LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

ADMINISTRATIVE RECORD

VOLUME 11 of 11

1995

Bate Stamp Numbers
016329 - 016708

Prepared for:

Department of the Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671

1995

VOLUME 11 of 11

1995

A. Title: Minutes - Subject: TRC Meeting
Group(s): All
Site(s): All
Location: Longhorn Army Ammunition Plant
Date: September 12, 1995
Bate Stamp: 016329

B. Title: Letter - Subject: Site Characterization Summary Report Remedial Investigation Sites 11, 1, XX, 27 (w/enclosure) Longhorn Army Ammunition Plant
Group(s): 1
Site(s): 1, 11, XX, 27
Location: Longhorn Army Ammunition Plant
Agency: United States Environmental Protection Agency
Author(s): Ms. Lisa Marie Price, Remedial Project Manager, Superfund Division
Recipient: Mr. David Tolbert, Project Manager
Date: November 1, 1995
Bate Stamp: 016330-016332

C. Title: Letter - Subject: Longhorn Army Ammunition Plant, Draft Final Site Characterization Summary Report for the Remedial Investigation Sites 1, 11, XX, 27 (w/enclosure)
Group(s): 1
Site(s): Sites 1, 11, XX, 27
Location: Longhorn Army Ammunition Plant
Agency: Texas Natural Resource Conservation Commission
Author(s): Mr. Michael A. Moore, RI/FS Unit, Superfund Investigation Section
Recipient: Mr. David Tolbert, Project Manager
Date: November 14, 1995
Bate Stamp: 016333-016334

D. Title: Letter - Subject: LHAAP - Draft Phase II Investigations of 125 Waste Process Sumps and 20 Waste Rack Sumps
Group(s): 4
Site(s): 35 (Wastewater Sumps)
Location: Longhorn Army Ammunition Plant
Agency: Texas Natural Resource Conservation Commission
Author(s): Mr. Michael A. Moore, RI/FS II Unit, Superfund Investigation Section
Recipient: Mr. David Tolbert, Project Manager
Date: November 16, 1995
Bate Stamp: 016335

E. Title: Letter - Subject: Results of Phase II Investigation of 125 Waste Process Sumps and 20 Waste Rack Sumps, LHAAP
Group(s): 4
Site(s): 35 (Wastewater Sumps)
Location: Longhorn Army Ammunition Plant
Agency: United States Environmental Protection Agency
Author(s): Ms. Lisa Marie Price, Remedial Project Manager, Superfund Division

	Recipient:	Mr. David Tolbert, Project Manager
	Date:	November 17, 1995
	Bate Stamp:	016336-016337
F.	Title:	Memorandum - Subject: Review of the Site Characterization Summary Report for the Remedial Investigation of Sites II, I, XX, and 27 at LHAAP, Karnack, Texas, October, 1995, Prepared by Sverdrup Environmental, Inc.
	Group(s):	1
	Site(s):	1, 11, XX, 27
	Location:	Longhorn Army Ammunition Plant
	Agency:	Department of The Army
	Author(s):	Jack M. Heller, Ph.D, Acting Program Manager, Health Risk Assessment and Risk Communication
	Recipient:	Commander, U.S. Army Corps of Engineers, Tulsa District, ATTN: CESWP-PP-EA/Ms. Jonna Polk
	Date:	December 1, 1995
	Bate Stamp:	016338
G.	Title:	Memorandum - Subject: Review of the Draft Baseline Risk Assessments Group I Sites (Sites I, II, 27 and XX) at Longhorn Army Ammunition Plant, Karnack, Texas, October 1995
	Group(s):	1
	Site(s):	1, 11, XX, 27
	Location:	Longhorn Army Ammunition Plant
	Agency:	Department of The Army
	Author(s):	Jack M. Heller, Ph.D., Acting Program Manager, Health Risk Assessment and Risk Communication
	Recipient:	District Engineer, U.S. Army Engineering District, Tulsa, ATTN: CESWT-PP-EA/Ms. Jonna Polk
	Date:	December 8, 1995
	Bate Stamp:	016339
H.	Title:	Letter - Subject: LHAAP - Interim Remedial Action, Burning Ground No. 3, Phase III Work Plan, Volumes 1 through 5, Monitoring and Reporting Requirements for Plant Discharges (w/enclosures)
	Group(s):	2
	Site(s):	Burning Ground No. 3 (Sites 18/24)
	Location:	Longhorn Army Ammunition Plant
	Agency:	Texas Natural Resource Conservation Commission
	Author(s):	Mr. Michael A. Moore, RI/FS II Unit, Superfund Investigation Section
	Recipient:	Mr. David Tolbert, Project Manager
	Date:	December 13, 1995
	Bate Stamp:	016340-016349
I.	Title:	Letter - Subject: Ground Water Models
	Group(s):	All
	Site(s):	All
	Location:	Longhorn Army Ammunition Plant
	Agency:	U. S. Environmental Protection Agency
	Author(s):	Ms. Lisa Marie Price, Remedial Project Manager, Superfund Division
	Recipient:	Mr. David Tolbert, Project Manager
	Date:	December 15, 1995
	Bate Stamp:	016350-016351

J. Title: Letter - Subject: Progress at Superfund Sites in Texas
Group(s): All
Site(s): All
Location: Longhorn Army Ammunition Plant
Agency: TDC
Author(s) Mr. Mark Chance
Recipient: Mr. Sam Becker, Chief, Superfund Enforcement Branch, U. S. Environmental Protection Agency
Date: December 26, 1995
Bate Stamp: 016352

K. Title: General Work Plan - Subject: Interim Remedial Action, Burning Ground No. 3, Longhorn Army Ammunition Plant, Karnack, Texas
Group(s): 2
Site(s): Burning Ground No. 3 (Sites 18/24)
Location: Longhorn Army Ammunition Plant
Agency: Dow Environmental
Author(s): Dow Environmental
Recipient: Corps of Engineers
Date: December 28, 1995
Bate Stamp: 016353-016708

TRC MEETING
LONGHORN ARMY AMMUNITION PLANT
September 12, 1995

<u>Attendees</u>

H. L. Jones, TNRCC
Oscar Linebaugh, Jr., COE
Alvie Nichols, TNRCC
Lynn Muckelrath, LHAAP
David J. Bockelmann, Sverdrup
Lisa Marie Price, EPA
Jonna Polk, COE
Michael Moore, TNRCC, Superfund Inves.
Cliff Murray, COE
Joe Glenn, COE
John Wagner, COE
Diane Poteet, TNRCC
Ann Montgomery, LHAAP
James McPherson, LHAAP
Darrell Chinn, LHAAP, XO
Chris Edgmon, Dow Env.
David Tolbert, LHAAP
Jim Carter, COE

Captain Chinn opened the meeting with introductions and welcomed everyone to the meeting, noting that there was no outside participation.

James McPherson, Commander's Representative, contact for all general functions of the plant, spoke to the group. He stated that based on his knowledge he would use a very simple approach - we need to find out what the corrective measures are and secure funds. The environmental program is the #1 priority.

David Tolbert and Jonna Polk went over the Executive Summary (attached).

Next TRC meeting scheduled for December 12, 1995.

The meeting was adjourned at 11:00 AM.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

016330

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

NOV 0 1 1995

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Site Characterization Summary Report
Remedial Investigation Sites 11, 1, XX, 27
Longhorn Army Ammunition Plant

Dear David:

In accordance with the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the secondary document Site Characterization Summary Report Remedial Investigation Sites 11, 1, XX, 27 (Group #1) at Longhorn Army Ammunition Plant dated October 1995. EPA's comments are incorporated as an enclosure to this letter. Pursuant to the Federal Facility Agreement, EPA's comments should be addressed and changes incorporated when developing the Remedial Investigation Report.

If you have any questions about this or any other matter, please contact me at (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager

Enclosure

cc: Captain Darrell W. Chinn
Executive Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Ms. Jonna Polk
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Section MC143
Austin, TX 78711-3087

EPA's Comments 11/1/95
SCS Group #1 Sites

016331

General Comments:

#1 A table identifying the primary and secondary drinking water regulations proposed MCLs or MCLs as well as the Health Advisories for contaminants without proposed MCLs or MCLs should be provided in each of the sections for the sites under investigation. Discussion about concentrations of constituents above or below MCLs are useless without a frame of reference.

#2 For aii tables and figures: specifically identify dates (i.e., years) for "previous" investigations or phases of investigations; clarify what "existing" means and give a date for the installation or collection of the sample (eg. Figure 3-1 indicates "existing" for the surface water/sediment sample location; Figure 4-1 indicates "existing" for a monitoring well).

#3 In the nature and extent of contamination sections for each of the sites under investigation, no conclusion is presented as to whether contamination related to site activities or suspected site activities has resulted in a release of contamination.

Specific Comments:

#4 Section 2.6, page 13 of 19, 1st para.: A draft 1990 USATHAMA document is the reference for Figure 2-4; what document is this? Given that a more current ground water elevation map (November 1994) was generated (See Hydrogeological Assessment, Volume I. May 1995, Figure 12) and ground water potentiometric information is presented for most of the sites under investigation, current data should be presented.

#5 Section 3.1.1, 1st sentence: The location is known but the activities are undocumented.

#6 Section 3.1.4: Delete the sentence "*The site-specific background level of 1,3,5-TNB was 30 μg/kg.*"

#7 Sections 3.2.1, 4.2.1, 5.2.1, 6.2.1/Tables 3-2, 3-3, 3-4, 4-2, 5-2, 6-2: When discussing metal concentrations in reference to "background", use one value (i.e., UCL). The use of "maximum background concentrations...background ranges...[and] the background concentration" is very confusing. For purposes of comparing data (eg. tables illustrating maximum values detected during the investigation vs. background concentrations), UCL data shouid be included.

EPA's Comments 11/1/95
SCS Group #1 Sites

#8 Section 3.2.2, Table 3-5, Section 3.4, Section 4.2.2, Table 4-3, Section 5.2.2, Table 5-3, Section 5.4, Section 6.2.2, Table 6-5, Section 6.4: Qualify ground water grab information because the ground water grab sample should be used only as a screening tool, not as a definitive indicator of the nature and extent of ground water contamination.

#9 Section 3.2.3, 1st para., 4th sentence: To whose water quality standard are you referring?

#10 Section 3.3.2, 2nd para., 6th (last) sentence: "*This clay unit could act as an aquitard between this upper...transmissive unit and lower water-bearing units.*" All the "*units*" within the Wilcox are hydraulically connected (Section 2.6, 1st para., 4th sentence).

#11 Section 4.2.1, page 9 of 26, 2nd para.: Identify PAH acronym and identify what constitutes a PAH contaminant.

#12 Section 4.4: To whose water quality health criteria are you referring? Is there a lab contamination problem with the data for the investigations for this site or are acetone, methylene chloride, and the phthalate contaminants possible site-related contaminants? What about the significant number and amount of semi-volatiles detected in soil boring SB26 and sediment sample SD-09?

#13 Section 5.4: See General Comment #3. Additionally, more explanation will have to be given regarding acetone concentrations detected during the Phase 1 investigation and the lack of detectable concentrations during the Phase 2 investigation.

#14 Section 6.1.4, 1st para., 3rd sentence: A concentration of 10.2 mg/kg is NOT a trace concentration! Is the unit reported incorrectly in the Table 6-1? The 2,4,6-TNT concentration for soil sample 0402 is not reported in Table 6-1.

#15 Section 6.4, 2nd para., 4th and 5th sentences: Is nickel suspected to be a contaminant at this site?

016333

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

November 14, 1995

CERTIFIED MAIL
P 836 901 715
RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SIOLH-OR
Marshall, TX 75671-1059

Re: Longhorn Army Ammunition Plant
Draft Final Site Characterization Summary Report
For the Remedial Investigation Sites II, I XX, 27

Dear Mr. Tolbert:

The Texas Natural Resource Conservation Commission (TNRCC) staff has completed its review of the above referenced report, which was received on October 18, 1995. Our comments are enclosed. If you have any questions or comments, please contact me at (512) 239-2483.

