946802	0.33	0.359080	0.008
2000	66	200.00	66.67	20.00	1.03	0.853952	0.25	0.276326	0.005
2500	82	250.00	83.33	25.00	0.82	0.753528	0.20	0.222703	0.004
3000	98	300.00	100.00	30.00	0.68	0.663492	0.17	0.189879	0.003
3500	115	350.00	116.67	35.00	0.59	0.595749	0.14	0.156890	0.002
4000	131	400.00	133.33	40.00	0.51	0.529065	0.13	0.145780	0.002
4500	148	450.00	150.00	45.00	0.46	0.484486	0.11	0.123570	0.001
5000	164	500.00	166.67	50.00	0.41	0.437810	0.10	0.112463	0.001
5500	180	550.00	183.33	55.00	0.37	0.398986	0.09	0.101245	0.001
5715	188	571.50	190.50	57.15	0.36	0.389184	0.09	0.101245	0.001
6000	197	600.00	200.00	60.00	0.34	0.369231	0.08	0.090030	0.001
6500	213	650.00	216.67	65.00	0.32	0.348929	0.08	0.090030	0.001
7000	230	700.00	233.33	70.00	0.29	0.318167	0.07	0.078808	0.001
7500	246	750.00	250.00	75.00	0.27	0.297246	0.07	0.078808	0.001
8000	262	800.00	266.67	80.00	0.26	0.286786	0.06	0.067590	0.000
8500	279	850.00	283.33	85.00	0.24	0.265601	0.06	0.067590	0.000
9000	295	900.00	300.00	90.00	0.23	0.254877	0.06	0.067590	0.000
10000	328	1000.00	333.33	100.00	0.21	0.233428	0.05	0.056372	0.000
10500	344	1050.00	350.00	105.00	0.20	0.222703	0.05	0.056372	0.000
11000	361	1100.00	366.67	110.00	0.19	0.211762	0.05	0.056372	0.000
12000	394	1200.00	400.00	120.00	0.17	0.189879	0.04	0.045098	0.000
13000	427	1300.00	433.33	130.00	0.16	0.178937	0.04	0.045098	0.000
14000	459	1400.00	466.67	140.00	0.15	0.167996	0.04	0.045098	0.000
15000	492	1500.00	500.00	150.00	0.14	0.156689	0.03	0.033823	0.000
16000	525	1600.00	533.33	160.00	0.13	0.145783	0.03	0.033823	0.000
17000	558	1700.00	566.67	170.00	0.12	0.134676	0.03	0.033823	0.000
18000	591	1800.00	600.00	180.00	0.11	0.123570	0.03	0.033823	0.000
19000	623	1900.00	633.33	190.00	0.11	0.123570	0.03	0.033823	0.000
20000	656	2000.00	666.67	200.00	0.10	0.112463	0.03	0.033823	0.000
21000	689	2100.00	700.00	210.00	0.10	0.112463	0.02	0.022550	0.000
22000	722	2200.00	733.33	220.00	0.09	0.101245	0.02	0.022550	0.000
23000	755	2300.00	766.67	230.00	0.09	0.101245	0.02	0.022550	0.000
24000	787	2400.00	800.00	240.00	0.09	0.101245	0.02	0.022550	0.000
25000	820	2500.00	833.33	250.00	0.08	0.090027	0.02	0.022550	0.000
26000	853	2600.00	866.67	260.00	0.08	0.090027	0.02	0.022550	0.000
26670	875	2667.00	889.00	266.70	0.06	0.090027	0.02	0.022550	0.000





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North Fuel Farm NSA Mid-South

Procedure to Obtain Closure for Site in the Monitoring Only Program - TGD-015

Site Groundwater Concentrations

Gasoline Range Organics (GRO)

