FINAL

ADDENDUM TO

CORRECTIVE ACTION PLAN - PART A REPORT
FOR
FACILITY ID #9-089115
UNDERGROUND STORAGE TANK 100
AT
BUILDING 1343
FORT STEWART, GEORGIA

Prepared for:

U.S. Army Corps of Engineers - Savannah District
and
Fort Stewart Directorate of Public Works
Under Contract Number DACA21-95-D-0022
Delivery Order 0024

Prepared by:

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800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

September 1998

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ADDENDUM TABLES (includes only revised tables with data collected as part of this addendum)

ADDENDUM FIGURES (includes only revised figures with information collected as part of this addendum)

I. CORRECTIVE ACTION PLAN - PART A FORM & CERTIFICATION

This document represents the Addendum to the Corrective Action Plan (CAP)-Part A Report for underground storage tank (UST) 100 that was located at Building 1343 (Facility ID #9-089115), Fort Stewart, Georgia. The CAP-Part A site investigation for UST 100 was originally conducted in September 1996. Results of this investigation were documented in the original CAP-Part A Report *Corrective Action Plan - Part A Report for Facility ID #9-089115, Underground Storage Tank 100 at Building 1343, Fort Stewart, Georgia,* submitted to Georgia Environmental Protection Division (GA EPD) in May 1997.

Comments received from GA EPD on March 13, 1998, indicated that the investigation activities performed to date were adequate to delineate the horizontal and vertical extent of contamination. However, GA EPD stated that the soil and groundwater contamination identified at the site had to be addressed. Thus, in correspondence dated April 20, 1998 (Brown 1998), Fort Stewart proposed to collect site-specific geological information and perform fate and transport modeling to demonstrate that soil and groundwater contamination will not adversely affect the downgradient surface water body or any public withdrawal points. These results are summarized in this addendum to the original CAP-Part A Report. Based on the results of the fate and transport modeling, a no-further-action-required status is recommended for this site.

Part I of this addendum contains an updated CAP-Part A form, including re-certification of the plan (with addendums). Supporting documentation related to information indicated on the CAP-Part A form is presented in Parts II through VI of this addendum and in the original CAP-Part A Report submitted in May 1997.

Georgia Department of Natural Resources

Environmental Protection Division

Underground Storage Tank Management Program
4244 International Parkway, Suite 104, Atlanta, Georgia 30354
Lonice C. Barrett, Commissioner
Harold Reheis, Director
(404)362-2687

CORRECTIVE ACTION PLAN
PART A

Facility Name: Building 1343 Area, UST 100 Site

Street Address: Wilson Avenue north of W. 18th Street

City: Fort Stewart County: Liberty Facility ID: 9-089015

Submitted by UST Owner/Operator:	**Prepared by:**
Name: Thomas C. Fry/Environmental Branch	Name: Patricia Stoll
Company: U.S. Army/HQ 3d Inf. Div. (Mech.)	Company: SAIC
Address: ATTN: DPW ENRD ENV. Br. (Fry) 1557 Frank Cochran Drive	Address: P.O. Box 2502
City: Fort Stewart State: Georgia	City: Oak Ridge State: Tennessee
Zip Code: 31314-4928	Zip Code: 37830

I. PLAN CERTIFICATION:

A. UST Owner/Operator

I hereby certify that the information contained in this plan and in all the attachments is true, accurate, and complete, and the plan satisfies all criteria and requirements of Rule 391-3-15-.09 of the Georgia Rules for Underground Storage Tank Management.

Name: Thomas C. Fry

Signature: Thomas C. Fry

Date: 09/14/98

B. Professional Engineer or Professional Geologist

I hereby certify that I have directed the field work and preparation of this plan, in accordance with State Rules and Regulations. As a registered geologist and/or engineer, I certify that I am a qualified groundwater professional, as defined by the Georgia State Board of Professional Geologists. All of the information and laboratory data in this plan and in all of the attachments are true, accurate, complete, and in accordance with applicable State Rules and Regulations.

Name: Patricia Stoll

Signature: Patricia Stoll

Date: 9/3/98

22851
PROFESSIONAL ENGINEER
P. A. STOLL

Georgia Stamp or Seal

Please complete the following form, check all of the boxes below that apply, and attached supporting documentation (such as narrative, figures, tables, maps, boring/well logs, etc.) where specified and applicable. Supporting documentation should be three-hole punched and prepared in conformity with the attached guidance document "Underground Storage Tank (UST) Release: Corrective Action Plan - Part A (CAP-A) Content", GUST-7A.

II. INITIAL RESPONSE REPORT:

A. Initial Abatement:

☒ No Action Required

☐ Further Release or Migration of Contaminants Prevented

☐ Fire And Safety Hazards From Vapors And/Or Free Product Monitored and Mitigated

☐ Other (specify) ____________________

B. Free Product Removal:

☒ No Free Product Identified As Originating From Release

☐ Free Product (Non-Aqueous Phase Hydrocarbons) Removed by:

- ☐ Manual Bailing
- ☐ Passive Skimming
- ☐ Automated Skimming
- ☐ Automated Total Fluids Pumping, With Treatment System And Approved Wastewater Discharge
- ☐ Other (specify) ____________________

C. Tank History

☒ Site Map Attached Identifying Former and/or Existing USTs (see Figure II-1, CAP-Part A)

☐ Not Applicable

D. Initial Site Characterization:

☒ Site Map: include the following items on an attached site map

- Tank Pit Area
- Piping Trenches
- Dispensers
- Sewer Lines (if present)
- Water Lines
- North Arrow
- Sample Locations (with sample numbers and depths)
- Tanks with ID#s, corresponding to Notification Form 7530-1
- Scale 1 in = 40 ft

1. Regulated Substance Released

☐ Gasoline ☐ Diesel ☐ Kerosene ☒ Waste oil

☐ Other ______

2. Source of Contamination

Number of USTs: in use 0 ; closed/removed 1

☐ Existing UST System(s): ☐ piping ☐ tank ☐ other

☒ Former UST System(s): ☒ piping ☒ tank ☐ other

3. Impacted Environmental Media

☒ Groundwater

  ☐ Free product

  ☒ Dissolved (BTEX and/or PAH) contamination exceeding:

    ☐ In-stream water quality standards

    ☒ Drinking water Maximum Contaminant Levels (MCLs)

☒ Soil Exceeding:

  ☐ Laboratory Detection Limits, but TPH is vertically delineated to Below Detection Limits (BDL) above the groundwater table or a groundwater sample from the worst-case location has BTEX and/or PAHs below applicable Drinking and/or In-stream water quality standards.

  ☒ Thresholds listed in Table A, Rule 391-3-15-.09

  ☐ Thresholds listed in Table B, Rule 391-3-15-.09

  ☐ Alternate Threshold Levels (ATLs) (Reference Appendix I)

D. **Initial Site Characterization** (continued):

☐ Drinking Water Supply Impacted

☐ Surface Water Impacted

☒ Attach Laboratory Analytical Data: the following items must be included (see Appendix C)

- Laboratory Method
- Date of Analysis
- Signed Chain of Custody
- Date of Sampling
- Detection Limits
- Quality Control Data

4. Local Water Resources

☒ Drinking Water Supplies Located In:

High or average groundwater pollution susceptibility area:*

☒ Public water systems within 2.0 miles

☐ Non-public water systems within 0.5 mile

Low groundwater pollution susceptibility area:*

☐ Public water systems within 1.0 mile

☐ Non-public water systems within 0.25 mile

* As defined by the Groundwater Pollution Susceptibility Map of Georgia.

☒ Surface Water Bodies: Distance (nearest) 300 (drainage ditch) 1420 (Childpen's Pond) feet (regardless of hydraulic gradient)

☒ Attach Documentation of Water Supply Survey and Field Reconnaissance

5. Other Hydrogeologic Data (specify values)

☒ Depth To Groundwater (shallowest) 6.54 feet BGS

☒ Groundwater Flow Direction Southeast to Northwest

☒ Hydraulic Gradient 0.0094 feet/feet

6. Corrective Action Completed Or In-Progress

☒ USTs/Source Removed (after confirmed release)

☐ Excavation And Treatment/Disposal Of Contaminated Backfill Materials & Native Soils
  ☐ Attach manifest of proper soil disposal

☐ Other (specify) ____________________

D. Initial Site Characterization (continued):

7. Conclusions And Recommendations

☒ No Further Action Required, including the preparation or implementation of a Site Investigation Plan. NOTE: Based on additional sampling required by GA EPD and the results of site-specific fate and transport modeling, no further action is required; however, a Site Investigation Plan has been prepared which provides justification for the NFAR status.

☐ OR

Prepare Corrective Action Plan - Part B, with a schedule for SIP implementation and submittal of CAP-Part B

8. Site Ranking

Environmental Sensitivity Score: 530
(see Appendix II)

III. SITE INVESTIGATION PLAN:

A. Horizontal And Vertical Extent Of Contaminants In:

☐ Soil

☐ Groundwater

  ☐ Free product

  ☐ Dissolved phase

☐ Surface Water

☒ Not applicable since horizontal and vertical extent have been determined.

B. Vadose Zone and Aquifer Characteristics:

☐ Vertical Soil Permeability (Optional)

☐ Infiltration Rate (Optional)

☐ Saturated Horizontal Hydraulic Conductivity

☐ Total Organic Carbon (Optional)

☐ Dissolved Iron (Optional)

☐ Effective Porosity

☐ Seepage Velocity

☐ Grain-size Distribution (Optional)

☐ Total Petroleum Hydrocarbons (Optional)

☐ Pilot Test(s) (Optional)

☒ Other (specify) No Further Investigation Required

IV. PUBLIC NOTICE:

☐ Certified Letters to Adjacent and Potentially Affected Property Owners and Local Officials

☒ Legal Notice in Newspaper, as pre-approved by EPD

☐ Other EPD Approved Method (specify): ____________________

V. CLAIM FOR REIMBURSEMENT: (For GUST Trust Fund sites only)

☐ GUST Trust Fund Application (GUST-36), must be attached if applicable

☐ Cost Proposal

- ☐ Non-Reimbursable Costs

  OR

- ☐ Reimbursable Costs
  - ☐ Invoices and Proofs-of-Payment, per GUST-91
  - ☐ Total Projected Costs to implement the Site Investigation Report (SIR) and prepare data for the Site Investigation Review Meeting, per GUST-91

☐ Payment Schedule for Reimbursement

☒ Not Applicable

II. INITIAL RESPONSE REPORT

II.A Initial Abatement

No change from the original CAP-Part A Report submitted in May 1997; no action was required.

II.B Free Product Removal

Temporary piezometers were installed in the boreholes and screened across the water table to monitor for free product. No free product was detected during the 1996 investigation.

II.C Tank History

No change from the original CAP-Part A Report submitted in May 1997.

II.D Initial Site Characterization

No change from the original CAP-Part A Report submitted in May 1997.

II.D.1 Regulated Substance Released

No change from the original CAP-Part A Report submitted in May 1997.

II.D.2 Source of Contamination

No change from the original CAP-Part A Report submitted in May 1997.