Sincerely yours,

Michael A. Moore (MC 143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

Enclosure

cc: Jonna Polk, COE Tulsa District (CESWT-PP-EA)
Lisa Price, EPA Region 6 (6SF-AT)

016334

Longhorn Army Ammunition Plant

Draft Final Site Characterization Summary Report For the Remedial Investigation Sites II, I XX, 27

No.	Section/page	Comment
1	General	Please include the relevant tables which have been referenced from the <u>Final Soil Background Concentration Report, March 1995</u>.
2	Section 3.1.4 (Suspected TNT Burial Site)/page 4 of 19	In the first paragraph, the units for the concentration of 1,3,5-TNB are μg/kg, whereas in Table 3-1 on the same page, the units are μg/g. Please determine which is correct and if the amount "117" is correct. If the results for TNB are over the site's specific background level, what do these results mean in terms of the objectives of the report? (Please check all units for consistency in the report.)
3	Figure 3-1/page 2 of 19	Please put groundwater flow direction arrows on this figure since no potentiometric map was provided for this site.
4	General	Please use consistent well numbering in tables and text (for example, 27WW01 or WW01 or WW-01 not all three types).
5	General	We concur with EPA's comments, dated November 1, 1995. Additionally, regarding EPA's General Comment #3, were the objectives of the study met and are the data adeqate to perform the Risk Assessment?
6	General	Refer to: <u>Draft Sampling and Data Results Report Volume Laboratory Data Validation Report for the Remedial Investigation site II, I, XX, 27</u>, dated November 1994: Section 5, page 5 of 9 - How do the conclusions of this section affect the objectives of the study? Section 5.4, page 4 of 9 - How do the antimony data results affect the objectives?

016335

D

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

November 16, 1995

CERTIFIED MAIL
P 836 901 716
RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SIOLH-OR
Marshall, Texas 75671-1059

Re: Longhorn Army Ammunition Plant
Draft Phase II Investigations of 125 Waste Process Sumps and 20 Waste Rack Sumps

Dear Mr. Tolbert:

The Texas Natural Resource Conservation Commission (TNRCC) staff has completed its review of the above referenced report, which was received on October 20, 1995. We found the report to be well written and thorough. We concur with the comments made during the Risk Assessment Scoping Meeting held on October 26, 1995 and have no further comments regarding this report. If you have any questions or comments, please contact me at (512) 239-2483.

Sincerely yours,

Michael A. Moore

Michael A. Moore (MC 143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

cc: Jonna Polk, COE Tulsa District (CESWT-PP-EA)
Lisa Price, EPA Region 6 (6SF-AT)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

016336

NOV 17 1995

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Results of Phase II Investigation of
125 Waste Process Sumps and 20 Waste Rack Sumps
Longhorn Army Ammunition Plant

Dear David:

In accordance with the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA reviewed the draft results of the Phase II Investigation of 125 Waste Process Sumps and 20 Waste Rack Sumps for the Longhorn Army Ammunition Plant dated October 1995. EPA received the document October 19, 1995.

During the October 25 and 26, 1995 meetings held with you and representatives from the Texas Natural Resource Conservation Commission, we discussed the document in general terms of data results and data gaps. Because characterization of the nature and extent of contamination associated with the sumps has not be accomplished, EPA has no comments on the draft results of the Phase II Investigation of 125 Waste Process Sumps and 20 Waste Rack Sumps other than those discussed during the October meetings.

If you have any questions about this or any other matter, please contact me at (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Division

cc: Captain Darrell W. Chinn
Executive Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

016337

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Ms. Jonna Polk
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Section MC143
Austin, TX 78711-30873

11 DEC 1995

DEPARTMENT OF THE ARMY

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

016338

MCHB-DE-HR (40)

MEMORANDUM FOR Commander, U.S. Army Corps of Engineers, Tulsa District, ATTN: CESWT-PP-EA/Ms. Jonna Polk, Post Office Box 61, Tulsa, Oklahoma 74121-0061

SUBJECT: Review of the Site Characterization Summary Report for the Remedial Investigation of Sites 11, 1, XX, and 27 at Longhorn Army Ammunition Plant, Karnack, Texas, October, 1995, Prepared by Sverdrup Environmental, Inc.

The U.S. Army Center for Health Promotion and Preventive Medicine reviewed the subject document, without comment, on behalf of the Office of The Surgeon General. The scientist reviewing the document and our point of contact is Mr. Mark A. Dossey, Health Risk Assessment and Risk Communication Program, DSN 584-7282 or commercial (410) 612-7282.

FOR THE COMMANDER:

Jackson M. Heller

JACK M. HELLER, Ph.D.
Acting Program Manager, Health Risk
Assessment and Risk Communication

CF:
HQDA (DASG-HS-PE)
CDR, USAMEDCOM, ATTN: MCHO-CL-P
CDR, AMC, ATTN: AMCEN-A
CDR, CEMRD, ATTN: CEMRD-ET-EH
CDR, USAEC, ATTN: SFIM-AEC-IRP
CDR, LHAAP, ATTN: SMCLO-EN

11 DEC 1995

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

016339

REPLY TO
ATTENTION OF

MCHB-DE-HR (40)

08 DEC 1995

MEMORANDUM FOR District Engineer, U.S. Army Engineering District, Tulsa, ATTN: CESWT-PP-EA/Ms. Jonna Polk, P.O. Box 61, Tulsa, OK 74121-0061

SUBJECT: Review of the Draft Baseline Risk Assessments Group 1 Sites (Sites 1, 11, 27, and XX) at Longhorn Army Ammunition Plant, Karnack, Texas, October 1995

1. The U.S. Army Center for Health Promotion and Preventive Medicine reviewed the subject document on behalf of the Office of The Surgeon General. The subject document adequately addresses public health concerns; therefore, no comments are enclosed.

2. The scientist reviewing the document and our point of contact is Mr. Mark A. Dossey, Health Risk Assessment and Risk Communication Program, DSN 584-7282 or commercial (410) 612-7282.

FOR THE COMMANDER:

for Dennis E. Druck

JACK M. HELLER, Ph.D.
Acting Program Manager, Health Risk Assessment and Risk Communication

CF:
HQDA (DASG-HS-PE)
CDR, USAMEDCOM, ATTN: MCHO-CL-P
CDR, CEMRD, ATTN: CEMRD-ET-EH
CDR, USAEC, ATTN: SFIM-AEC-IRP
CDR, LHAAP, ATTN: SMCLO-EN

Readiness thru Health

AD 016340

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

December 13, 1995

CERTIFIED MAIL
P 836 901 073
RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SIOLH-OR
Marshall, Texas 75671-1059

Re: Longhorn Army Ammunition Plant
Interim Remedial Action - Burning Ground No.3
Phase III Work Plan, Volumes 1 through 5
Monitoring and Reporting Requirements for Plant Discharges

Dear Mr. Tolbert:

Please find the attached comments in response to the discussions held on November 30, 1995 between the staff of the Texas Natural Resource Conservation Commission (TNRCC), DOW Environmental, and the U. S. Army Corps of Engineers, regarding monitoring and reporting requirements for the above referenced project. Also attached, please find a copy of TNRCC's standard permit provisions, which are based on 30 TAC Chapter 305, which has previously been identified as Applicable or Relevant and Appropriate Requirements (ARARs), which support these comments.

In response to the your request made during the Project Manager's Meeting held on November 30, 1995, regarding the format for the Quarterly Ground-Water Monitoring Report, a letter report will be acceptable. According to our Industrial and Hazardous Waste staff, the following information is to be included in the letter report: dates of period being reported, analytical results tables (no raw data), potentiometric maps, potentiometric data tables, well location maps, analytical concentration data maps (if available), and any additional information applicable, such as well functioning problems. If you have any questions or comments, please contact me at (512) 239-2483.

Sincerely yours,

Michael A. Moore

Michael A. Moore (MC 143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

Enclosures

cc: Jonna Polk, COE Tulsa District (CESWT-PP-EA)
Lisa Price, EPA Region 6 (6SF-AT)

Superfund Engineering Section's Comments (Alvie Nichols)

No.	Section/page	TNRCC Comments to LHAAP response
8	Monitoring of Groundwater Quality	When on-site results show water has passed cleanup requirements and off-site results show failure and water has already been discharged then the USACE must notify the TNRCC in accordance with the attached: Paragraph 7, Noncompliance Notification, Monitoring and Reporting Requirements, DEFINITIONS AND STANDARD PERMIT CONDITIONS. Notifications shall be made to the Project Manager in lieu of Enforcement Section of the Watershed Management Division.
13	Monitoring of Groundwater Quality and Soils and Source Material treatment	The USACE shall maintain records of groundwater treatment monitoring activities in accordance with the attached: Items a and c of Paragraph 3, Records of Results, Monitoring and Reporting Requirements, DEFINITIONS AND STANDARD PERMIT CONDITIONS. Records shall be maintained at the facility site and/or shall be readily available for review by the TNRCC for a period of 3 years from the date of the record of sample, measurement, report or certification. The USACE shall also provide a monthly report to the TNRCC Project Manager. Report shall include at a minimum: total volume discharged for that month, total volume discharged to date, and list of noncompliance(s), if applicable. The USACE shall also maintain records of soils and source material treatment in accordance with the same as above. The USACE shall also provide a monthly report to the TNRCC Project Manager. Report shall include volume treated and transported for that month, and total volume treated and transported to date.

016341

DEFINITIONS AND STANDARD PERMIT CONDITIONS

As required by Title 30 Texas Administrative Code (TAC) Chapter 305, certain regulations appear as standard conditions in waste discharge permits. 30 TAC §§305.121-305.129, Subchapter F, "Permit Characteristics and Conditions" as promulgated under the Texas Water Code, §§5.103 and 5.105, and §§361.017 and 361.024(a) of the Texas Solid Waste Disposal Act establish the characteristics and standards for waste discharge permits, including sewage sludge. The following text includes these conditions and incorporates them into this permit. All definitions contained in Section 26.001 of the Texas Water Code shall apply to this permit and are incorporated herein by reference. Additional definitions of words or phrases used in this permit are as follows:

1. Flow Measurements

   a. Daily average flow - the arithmetic average of all determinations of the daily discharge within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily discharge, the determination shall be the arithmetic average of all instantaneous measurements taken during that month. Daily average flow determination for intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.

   b. Instantaneous flow - the measured flow during the minimum time required to interpret the flow measuring device.

   c. 2-hour peak (domestic wastewater treatment plants) - the maximum flow sustained for a two-hour period during the period of daily discharge. Multiple measurements of instantaneous maximum flow within a two-hour period may be compared to the permitted 2-hour peak flow.

   d. Daily maximum flow - the highest total flow for any 24-hour period in a calendar month.

2. Concentration Measurements

   a. Daily average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit within a period of one calendar month, consisting of at least four separate representative measurements. When four samples are not available in a calendar month, the arithmetic average of the four most recent measurements or the arithmetic average (weighted by flow) of all values taken during the month shall be utilized as the daily average concentration.

   b. 7-day average concentration - the arithmetic average of all effluent samples, composite or grab, within a period of one calendar week, Sunday through Saturday, consisting of at least three separate measurements.

   c. Daily maximum concentration - the maximum concentration measured on a single day, by composite sample, unless otherwise specified elsewhere in this permit.

   d. Fecal Coliform bacteria - the number of colonies per 100 milliliters effluent.

3. Sample Type

   a. Composite sample - a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow collected no closer than two hours for domestic sewage. For industrial wastewater a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow collected no closer than one hour.

   b. Grab sample - an individual sample collected in less than 15 minutes.

4. Treatment Facility (facility) - wastewater facilities used in the conveyance, storage, treatment, recycling, reclamation and/or disposal of domestic sewage, industrial wastes, agricultural wastes, recreational wastes, or other wastes including sludge handling or disposal facilities under the jurisdiction of the Commission.

5. The term "sewage sludge" is defined as solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in 30 TAC Chapter 312. This includes the solids separated from wastewater by unit processes which have not been classified as hazardous waste.

MONITORING AND REPORTING REQUIREMENTS

1. Self-Reporting

   Monitoring results shall be provided at the intervals specified in the permit. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall conduct effluent sampling and reporting in accordance with 30 TAC §§319.4 - 319.12. Unless otherwise specified, a monthly effluent report shall be submitted each month by the 20th day of the following month for each discharge which is described by this permit whether or not a discharge is made for that month.

   As provided by State Law, the permittee is subject to administrative, civil and criminal penalties, as applicable, for negligently or knowingly violating the Clean Water Act, the Texas Water Code, Chapters 26, 27, and 28, and Texas Health and Safety Code, Chapter 361, including but not limited to knowingly making any false statement on any report or document, falsifying, tampering with or knowingly rendering inaccurate any monitoring device or method required by this permit or violating any other requirement imposed by state or federal regulations.