A	soil bulk density:		1.70	g soil/cubic cm soil	(default value)
B	volumetric water content in vadose zone soils:		0.12	cubic cm water/cubic cm soil	(default value)
C	carbon-water sorption coefficient:		479.00	square cm water/g carbon	(published value)
D	fractional organic carbon:		0.01	fraction	(default value)
E	soil-water sorption coefficient:	(CxD)	4.79	g water/g soil	(calculated)
F	henry's law constant:		5.07	unitless	(published value)
G	volumetric air content in vadose zone soils:		0.26	cubic cm air/cubic cm soil	(default value)
H	soil to leachate partition (Ksw):	[A / (B+(E x A)+(F x G)]	0.18	ppm water/ppm soil	(calculated)
I	groundwater darcy velocity:		49.80	cm/yr	(calculated)
J	groundwater mixing zone thickness:		200.00	cm	(default value)
K	infiltration rate of water through soil (I):		30.00	cm/yr	(default value)
L	width of source area parallel to gw flow direction (Sw):		1500.00	cm	(default value)
M	leachate to groundwater dilution factor:	[1+(I x J)/(P x L)]	1.25	unitless	(calculated)
N	leaching factor (LFsw), soil to groundwater:	(H/M)	0.14	ppm/ppm	(calculated)
O	percent of soil plume which is covered (icover):		0.10		(calculated)
P	site specific infiltration rate (Isite):	[K x (1-O)]	27.00	cm/yr	(calculated)
R	avg. soil contamination (Csoil ave):		23.50	ppm	(calculated)
S	cont. in gw contributed by leaching (Cleaching):	(R x N)	3.35	ppm	(calculated)

			N-MW-1	N-MW-2	N-MW-3	N-MW-4	N-MW-5	N-MW-6	N-RW-1	
T	Avg. site gw contamination for GRO (Cgw ave):	3rd most recent event	nd	nd	nd	nd	ns	nd	nd	PPM
		2nd most recent event	nd	nd	nd	nd	0.000	nd	nd	PPM
		1st most recent event	nd	nd	nd	nd	0.141	nd	nd	PPM
		Cgw ave/well	NA	NA	NA	NA	0.071	NA	NA	
		Cgw ave/site	0.071	PPM						

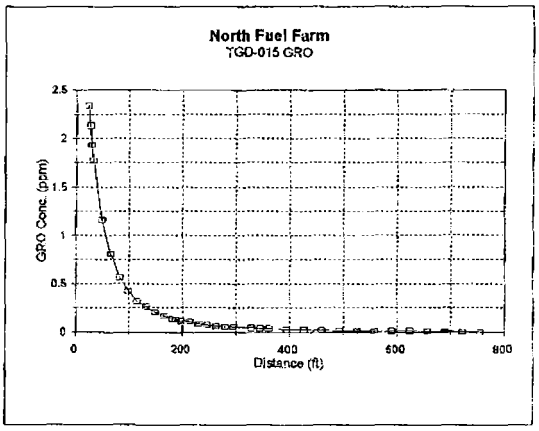
U	Concentration at the source (Csource):	(S + T)	3.42	ppm	GRO only	
V	Source depth, Sd		200.00	cm		(default value)

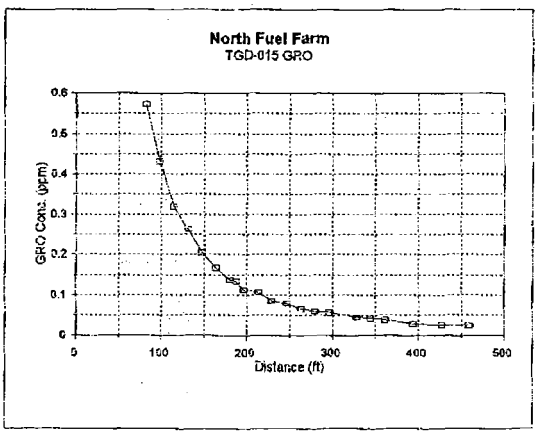
North Fuel Farm NSA Mid-South

Procedure to Obtain Closure for Site in the Monitoring Only Program - TGD-015

Conc. at distance x (Cx) = Csource x erf[Sw/(4 x SQRT(trans. disp. x dist.))] x [erf[Sd/(4 x SQRT(vert. disp. x dist.))]