II.D.3 Impacted Environmental Media

II.D.3.a Soils

A summary of the analytical results for the soil samples collected during the September/December 1996 CAP-Part A site investigation activities at the site is presented in Table II-3 of the original CAP-Part A Report submitted in May 1997. Laboratory data sheets for the September/December 1996 samples and the project Quality Control Summary Report (QCSR) were presented in Appendices C-1 and C-3 of the original CAP-Part A Report submitted in May 1997.

II.D.3.a.1 Initial Site Characterization

During the initial site characterization by Anderson Columbia, soil samples collected from the tank pit after the tank removal indicated elevated concentrations of total petroleum hydrocarbon (TPH) requiring further investigation.

II.D.3.a.2 CAP-Part A Investigation (September 1996)

Trace concentrations of toluene, ethylbenzene, and xylenes were detected in samples located in the tank pit and around the perimeter; however, the concentrations were well below the corresponding soil threshold levels. Benzene was detected in sample 4002D1 at a concentration of 0.13 mg/kg, which exceeds the soil threshold level (i.e., Table A, Column 2). In addition, naphthalene was detected in borehole 40-02; however, there are no soil threshold levels for this polynuclear aromatic hydrocarbon (PAH) compound. TPH concentrations ranged from 92.6 mg/kg to 23,100 mg/kg. The extent of contamination appeared to be limited to the immediate vicinity of the tank pit area.

II.D.3.a.3 CAP Part A Investigation (May 1998)

In August 1997, representatives from GA EPD, Fort Stewart Directorate of Public Works (DPW), and Science Applications International Corporation (SAIC) conducted a review of the available data on the site, visited the site, and determined that no additional borings were necessary to determine the extent of contamination. In addition, all parties agreed that site-specific geotechnical parameters would be collected for fate and transport modeling.

Thus, boring 40-06 was installed near the tank pit and a geotechnical soil sample was collected.

II.D.3.a.4 Soil Investigation Conclusions

The nature and extent of the soil contamination at the UST 100 site was evaluated using analytical data from the CAP-Part A site investigation and the initial site characterization (i.e., tank removal). Although benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds were not detected in the tank pit during closure activities at concentrations exceeding their respective threshold levels, the soil samples contained elevated concentrations of TPH. Soil samples collected during the CAP-Part A investigation only indicated the presence of benzene above applicable soil threshold level (i.e., Table A, Column 2) in a borehole located in the tank pit. Benzene was detected at concentration of 0.13 mg/kg in sample 4002D1. This sample was collected above the water table, and the groundwater sample from this borehole did not indicate the presence of benzene.

Therefore, it is concluded that the soil contamination is limited to the immediate area of the tank pit and that the horizontal and vertical extent of contamination has been delineated.

II.D.3.b Groundwater

A summary of the analytical results for the groundwater samples collected during the September/December 1996 CAP-Part A site investigation activities at the site is presented in Table II-4 of the CAP-Part A Report submitted in May 1997. Laboratory data sheets for the September/December 1996 samples and the project QCSR are presented in Appendices C-2 and C-3 of the CAP-Part A Report submitted in May 1997.

II.D.3.b.1 Initial Site Characterization

Groundwater samples were not collected during tank removal activities.

II.D.3.b.2 CAP-Part A Investigation (September/December 1996)

Of the five groundwater samples collected during the 1996 site investigation activities, one sample (4001W2) had detectable concentrations of BTEX compounds; however, only benzene was above its respective MCL. For sample 4001W2, the benzene concentration was 6.9 µg/L, ethylbenzene was 23.8µg/L, toluene was 6.0 µg/L, and xylene was 84.6 µg/L. The MCLs for benzene, ethylbenzene, toluene, and xylene are 5 µg/L, 700 µg/L, 1000 µg/L, and 10000 µg/L, respectively.

Since benzene was the only constituent identified above MCLs and it only exceeded the MCL in one sample, the Installation requested that fate and transport modeling be conducted at the site to determine whether or not groundwater will affect nearby drinking water supply wells or surface water bodies. Comments received from GA EPD on March 13, 1998, indicated that the investigation activities performed to date were adequate to delineate the horizontal and vertical extent of contamination. However, GA EPD stated that the soil and groundwater contamination identified at the site had to be addressed. Thus, in correspondence dated April 20, 1998, the Installation proposed to collect site-specific geological information and perform fate and transport modeling to assess contaminant migration impacts. Site-specific geotechnical data, which is presented in Appendix C and Addendum Table II-6, were collected in May 1998 for use in fate and transport modeling. The results of the potential receptor survey, risk screening, and fate and transport modeling are presented in Appendix G.

II.D.3.b.3 CAP-Part A Investigation (May 1998)

No groundwater samples were collected in May 1998.

II.D.3.b.4 Groundwater Investigation Conclusions

The extent of groundwater contamination was determined to be limited to the tank pit. The results of the potential receptor survey, risk screening, and fate and transport modeling indicate that a no-further-action-required status is warranted for this site.

II.D.3.c Surface Water Impacted

No change from the original CAP-Part A Report submitted in May 1997.

II.D.3.d Drinking Water Impacted

No change from the original CAP-Part A Report submitted in May 1997.

II.D.4 Local Water Resources

II.D.4.a Drinking Water Supplies

No change from the original CAP-Part A Report submitted in May 1997.

II.D.4.b Surface Water Bodies

No change from the original CAP-Part A Report submitted in May 1997.

II.D.5 Other Hydrogeologic Data

II.D.5.a Depth to Groundwater

No change from the original CAP-Part A Report submitted in May 1997.

II.D.5.b Groundwater Flow Direction

No change from the original CAP-Part A Report submitted in May 1997.

II.D.5.c Hydraulic Gradient

No change from the original CAP-Part A Report submitted in May 1997.

II.D.5.d Total Organic Carbon (Optional)

No changes from the original CAP-Part A Report submitted in May 1997.

II.D.5.e Grain Size Distribution

No changes from the original CAP-Part A Report submitted in May 1997. Sample 400631, collected July 1, 1998 was analyzed for grain size distribution and the results are presented in Addendum Table II-6 and Appendix C.

II.D.5.f Total Petroleum Hydrocarbons (Optional)

Soil samples were analyzed for TPH and the results are presented in Addendum Table II-3 and were discussed in Section II.D.3.a.2 of this addendum.

II.D.6 Corrective Action Completed or In Progress

II.D.6.a USTs Removed

No change from the original CAP-Part A Report submitted in May 1997.

II.D.6.b Excavation and Treatment/Disposal of Backfill and Native Soils

No change from the original CAP-Part A Report submitted in May 1997.

II.D.7 Conclusions and Recommendations

II.D.7.a Summary of Conclusions

The UST 100 site, Facility ID #9-089115, is located within an average or higher groundwater pollution susceptibility area. Public groundwater supply wells are located within a 2-mile radius of the site; however, the distance between the site and the nearest supply well is greater than 500 feet. Surface water bodies are located within a 1-mile radius of the site; however, the distance between the site and the nearest surface water body is greater than 500 feet. Based on this information, the applicable soil threshold levels for the site are those listed in Table A (GA EPD Rules for Underground Storage Tank Management, Chapter 391-3-15) for the Average or Higher Groundwater Pollution Susceptibility Area (Column 2) greater than 500 feet to a withdrawal point category. Regulatory limits [i.e., maximum contaminant levels (MCLs)] for groundwater contamination at the site are in accordance with the Safe Drinking Water Act.

The site was characterized through soil sampling conducted during the removal of UST 100, and a CAP-Part A site investigation that involved both soil and groundwater sampling. Six soil samples were collected from the tank pit excavation during removal activities. In 1996, five soil boreholes were drilled, two located within the former tank pit and three others around the perimeter of the pit. Two soil samples and one groundwater sample were collected from each of the five boreholes. In 1998, an additional soil boring was drilled to collected a soil sample for site-specific geotechnical information.

Soil analytical data from the tank removal sampling indicated that the soil from the tank pit had elevated concentrations of TPH. Benzene contamination in soil above applicable soil threshold levels was found in boring 40-02 during the CAP-Part A investigation. None of the other borings contained BTEX or PAH compounds above applicable soil threshold levels.

Groundwater analytical data from the site characterization of the CAP-Part A investigation indicate that benzene contamination in the groundwater sample from boring 40-01 exceeds its MCL. However, this contamination was delineated and is limited to an area in the immediate vicinity of the tank pit. Waste oil analytes were not detected above detection limits or MCLs in groundwater samples collected from piezometers installed around the perimeter of the former tank pit (i.e., 40-02 through 40-05).

As a result of the risk screening, benzene was selected as a chemicals of concern (COC) for soils and benzene and lead were selected as COCs for groundwater. However, the lead concentrations in groundwater were attributed to the suspended particles in the samples. Benzene concentrations in groundwater were below the alternate concentration limit (ACL) of 990 μg/L.

Results of the fate and transport modeling indicate that benzene will not reach a drainage ditch located 300 feet north of the site or Childpen's Pond located 1420 feet northwest of the site. Vertical migration of the contaminant plume to the Principal Artesian aquifer is improbable due to the thick and impermeable confining unit that separates the surficial aquifer from the Principal Artesian aquifer.

II.D.7.b Recommendations

Analytical results for soil and groundwater samples collected during the site investigation at the site are sufficient to define the nature and extent of petroleum-related contamination at the site. Based on these findings, further investigation of the UST 100 site, Facility ID #9-089115, is not required and a no-further-action-required status is recommended for this site. The rationale for this recommendation is presented in Section III, Site Investigation Plan (SIP).

II.D.8 Site Ranking

No change from the original CAP-Part A Report submitted in May 1997.

III. SITE INVESTIGATION PLAN

This SIP presents the technical approach used to delineate the full extent of soil and/or groundwater contamination as a result of releases from UST 100, Facility ID #9-089115 and provides justification for a no-further-action-required status for this site.

III.A Horizontal and Vertical Extent of Contamination

III.A.1 Soils

Soil contamination was delineated by analyzing soil collected during initial site characterization (i.e., tank removal) and CAP-Part A site investigation. The CAP-Part A investigations consisted of two boreholes in the tank pit, and four boreholes around the perimeter of the tank pit. Soil samples that were collected from the tank pit after the tank removal indicated elevated concentrations of TPH. No BTEX compounds exceeded applicable soil threshold levels during the tank removal. The depth at which the tank removal samples were collected is not known; however, given the fact that the groundwater table is located at a depth of approximately 3 to 4 feet below ground surface (BGS), it is unlikely that these samples were taken from a point at or below the groundwater table. Soil samples collected from boreholes 40-01, 40-03, 40-04, and 40-05 that were located in and around the perimeter of the tank pit did not indicate the presence of BTEX or PAH compounds above applicable soil threshold levels. Benzene was detected in soil boring 40-02 at 0.13 mg/kg.

The extent of the soil contamination was determined during the CAP-Part A site investigations. Therefore, no additional soil borings are recommended as part of the SIP.

III.A.2 Groundwater

Groundwater contamination was delineated by analyzing groundwater from five temporary piezometers installed in and around the contamination source during the CAP-Part A site investigations. Groundwater samples collected from three piezometers that were located around the perimeter of the tank pit did not indicate the presence of BTEX or PAH compounds above applicable MCLs. The groundwater sample collected from the borehole 40-01 (the borehole in the tank pit) indicated that the concentration of benzene exceeded its respective MCL.