2. Test Procedures

   Unless otherwise specified in this permit, test procedures for the analysis of pollutants shall comply with procedures specified in 30 TAC §§319.11 - 319.12. Measurements, tests and calculations shall be accurately accomplished in a representative manner.

3. Records of Results

   a. Monitoring samples and measurements shall be taken at times and in a manner so as to be representative of the monitored activity.

   b. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503), monitoring and reporting records, including strip charts and records of calibration and maintenance, copies of all records required by this permit, and the certification required by 40 Code of Federal Regulations §264.73(b)(9) shall be retained at the facility site and/or shall be readily available for review by a TNRCC representative for a period of three years from the date of the record or sample, measurement, report or certification. This period may be extended at the request of the Executive Director.

   c. Records of monitoring activities shall include the following:

      i. date, time and place of sample or measurement;
      ii. identity of individual who collected the sample or made the measurement.
      iii. date and time of analysis;
      iv. identity of the individual and laboratory who performed the analysis;
      v. the technique or method of analysis; and
      vi. the results of the analysis or measurement and quality assurance/quality control records.

   The period during which records are required to be kept shall be automatically extended to and through the final disposition of any administrative or judicial enforcement action that maybe instituted against the permittee.

4. Additional Monitoring by Permittee

   If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit using approved analytical methods as specified above, all results of such monitoring shall be included in the calculation and reporting of the values submitted on the required monthly effluent report. Increased frequency of sampling shall be indicated on the monthly effluent report.

5. Calibration of Instruments

All automatic flow measuring and/or recording devices and/or totalizing meters required by the permit for measuring permit limited flows shall be accurately calibrated by a trained person at plant start-up and as often thereafter as necessary to ensure accuracy, but not less often than annually unless authorized by the Executive Director for a longer period. Such person shall verify in writing that the device is operating properly and giving accurate results. Copies of the verification shall be kept at the plant site for at least three years.

6. Compliance Schedule Reports

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date to the appropriate Regional Office and the Watershed Management Division enforcement staff.

7. Noncompliance Notification

a. Unless specified otherwise, any noncompliance which may endanger human health or safety, or the environment shall be reported to the TNRCC. Report of such information shall be provided orally or by facsimile transmission (FAX) to the Regional Office within 24 hours of becoming aware of the noncompliance. A written submission of such information shall also be provided to the Regional Office and to the Enforcement Section of the Watershed Management Division within five working days of becoming aware of the noncompliance. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

b. Unauthorized discharges as defined in Permit Condition 2(g) of this permit shall be reported under Part a of this noncompliance notification provision.

c. Notwithstanding any of the above, any effluent violation which deviates from the permitted effluent limitation by more than 40% shall be reported in writing to the Regional Office and the Enforcement Section of the Watershed Management Division within 5 working days of becoming aware of the noncompliance.

d. Any noncompliance other than that specified in this section, or any required information not submitted or submitted incorrectly, shall be reported to the Enforcement Section of the Watershed Management Division as promptly as possible. This requirement means to report these types of noncompliance on the monthly self-report form.

8. Signatories to Reports

All reports and other information requested by the Executive Director shall be signed by the person and in the manner required by 30 TAC §305.128 (relating to Signatories to Reports).

PERMIT CONDITIONS

1. General

a. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in an application or in any report to the Executive Director, it shall promptly submit such facts or information.

b. This permit is granted on the basis of the information supplied and representations made by the permittee during the application process, relying upon the accuracy and completeness of that information and those representations. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked, in whole or in part in accordance with 30 TAC 305.61 - 305.62, during its term for cause including but not limited to, the following:

i. Violation of any terms or conditions of this permit;

ii. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

iii. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

c. The permittee shall furnish to the Executive Director, upon request and within a reasonable time, any information to determine whether cause exists for amending, revoking, suspending or terminating the permit. The permittee shall also furnish to the Executive Director, upon request, copies of records required by the permit.

2. Compliance

a. Acceptance of the permit by the person to whom it is issued constitutes acknowledgement and agreement that such person will comply with all the terms and conditions embodied in the permit, and the rules and other orders of the Commission.

b. The permittee has a duty to comply with all conditions of the permit. Failure to comply with any permit condition constitutes a violation of the permit and the Texas Water Code or the Texas Solid Waste Disposal Act, and is grounds for enforcement action, for permit amendment, revocation or suspension, or for denial of a permit renewal application or of an application for a permit for another facility.

c. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

d. The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal or other permit violation which has a reasonable likelihood of adversely affecting human health or the environment.

e. Authorization from the Commission is required before beginning any change in the permitted facility or activity that may result in noncompliance with any permit requirements.

f. A permit may be amended, suspended and reissued, or revoked for cause. The filing of a request by the permittee for a permit amendment, suspension and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

g. There shall be no unauthorized discharge of wastewater or any other waste. For the purpose of this permit, an unauthorized discharge is considered to be any discharge of wastewater into or adjacent to waters in the state at any location not permitted as an outfall or otherwise defined in the Other Requirements of this permit.

h. A temporary diversion of wastewater around a unit or units to a permitted outfall for the purposes of maintenance or repair is not a violation of this permit as long as the wastewater complies with all other standards, terms and conditions of this permit. Notice shall be provided to the Regional Office at least 24 hours in advance of any temporary diversion, where practical. Where prior notice for a temporary diversion is not practical, notice shall be provided to the Regional Office as soon as possible but at least within 24 hours after beginning the temporary diversion. Not withstanding any of the above, the Commission may require that an application be submitted for formal authorization.

3. Inspections and Entry

a. Inspection and entry shall be allowed as prescribed in the Texas Water Code, Chapters 26, 27, and 28, and Texas Health and Safety Code, Chapter 361.

b. The members of the Commission and employees and agents of the Commission are entitled to enter any public or private property at any reasonable time for the purpose of inspecting and investigating conditions relating to the quality of water in the state. Members, employees, or agents acting under this authority who enter private property shall observe the establishment's rules and regulations concerning safety, internal security, and fire protection, and if the property has management in residence, shall notify management or the person then in charge of his or her presence and shall exhibit proper credentials. If any member, employee, or agent is refused the right to enter in or on public or private property under this authority, the Executive Director may invoke the remedies authorized in Texas Water Code Section 26.123.

4. Permit Amendment

   a. The permittee shall give notice to the Executive Director prior to physical alterations or additions to the permitted facility if such alterations or additions would require a permit amendment or result in a violation of permit requirements.

   b. Prior to any facility modifications, additions and/or expansions of a permitted facility that will increase the plant capacity beyond the permitted flow, the permittee must apply for and obtain proper authorization from the Commission before commencing construction.

   c. The permittee must apply for an amendment or renewal at least 180 days prior to expiration of the existing permit in order to continue a permitted activity after the expiration date of the permit. Authorization to continue such activity will terminate upon the effective denial of said application.

   d. Prior to accepting wastes which are not described in the permit application or which would result in a significant change in the quantity or quality of the existing discharge, the permittee must report the proposed changes to the Commission. The permittee must apply for a permit amendment reflecting any necessary changes in permit conditions, including effluent limitations for pollutants not identified and limited by this permit.

   e. Texas Water Code §26.029(b) After a public hearing, notice of which shall be given to the permittee, the Commission may require the permittee, from time to time, for good cause, to conform to new or additional conditions. The Commission shall allow the permittee a reasonable time to conform to the new or additional conditions, and on application of the permittee, the Commission may grant additional time.

5. Permit Transfer

   a. Prior to any transfer of this permit, Commission approval must be obtained. The Commission shall be notified, in writing, of any change in control or ownership of facilities authorized by this permit. Such notification should be sent to the Permit Application Team in the Watershed Management Division.

   b. A permit may be transferred only according to the provisions of 30 TAC §305.64 (relating to Transfer of Permits) and 30 TAC 305.97 (relating to Action on Application for Transfer).

6. Relationship to Hazardous Waste Activities

   This permit does not authorize any activity of hazardous waste or solid waste storage, processing or disposal which requires a permit or other authorization pursuant to the Texas Health and Safety Code.

7. Relationship to Water Rights

   Disposal of treated effluent by any means other than discharge directly to the waters in the state must be specifically authorized in this permit and may require a permit pursuant to Chapter 11 of the Texas Water Code.

8. Property Rights

   A permit does not convey any property rights of any sort, or any exclusive privilege.

9. Permit Enforceability

   The conditions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

OPERATIONAL REQUIREMENTS

1. The permittee shall at all times ensure that the facility and all its systems of collection, treatment, and disposal are properly operated. This includes the regular, periodic examination of wastewater solids within the treatment plant by the operator in order to maintain an appropriate quantity and quality of solids inventory as described in the various operator training manuals and according to accepted industry standards for process control such as the Commission's "Recommendations for Minimum Process Control Tests for Domestic Wastewater Treatment Facilities." Process control records shall be retained at the facility site and/or shall be readily available for review by a TNRCC representative for a period of three years.

2. Upon request of the Executive Director, the permittee shall take appropriate samples and provide proper analysis in order to demonstrate compliance with Commission rules. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall comply with all provisions of 30 TAC §312.1-§312.13 concerning sewage sludge use and disposal and §§319.21 - 319.29 concerning the discharge of certain hazardous metals.

3. Domestic wastewater treatment facilities shall comply with the following provisions:

   a. The permittee shall notify the Executive Director in care of the Permitting Section , Watershed Management Division, in writing of any closure activity or facility expansion at least 90 days prior to conducting such activity.

   b. Closure activities include those associated with any pit, tank, pond, lagoon, or surface impoundment regulated by this permit.

   c. As part of the notification, the permittee shall submit to the Municipal Permits Team in Austin, a closure plan which has been developed in accordance with the "Closure Guidance Documents" available through Record System Services for the Office of Waste Management & Pollution Cleanup.

4. The permittee is responsible for installing prior to plant start-up, and subsequently maintaining, adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures by means of alternate power sources, standby generators, and/or retention of inadequately treated wastewater.

5. Unless otherwise specified, the permittee shall provide a readily accessible sampling point and, where applicable, an effluent flow measuring device or other acceptable means by which effluent flow may be determined.

6. The permittee shall remit an annual waste treatment fee to the Commission as required by 30 TAC 305 (Subchapter M) and an annual water quality assessment fee to the Commission as required by 30 TAC 320. Failure to pay either fee may result in revocation of this permit.

7. Documentation

   For all written notifications to the Commission required of the permittee by this permit, the permittee shall keep and make available a copy of each such notification, upon the same basis as self-monitoring data are required to be kept and made available.

8. Facilities which generate domestic wastewater shall comply with these provisions; domestic wastewater treatment facilities at permitted industrial sites are excluded.

   a. Whenever flow measurements for any domestic sewage treatment facility reach 75 percent of the permitted average daily flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the domestic wastewater treatment and/or collection facilities. Whenever, the average daily flow reaches 90 percent of the permitted average daily flow for three consecutive months, the permittee shall obtain necessary authorization from the Commission to commence construction of the necessary additional treatment and/or collection facilities. In the case of a domestic wastewater treatment facility which reaches 75 percent of the permitted daily average flow for three consecutive months, and the planned population to be served or the quantity of waste produced is not expected to exceed the design limitations of the treatment facility, the permittee shall submit an engineering report supporting this claim to the Executive Director of the Commission. If in the judgement of the Executive Director the population to be served will not cause permit noncompliance, then the requirement of this section may be waived. To be effective, any waiver must be in writing and signed by the director of the Watershed Management Division of the Commission or an authorized agent, and such waiver of these requirements will be reviewed upon expiration of the existing permit; however, any such waiver shall not be interpreted as condoning or excusing any violation of any permit parameter.

b. The plans and specifications for domestic sewage collection and treatment works associated with any domestic permit must be approved by the Commission, and failure to secure approval before commencing construction of such works or making a discharge is a violation of this permit and each day is an additional violation until approval has been secured.

c. Permits for domestic wastewater treatment plants are granted subject to the policy of the Commission to encourage the development of area-wide waste collection, treatment and disposal systems. The Commission reserves the right to amend any domestic wastewater permit in accordance with applicable procedural requirements to require the system covered by this permit to be integrated into an area-wide system, should such be developed; to require the delivery of the wastes authorized to be collected in, treated by or discharged from said system, to such area-wide system; or to amend this permit in any other particular to effectuate the Commission's policy. Such amendments may be made when the changes required are advisable for water quality control purposes and are feasible on the basis of waste treatment technology, engineering, financial, and related considerations existing at the time the changes are required, exclusive of the loss of investment in or revenues from any then existing or proposed waste collection, treatment or disposal system.