x (cm)	x (ft)	x longitudinal dispersivity (cm)	y transverse dispersivity (cm)	z vertical dispersivity (cm)	Beta1	erf	Beta2	erf	GRO (ppm)
100	3	10.00	3.33	1.00	20.54		5.00		0.000
200	7	20.00	6.67	2.00	10.27		2.50		0.000
300	10	30.00	10.00	3.00	6.85		1.67		0.000
400	13	40.00	13.33	4.00	5.13		1.25		0.000
500	16	50.00	16.67	5.00	4.11		1.00	0.842701	0.000
600	20	60.00	20.00	6.00	3.42		0.83	0.759240	0.000
700	23	70.00	23.33	7.00	2.93	0.999965	0.71	0.684470	2.339
800	26	80.00	26.67	8.00	2.57	0.999713	0.63	0.626760	2.141
900	30	90.00	30.00	9.00	2.28	0.990713	0.56	0.571430	1.935
1000	33	100.00	33.33	10.00	2.05	0.996172	0.50	0.520500	1.772
1500	49	150.00	50.00	15.00	1.37	0.946802	0.33	0.359080	1.162
2000	66	200.00	66.67	20.00	1.03	0.853952	0.25	0.276326	0.806
2500	82	250.00	83.33	25.00	0.82	0.753528	0.20	0.222703	0.573
3000	98	300.00	100.00	30.00	0.68	0.663492	0.17	0.189879	0.430
3500	115	350.00	116.67	35.00	0.59	0.595749	0.14	0.156890	0.319
4000	131	400.00	133.33	40.00	0.51	0.529065	0.13	0.145780	0.264
4500	148	450.00	150.00	45.00	0.46	0.484486	0.11	0.123570	0.205
5000	164	500.00	166.67	50.00	0.41	0.437810	0.10	0.112463	0.168
5500	180	550.00	183.33	55.00	0.37	0.398986	0.09	0.101245	0.138
5715	188	571.50	190.50	57.15	0.36	0.389184	0.09	0.101245	0.135
6000	197	600.00	200.00	60.00	0.34	0.369231	0.08	0.090030	0.114
6500	213	650.00	216.67	65.00	0.32	0.348929	0.08	0.090030	0.107
7000	230	700.00	233.33	70.00	0.29	0.316167	0.07	0.078808	0.086
7500	246	750.00	250.00	75.00	0.27	0.297246	0.07	0.078808	0.080
8000	262	800.00	266.67	80.00	0.26	0.286786	0.06	0.067590	0.066
8500	279	850.00	283.33	85.00	0.24	0.265601	0.06	0.067590	0.061
9000	295	900.00	300.00	90.00	0.23	0.254877	0.06	0.067590	0.059
10000	328	1000.00	333.33	100.00	0.21	0.233428	0.05	0.056372	0.045
10500	344	1050.00	350.00	105.00	0.20	0.222703	0.05	0.056372	0.043
11000	361	1100.00	366.67	110.00	0.19	0.211762	0.05	0.056372	0.041
12000	394	1200.00	400.00	120.00	0.17	0.189879	0.04	0.045098	0.029
13000	427	1300.00	433.33	130.00	0.16	0.178937	0.04	0.045098	0.028
14000	459	1400.00	466.67	140.00	0.15	0.167996	0.04	0.045098	0.026
15000	492	1500.00	500.00	150.00	0.14	0.156889	0.03	0.033823	0.018
16000	525	1600.00	533.33	160.00	0.13	0.145783	0.03	0.033823	0.017
17000	558	1700.00	566.67	170.00	0.12	0.134676	0.03	0.033823	0.016
18000	591	1800.00	600.00	180.00	0.11	0.123570	0.03	0.033823	0.014
19000	623	1900.00	633.33	190.00	0.11	0.123570	0.03	0.033823	0.014
20000	656	2000.00	666.67	200.00	0.10	0.112463	0.03	0.033823	0.013
21000	689	2100.00	700.00	210.00	0.10	0.112463	0.02	0.022550	0.009
22000	722	2200.00	733.33	220.00	0.09	0.101245	0.02	0.022550	0.008
23000	755	2300.00	766.67	230.00	0.09	0.101245	0.02	0.022550	0.008
24000	787	2400.00	800.00	240.00	0.09	0.101245	0.02	0.022550	0.008
25000	820	2500.00	833.33	250.00	0.08	0.090030	0.02	0.022550	0.007
26000	853	2600.00	866.67	260.00	0.08	0.090030	0.02	0.022550	0.007
26670	875	2667.00	889.00	266.70	0.08	0.090030	0.02	0.022550	0.007