The extent of the groundwater contamination was determined during the CAP-Part A site investigation. Therefore, no monitoring wells are recommended as part of the SIP.

III.A.3 Surface Water

No changes from the original CAP-Part A Report submitted in May 1997.

III.B Vadose Zone and Aquifer Characteristics

No changes from the original CAP-Part A Report submitted in May 1997.

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IV. PUBLIC NOTICE

No change from the original CAP-Part A Report submitted in May 1997.

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V. CLAIM FOR REIMBURSEMENT: GUST TRUST FUND

No change from the original CAP-Part A Report submitted in May 1997.

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VI. REFERENCES

Brown, Carey, W. 1998. Letter to Kenneth White (GA EPD), April 20, 1998.

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TABLES

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Addendum Table II-6. Geotechnical Results for Soil Samples Collected at UST 100; Facility ID #9-089115

	40-06
Sample ID	400631
Depth Interval (ft BGS)	8.0 - 10.0
Grain size analysis - % Fines	37
Grain size analysis - % Sand	63
Grain size analysis - % Gravel	0
Liquid Limit	44.5
Plastic Limit	17.3
Plasticity Index	27.2
Natural Moisture Content (%)	12.1
Permeability (cm/sec)	4.8×10^{-5}
Porosity	0.58
Specific Gravity	2.61

NP = Nonplastic.

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FIGURES

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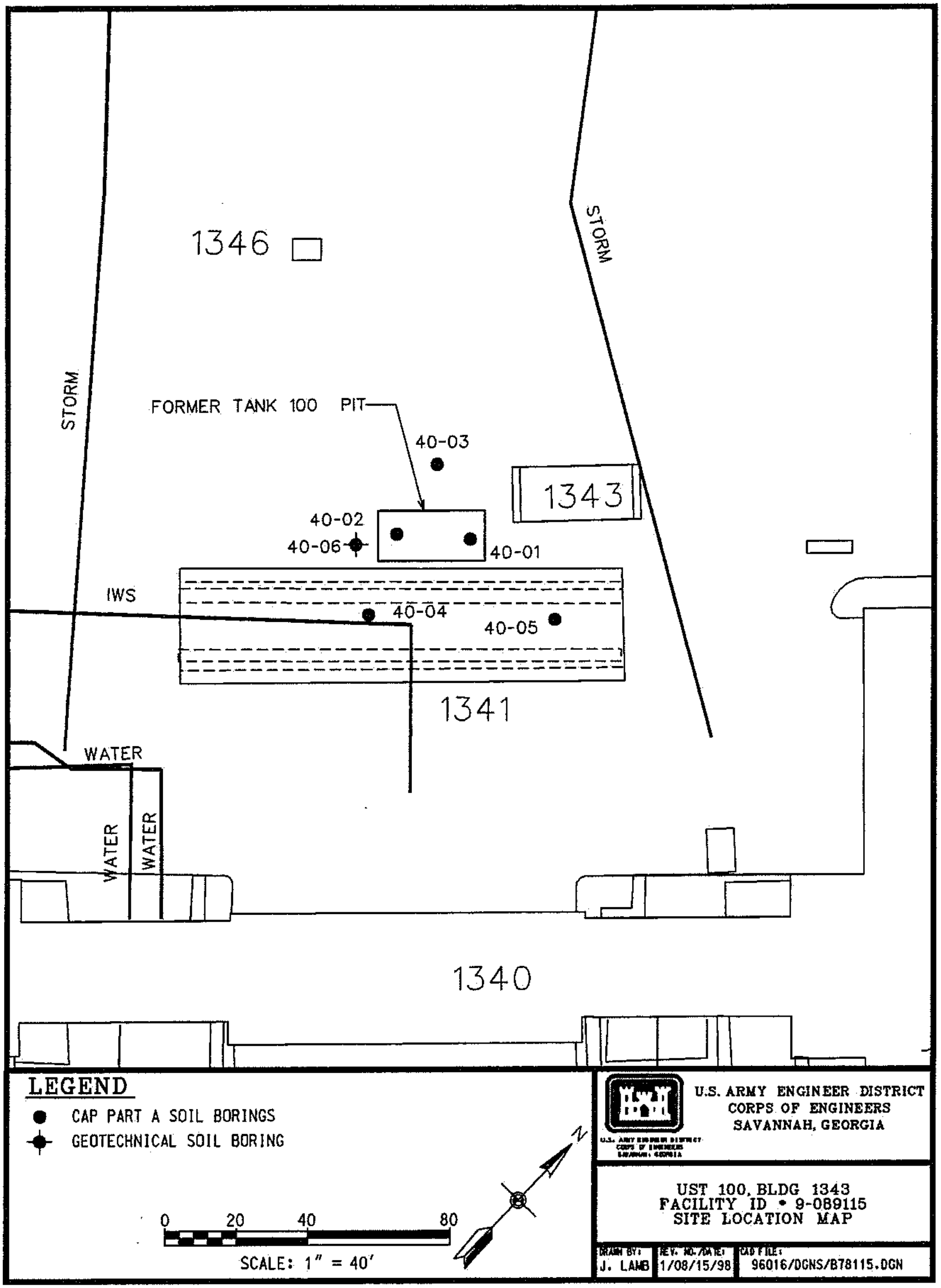

Addendum Figure II-1. Site Location Map for UST 100, Facility ID #9-089115

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APPENDIX A

SOIL BORING LOGS

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No changes from the original CAP-Part A submitted to GA EPD in May 1997.

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APPENDIX B

TECHNICAL APPROACH FOR FACILITY ID #9-089115

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No changes from the original CAP-Part A submitted to GA EPD in May 1997.

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APPENDIX C

ANALYTICAL DATA SHEETS

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GEOTECHNICAL DATA

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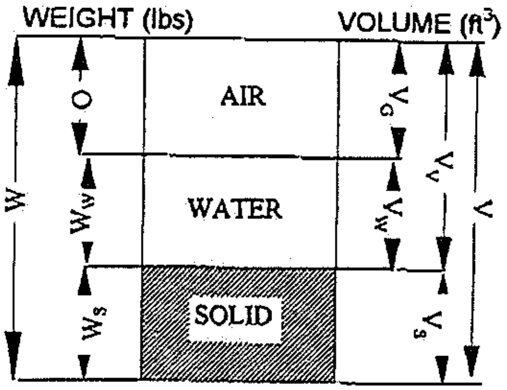
SPECIFIC GRAVITY AND POROSITY

PROJECT: Fort Stewart
LOCATION OF PROJECT: CAP Part A
DESCRIPTION OF SOIL: Lt. Grayish Brown Clayey Sand
TESTED BY: B.J. Vance

JOB NO.: 98066
SAMPLE NO: 400631
DEPTH OF SAMPLE:
DATE OF TESTING: 7/29/98



$W = 0.51565$
$W_W = W - W_S = 0.05563$
$W_S = Y_d{}^*V = 0.4600$

$V = 0.00637$
$V_W = W_W/Y_W = 0.0009$
$V_S = W_S/G_S{}^*Y_W = 0.0028$
$V_G = V - (V_S + V_W) = 0.00266$
$V_V = V_G + V_W = 0.0035$

MEASUREMENTS OF TUBE/CAN

HEIGHT= 10.4 cm
DIAMETER= 4.7 cm

CALCULATED VOLUME OF TUBE/CAN

V= 180.43 cm^3
0.00637 ft^3

WT. OF TUBE/CAN + WET SOIL= 509.40 g
WEIGHT OF TUBE/CAN= 275.5 g
WEIGHT OF WET SOIL= 233.90 g
W = 0.51565 lb

MOISTURE CONTENT

M_{CWS} =	35.40	g	M_C =	15.10	g
M_{CDS} =	33.21	g	M_S =	18.11	g
M_W =	2.19	g	w =	12.1	%

Wet Density, $Y_m = W / V$

Dry Density, $Y_d = W_s / V$ or $Y_d = Y_m / (1+w)$	
double check $Y_d = W_s / V$	$Y_d = Y_m / (1+w)$ Y_m= 80.91 lbs/ft³
Y_d= 72.18 lbs/ft³	Y_d= 72.18 lbs/ft³

Void Ratio, $e = V_V/V_S$
e = 1.2573

Porosity, $n = V_V/V$
n = 0.56

Specific Gravity = 2.61

Degree of Saturation, $S = V_W/V_V$
S = 0.2510

PERMEABILITY TEST ANALYSIS (ASTM D5084)

Project : Fort Stewart
Location of Project : CAP Part A
Description of Soil : Lt.Grayish Brown Clayey Sand

Job # : 98066
Date of Testing: 7/24-27/98
Tested by: BV-CA
Boring # :
Sample # : 400631
Sample Depth :

Sample Type (Undisturbed or Remolded)
Standard Proctor:
Maximim Dry Density: ______ pcf
Optimum Moisture Content: ______ %

% Sample Compaction: ______ %
Sample Dry Density: ______ pcf
Sample Moisture Content: ______ %
Sample Wet Density: ______ pcf

Sample Permeation:

De-Aired Water
% Saturation: 100 %
Cell Pressure: 65 psi
Lower Pressure: 61 psi
Upper Pressure: 60 psi
Gradient: 12.13

Sample Dimensions		
	Before	After
Length (cm)	5.80	5.80
Diameter (cm)	4.70	4.75
Water Content (%)	13.1	18.5
Weight (g)	--	188.7

Constant Head Calculation:

$$K = [V(t_1,t_2)\ LR_T]/[P_B A t]\ \text{(cm/sec)}$$

$V(t_1,t_2)$ = Volume of flow from t_1 to t_2 (cm^2)
L = Length of Sample = 5.80 cm
A = Area of Sample = 17.35 cm^2
t = $t_2 - t_1$ (sec)
P_B = Bias Pressure = 1 psi x 70.37 cm/psi $_{(cm - H2O)}$ 70.37 cm
R_T = Temperature correction = 0.931

t_2 (min)	t_1 (min)	$(t_2 - t_1)$*60 (sec)	V (cm^3)	$[LR_T]/[P_BA]$ (cm^{-1})	K (cm/sec)
57	56	60	0.7	4.42E-03	5.16E-05
58	57	60	0.7	4.42E-03	5.16E-05
59	58	60	0.6	4.42E-03	4.42E-05
60	59	60	0.6	4.42E-03	4.42E-05

K_{avg} = 4.79E-05 cm/sec

ATTERBERG LIMITS DETERMINATION (ASTM D4318-93)