9. Domestic wastewater treatment plants shall be operated and maintained by sewage plant operators holding a valid certificate of competency at the required level as defined in 30 TAC Chapter 325.

10. Facilities which generate industrial solid waste as defined in 30 Texas Administrative Code (TAC) §335.1 shall comply with these provisions:

a. Any solid waste generated by the permittee during the management and treatment of wastewater, as defined in 30 Texas Administrative Code (TAC) §335.1 (including but not limited to such wastes as garbage, refuse, sludge from a waste treatment, water supply treatment plant or air pollution control facility, discarded materials, discarded materials to be recycled, whether the waste is solid, liquid, or semisolid) must be managed in accordance with all applicable provisions of 30 TAC Chapter 335, relating to Industrial Solid Waste Management.

b. Industrial wastewater that is being collected, accumulated, stored, or processed before discharge through any final discharge outfall, specified by this permit, is considered to be industrial solid waste until the wastewater passes through the actual point source discharge and must be managed in accordance with all applicable provisions of 30 TAC Chapter 335.

c. The permittee shall provide written notification, pursuant to the requirements of 30 TAC §335.6(g), to the Corrective Action Section of the Commission's Industrial and Hazardous Waste Division informing the Commission of any closure activity involving an Industrial Solid Waste Management Unit, at least 90 days prior to conducting such an activity.

d. Construction of any industrial solid waste management unit requires the prior written notification of the proposed activity to the Waste Evaluation Section of the Commission's Industrial and Hazardous Waste Division. No person shall dispose of industrial solid waste, including sludge or other solids from wastewater treatment processes, prior to fulfilling the deed recordation requirements of 30 TAC §335.5.

e. The term "industrial solid waste management unit" means a landfill, surface impoundment, waste-pile, industrial furnace, incinerator, cement kiln, injection well, container, drum, salt dome waste containment cavern, or any other structure vessel, appurtenance, or other improvement on land used to manage industrial solid waste.

f. The permittee shall keep management records for all sludge (or other waste) removed from any wastewater treatment process. These records shall fulfill all applicable requirements of 30 TAC Chapter 335 and must include the following, as it pertains to wastewater treatment and discharge:

i. Volume of waste and date(s) generated from treatment process;
ii. Volume of waste disposed of on-site or shipped off-site;
iii. Date(s) of disposal;
iv. Identity of hauler or transporter;
v. Location of disposal site; and
vi. Method of final disposal.

The above records shall be maintained on a monthly basis and be available at the plant site for inspection by authorized representatives of the Texas Natural Resource Conservation Commission for at least five years.

11. For facilities to which the requirements of 30 Texas Administrative Code (TAC) Chapter 335 do not apply, sludge and solid wastes, including tank cleaning and contaminated solids for disposal, shall be disposed of in accordance with Chapter 361 of the Health and Safety Code of Texas.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

016350

DEC 15 1995

VIA FACSIMILE AND REGULAR MAIL

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Ground Water Models

Dear David:

During the October 1995 Project Coordinators meeting, EPA was requested to provide some input on types of ground water fate and transport models. In reviewing some of the available models for pure phase (NAPL) contaminants, MOFAT or MOTRANS might be acceptable models since they can accomplish multiple-phase modelling. Available models for dissolved phase contamination that take into account the heterogeneity of saturated zones, acceptable models might include MODFLOW (for the hydraulics) coupled with MT3D (for the contaminants), MOC, WINFLOW with WINTRANS, BIOPLUME2, and BIOTRANS.

A simpler or screening ground water fate and transport model for dissolved phase contaminants may be used on some sites. Acceptable models may include WINFLOW and WINTRANS, however, the assumptions for the modelling may or may not be appropriate. In general, any analytical method of modelling could be acceptable as a screening model.

EPA has published a document entitled *Compilation of Ground Water Models: EPA/600/RD-93-118*. The document is available from the R.S. Kerr Laboratory. As I do not have a copy, it would probably be faster for the contractor to contact the lab directly to obtain a copy.

If you have any questions about this or any other matter, please contact me at (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Division

cc: Captain Darrell W. Chinn
Executive Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers **via facsimile**
P.O. Box 61
Attn: Ms. Jonna Polk
CESWT-PP-E
Tulsa, OK 74121-0061

016351

Mike Moore, Superfund **via facsimile**
Texas Natural Resource Conservation Commission
P.O. Box 13087
Section MC143
Austin, TX 78711-30873

Betty Williamson (6SF) — Can you reply for me. Thanks

Mark Chance
TDC 704479
P.O. Box 9200
New Boston, TX 75570

016352

December 26, 1995

Sam Becker, Chief
Superfund Enforcement Branch
United States Environmental Protection Agency
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Dear Mr. Becker,

Please send the latest Progress at Superfund Sites in Texas. In addition, as I am specifically interested in cleanup efforts at the Longhorn Army Ammunition Plant in Karnack, Texas, please send the latest Proposed Plan of Action for the various sites.

Thank you for your time and assistance in this matter.

Sincerely,

Mark Chance

Mark Chance

LISA - CAN YOU HAVE THE ARMY SEND THIS GENTLEMAN A PROPOSED PLAN? WE'LL SEND THE TEXAS SITE STATUS SUMMARIES —

THANKS —

Verne

FINAL

GENERAL WORK PLAN

016353

INTERIM REMEDIAL ACTION
BURNING GROUND NO. 3
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

VOLUME 1 OF 5

Prepared for:

UNITED STATES ARMY CORPS OF ENGINEERS
TULSA AND FORT WORTH DISTRICTS

Prepared by:

Dow Environmental

DECEMBER 28, 1995
USACE CONTRACT DACA56-93-D-0016
DELIVERY ORDER NO. 0002
DEI PROJECT NO. 2379
ROCKVILLE, MARYLAND

FINAL

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016354

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DECEMBER 27, 1995
USACE CONTRACT NUMBER DACA56-93-D-0016
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LIST OF ACRONYMS

ACD	Air Curtain Destructor
AMP	Air Monitoring Plan
ASTM	American Society of Testing Materials
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
CQCP	Construction Quality Control Plan
DEI	Dow Environmental Inc.
DNAPLs	Dense Non-Aqueous Phase Liquids
EPA	Environmental Protection Agency
eV	Electron Volts
EZ	Exclusion Zone
FFA	Federal Facility Agreement
FID	Flame Ionization Detector
GWTP	Ground Water Treatment Plant
HEW	Horizontal Extraction Well
HTRW	Hazardous, Toxic, and Radioactive Waste
ICT	Interceptor Collection Trench
INF	Intermediate-Range Nuclear Force
IRA	Interim Remedial Action
LDRs	Land Disposal Restrictions
LHAAP	Longhorn Army Ammunition Plant
MSDS	Material Safety Data Sheet
msl	Mean Sea Level
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priorities List
OEW	Ordnance and Explosive Waste
PM	Project Manager
PPE	Personal Protective Equipment
QAR	Quality Assurance Representative
OSHA	Occupational Safety and Health Administration
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SM	Site Manager
SSHP	Site Safety and Health Plan
STP	Soil Treatment Plant
TCE	Trichloroethylene
TNRCC	Texas Natural Resource Conservation Commission
UEP	Unlined Evaporation Pond
USACE	United States Army Corps of Engineers
VEW	Vertical Extraction Well
VOCs	Volatile Organic Compounds
WMP	Waste Management Plan

1.0 INTRODUCTION

1.1 General

This Work Plan addresses the Phase III Scope of Work for the proposed Interim Remedial Action (IRA) at Burning Ground No. 3 which is also referred to as site LHAAP 18 & 24. The site is located within Longhorn Army Ammunition Plant (LHAAP) in Karnack, Texas. It is submitted by Dow Environmental Inc. (DEI) in partial fulfillment of the requirements of Contract No. DACA56-93-D-0016, Delivery Order No. 0002, for the U.S. Army Corps of Engineers (USACE), Tulsa District.

The Phase III Work Plan consists of five volumes:

- The General Work Plan (Volume 1) which represents the primary volume of the work plan. It contains information on the site conditions and background, a summary of activities, detailed scope of work, and project organization and management.
- The Chemical Data Acquisition Plan (CDAP) (Volume 2) which addresses the data quality procedures and techniques used to insure that all collected data are of acceptable quality.
- The Site Safety and Health Plan (SSHP) (Volume 3) which establishes procedures to protect personnel during the field activities at LHAAP Units 18 and 24.
- The Waste Management Plan (WMP) (Volume 4) which describes the approach and procedures for the management of generated waste and spill control.
- The Construction Quality Control Plan (CQCP) (Volume 5) which describes the construction element CQC system employed by DEI to assure the construction activities comply with the requirements of the project scope.

1.2 Location and Description

Longhorn Army Ammunition Plant (LHAAP) is located in central east Texas in the northeast corner of Harrison County, approximately 14 miles northeast of Marshall, Texas, and approximately 40 miles west of Shreveport, Louisiana as shown on Figure 1. The installation

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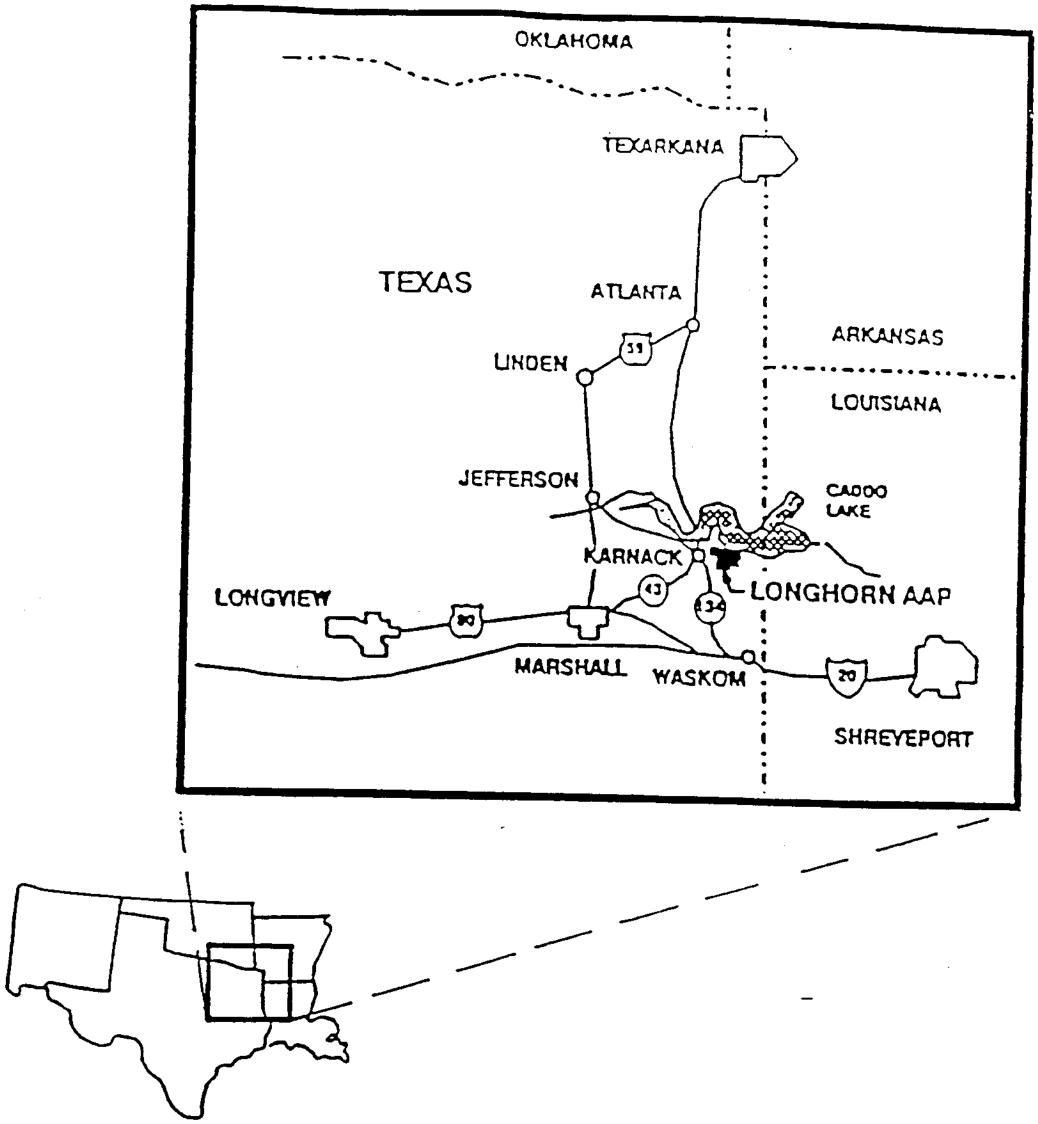

US Army Corps of Engineers Tulsa District

REGIONAL LOCATION MAP

LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

FIGURE NUMBER 1

2379-382-EDP-C002

occupies 8,493 acres between State Highway 43 and the western shore of Caddo Lake and is accessed by State Highways 43 and 134.