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North Fuel Farm NSA Mid-South

Procedure to Obtain Closure for Site in the Monitoring Only Program - TGD-015

Site Groundwater Concentrations

Petroleum Hydrocarbons (EPH or TPH)

A	soil bulk density:		1.70	g soil/cubic cm soil	(default value)
B	volumetric water content in vadose zone soils:		0.12	cubic cm water/cubic cm soil	(default value)
C	carbon-water sorption coefficient:		1290.00	square cm water/g carbon	(published value)
D	fractional organic carbon:		0.01	fraction	(default value)
E	soil-water sorption coefficient:	(CxD)	12.90	g water/g soil	(calculated)
F	henry's law constant:		0.049	unitless	(published value)
G	volumetric air content in vadose zone soils:		0.26	cubic cm air/cubic cm soil	(default value)
H	soil to leachate partition (Ksw):	[A / (B+(E x A)+(F x G)]	0.08	ppm water/ppm soil	(calculated)
I	groundwater darcy velocity:		49.80	cm/yr	(calculated)
J	groundwater mixing zone thickness:		200.00	cm	(default value)
K	infiltration rate of water through soil (I):		30.00	cm/yr	(default value)
L	width of source area parallel to gw flow direction (Sw):		1500.00	cm	(default value)
M	leachate to groundwater dilution factor:	[1+(I x J)/(P x L)]	1.25	unitless	(calculated)
N	leaching factor (LFsw), soil to groundwater:	(H/M)	0.06	ppm/ppm	(calculated)
O	percent of soil plume which is covered (Icover):		0.10		(calculated)
P	site specific infiltration rate (Isite):	[K x (1-O)]	27.00	cm/yr	(calculated)
R	avg. soil contamination (Csoil ave):		101.40	ppm	(calculated)
S	cont. in gw contributed by leaching (Cleaching):	(R x N)	6.27	ppm	(calculated)

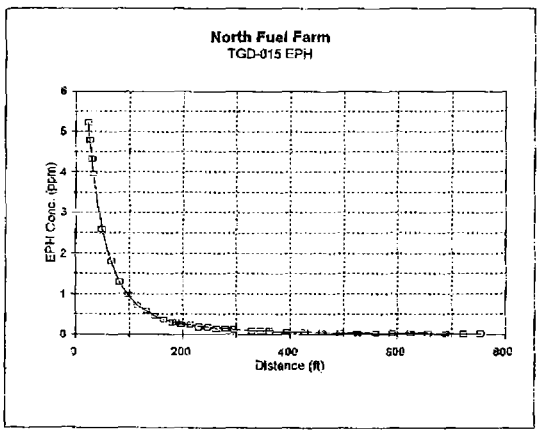
			N-MW-1	N-MW-2	N-MW-3	N-MW-4	N-MW-5	N-MW-6	N-RW-1	
T	Avg. site gw contamination for EPH (Cgw ave):	3rd most recent event	0.225	0.261	0.000	0.213	ns	0.902	0.902	PPM
		2nd most recent event	0.000	0.134	0.103	0.167	2.130	0.660	0.160	PPM
		1st most recent event	0.183	0.156	0.000	0.138	2.740	0.729	0.213	PPM
		Cgw ave/well	0.136	0.164	0.034	0.17	2.435	0.764	0.425	
		Cgw ave/site	1.383	PPM						