Project Fort Stewart Job No. 980666

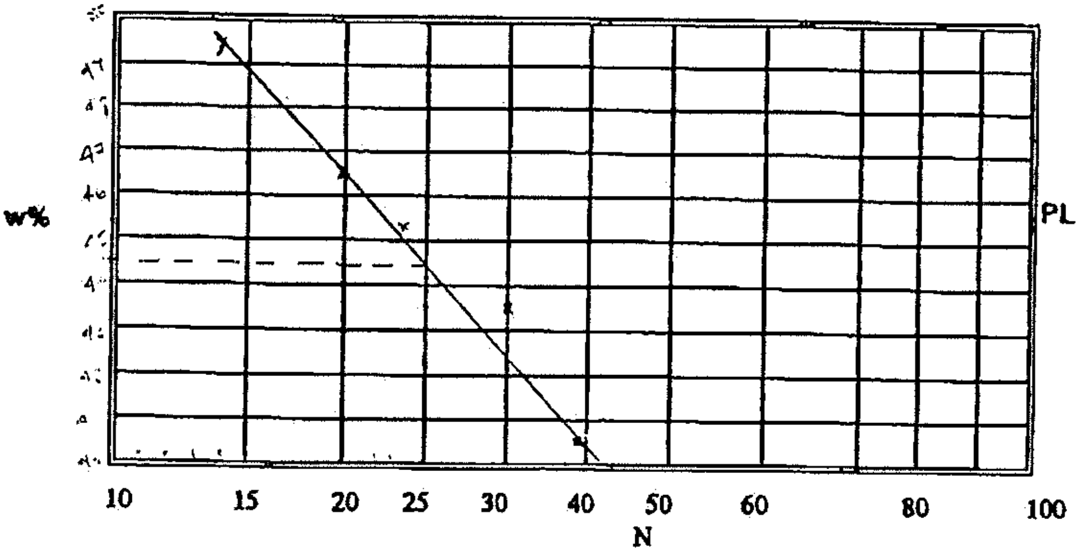
Location of Project CAP part A Boring No. ________ Sample No. 400631

Description of Soil Light grayish brown clayey sand CL

Depth of Sample ________ Tested By CA Date of Testing 7/27/98

Liquid Limit Determination

Can no.	C20	C10	C14	C7	C5	
Wt. of soil + can, M_{cws}	6.40	5.70	5.72	5.96	7.84	
Wt. of dry soil + can, M_{cds}	5.25	4.70	4.67	4.85	6.04	
Wt. of can, M_c	2.41	2.40	2.41	2.40	2.40	
Wt. of dry soil, M_s	2.84	2.30	2.26	2.45	3.64	
Wt. of moisture	1.15	1.0	1.05	1.11	1.8	
Water content, w%	40.49	43.48	46.46	45.31	49.45	
No. of blows, N	39	30	20	23	13	



LIQUID LIMIT = 44.5

PLASTIC LIMIT = 17.3

PLASTICITY INDEX = 27.2

CL

Plastic Limit Determination

Can no.	CC8	CC7	CC21	
Wt. of wet soil + can, M_{cws}	2.99	3.13	2.58	
Wt. of dry soil + can, M_{cds}	2.82	2.94	2.49	
Wt. of can, M_c	1.90	1.91	1.89	
Wt. of dry soil, M_s	0.92	1.03	0.6	
Wt. of moisture, M_w	0.17	0.19	0.09	
Water content, w% = w_p	18.48	18.45	15.0	

GRAIN SIZE ANALYSIS-SIEVE (ASTM D422)

Project Fort Stewart → Job No. 98066

Location of Project CAP Pair A Sample No. 400631

Description of Soil Light grayish brown clayey sand Depth of Sample ______ Boring No.______

Tested By CA Date of Testing 7/29/98

Sample preparation procedures outlined in ASTM D421 and D2217.

Nominal diameter of largest particle	Approximate minimum Wt. of sample, g
No. 10 sieve	200
No. 4 sieve	500
3/4 in.	1500

Weight of sample used, M_{ws}= __________ g

M_{cws}	M_{cds}	M_c X1	M_w	M_s	w %	M_{ws}	M_s
		113.86					137.40

Sieve analysis and grain shape

Sieve no.	Diam. (mm)	Wt. retained	% retained	Σ % retained	% passing
3"					
2"					
1 1/2 "					
3/4"					
3/8"					
#4					
#10		0.07	0.05	0.05	99.95
#20		3.14	2.28	2.33	97.67
#40		7.71	5.61	7.94	92.06
#60		8.84	6.43	14.37	85.63
#140		59.78	43.49	57.86	42.14
#200		7.70	5.60	63.46	36.54
pan		0.19	0.14	63.6	—

% retained = (Wt. retained/W_s) · 100

% passing = 100 - Σ % retained.

APPENDIX D

DOCUMENTATION OF WATER SUPPLY SURVEY FOR THE FORT STEWART GARRISON AREA

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No changes from the original CAP-Part A submitted to GA EPD in May 1997.

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APPENDIX E

SITE RANKING FORM OF FACILITY ID #9-089115

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No changes from the original CAP-Part A submitted to GA EPD in May 1997.

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APPENDIX F

PUBLIC NOTIFICATION NEWSPAPER ANNOUNCEMENT FOR FACILITY ID #9-089115

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No changes from the original CAP-Part A submitted to GA EPD in May 1997.

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APPENDIX G

RISK-BASED CORRECTIVE ACTION

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G. PROVIDE RISK-BASED CORRECTIVE ACTION

G.1 Approach

A risk-based approach was utilized to determine the need for further action at the UST 100 site. Due to the nature of the contamination (petroleum hydrocarbon contamination of groundwater), the risk-based approach was limited to human health concerns. Ecological risk concerns are negligible as a result of the lack of habitat available for ecological receptors due to 10 to 12 inches of concrete overlying the site.

The methods for assessing human health concerns for the site were derived primarily from recent Georgia Environmental Protection Division (GA EPD) guidance (GA EPD 1996) and the *Supplemental Guidance to RAGS: Region IV Bulletin Human Health Risk Assessment* (EPA 1994); these were supplemented by additional guidance documents on risk assessment methods referenced in this section. Risk-based remediation threshold levels were identified in two steps: (1) screening against risk-based and applicable, relevant, and appropriate requirement (ARAR)-based screening levels for chemicals of concern (COCs), and (2) development of site-specific alternate concentration limits (ACLs) for the COCs identified during the screening. The following sections present the conceptual model of the exposure setting and potential receptors and the general methodology employed to perform the screening for COCs and the development of ACLs.

G.2 Potential Receptor Survey

G.2.1 Exposure Assessment

The exposure assessment identifies any potentially complete pathways between the contaminant source and potential receptors. This involves identifying potential current and future receptors, release mechanisms through which contamination may come into contact with the receptors, and the routes of exposure through which the receptors may be exposed.

The site is located within an active military installation. The UST 100 site is located within an access-controlled fence of a secured motor pool. The land use at the site is currently military industrial. An Installation housing area is located approximately 3000 feet to the northeast. Mill Creek is located upgradient of the site at a distance of approximately 2750 feet to the southwest. Potential downgradient receptors are a drainage ditch and Childpen's Pond, which are located approximately 300 feet north and 1420 feet northwest of the site, respectively.

No current on-site receptors have been identified for the site. Potential current off-site receptors include military residents and children. Potential future on-site receptors may include industrial workers and residential receptors.

No connection between site contamination and current off-site receptors has been identified. It is unlikely that Installation residents will come in contact with contaminated groundwater due to the depth at which drinking water is pumped from the Floridan aquifer and the thick confining layer located between this aquifer and the surficial aquifer. No basements have been identified in the area that could potentially be affected by vapor intrusion from chemicals in the groundwater. None of the Installation's water supply wells are located downgradient of the UST 100 site. The water supply wells are separated from the surficial aquifer by the Hawthorn Formation, a thick and highly effective confining unit.

Potential future on-site industrial receptors may come in direct contact with site soil contamination during construction or excavation activities. Potential future residential receptors may come in direct contact with groundwater contamination during household water use.

Exposure from *direct contact pathways* represents exposure via direct contact with the source media. For direct contact pathways the exposure point concentration is the concentration source term (EPA 1994) and is represented by data collected at the site. Screening for the direct contact pathways utilize the results of the data collected at the UST 100 site to perform the screens.

Exposure pathways that incorporate chemical migration to a secondary media (groundwater, surface water, sediments, air, and biota) or to an off-site receptor are referred to as *indirect contact pathways*. The exposure point concentrations for the secondary media will be determined using mathematical models that take into consideration chemical-specific and media-specific properties to estimate the chemical concentration in the secondary exposure media.

G.2.2 Screening for Chemicals of Concern

The purpose of a risk evaluation screen is to identify the COCs and areas of concern at a site, and possibly identify sites for which no further action is needed. The first step in the risk process uses screening levels that are readily obtainable and, due to their conservative nature, can be used with a high degree of confidence to indicate sites for which no further action is required.

An American Society for Testing and Materials (ASTM) (ASTM 1995) Tier 1-type risk evaluation process will be applied to the data collected for the UST 100 site to identify any COCs and media for which no further action is needed. The risk evaluation screen involves the following steps:

- Identify potential migration and exposure pathways associated with the site and identify potential exposure scenarios that should be used to select screening levels.
- Identify risk-based and ARAR-based screening levels for each contaminant.
- Compare site-related concentrations to screening levels to determine if any chemicals of potential concern exist at the site.
- Compare detection limits to screening levels to identify potential false negative screening results.

The screening levels for the UST 100 site data have been taken from the following sources based on GA EPD guidance (GA EPD 1996):

- Federal MCLs (EPA 1989);

- GUST Soil Threshold Levels (Table A, Column 2);

- Soil screening levels developed by U.S. Environmental Protection Agency (EPA 1996); and
- Soil and groundwater risk-based concentrations developed by EPA Region 3 (EPA 1996).

These values reflect screening levels based on a combination of ARARs (i.e., MCLs and GUST Soil Threshold Levels), and calculated risk-based values (i.e., EPA Region 3 risk-based concentrations). Soil and groundwater screening levels reflect a combination of both ARAR-based and risk-based values.

Screening levels inherently incorporate assumptions about land use. In identifying COCs, it is generally accepted that screening levels will reflect any potential future land uses and, thus, reflect a conservative residential use scenario (EPA 1991; EPA 1996; ASTM 1995). Based on GA EPD guidance, risk-based screening levels reflect residential land use for groundwater and industrial land use for deep soils (GA EPD 1996).

Default residential exposure scenarios for groundwater assume that use of the land could someday be residential, and that the following exposures could occur:

- Ingestion of groundwater, and
- Inhalation of volatiles during showering.

The default industrial exposure assumptions for deep soils assume that the following exposures could occur:

- Incidental ingestion of soil, and
- Inhalation of volatiles and dust.

The EPA Soil Screening Guidance (EPA 1996) provides two options for selecting soil values that address protection of groundwater. One value assumes no contaminant dilution or attenuation would occur between the soil and groundwater; a second value assumes a 20-fold dilution-attenuation factor (DAF). A DAF of 20 was used to develop soil screening values protective of groundwater at the UST 100 site.

If ARAR- or risk-based values are not available, it generally reflects (1) that the chemical is not considered to be toxic except perhaps at extremely high concentrations (e.g., aluminum, sodium, etc.); (2) no dose-response data indicate a toxic effect; or (3) EPA is currently reviewing toxicity information and no reference dose or cancer slope factor currently is available.

G.2.3 Results

The risk screening process is a systematic screening of sample results to determine site-related COCs. Chemical concentrations below risk- or ARAR-based screening levels are not considered COCs and are not evaluated further. Tables G.1 and G.2 present the results of the risk-based screening for the Part A SI soil and groundwater data, respectively.