Burning Ground No. 3 is a fenced 34.5-acre secured area located in the southeastern quadrant of LHAAP, as shown on Figure 2. Harrison Bayou flows within 1,000 feet of the western edge and within 500 feet of the northern edge of the site.

Burning Ground No. 3 is situated on a natural topographic high slightly west of the crest of a small topographic divide between Harrison Bayou and Saunder's Branch as shown on Figure 3. The topography of the site has been greatly altered by operations conducted over the past 35 years. Ground surface elevations across the site vary from 206 feet to about 174 feet msl.

LHAAP is located in a region that is commonly called the Pineywoods, a deep inland extension of the Gulf Coastal Plain that extends into Texas, Louisiana, Arkansas, and Oklahoma. The facility is forested with loblolly and shortleaf pines, a variety of oaks, sweet gum, black tupelo, ash, bald cypress, and a few scattered willows. Pines predominate throughout the installation. Burning Ground No. 3 is a cleared area within a heavily wooded section of LHAAP.

Caddo Lake, Caddo Lake State Park, and the small unincorporated town of Karnack border LHAAP. All surface water from LHAAP drains into Caddo Lake via four drainage systems that cross portions of the installation, as shown on Figure 3. These systems are known as Saunder's Branch, Harrison Bayou, Central Creek, and Goose Prairie Bayou. The surface drainage at Burning Ground No. 3 occurs in all directions, but is generally directed towards Harrison Bayou to the west and to the north by both natural and manmade ditches and drainage swales. Harrison Bayou eventually drains into Caddo Lake, which is located approximately 1 mile downstream from the site. The extreme western corner of Burning Ground No. 3 is located within the 100-year floodplain of Harrison Bayou.

LHAAP, including Burning Ground No. 3, is situated on an outcrop of the Wilcox Group, which crops out over a large part of the eastern half of Harrison County. The Wilcox consists mostly of fine- to medium-grained sands interbedded with a considerable amount of clay and seams of lignite. The Wilcox Group is underlain conformably by the predominantly calcareous clay of the Midway Group. Regional dip of the Wilcox is to the northwest into the East Texas syncline, while the ground surface generally dips gently to the southeast.

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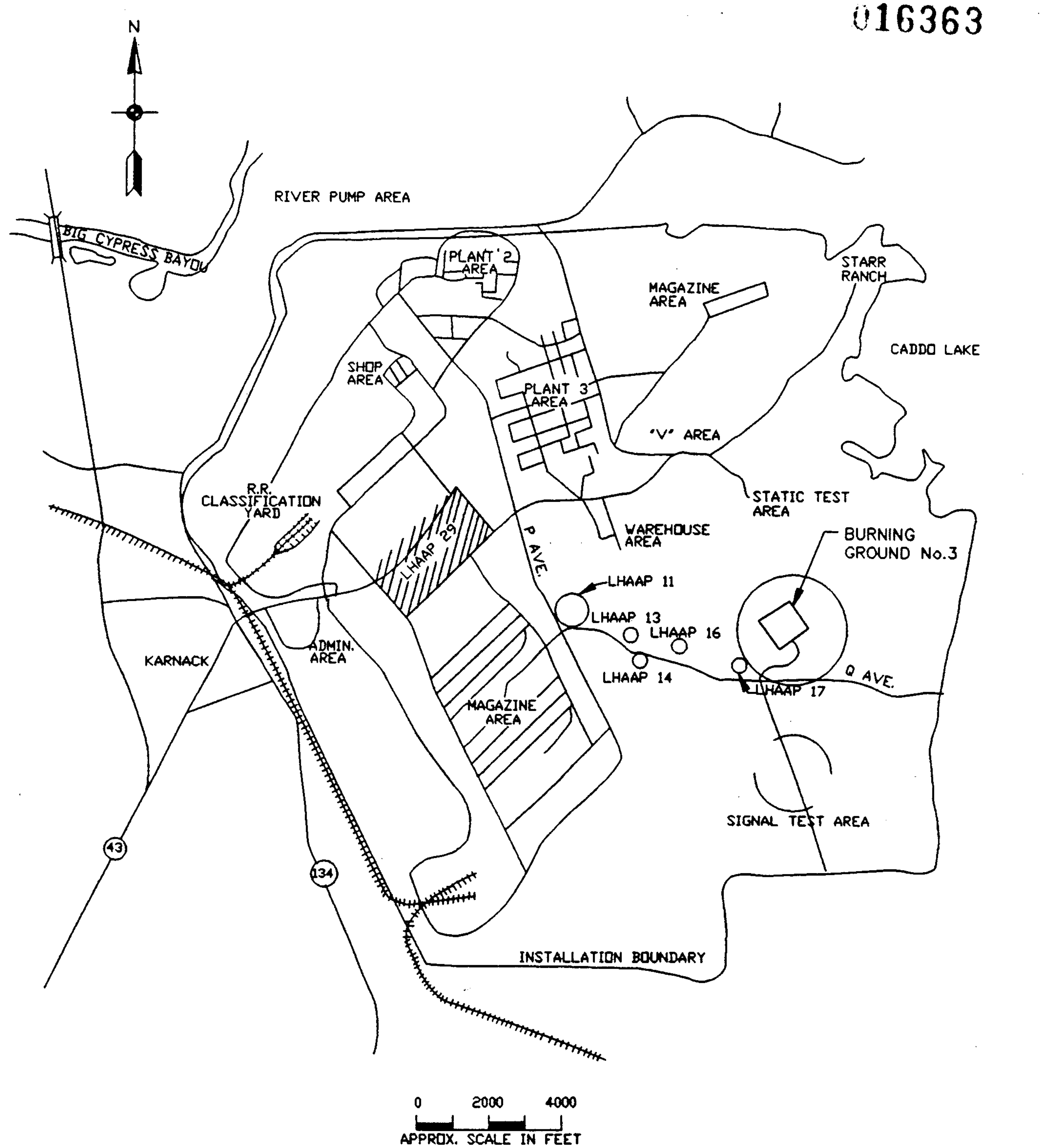

US Army Corps of Engineers Tulsa District

LOCATION MAP FOR BURNING GROUND No. 3

LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

FIGURE NUMBER 2

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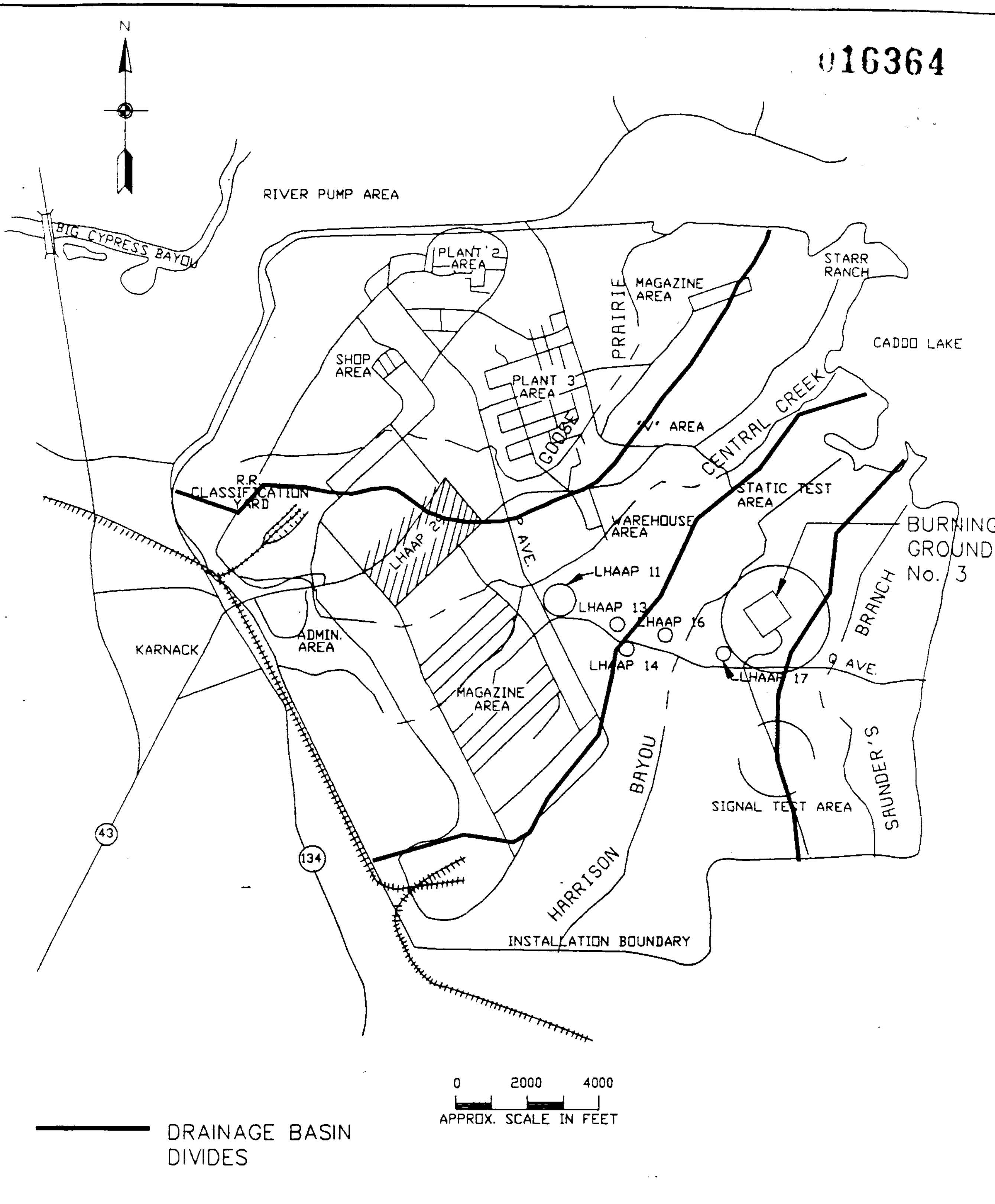


US Army Corps of Engineers
Tulsa District

DRAINAGE BASINS

LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

FIGURE NUMBER 3

2379-382-EDP-C003

Burning Ground No. 3 is situated over the regional Cypress aquifer. Evidence obtained from geophysical logs run in deep stratigraphic test borings drilled during previous investigations at the site suggest that the contact between the Wilcox and Midway Groups occurs anywhere from an approximate elevation of 80 feet msl immediately east of the burning grounds area to approximately 25 feet msl on the western side of the site.

1.3 Site History and Enforcement Activities

LHAAP is a government-owned, contractor-operated industrial facility under the jurisdiction of the U.S. Army Armament, Munitions, and Chemical Command. Its primary mission is to load, assemble, and pack pyrotechnic and illuminating/signal ammunition and solid propellant rocket motors.

Longhorn Army Ammunition Plant was established in October 1942 with the primary mission of producing trinitrotoluene (TNT) flake in the Plant 1 area. Production of TNT continued through World War II until August 1945 when the plant went on standby status until February 1952. Pyrotechnic ammunition as photoflash bombs, simulators, hand signals, and tracers for 40mm were manufactured at LHAAP from 1952 until 1956. Plant 3 area rocket motor facility began operation in November of 1955. Production of rocket motors continued to be the primary mission of LHAAP until 1965, when the production of pyrotechnic and illuminating ammunition was re-established.

Recent operations consist of compounding pyrotechnic and propellant mixtures, load, assemble and pack activities, accommodating receipt and shipment of containerized cargo, and the maintenance and/or layaway of standby facilities and equipment as they apply to mobilization planning. The installation has also been responsible for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate-Range Nuclear Force (INF) Treaty in effect between the United States and the former Soviet Union.