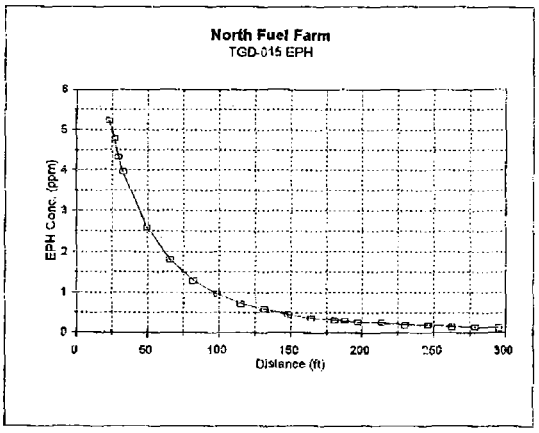
U	Concentration at the source (Csource):	(S + T)	7.654	ppm	EPH only	
V	Source depth, Sd		200.00	cm		(default value)

North Fuel Farm NSA Mid-South
Procedure to Obtain Closure for Site in the Monitoring Only Program - TGD-015

Conc. at distance x (Cx) = Csource x erf[Sw/(4 x SQRT(trans. disp. x dist.))] x [erf[Sd/(4 x SQRT(vert. disp. x dist.))]

x (cm)	x (ft)	x longitudinal dispersivity (cm)	y transverse dispersivity (cm)	z vertical dispersivity (cm)	Beta1	erf	Beta2	erf	EPH/TPH (ppm)
100	3	10.00	3.33	1.00	20.54		5.00		0.000
200	7	20.00	6.67	2.00	10.27		2.50		0.000
300	10	30.00	10.00	3.00	6.85		1.67		0.000
400	13	40.00	13.33	4.00	5.13		1.25		0.000
500	16	50.00	16.67	5.00	4.11		1.00	0.842701	0.000
600	20	60.00	20.00	6.00	3.42		0.83	0.759240	0.000
700	23	70.00	23.33	7.00	2.93	0.999965	0.71	0.684470	5.239
800	26	80.00	26.67	8.00	2.57	0.999713	0.63	0.626760	4.796
900	30	90.00	30.00	9.00	2.28	0.990713	0.56	0.571430	4.333
1000	33	100.00	33.33	10.00	2.05	0.996172	0.50	0.520500	3.969
1500	49	150.00	50.00	15.00	1.37	0.946802	0.33	0.359080	2.602
2000	66	200.00	66.67	20.00	1.03	0.853952	0.25	0.276326	1.806
2500	82	250.00	83.33	25.00	0.82	0.753528	0.20	0.222703	1.285
3000	98	300.00	100.00	30.00	0.68	0.663492	0.17	0.189879	0.964
3500	115	350.00	116.67	35.00	0.59	0.595749	0.14	0.156890	0.715
4000	131	400.00	133.33	40.00	0.51	0.529065	0.13	0.145780	0.590
4500	146	450.00	150.00	45.00	0.46	0.464486	0.11	0.123570	0.456
5000	164	500.00	166.67	50.00	0.41	0.437810	0.10	0.112463	0.377
5500	180	550.00	183.33	55.00	0.37	0.398986	0.09	0.101245	0.309
5715	188	571.50	190.50	57.15	0.36	0.389184	0.09	0.101245	0.302
6000	197	600.00	200.00	60.00	0.34	0.369231	0.08	0.090030	0.254
6500	213	650.00	216.67	65.00	0.32	0.348929	0.08	0.090030	0.240
7000	230	700.00	233.33	70.00	0.29	0.318167	0.07	0.078808	0.192
7500	246	750.00	250.00	75.00	0.27	0.297246	0.07	0.078808	0.179
8000	262	800.00	266.67	80.00	0.26	0.286786	0.06	0.067590	0.148
8500	279	850.00	283.33	85.00	0.24	0.265601	0.06	0.067590	0.137
9000	295	900.00	300.00	90.00	0.23	0.254877	0.06	0.067590	0.132
10000	328	1000.00	333.33	100.00	0.21	0.233428	0.05	0.056372	0.101
10500	344	1050.00	350.00	105.00	0.20	0.222703	0.05	0.056372	0.096
11000	361	1100.00	366.67	110.00	0.19	0.211762	0.05	0.056372	0.091
12000	394	1200.00	400.00	120.00	0.17	0.189879	0.04	0.045098	0.066
13000	427	1300.00	433.33	130.00	0.16	0.178937	0.04	0.045098	0.062
14000	459	1400.00	466.67	140.00	0.15	0.167996	0.04	0.045098	0.058
15000	492	1500.00	500.00	150.00	0.14	0.156889	0.03	0.033823	0.041
16000	525	1600.00	533.33	160.00	0.13	0.145783	0.03	0.033823	0.038
17000	558	1700.00	566.67	170.00	0.12	0.134676	0.03	0.033823	0.035
18000	591	1800.00	600.00	180.00	0.11	0.123570	0.03	0.033823	0.032
19000	623	1900.00	633.33	190.00	0.11	0.123570	0.03	0.033823	0.032
20000	656	2000.00	666.67	200.00	0.10	0.112463	0.03	0.033823	0.029
21000	689	2100.00	700.00	210.00	0.10	0.112463	0.02	0.022550	0.019
22000	722	2200.00	733.33	220.00	0.09	0.101245	0.02	0.022550	0.017
23000	755	2300.00	766.67	230.00	0.09	0.101245	0.02	0.022550	0.017
24000	787	2400.00	800.00	240.00	0.09	0.101245	0.02	0.022550	0.017
25000	820	2500.00	833.33	250.00	0.08	0.090030	0.02	0.022550	0.016
26000	853	2600.00	866.67	260.00	0.08	0.090030	0.02	0.022550	0.016
26670	875	2667.00	889.00	266.70	0.08	0.090030	0.02	0.022550	0.016