Addendum Table G.1. Comparison of Fort Stewart CAP A UST 100 Soil Results to Screening Levels

Station:	Screening Levels			40-01	40-01	40-02	40-02	40-03
Sample ID:				4001B1	4001C1	4002C1	4002D1	4003A1
Sample Interval:	Georgia UST Corrective Action Levels for Soil[a]	Risk-based Screening Level[b]	Leaching to Groundwater[c]	25.' - 5.0'	5.0' - 7.5'	5.0' - 7.5'	7.5' - 10.0'	1.1' - 2.5'
Media:				Soil	Soil	Soil	Soil	Soil
Sample Type:				Grab	Grab	Grab	Grab	Grab
Collection Date:				06-Sep-96	06-Sep-96	19-Sep-96	19-Sep-96	15-Dec-96
Units:	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
2-Chloronaphthalene[d]	N/A[e]	82000000	84000	374 U	384 U	33800 UJ	384 U	344 U
Acenaphthene	N/A[e]	120000000	570000	374 U	384 U	3580 UJ	384 U	344 U
Acenaphthylene	N/A[e]	61000000	4200000	374 U	384 U	33800 UJ	384 U	344 U
Anthracene	N/A[e]	610000000	12000000	374 U	384 U	33800 UJ	384 UJ	344 U
Benzene	8	200000	30	5.7 U	5.8 U	**52 U**	**130 =**	**26.6 U**
Benzo(a)anthracene	N/A[e]	7800	2000	374 U	384 U	*33800 UJ*	384 U	344 U
Benzo(a)pyrene	N/A[e]	780	8000	374 U	384 U	*33800 UJ*	384 U	344 U
Benzo(b)fluoranthene	N/A[e]	7800	5000	374 U	384 U	*33800 UJ*	384 U	344 U
Benzo(g,h,i)perylene	N/A[e]			374 U	384 U	33800 UJ	384 U	344 U
Benzo(k)fluoranthene	N/A[e]	78000	49000	374 U	384 U	33800 UJ	384 U	344 U
Chrysene	N/A[e]	780000	160000	374 U	384 U	33800 UJ	384 U	344 U
Dibenzo(a,h)anthracene	N/A[e]	780	2000	374 UJ	384 U	*33800 UJ*	384 U	344 U
Ethylbenzene	10000	200000000	13000	5.7 U	5.8 U	340 =	1500 =	4.5 J
Fluoranthene	N/A[e]	82000000	4300000	374 U	384 U	33800 UJ	384 UJ	344 U
Fluorene	N/A[e]	82000000	560000	374 U	384 U	33800 UJ	384 U	344 U
Indeno(1,2,3-cd)pyrene	N/A[e]	7800	14000	374 U	384 U	*33800 UJ*	384 U	344 U
Lead	--	5000000	--		2400 =	1500 =		7200 =
Naphthalene	N/A[e]	82000000	84000	374 U	384 U	33800 UJ	485 =	344 U
Phenanthrene[f]	N/A[e]	61000000	4200000	374 U	384 U	33800 UJ	1300 J	344 U
Pyrene	N/A[e]	61000000	4200000	374 U	384 U	33800 UJ	384 U	344 U
Toluene	6000	410000000	12000	5.7 U	5.8 U	52 U	120 =	22 J
Total Petroleum Hydrocarbons	--	--	--	10400 U	13400 U	23100000 =	4350000 =	431000 =
Xylenes, Total	700000	1000000000	190000	5.7 U	5.8 U	800 =	4900 =	15.9 J

[a] Average or higher groundwater pollution susceptability area (where public water supply is within 2.0 mi.).

[b] Protective of soil exposure during Industrial Land Use.

[c] Protective of groundwater ingestion. Used a dilution attenuation factor of 20.

[d] Values based on naphthalene as a surrogate chemical.

[e] Not applicable. The screening level exceeds the expected soil concentration under free product condition.

[f] Values based on pyrene as a surrogate chemical.

10 Bold values indicate results exceeding Georgia UST action levels.

10 Italicized values indicate results exceeding risk-based screening levels.

10 Underlined values indicate results exceeding leaching to groundwater screening levels.

U Indicates that the compound was not detected above the reported sample quantitation limit

J Indicates that the value for the compound was an estimated value

UJ Indicates that the sample was not detected above an approximate sample quantitation limit

R Indicates that the sample results are unusable and the presence or absence of the compound could not be verified

= Indicates that the compound was detected at the concentration reported

Table G.1 (continued)

Station:	Screening Levels			40-03	40-04	40-04	40-05	40-05
Sample ID:				4003C1	4004B1	4004D1	4005B1	4005D1
Sample Interval:	Georgia UST Corrective Action Levels for Soil[a]	Risk-based Screening Level[b]	Leaching to Groundwater[c]	5.0' - 7.5'	2.5' - 5.0'	7.5' - 10.0'	2.5' - 5.0'	7.5' - 10.0'
Media:				Soil	Soil	Soil	Soil	Soil
Sample Type:				Grab	Grab	Grab	Grab	Grab
Collection Date:				15-Dec-96	15-Dec-96	15-Dec-96	15-Dec-96	15-Dec-96
Units:	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
2-Chloronaphthalene[d]	N/A[e]	82000000	84000	374 U	353 U	381 U	352 U	388 U
Acenaphthene	N/A[e]	120000000	570000	374 U	353 U	381 U	352 U	388 U
Acenaphthylene	N/A[e]	61000000	4200000	374 U	353 U	381 U	352 U	388 U
Anthracene	N/A[e]	610000000	12000000	374 U	353 U	381 U	352 U	388 U
Benzene	8	200000	30	5.7 U	5.4 U	5.9 U	5.4 U	6 U
Benzo(a)anthracene	N/A[e]	7800	2000	374 U	353 U	381 U	352 U	388 U
Benzo(a)pyrene	N/A[e]	780	8000	374 U	353 U	381 U	352 U	388 U
Benzo(b)fluoranthene	N/A[e]	7800	5000	374 U	353 U	381 U	352 U	388 U
Benzo(g,h,i)perylene	N/A[e]			374 U	353 U	381 U	352 U	388 U
Benzo(k)fluoranthene	N/A[e]	78000	49000	374 U	353 U	381 U	352 U	388 U
Chrysene	N/A[e]	780000	160000	374 U	353 U	381 U	352 U	388 U
Dibenzo(a,h)anthracene	N/A[e]	780	2000	374 U	353 U	381 U	352 U	388 U
Ethylbenzene	10000	200000000	13000	5.7 U	5.4 U	5.9 U	5.4 U	6 U
Fluoranthene	N/A[e]	82000000	4300000	374 U	353 U	381 U	352 U	388 U
Fluorene	N/A[e]	82000000	560000	374 U	353 U	381 U	352 U	388 U
Indeno(1,2,3-cd)pyrene	N/A[e]	7800	14000	374 U	353 U	381 U	352 U	388 U
Lead	--	5000000	--			6400 =		7200 =
Naphthalene	N/A[e]	82000000	84000	374 U	353 U	381 U	352 U	388 U
Phenanthrene[f]	N/A[e]	61000000	4200000	374 U	353 U	381 U	352 U	388 U
Pyrene	N/A[e]	61000000	4200000	374 U	353 U	381 U	352 U	388 U
Toluene	6000	410000000	12000	5.7 U	65 =	2.3 J	32 =	6 U
Total Petroleum Hydrocarbons	--	--	--	101000 =	7580 U	103000 =	4380 U	926000 =
Xylenes, Total	700000	1000000000	190000	5.7 U	5.4 U	5.9 U	5.4 U	6 U

[a] Average or higher groundwater pollution susceptability area (where public water supply is within 2.0 mi.).

[b] Protective of soil exposure during Industrial Land Use.

[c] Protective of groundwater ingestion. Used a dilution attenuation factor of 20.

[d] Values based on naphthalene as a surrogate chemical.

[e] Not applicable. The screening level exceeds the expected soil concentration under free product condition.

[f] Values based on pyrene as a surrogate chemical.

10 Bold values indicate results exceeding Georgia UST action levels.

10 Italicized values indicate results exceeding risk-based screening levels.

10 Underlined values indicate results exceeding leaching to groundwater screening levels.

U Indicates that the compound was not detected above the reported sample quantitation limit

J Indicates that the value for the compound was an estimated value

UJ Indicates that the sample was not detected above an approximate sample quantitation limit

R Indicates that the sample results are unusable and the presence or absence of the compound could not be verified

= Indicates that the compound was detected at the concentration reported

Addendum Table G.2. Comparison of Fort Stewart CAP A UST 100 Groundwater Results to Screening Levels

Station:	Screening Levels		40-01	40-02	40-03	40-04	40-05
Sample ID:			4001W2	4002W2	4003W2	4004W2	4005W2
Media:		Risk-based	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Sample Type:	Federal	Screening	Grab	Grab	Grab	Grab	Grab
Collection Date:	SDWA MCLs	Level[a]	06-Sep-96	19-Sep-96	16-Dec-96	15-Dec-96	16-Dec-96
Units:	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
2-Chloronaphthalene[b]		1500	10 U	10 U	10 U	10 U	10 U
Acenaphthene		2200	10 U	10 U	10 U	10 U	10 U
Acenaphthylene		1100	10 U	10 U	10 U	10 U	10 U
Anthracene		11000	10 U	10 U	10 U	10 U	10 U
Benzene	5	0.36	6.9 =	5 U	5 U	5 U	5 U
Benzo(a)anthracene		0.092	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	0.2	0.0092	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**
Benzo(b)fluoranthene		0.092	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene			10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene		0.92	10 U	10 U	10 U	10 U	10 U
Chrysene		9.2	10 U	10 U	10 U	10 U	10 U
Dibenzo(a,h)anthracene		0.0092	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	700	1300	23.8 =	0.31 J	5 U	5 U	5 U
Fluoranthene		1500	10 U	10 U	10 U	10 U	10 U
Fluorene		1500	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene		0.092	10 U	10 U	10 U	10 U	10 U
Lead	15[d]				4.3 =	**248 =**	**1090 =**
Naphthalene		1500	25.3 =	10 U	10 U	10 U	10 U
Phenanthrene[c]		1100	10 U	10 U	10 U	10 U	10 U
Pyrene		1100	10 U	10 U	10 U	10 U	10 U
Toluene	1000	750	6 =	5 U	5 U	5 U	5 U
Xylenes, Total	10000	12000	84.6 =	0.57 J	5 U	5 U	5 U

[a] Protective of tap water ingestion by a resident.

[b] Values based on naphthalene as a surrogate chemical.

[c] Values based on pyrene as a surrogate chemical.

[d] Technology Action Level (Federal Register Vol. 56. No. 110, June 7, 1991)

10 Bold values indicate results exceeding Federal Safe Drinking Water Act Maximum Contaminant Levels.

10 Underlined values indicate results exceeding risk-based screening levels.

U Indicates that the compound was not detected above the reported sample quantitation limit

J Indicates that the value for the compound was an estimated value

UJ Indicates that the sample was not detected above an approximate sample quantitation limit

R Indicates that the sample results are unusable and the presence or absence of the compound could not be verified

= Indicates that the compound was detected at the concentration reported

Benzene was detected above the GUST corrective action level (8 µg/kg) and the risk-based screening value based on leaching to groundwater in one soil sample. Ethylbenzene, lead, naphthalene, phenanthrene, toluene, xylenes, and TPH were detected below screening levels. Benzene was selected as a COC for UST 100 site soils.