Burning Ground No. 3 has been in operation since 1955. The site has been used for the treatment, storage, and disposal of pyrotechnic and combustible solvent wastes by open burning, incineration, evaporation, and burial. Historical waste management units include open burning pits, an unlined evaporation pond (UEP), stockpiles of solvent soaked sawdust, and suspected waste burial pits. The UEP was constructed at the burning ground in 1963 as a holding pond to store wastes resulting from the washout of rocket motor casings. In 1973, the UEP also began receiving wash water containing solvent residues and solids collected from LHAAP operations involving pyrotechnic material preparation and mixing. These residues and solids commonly contained the metallic cations aluminum, arsenic, barium, cadmium, chromium, iron, lead, magnesium, sodium, strontium, and zinc; the nonmetallic anions nitrite, nitrate, and phosphate; and the organic solvents acetone, ethyl alcohol, methyl ethyl ketone, methylene chloride, trichloroethylene, and toluene. Sawdust soaked with methylene chloride and other solvents that were used to clean and scour mixers used for mixing illuminants were stockpiled along the southern berm of the UEP and were burned in trenches in the western portion of the burning ground. An Air Curtain Destructor was built in 1979 in the western corner of the burning ground for the purpose of disposing of explosive-contaminated wastes by burning. Use of burn pits and trenches was reportedly discontinued in 1984. Use of the UEP was discontinued in 1984 when it was discovered that the pond was contaminating ground water beneath the site. The UEP was closed as a Resource Conservation and Recovery Act (RCRA) interim status surface impoundment in 1986 by removing all waste and capping the impoundment. As part of the INF Treaty activities being conducted at LHAAP, a burn cage was added in 1989 for the open burning of Pershing II missile motors, from 1989 to 1993.

As part of the U.S. Army Installation Restoration Program, the LHAAP began an environmental investigation of current and previously used waste disposal sites in 1976. The LHAAP installation was added to the National Priorities List (NPL) on August 30, 1990. After being listed on the NPL, LHAAP, The U. S. Environmental Protection Agency (EPA) and the Texas Natural Resource Conservation Commission (TNRCC) - formerly known as the Texas Water Commission (TWC) - entered into a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120 Agreement for remedial activities at the facility. The CERCLA Section 120 Agreement, referred to as the Federal Facility Agreement (FFA), became effective on December 30, 1991.

1.4 Scope and Role of Response Action

The investigations at the Burning Ground No. 3 site have indicated the presence of high concentrations of chlorinated solvents and heavy metals in the shallow groundwater and buried waste. Increasing concentrations of contaminants have been detected in the groundwater monitoring wells at the site, and the contaminated shallow groundwater plume has increased in lateral extent over the past several years.

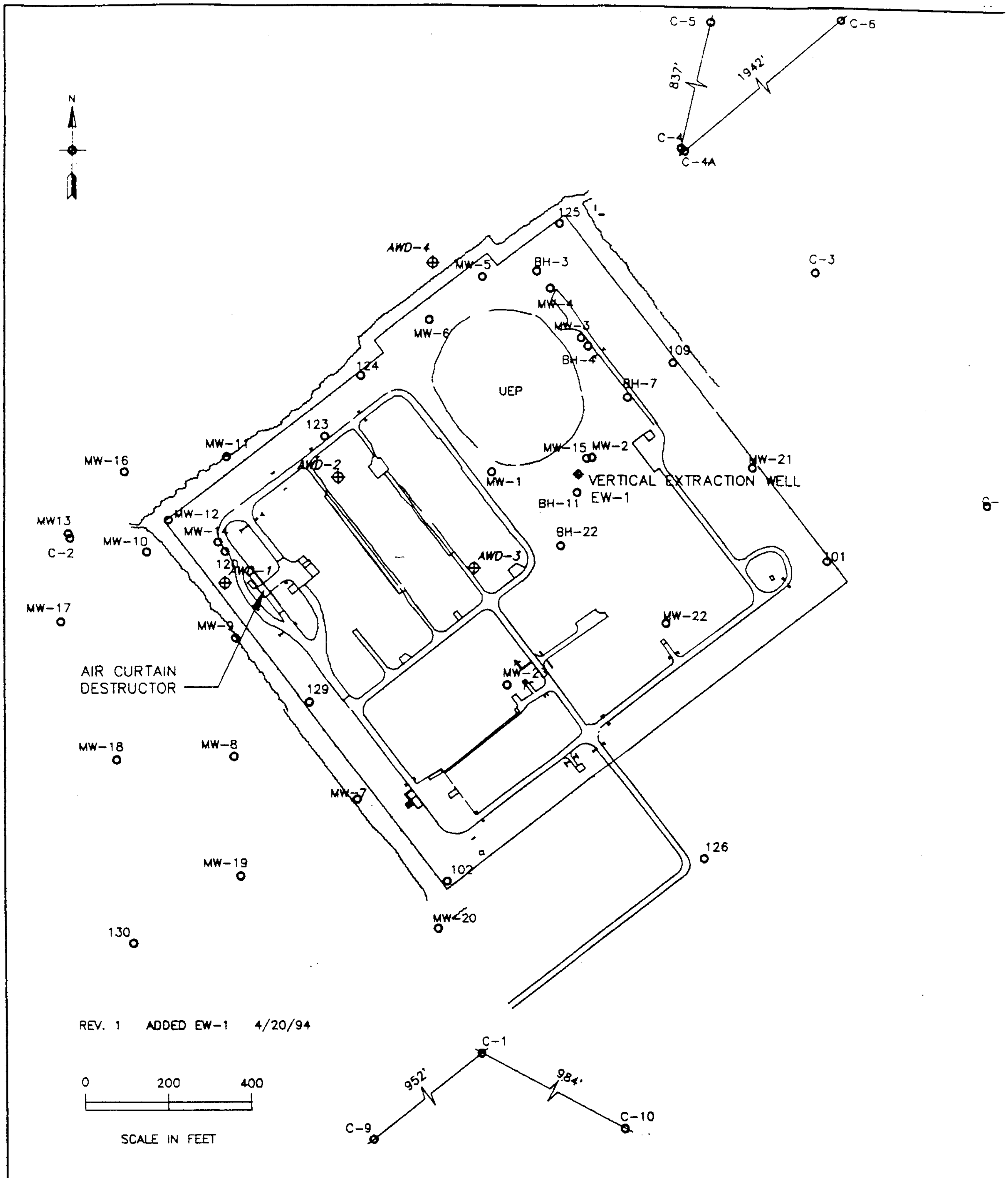
The IRA is necessary to address and mitigate potential risks associated with the high concentrations of contaminants in the shallow groundwater and their source material. The remedial objectives for the IRA are to eliminate or minimize the potential for exposure to human and ecological receptors. This will be accomplished by reducing or preventing further migration of contaminants from source material and shallow groundwater into deeper groundwater zones, and possibly surface water bodies.

The IRA will be implemented prior to completion of the site Risk Assessment. The ongoing Remedial Investigation/Feasibility Study (RI/FS) for the Burning Ground No. 3 site will continue as scheduled. The RI/FS will address all contaminated soil and groundwater at the site. Lessons learned during the implementation of the IRA, will be incorporated to the extent possible into the RI/FS. Therefore, the IRA will be consistent with planned future actions at the site.

1.5 Summary of Site Characteristics

Burning Ground No. 3 is situated on an outcrop of the Wilcox Group, with a contact between the primary materials of the Wilcox and recent alluvium running somewhere across the western corner of the site. This contact approximates the 100-year floodplain elevation of 180 feet msl. Although many borings have been drilled over this entire area, stratigraphic correlation is difficult due to the lateral and vertical heterogeneity of the materials comprising the Wilcox Group. Subsurface data from soil borings and monitoring wells drilled and constructed as part of past investigations of the Burning Ground No. 3 site show very few strata to be continuous across the site area. Strata are typical for the Wilcox Group, consisting of varying thicknesses of sands, silts, and clays that are lenticular and discontinuous in nature. Figures 4 and 5 show the locations of on-site monitoring wells and previous soil boring locations, respectively.

Groundwater at Burning Ground No. 3 generally occurs under unconfined conditions. Depth to groundwater, which has been measured at one foot to 23 feet beneath the ground surface, has been observed to vary approximately 2 feet over a 6-month period, reflecting the seasonal variations in rainfall. Although groundwater elevations are known to vary seasonally, the configuration of the groundwater surface varies little from that shown on Figure 6. The groundwater is mounded under the southern quadrant of the site in an elongated configuration extending from the southern corner of the fenced area toward the middle of the site. Groundwater flows in a radial pattern off Burning Ground No. 3, which contrasts with the regional direction of flow across the area which is to the northeast. This contrast in flow directions reflects the recharge effects of the