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Navy Flying Club NSA Mid-South
Procedure to Obtain Closure for Site in the Monitoring Only Program - TGD-015

Combined Groundwater Concentrations GRO & EPH

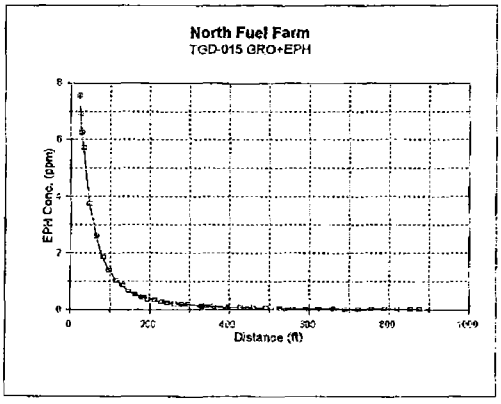
Csource TPH = Cleaching GRO + Cleaching DRO + Cgw ave TPH: (S + S + T) 11.07 ppm

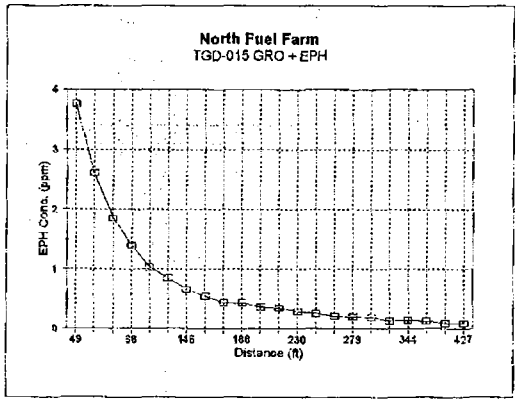
width of source area parallel to gw flow direction (Sw): 1500.00 cm

Source depth, Sd 200.00 cm

Conc. at distance x (Cx) = Csource x erf[Sw/(4 x SQRT(trans. disp. x dist.))] x [erf[Sd/(4 x SQRT(vert. disp. x dist.))]