Soil detection limits for benzene exceeded screening levels for two samples (4002C1 and 4003A1). Detection limits for four PAHs in one sample (4002C1) also exceeded screening levels. The elevated detection limits were the result of analytical dilutions of the samples to account for matrix interference during analysis. Detection limits represent levels of confidence where a reported value above the level is considered an accurate value. It is reasonable to assume that the analysis could measure values at the screening levels if the contaminants were present in soils at screening levels. As such, no COCs for soils were selected based on the detection limit screening.

Benzene was detected above the risk-based screening level (0.36 µg/L) and the MCL (5 µg/L) for one sample collected for UST 100 site groundwater. Lead was sampled for and detected in three samples. Two of these detections exceeded the technology action level of lead (15 µg/L). Ethylbenzene, naphthalene, toluene, and xylenes were detected below screening levels. Benzene and lead were selected as COCs for groundwater.

Detection limits for benzene and several PAHs exceeded risk-based screening levels. For these chemicals, risk-based values represent values below analytically achievable levels. The detection limits for one PAH, benzo(a)pyrene, also exceeded the federal MCL of 0.2 ppb by two orders of magnitude. No COCs for groundwater were selected based on the detection limit screening.

G.2.4 Uncertainties

Groundwater samples collected during the CAP-Part A investigations were collected from hydropunch sampling devices or temporary piezometers and contained a high amount of suspended solids and were very turbid. The lead concentrations in these samples above the technology action level is attributed to the suspended particles and not the contaminated groundwater.

G.2.5 Alternate Concentration Limits

Detections exceeding the conservative generic screening levels are considered COCs. ACLs are developed for the COCs using site-specific information. GA EPD recommends developing risk-based remediation levels using a risk goal at least 1×10^{-6} and not to exceed 1×10^{-4} for all carcinogens, and a hazard quotient (HQ) of 3 for noncarcinogens (GA EPD 1996).

Benzene was selected as a COC for UST 100 soils. A soil detection for benzene exceeded the GUST screening level. The GUST screening value is based on direct contact with contaminated soils. Direct contact with the contamination in the soil will not occur at the site. The former location of UST 100 is completely covered by a high strength concrete pad. Current and future land use for the site indicates that this cement pad will remain in place for the foreseeable future. As such, no actual risks to a on-site receptor will occur as no pathway exists where a receptor will encounter soils beneath the concrete.

If future land use decisions dictate the removal of the cement pad, soil ACLs will need to be developed that reflect the anticipated land use. Since no current or future land use is identified where receptors will encounter soil contamination for the site, no soil ACLs are developed.

The soil detection for benzene also exceeded the risk-based screening level based on leaching to drinking water. The UST 100 has been removed thus no on-going contaminant source exists. Soil contamination is the result of past releases from the USTs. Contaminant levels are expected to decrease over time due to natural attenuation and biodegradation. Soils may act as a limited source to the groundwater beneath the site. Partitioning of the benzene in soils to the groundwater (assuming equilibrium) results in a concentration (381 µg/L) two orders of magnitude higher than the highest concentration (6.9 µg/L) detected in the groundwater beneath the site.

Benzene and lead were selected as COCs for UST 100 site groundwater. No risk-based methodology can be employed to develop site-specific cleanup levels for lead in the groundwater at the site. The default screening level of 15 µg/L for lead based on the technology action level will be used as the ACL for the site. The ACL for benzene was developed using a target risk of 1×10^{-4}. No current receptor for groundwater contamination exists at the site. The most likely potential future exposure would be ingestion of groundwater by an industrial worker. An ACL for an industrial drinking water receptor was calculated using a target risk of 1×10^{-4} or an HQ of 3 and EPA methodology (EPA 1994). The groundwater ACL calculated for benzene is 990 µg/L and the ACL calculation is presented in Section G.5.

G.3 Fate and Transport Model

The AT123D model was used to determine the impact of dissolved hydrocarbons on potential receptors. Modeling of the leaching of soil contamination to the groundwater was performed because the highest benzene concentration in soil (130 µg/kg) exceeded the leaching to groundwater screening value (30 µg/kg). Thus, the benzene groundwater concentration was calculated from the benzene soil concentration by partitioning, which results in a groundwater concentration of 381 µg/L. Site-specific geotechnical data, which is presented in Appendix C and Addendum Table II-6, was collected in May 1998 for use in the fate and transport modeling. Vertical migration of the contaminant plume through the confining unit to the Principal Artesian aquifer is improbable. The confining unit has a vertical hydraulic conductivity on the order of 10^{-8} cm/sec and ranges from 15- to 90-feet thick. The surficial aquifer where the contaminant plume is located is not used as a source of drinking water.

The modeling results for benzene are provided in Section G.6 of this appendix. Two potential downgradient locations where a receptor may encounter migrating groundwater contamination were modeled. A drainage ditch approximately 300 feet north of the site and Childpen's Pond, which is located approximately 1420 feet northwest of the site, are the nearest possible locations where a receptor may encounter migrating groundwater contamination due to a possible hydraulic connection between the groundwater and the surface water in the ditch and the pond. Contaminant migration modeling for 100 years of groundwater migrating to surface water in the ditch and in the pond, when accounting for biodegradation, indicates that benzene will not reach either location in detectable levels. No hydraulic connection between the ditch and the groundwater is known to exist, and ignoring biodegradation and natural attenuation will result in an overly conservative modeling estimate. If the drainage ditch is receiving influx from the groundwater, benzene levels would not be expected to exceed the MCL under actual site conditions due to biodegradation and natural attenuation.

G.4 Conclusions and Recommendations

The following conclusions are based on a review of the CAP-Part A site investigation results using a risk-based approach:

- Risk-based screening results show that benzene exceeded initial risk-based screening levels in groundwater. Using a site-specific scenario of an industrial worker exposure, benzene does not exceed the ACL of 990 µg/L.
- The extent of soil and groundwater contamination was determined during the CAP-Part A investigation.
- Fate and transport modeling indicates that contamination from existing site conditions at Facility ID #9-089115 will never exceed MCLs at a conservatively defined downgradient receptor.

Considering the site characteristics, natural attenuation will provide the best corrective action. Therefore, based on the results of the risk screening and fate and transport modeling, a no-further-action-required status is recommended for this site. A monitoring program is not recommended to confirm the modeling predictions, since all additional requirements of GA EPD as stated in correspondence dated July 30, 1997, and March 13, 1998, have been completed. In addition, permanent wells do not exist at this site, as they were not required by GA EPD.

G.5 Alternate Concentration Limits Calculations

ACL Calculation for Benzene

CSF	Benzene oral Cancer Slope Factor	=	0.029 $(\text{mg/kg-day})^{-1}$
IR	Ingestion rate	=	1 L/day
EF	Exposure frequency	=	250 days/year
ED	Exposure duration	=	25 years
BW	Body weight	=	70 kg
AT	Averaging time = 70 years × 365 days/year	=	25550 days
TR	Target Risk	=	1×10^{-4}

$$\text{ACL} = \frac{\text{TR} \times \text{BW} \times \text{AT}}{\text{IR} \times \text{EF} \times \text{ED} \times \text{CSF}} = \frac{10^{-4} \times 70 \times 25550}{1 \times 250 \times 25 \times 0.029}$$

= 0.987 mg/L

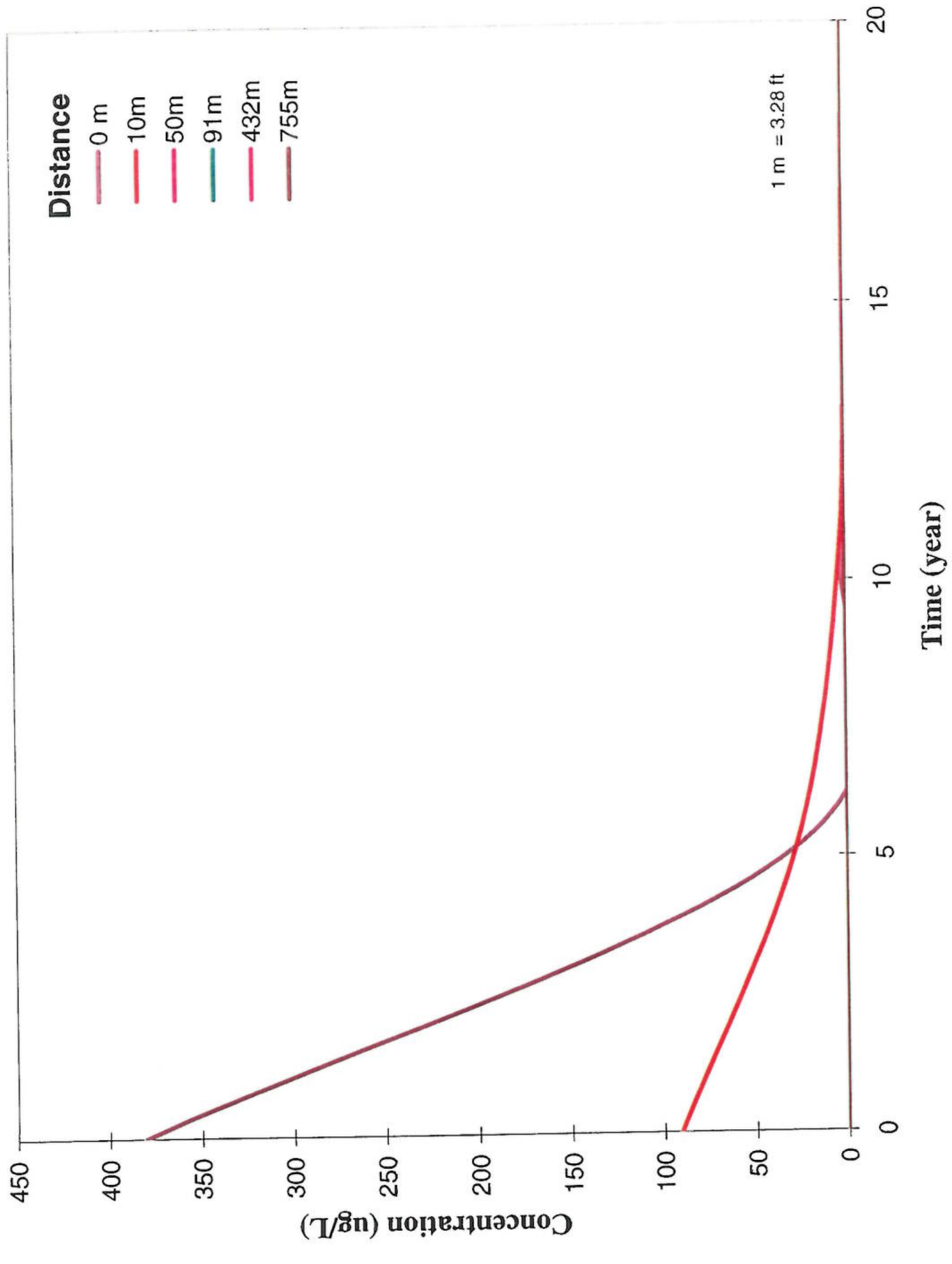
~ 0.990 mg/L

~ 990 µg/L

G.6 Fate and Transport Modeling Results

Following are the data for fate and transport modeling.