US Army Corps of Engineers Tulsa District

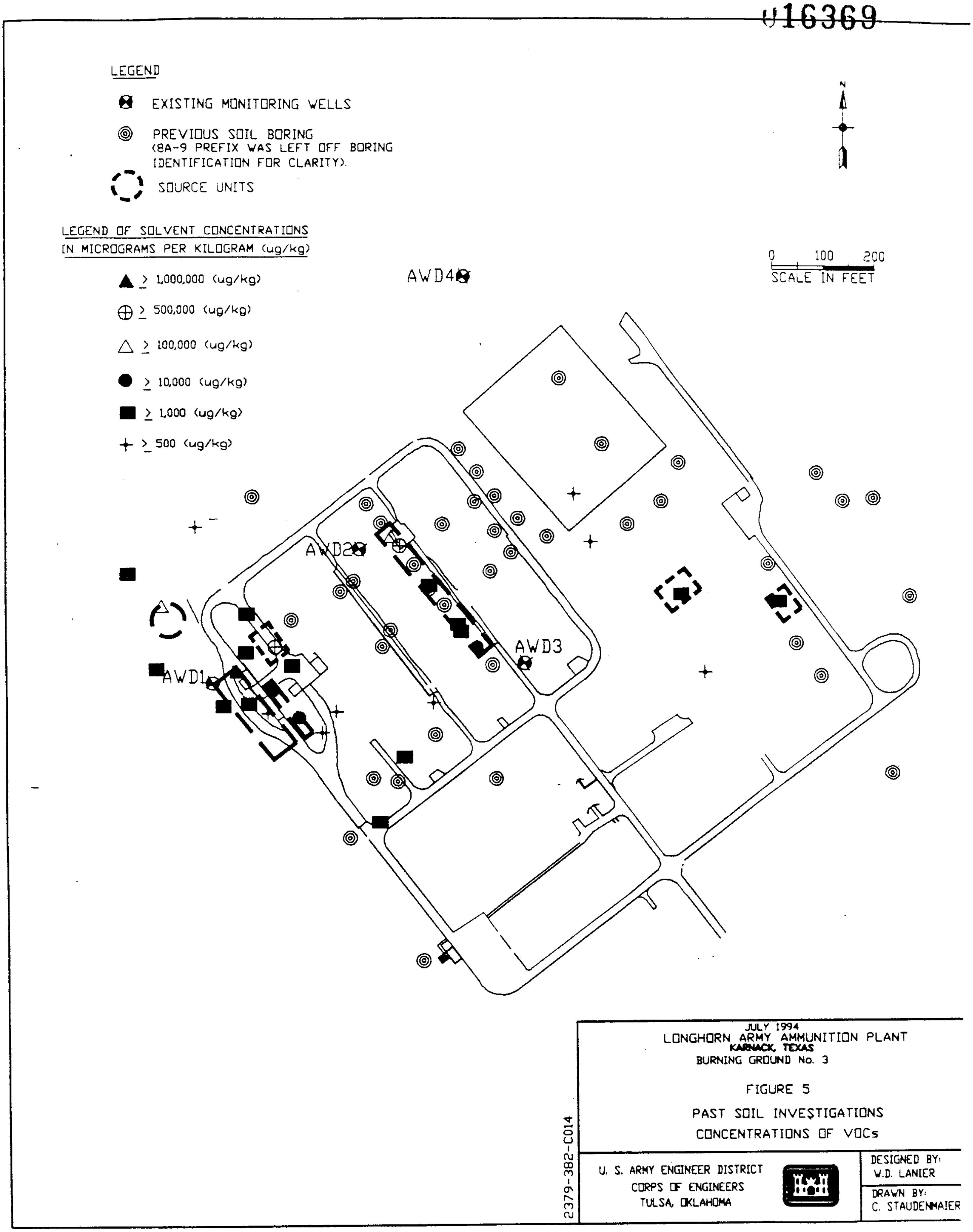
MONITORING WELLS
BURNING GROUND No.3

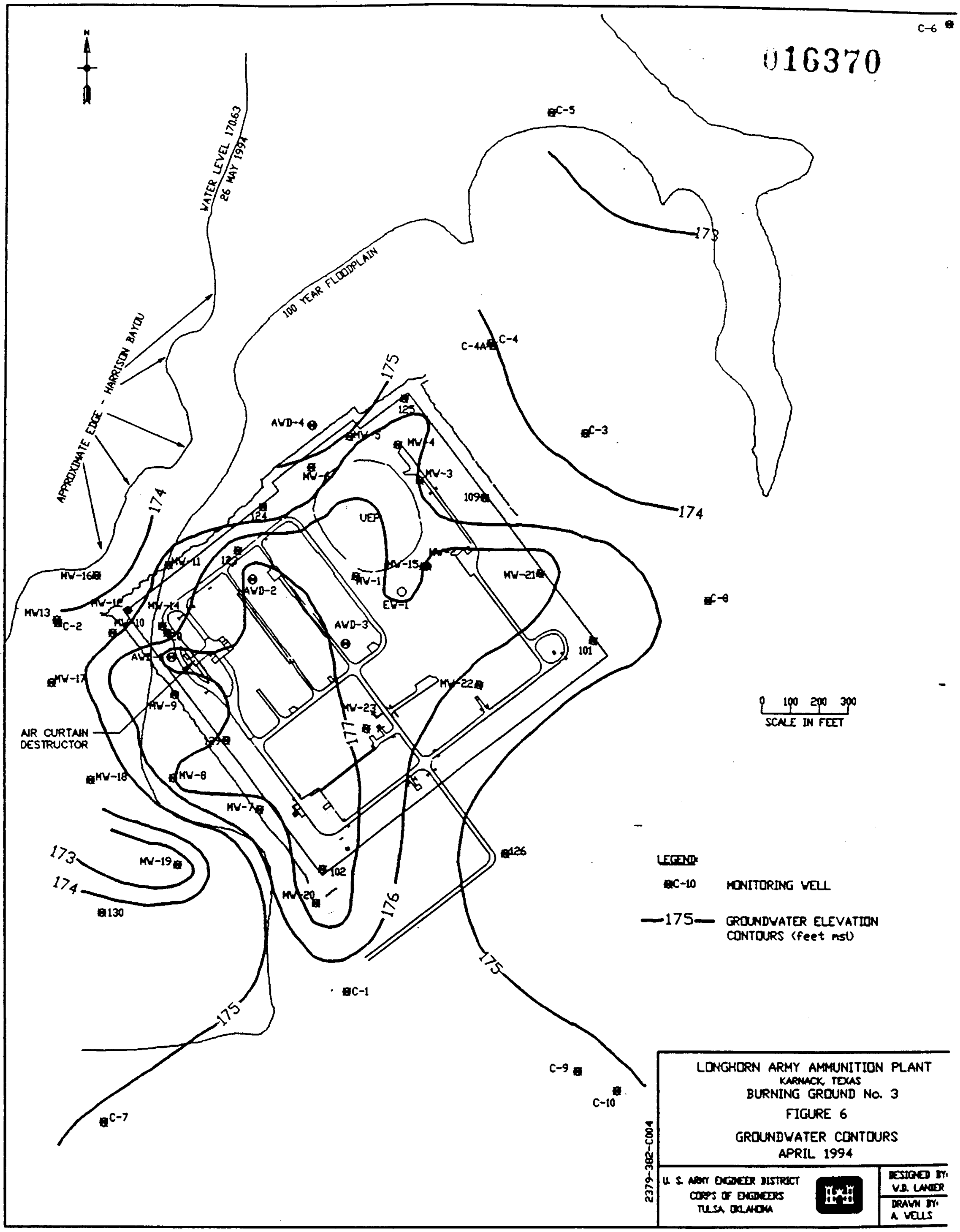
LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

FIGURE NUMBER 4

2379-382-EDP-C005

016369


LEGEND
EXISTING MONITORING WELLS
PREVIOUS SOIL BORING
(8A-9 PREFIX WAS LEFT OFF BORING IDENTIFICATION FOR CLARITY).
SOURCE UNITS
LEGEND OF SOLVENT CONCENTRATIONS IN MICROGRAMS PER KILOGRAM (ug/kg)
≥ 1,000,000 (ug/kg)
≥ 500,000 (ug/kg)
≥ 100,000 (ug/kg)
≥ 10,000 (ug/kg)
≥ 1,000 (ug/kg)
≥ 500 (ug/kg)
N
0 100 200
SCALE IN FEET
AWD4
AWD2
AWD3
AWD1
JULY 1994
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
BURNING GROUND No. 3
FIGURE 5
PAST SOIL INVESTIGATIONS
CONCENTRATIONS OF VOCs
U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA
DESIGNED BY:
W.D. LANIER
DRAWN BY:
C. STAUDENMAIER
2379-382-C014



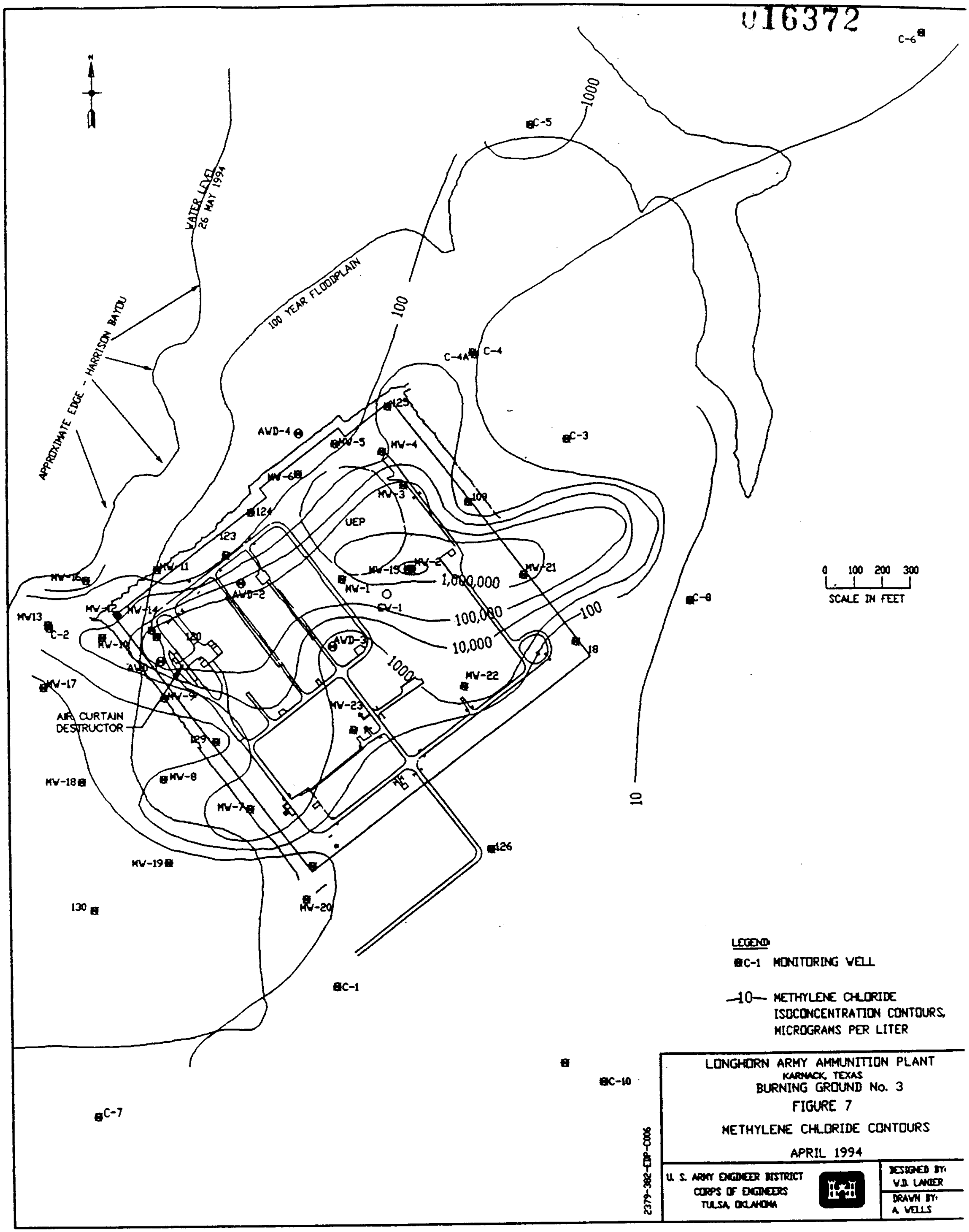
016370
N
WATER LEVEL 170.63
26 MAY 1994
100 YEAR FLOODPLAIN
APPROXIMATE EDGE - HARRISON BAYOU
AIR CURTAIN DESTRUCTOR
173
174
175
176
177
C-1
C-2
C-3
C-4
C-4A
C-5
C-6
C-7
C-8
C-9
C-10
MW-1
MW-3
MW-4
MW-7
MW-8
MW-9
MW-11
MW-12
MW-15
MW-16
MW-17
MW-18
MW-19
MW-20
MW-21
MW-22
MW-23
MW13
AWD-2
AWD-3
AWD-4
UEP
EW-1
101
102
109
124
125
126
130
0 100 200 300
SCALE IN FEET
LEGEND:
C-10 MONITORING WELL
175 GROUNDWATER ELEVATION CONTOURS (feet msl)
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
BURNING GROUND No. 3
FIGURE 6
GROUNDWATER CONTOURS
APRIL 1994
2379-382-C004
U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA
DESIGNED BY:
V.D. LANIER
DRAWN BY:
A. WELLS

topographically high Burning Ground No. 3.

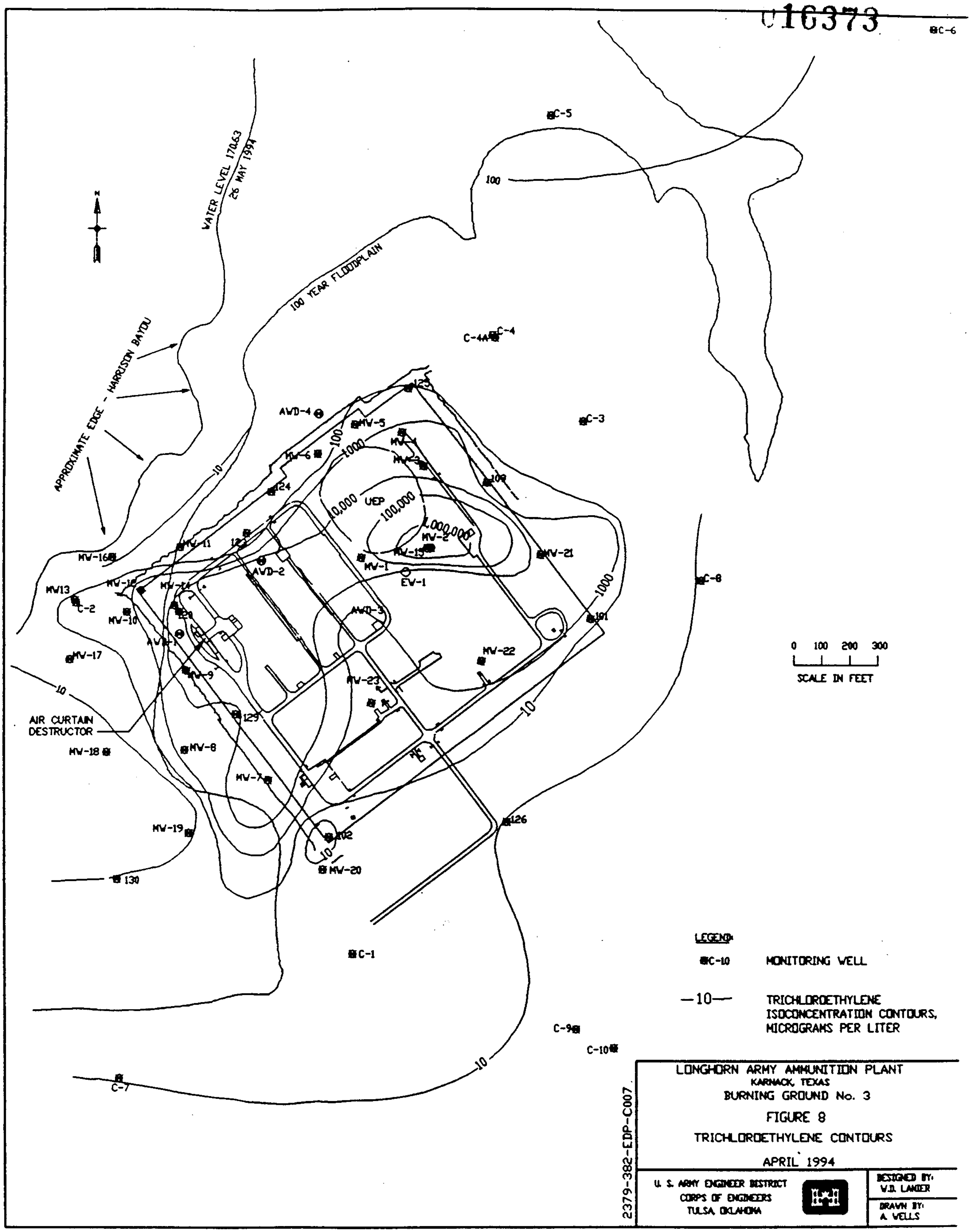
Several investigations have been performed at the Burning Ground No. 3 site since 1976. Existing data show that at least two known sources are contributing to the groundwater contamination beneath the site. The primary source is the past usage of the UEP. A second source is trenches still containing solvent-contaminated wastes in the vicinity of the Air Curtain Destructor location. A third possible source for ground-water contamination is contaminated soils at various burn pit locations throughout Burning Ground No. 3.