x (cm)	x (ft)	x longitudinal dispersivity (cm)	y transverse dispersivity (cm)	z vertical dispersivity (cm)	Beta1	erf	Beta2	erf	EPH+GRO total conc (ppm)
100	3	10.00	3.33	1.00	20.54		5.00		0.000
200	7	20.00	6.67	2.00	10.27		2.50		0.000
300	10	30.00	10.00	3.00	6.85		1.67		0.000
400	13	40.00	13.33	4.00	5.13		1.25		0.000
500	16	50.00	16.67	5.00	4.11		1.00	0.842701	0.000
600	20	60.00	20.00	6.00	3.42		0.83	0.759240	0.000
700	23	70.00	23.33	7.00	2.93	0.999965	0.71	0.684470	7.578
800	26	80.00	26.67	8.00	2.57	0.999713	0.63	0.626760	6.937
900	30	90.00	30.00	9.00	2.28	0.990713	0.56	0.571430	6.268
1000	33	100.00	33.33	10.00	2.05	0.996172	0.50	0.520500	5.741
1500	49	150.00	50.00	15.00	1.37	0.946802	0.33	0.359080	3.764
2000	66	200.00	66.67	20.00	1.03	0.853952	0.25	0.276326	2.613
2500	82	250.00	83.33	25.00	0.82	0.753528	0.20	0.222703	1.858
3000	98	300.00	100.00	30.00	0.68	0.663492	0.17	0.189879	1.395
3500	115	350.00	116.67	35.00	0.59	0.595749	0.14	0.156890	1.035
4000	131	400.00	133.33	40.00	0.51	0.529065	0.13	0.145780	0.854
4500	148	450.00	150.00	45.00	0.46	0.484486	0.11	0.123570	0.663
5000	164	500.00	166.67	50.00	0.41	0.437810	0.10	0.112463	0.545
5500	180	550.00	183.33	55.00	0.37	0.398986	0.09	0.101245	0.447
5715	188	571.50	190.50	57.15	0.36	0.389184	0.09	0.101245	0.436
6000	197	600.00	200.00	60.00	0.34	0.369231	0.08	0.090030	0.368
6500	213	650.00	216.67	65.00	0.32	0.348929	0.08	0.090030	0.348
7000	230	700.00	233.33	70.00	0.29	0.318167	0.07	0.078808	0.278
7500	246	750.00	250.00	75.00	0.27	0.297246	0.07	0.078808	0.259
8000	262	800.00	266.67	80.00	0.26	0.286786	0.06	0.067590	0.215
8500	279	850.00	283.33	85.00	0.24	0.265801	0.06	0.067590	0.199
9000	295	900.00	300.00	90.00	0.23	0.254877	0.06	0.067590	0.191
10000	328	1000.00	333.33	100.00	0.21	0.233426	0.05	0.056372	0.146
10500	344	1050.00	350.00	105.00	0.20	0.222703	0.05	0.056372	0.139
11000	361	1100.00	366.67	110.00	0.19	0.211762	0.05	0.056372	0.132
12000	394	1200.00	400.00	120.00	0.17	0.189879	0.04	0.045098	0.095
13000	427	1300.00	433.33	130.00	0.16	0.178937	0.04	0.045098	0.089
14000	459	1400.00	466.67	140.00	0.15	0.167996	0.04	0.045098	0.084
15000	492	1500.00	500.00	150.00	0.14	0.156889	0.03	0.033823	0.059
16000	525	1600.00	533.33	160.00	0.13	0.145783	0.03	0.033823	0.055
17000	558	1700.00	566.67	170.00	0.12	0.134676	0.03	0.033823	0.050
18000	591	1800.00	600.00	180.00	0.11	0.123570	0.03	0.033823	0.046
19000	623	1900.00	633.33	190.00	0.11	0.123570	0.03	0.033823	0.046
20000	656	2000.00	666.67	200.00	0.10	0.112463	0.03	0.033823	0.042
21000	689	2100.00	700.00	210.00	0.10	0.112463	0.02	0.022550	0.028
22000	722	2200.00	733.33	220.00	0.09	0.101245	0.02	0.022550	0.025
23000	755	2300.00	766.67	230.00	0.09	0.101245	0.02	0.022550	0.025
24000	787	2400.00	800.00	240.00	0.09	0.101245	0.02	0.022550	0.025
25000	820	2500.00	833.33	250.00	0.08	0.090027	0.02	0.022550	0.022
26000	853	2600.00	866.67	260.00	0.08	0.090027	0.02	0.022550	0.022
26670	875	2667.00	889.00	266.70	0.08	0.090027	0.02	0.022550	0.022





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