AT123D modeled concentration of benzene in groundwater at different distances from the source (UST 100)



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Ft Stewart, UST 100, Benzene (calibrated plume)


NO. OF POINTS IN X-DIRECTION .......................   10
NO. OF POINTS IN Y-DIRECTION .......................    5
NO. OF POINTS IN Z-DIRECTION .......................    1
NO. OF ROOTS: NO. OF SERIES TERMS .................  400
NO. OF BEGINNING TIME STEP .........................  122
NO. OF ENDING TIME STEP ........................... 1215
NO. OF TIME INTERVALS FOR PRINTED OUT SOLUTION ....   64
INSTANTANEOUS SOURCE CONTROL = 0 FOR INSTANT SOURCE    1
SOURCE CONDITION CONTROL = 0 FOR STEADY SOURCE ....    0
INTERMITTENT OUTPUT CONTROL = 0 NO SUCH OUTPUT ....    1
CASE CONTROL =1 THERMAL, = 2 FOR CHEMICAL, = 3 RAD     2

AQUIFER DEPTH, = 0.0 FOR INFINITE DEEP (METERS) ...  0.1006E+02
AQUIFER WIDTH, = 0.0 FOR INFINITE WIDE (METERS) ...  0.0000E+00
BEGIN POINT OF X-SOURCE LOCATION (METERS) ......... -0.4572E+01
END POINT OF X-SOURCE LOCATION (METERS) ...........  0.4572E+01
BEGIN POINT OF Y-SOURCE LOCATION (METERS) ......... -0.2286E+01
END POINT OF Y-SOURCE LOCATION (METERS) ...........  0.2286E+01
BEGIN POINT OF Z-SOURCE LOCATION (METERS) .........  0.0000E+00
END POINT OF Z-SOURCE LOCATION (METERS) ...........  0.2000E+01

POROSITY ..........................................  0.2000E+00
HYDRAULIC CONDUCTIVITY (METER/HOUR) ...............  0.7200E-02
HYDRAULIC GRADIENT ................................  0.9400E-02
LONGITUDINAL DISPERSIVITY (METER) .................  0.9000E+01
LATERAL DISPERSIVITY (METER) ......................  0.1000E+01
VERTICAL DISPERSIVITY (METER) .....................  0.1000E+01
DISTRIBUTION COEFFICIENT, KD (M**3/KG) ............  0.3410E-03
HEAT EXCHANGE COEFFICIENT (KCAL/HR-M**2-DEGREE C)..  0.0000E+00

MOLECULAR DIFFUSION MULTIPLY BY POROSITY (M**2/HR)   0.3530E-05
DECAY CONSTANT (PER HOUR) .........................  0.4012E-04
BULK DENSITY OF THE SOIL (KG/M**3) ................  0.1096E+04
ACCURACY TOLERANCE FOR REACHING STEADY STATE ......  0.1000E-02
DENSITY OF WATER (KG/M**3) ........................  0.1000E+04
TIME INTERVAL SIZE FOR THE DESIRED SOLUTION (HR) ..  0.7200E+03
DISCHARGE TIME (HR) ...............................  0.8760E+05
WASTE RELEASE RATE (KCAL/HR), (KG/HR), OR (CI/HR) .  0.2190E-05

RETARDATION FACTOR ................................  0.2869E+01
RETARDED DARCY VELOCITY (M/HR) ....................  0.1180E-03
RETARDED LONGITUDINAL DISPERSION COEF. (M**2/HR) ..  0.1068E-02
RETARDED LATERAL DISPERSION COEFFICIENT (M**2/HR) .  0.1241E-03
RETARDED VERTICAL DISPERSION COEFFICIENT (M**2/HR).  0.1241E-03
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DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.0000E+00 HRS
  (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                   Z =       0.00
                                                    X
 Y          0.         2.         5.        10.        20.        50.        91.       100.       432.       838.

 5.  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 4.  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 3.  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 2.  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 0.  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8712E+05 HRS
  (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                   Z =       0.00
                                                    X
 Y          0.         2.         5.        10.        20.        50.        91.       100.       432.       838.

 5.  0.232E-01  0.244E-01  0.230E-01  0.154E-01  0.387E-02  0.838E-05  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 4.  0.525E-01  0.545E-01  0.482E-01  0.277E-01  0.565E-02  0.105E-04  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 3.  0.124E+00  0.125E+00  0.100E+00  0.461E-01  0.769E-02  0.126E-04  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 2.  0.260E+00  0.259E+00  0.187E+00  0.677E-01  0.963E-02  0.143E-04  0.000E+00  0.000E+00  0.000E+00  0.000E+00
 0.  0.381E+00  0.378E+00  0.269E+00  0.911E-01  0.116E-01  0.158E-04  0.000E+00  0.000E+00  0.000E+00  0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.1332E+06 HRS
  (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                   Z =       0.00
                                                    X
 Y          0.         2.         5.        10.        20.        50.        91.       100.       432.       838.

 5.  0.189E-02  0.208E-02  0.228E-02  0.236E-02  0.162E-02  0.340E-04  0.260E-08  0.161E-09  0.000E+00  0.000E+00
 4.  0.397E-02  0.435E-02  0.475E-02  0.481E-02  0.309E-02  0.477E-04  0.324E-08  0.199E-09  0.000E+00  0.000E+00
 3.  0.844E-02  0.924E-02  0.100E-01  0.994E-02  0.585E-02  0.632E-04  0.384E-08  0.234E-09  0.000E+00  0.000E+00
 2.  0.163E-01  0.178E-01  0.192E-01  0.187E-01  0.102E-01  0.784E-04  0.434E-08  0.263E-09  0.000E+00  0.000E+00
 0.  0.235E-01  0.257E-01  0.276E-01  0.268E-01  0.144E-01  0.933E-04  0.479E-08  0.288E-09  0.000E+00  0.000E+00
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 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.1793E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                 Z =        0.00
                                                 X
Y           0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

5.   0.202E-03   0.224E-03   0.253E-03   0.287E-03   0.279E-03   0.314E-04   0.293E-07   0.390E-08   0.000E+00   0.000E+00
4.   0.418E-03   0.462E-03   0.520E-03   0.586E-03   0.555E-03   0.523E-04   0.385E-07   0.500E-08   0.000E+00   0.000E+00
3.   0.875E-03   0.966E-03   0.109E-02   0.121E-02   0.111E-02   0.856E-04   0.480E-07   0.609E-08   0.000E+00   0.000E+00
2.   0.167E-02   0.184E-02   0.206E-02   0.229E-02   0.205E-02   0.132E-03   0.564E-07   0.703E-08   0.000E+00   0.000E+00
0.   0.240E-02   0.264E-02   0.296E-02   0.329E-02   0.292E-02   0.177E-03   0.644E-07   0.788E-08   0.000E+00   0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.2254E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                 Z =        0.00
                                                 X
Y           0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

5.   0.234E-04   0.259E-04   0.297E-04   0.351E-04   0.399E-04   0.119E-04   0.701E-07   0.144E-07   0.000E+00   0.000E+00
4.   0.480E-04   0.532E-04   0.608E-04   0.716E-04   0.804E-04   0.217E-04   0.103E-06   0.202E-07   0.000E+00   0.000E+00
3.   0.998E-04   0.111E-03   0.126E-03   0.148E-03   0.163E-03   0.396E-04   0.145E-06   0.272E-07   0.000E+00   0.000E+00
2.   0.189E-03   0.209E-03   0.238E-03   0.279E-03   0.304E-03   0.672E-04   0.193E-06   0.345E-07   0.000E+00   0.000E+00
0.   0.271E-03   0.300E-03   0.342E-03   0.400E-03   0.435E-03   0.934E-04   0.241E-06   0.416E-07   0.000E+00   0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.2714E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                 Z =        0.00
                                                 X
Y           0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

5.   0.281E-05   0.312E-05   0.359E-05   0.435E-05   0.542E-05   0.293E-05   0.670E-07   0.193E-07   0.000E+00   0.000E+00
4.   0.575E-05   0.638E-05   0.734E-05   0.887E-05   0.110E-04   0.557E-05   0.108E-06   0.300E-07   0.000E+00   0.000E+00
3.   0.119E-04   0.132E-04   0.152E-04   0.183E-04   0.224E-04   0.106E-04   0.173E-06   0.456E-07   0.000E+00   0.000E+00
2.   0.225E-04   0.249E-04   0.286E-04   0.344E-04   0.418E-04   0.188E-04   0.261E-06   0.656E-07   0.000E+00   0.000E+00
0.   0.322E-04   0.358E-04   0.411E-04   0.494E-04   0.598E-04   0.265E-04   0.346E-06   0.851E-07   0.000E+00   0.000E+00
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 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.3175E+06 HRS
   (ADSORBED CHEMICAL CONC. =    0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                     Z =        0.00

                                                    X
 Y        0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

 5.   0.346E-06   0.385E-06   0.445E-06   0.546E-06   0.722E-06   0.578E-06   0.353E-07   0.132E-07   0.000E+00   0.000E+00
 4.   0.706E-06   0.784E-06   0.906E-06   0.111E-05   0.146E-05   0.112E-05   0.610E-07   0.221E-07   0.000E+00   0.000E+00
 3.   0.146E-05   0.162E-05   0.187E-05   0.229E-05   0.299E-05   0.219E-05   0.105E-06   0.368E-07   0.000E+00   0.000E+00
 2.   0.274E-05   0.305E-05   0.352E-05   0.431E-05   0.559E-05   0.396E-05   0.171E-06   0.578E-07   0.000E+00   0.000E+00
 0.   0.394E-05   0.437E-05   0.505E-05   0.617E-05   0.800E-05   0.561E-05   0.233E-06   0.779E-07   0.000E+00   0.000E+00
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 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.3636E+06 HRS
   (ADSORBED CHEMICAL CONC. =    0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                     Z =        0.00

                                                    X
 Y        0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

 5.   0.432E-07   0.481E-07   0.558E-07   0.693E-07   0.953E-07   0.101E-06   0.127E-07   0.581E-08   0.000E+00   0.000E+00
 4.   0.881E-07   0.979E-07   0.114E-06   0.141E-06   0.193E-06   0.198E-06   0.228E-07   0.102E-07   0.000E+00   0.000E+00
 3.   0.182E-06   0.202E-06   0.234E-06   0.290E-06   0.395E-06   0.392E-06   0.413E-07   0.180E-07   0.000E+00   0.000E+00
 2.   0.341E-06   0.380E-06   0.440E-06   0.544E-06   0.740E-06   0.716E-06   0.699E-07   0.298E-07   0.000E+00   0.000E+00
 0.   0.489E-06   0.544E-06   0.630E-06   0.780E-06   0.106E-05   0.102E-05   0.971E-07   0.410E-07   0.000E+00   0.000E+00
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 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.4097E+06 HRS
   (ADSORBED CHEMICAL CONC. =    0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                     Z =        0.00

                                                    X
 Y        0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

 5.   0.547E-08   0.608E-08   0.707E-08   0.885E-08   0.126E-07   0.163E-07   0.354E-08   0.190E-08   0.000E+00   0.000E+00
 4.   0.111E-07   0.124E-07   0.144E-07   0.180E-07   0.254E-07   0.323E-07   0.657E-08   0.346E-08   0.000E+00   0.000E+00
 3.   0.229E-07   0.255E-07   0.296E-07   0.369E-07   0.521E-07   0.646E-07   0.123E-07   0.633E-08   0.000E+00   0.000E+00
 2.   0.430E-07   0.478E-07   0.555E-07   0.693E-07   0.974E-07   0.119E-06   0.213E-07   0.108E-07   0.000E+00   0.000E+00
 0.   0.616E-07   0.685E-07   0.796E-07   0.994E-07   0.140E-06   0.169E-06   0.298E-07   0.150E-07   0.000E+00   0.000E+00
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 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.4558E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                    Z =        0.00
                                                X
Y         0.         2.         5.        10.        20.        50.        91.       100.       432.       838.

5.  0.697E-09  0.776E-09  0.903E-09  0.114E-08  0.165E-08  0.252E-08  0.837E-09  0.509E-09  0.000E+00  0.000E+00
4.  0.142E-08  0.158E-08  0.183E-08  0.231E-08  0.334E-08  0.501E-08  0.158E-08  0.948E-09  0.000E+00  0.000E+00
3.  0.291E-08  0.324E-08  0.377E-08  0.474E-08  0.685E-08  0.101E-07  0.302E-08  0.178E-08  0.000E+00  0.000E+00
2.  0.546E-08  0.608E-08  0.708E-08  0.889E-08  0.128E-07  0.186E-07  0.533E-08  0.310E-08  0.000E+00  0.000E+00
0.  0.783E-08  0.872E-08  0.101E-07  0.127E-07  0.184E-07  0.265E-07  0.751E-08  0.435E-08  0.000E+00  0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.5018E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                    Z =        0.00
                                                X
Y         0.         2.         5.        10.        20.        50.        91.       100.       432.       838.

5.  0.894E-10  0.995E-10  0.116E-09  0.147E-09  0.217E-09  0.376E-09  0.176E-09  0.118E-09  0.000E+00  0.000E+00
4.  0.181E-09  0.202E-09  0.236E-09  0.298E-09  0.440E-09  0.750E-09  0.337E-09  0.224E-09  0.000E+00  0.000E+00
3.  0.373E-09  0.415E-09  0.484E-09  0.612E-09  0.901E-09  0.151E-08  0.652E-09  0.427E-09  0.000E+00  0.000E+00
2.  0.700E-09  0.779E-09  0.908E-09  0.115E-08  0.169E-08  0.280E-08  0.117E-08  0.756E-09  0.000E+00  0.000E+00
0.  0.100E-08  0.112E-08  0.130E-08  0.164E-08  0.241E-08  0.400E-08  0.165E-08  0.106E-08  0.000E+00  0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.5479E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                    Z =        0.00
                                                X
Y         0.         2.         5.        10.        20.        50.        91.       100.       432.       838.

5.  0.115E-10  0.128E-10  0.150E-10  0.190E-10  0.286E-10  0.549E-10  0.340E-10  0.248E-10  0.000E+00  0.000E+00
4.  0.234E-10  0.261E-10  0.304E-10  0.386E-10  0.579E-10  0.110E-09  0.657E-10  0.475E-10  0.000E+00  0.000E+00
3.  0.480E-10  0.535E-10  0.624E-10  0.792E-10  0.119E-09  0.222E-09  0.128E-09  0.917E-10  0.000E+00  0.000E+00
2.  0.901E-10  0.100E-09  0.117E-09  0.148E-09  0.222E-09  0.412E-09  0.232E-09  0.164E-09  0.000E+00  0.000E+00
0.  0.129E-09  0.144E-09  0.168E-09  0.213E-09  0.318E-09  0.588E-09  0.328E-09  0.232E-09  0.000E+00  0.000E+00
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 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.5940E+06 HRS
   (ADSORBED CHEMICAL CONC. =    0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                    Z =       0.00
                                                   X
Y          0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

5.   0.149E-11   0.166E-11   0.194E-11   0.248E-11   0.377E-11   0.788E-11   0.615E-11   0.480E-11   0.000E+00   0.000E+00
4.   0.303E-11   0.337E-11   0.394E-11   0.502E-11   0.762E-11   0.158E-10   0.120E-10   0.928E-11   0.000E+00   0.000E+00
3.   0.622E-11   0.693E-11   0.809E-11   0.103E-10   0.156E-10   0.320E-10   0.236E-10   0.181E-10   0.000E+00   0.000E+00
2.   0.117E-10   0.130E-10   0.152E-10   0.193E-10   0.292E-10   0.594E-10   0.428E-10   0.327E-10   0.000E+00   0.000E+00
0.   0.167E-10   0.186E-10   0.217E-10   0.276E-10   0.418E-10   0.848E-10   0.608E-10   0.463E-10   0.000E+00   0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.6401E+06 HRS
   (ADSORBED CHEMICAL CONC. =    0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                    Z =       0.00
                                                   X
Y          0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

5.   0.194E-12   0.216E-12   0.253E-12   0.323E-12   0.497E-12   0.112E-11   0.106E-11   0.878E-12   0.000E+00   0.000E+00
4.   0.394E-12   0.439E-12   0.513E-12   0.655E-12   0.101E-11   0.224E-11   0.208E-11   0.171E-11   0.000E+00   0.000E+00
3.   0.808E-12   0.900E-12   0.105E-11   0.134E-11   0.206E-11   0.455E-11   0.412E-11   0.336E-11   0.000E+00   0.000E+00
2.   0.151E-11   0.169E-11   0.197E-11   0.252E-11   0.385E-11   0.845E-11   0.751E-11   0.609E-11   0.000E+00   0.000E+00
0.   0.217E-11   0.242E-11   0.282E-11   0.360E-11   0.552E-11   0.121E-10   0.107E-10   0.864E-11   0.000E+00   0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.6862E+06 HRS
   (ADSORBED CHEMICAL CONC. =    0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                    Z =       0.00
                                                   X
Y          0.          2.          5.         10.         20.         50.         91.        100.        432.        838.

5.   0.253E-13   0.282E-13   0.330E-13   0.423E-13   0.656E-13   0.157E-12   0.176E-12   0.153E-12   0.000E+00   0.000E+00
4.   0.513E-13   0.572E-13   0.669E-13   0.857E-13   0.133E-12   0.315E-12   0.347E-12   0.300E-12   0.000E+00   0.000E+00
3.   0.105E-12   0.117E-12   0.137E-12   0.176E-12   0.272E-12   0.640E-12   0.691E-12   0.593E-12   0.000E+00   0.000E+00
2.   0.197E-12   0.220E-12   0.257E-12   0.329E-12   0.508E-12   0.119E-11   0.126E-11   0.108E-11   0.000E+00   0.000E+00
0.   0.282E-12   0.315E-12   0.368E-12   0.471E-12   0.728E-12   0.170E-11   0.180E-11   0.153E-11   0.000E+00   0.000E+00
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 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7322E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                Z =       0.00
                                                 X
Y          0.        2.        5.        10.        20.        50.        91.        100.        432.        838.

5.   0.331E-14  0.369E-14  0.432E-14  0.555E-14  0.867E-14  0.219E-13  0.284E-13  0.258E-13  0.000E+00  0.000E+00
4.   0.671E-14  0.748E-14  0.876E-14  0.112E-13  0.175E-13  0.439E-13  0.561E-13  0.507E-13  0.000E+00  0.000E+00
3.   0.138E-13  0.153E-13  0.180E-13  0.230E-13  0.359E-13  0.894E-13  0.112E-12  0.101E-12  0.000E+00  0.000E+00
2.   0.258E-13  0.287E-13  0.336E-13  0.431E-13  0.672E-13  0.166E-12  0.206E-12  0.184E-12  0.000E+00  0.000E+00
0.   0.369E-13  0.411E-13  0.481E-13  0.617E-13  0.962E-13  0.238E-12  0.293E-12  0.262E-12  0.000E+00  0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7783E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                Z =       0.00
                                                 X
Y          0.        2.        5.        10.        20.        50.        91.        100.        432.        838.

5.   0.434E-15  0.484E-15  0.567E-15  0.729E-15  0.115E-14  0.303E-14  0.447E-14  0.421E-14  0.000E+00  0.000E+00
4.   0.880E-15  0.981E-15  0.115E-14  0.148E-14  0.232E-14  0.609E-14  0.886E-14  0.831E-14  0.000E+00  0.000E+00
3.   0.180E-14  0.201E-14  0.235E-14  0.302E-14  0.475E-14  0.124E-13  0.177E-13  0.166E-13  0.000E+00  0.000E+00
2.   0.338E-14  0.376E-14  0.441E-14  0.566E-14  0.888E-14  0.231E-13  0.326E-13  0.304E-13  0.000E+00  0.000E+00
0.   0.483E-14  0.539E-14  0.631E-14  0.810E-14  0.127E-13  0.330E-13  0.465E-13  0.432E-13  0.000E+00  0.000E+00


 DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8244E+06 HRS
   (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                Z =       0.00
                                                 X
Y          0.        2.        5.        10.        20.        50.        91.        100.        432.        838.

5.   0.570E-16  0.636E-16  0.745E-16  0.959E-16  0.152E-15  0.418E-15  0.690E-15  0.672E-15  0.000E+00  0.000E+00
4.   0.116E-15  0.129E-15  0.151E-15  0.194E-15  0.307E-15  0.841E-15  0.137E-14  0.133E-14  0.000E+00  0.000E+00
3.   0.237E-15  0.264E-15  0.309E-15  0.398E-15  0.629E-15  0.171E-14  0.275E-14  0.266E-14  0.000E+00  0.000E+00
2.   0.443E-15  0.494E-15  0.579E-15  0.744E-15  0.118E-14  0.319E-14  0.507E-14  0.488E-14  0.000E+00  0.000E+00
0.   0.634E-15  0.707E-15  0.829E-15  0.107E-14  0.168E-14  0.456E-14  0.723E-14  0.695E-14  0.000E+00  0.000E+00
STEADY STATE SOLUTION HAS NOT BEEN REACHED BEFORE FINAL SIMULATING TIME
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DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8705E+06 HRS
  (ADSORBED CHEMICAL CONC. =   0.3410E+00 * DISSOLVED CHEMICAL CONC.)
                    Z =        0.00
                                                 X
Y          0.         2.         5.         10.        20.        50.        91.        100.       432.       838.

5.   0.751E-17  0.837E-17  0.981E-17  0.126E-16  0.201E-16  0.574E-16  0.105E-15  0.105E-15  0.000E+00  0.000E+00
4.   0.152E-16  0.169E-16  0.199E-16  0.256E-16  0.407E-16  0.116E-15  0.208E-15  0.208E-15  0.000E+00  0.000E+00
3.   0.311E-16  0.347E-16  0.407E-16  0.524E-16  0.833E-16  0.236E-15  0.419E-15  0.417E-15  0.000E+00  0.000E+00
2.   0.583E-16  0.650E-16  0.761E-16  0.981E-16  0.156E-15  0.439E-15  0.774E-15  0.768E-15  0.000E+00  0.000E+00
0.   0.834E-16  0.930E-16  0.109E-15  0.140E-15  0.223E-15  0.628E-15  0.110E-14  0.109E-14  0.000E+00  0.000E+00
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G.7. References

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