High concentrations of solvents (volatile organic compounds (VOCs)), primarily methylene chloride and trichloroethylene, and traces of heavy metals, such as barium, have been detected within subsurface soils, buried waste, and the uppermost water-bearing zone at the site. The methylene chloride plume covers a larger area and has higher concentrations than the trichloroethylene plume. This difference could be attributed to the fact that methylene chloride is more soluble in water, more mobile, and is less likely to be absorbed to the soil than trichloroethylene. The concentrations of methylene chloride, as of April 1994, range from approximately 10,550 parts per million, near the center of the plume, to less than 0.005 parts per million, near the northwest edge of the plume. The concentrations of trichloroethylene, as of April 1994, range from approximately 1,520 parts per million near the center of the plume, to less than 0.005 parts per million near the northwest edge of the plume. Figures 7 and 8 show the isoconcentration contours of the methylene chloride and trichloroethylene plumes, respectively, as of April, 1994. Groundwater monitoring results have indicated the potential presence of methylene chloride and trichloroethylene in a free-phase in the shallow groundwater beneath Burning Ground No. 3 to the south and west of the UEP and in the vicinity of the Air Curtain Destructor. Since these chemicals have a density that is greater than water, the free-phase of these compounds is also referred to as dense nonaqueous phase liquids (DNAPLs). There is no evidence of light nonaqueous phase liquids at the site.

From 1987 through 1989, 174 soil samples were analyzed for VOCs. Trichloroethylene was detected in 103 samples with a maximum concentration of 1,000 mg/kg. Methylene chloride was detected in 64 samples with a maximum concentration of 742 mg/kg. Acetone was also detected in 38 of the 174 samples with maximum concentration of 33 mg/kg. These VOCs were also detected in samples collected from potential source areas for the treatability studies program conducted in December 1993. Buried saw dust was encountered during the treatability studies sampling in the area adjacent to the southeast corner of the Air Curtain Destructor.


016372
N
WATER LEVEL 26 MAY 1994
APPROXIMATE EDGE - HARRISON BAYOU
100 YEAR FLOODPLAIN
1000
100
10
1,000,000
100,000
10,000
1000
UEP
AIR CURTAIN DESTRUCTOR
C-1
C-2
C-3
C-4
C-4A
C-5
C-6
C-7
C-8
C-10
MW-1
MW-2
MW-3
MW-4
MW-5
MW-6
MW-7
MW-8
MW-9
MW-10
MW 11
MW-12
MW13
MW-14
MW-15
MW-16
MW-17
MW-18
MW-19
MW-20
MW-21
MW-22
MW-23
AWD-2
AWD-3
AWD-4
SV-1
18
109
120
123
124
125
126
129
130
0 100 200 300
SCALE IN FEET
LEGEND
C-1 MONITORING WELL
10 METHYLENE CHLORIDE ISOCONCENTRATION CONTOURS, MICROGRAMS PER LITER
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
BURNING GROUND No. 3
FIGURE 7
METHYLENE CHLORIDE CONTOURS
APRIL 1994
U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA
DESIGNED BY: V.D. LANIER
DRAWN BY: A. WELLS
2379-382-EDP-C006

016373



LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
BURNING GROUND No. 3
FIGURE 8
TRICHLOROETHYLENE CONTOURS
APRIL 1994

Barium, chromium, and lead have also been detected in site soil samples at concentrations exceeding expected background concentrations (verification of background concentrations is on-going) for the area. Known soil and debris source material locations based on the review of a historical aerial photograph and soil sampling and testing results are shown on Figure 5.

Based on the soil sampling results, historical information, and on materials encountered during the installation of the Air Curtain Destructor and monitoring wells at the site, there continue to be sources of contamination for soil and groundwater at the Burning Ground No. 3 site. The nature and extent of the source areas are not well defined. The presence of various inactive units including burn/demolition burial pits, a row of 18 burn pits, a heavy propellant pit, a liquid waste sump, and waste trenches surrounding the Air Curtain Destructor have been confirmed and are possible sources.

A risk assessment has not been completed for the Burning Ground No. 3 site since the true nature and extent of contamination has not yet been completely determined. A risk assessment will be conducted concurrently with the completion of the ongoing RI/FS work. The conclusions and recommendations of the risk assessment will be used during the development of the final response action for the site. However, ongoing plume monitoring has indicated that contaminant concentrations in on-site monitoring wells and the plume lateral extent has increased over the past several years. Therefore, the IRA is warranted to mitigate the potential risks posed by the high concentrations of VOCs and heavy metals detected in both the shallow groundwater and source material.

DEI has completed the Phase I and Phase II portions of the IRA. Phase I included confirmation sampling required in order to complete site characterization and the installation of a vertical extraction well (VEW). The Phase I work also included several laboratory treatability verifications for the onsite contaminated soils and groundwater. The objective of the Phase II work was to determine the effectiveness of different systems for groundwater extraction. The implementation of the Phase II work provided data and information regarding construction methods (i.e. problems/solutions) of the extraction systems, attainable groundwater flow rates, and groundwater quality parameters.

1.6 Summary of Activities

This Phase III work plan describes the activities associated with the IRA which will consist of the construction and maintenance of a groundwater extraction and treatment system, contaminated soils and source material excavation and treatment, and site restoration. Drawing SP-III-1 shows the burning ground site and the temporary storage and staging area (TSSA) where the treatment plants would be located.

The tasks associated with groundwater extraction and treatment system are described in detail in Section 2.0. They are as follows:

Task 1 - Construction of a total of 5000 feet of Interceptor Collection Trench (ICT) sections.

Task 2 - Installation of up to eight vertical extraction wells (VEWs) as necessary. VEWs will be installed only if required following the installation and evaluation of ICT sections.

Task 3 - Installation of a piping network to collect the extracted water and convey it to the groundwater treatment plant.

Task 4 - Construction of a groundwater treatment plant to treat the extracted groundwater.

Task 5 - Installation of a piping system to convey treated groundwater to Harrison Bayou and if necessary Central Creek.

Task 6 - Starting up the groundwater treatment plant.

Task 7 - Operating and maintaining the groundwater treatment plant for one year.

Task 8 - Performing groundwater flow tests on each completed section of ICT and each VEW.

Task 9 - Evaluating the hydraulic effectiveness of the extraction system.

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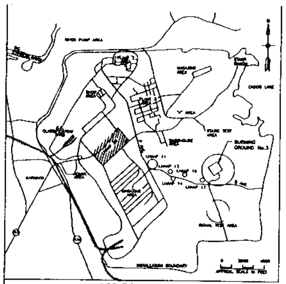
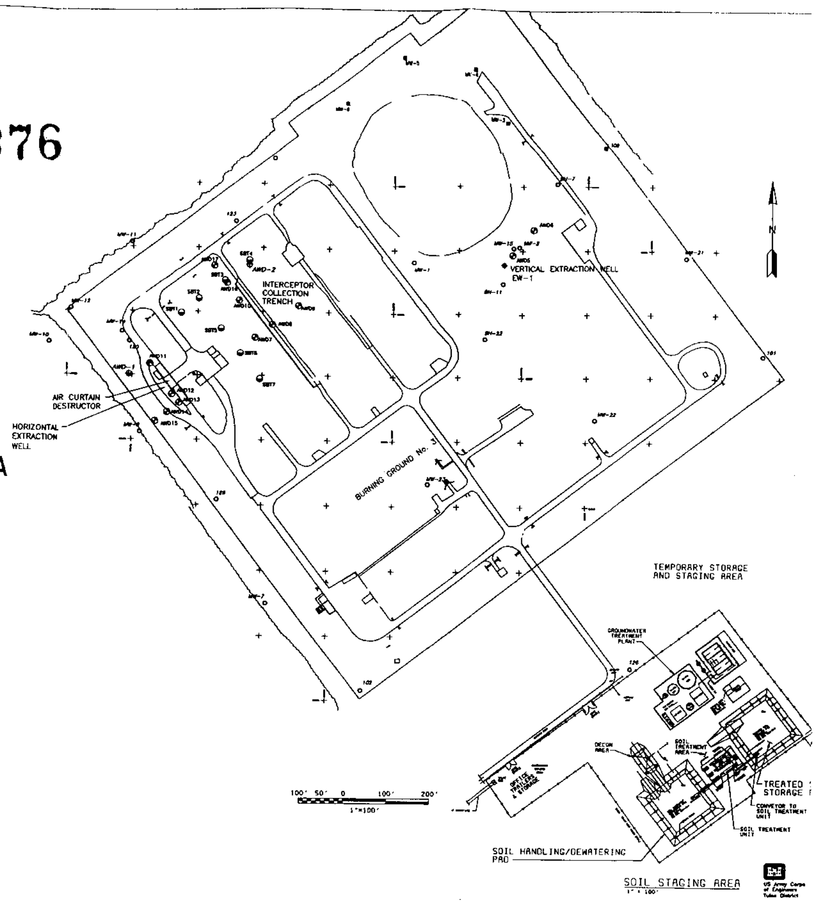


LOCATION MAP
FOR BURNING GROUND No. 3 AND UEP
(LHAAP 18 & 24)

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
BURNING GROUND NO.3 &
TEMPORARY STORAGE AND STAGING AREA



LEGEND AND ABBREVIATIONS

	COMPACTED CLAY
	CONCRETE
	EARTH
	GRAVEL
	SAND
	SELECTED SOIL
40 MIL	POLY SHEETING
60 MIL	POLY SHEETING
DECON	DECONTAMINATION
HDPE	HIGH DENSITY POLYETHYLENE
MW-1	MONITORING WELL
BH-22	BORE HOLE
SBT6	IN TRENCH SOIL BORING
AWD7	DEI INSTALLED MONITORING WELL
102	MONITORING WELL NUMBER
EW-1	VERTICAL EXTRACTION WELL
△	40 MIL HDPE MONITORING WELL
●	60 MIL HDPE MONITORING WELL
	SLOPE
Y	SLOPE DIRECTION
(TYP.)	TYPICAL

1 / SP-3 — SECTION NUMBER OR DETAIL LETTER / DRAWING NUMBER ON WHICH SECTION OR DETAIL APPEARS

LIST OF DRAWINGS

	DRAWING NO.	TITLE
1	SP-III-1	SITE PLAN
2	ICT-III-1	PLAN LAYOUT FOR IRA GROUNDWATER EXTRACTION SYSTEM
3	ICT-III-2	TYPICAL TRENCH CROSS-SECTION FOR ICT'S SINGLE OR MULTIPLE SUMPS
4	GWCP-III-1	CONCEPTUAL WELLHEAD AND UNDERGROUND GATHERING SYSTEM PIPING & PLOT PLAN
5	GWDP-III-1	GROUNDWATER TREATMENT PIPING EFFLUENT DISCHARGE
6	GWDP-III-2	EFFLUENT DISCHARGE DETAIL PROPOSED EFFLUENT DISCHARGE SYSTEM AT HARRISON BAYOU
8	SHDP-III-1	SOIL HANDLING/DEWATERING PAD PLAN, SECTIONS AND DETAILS
9	SHDP-III-2	SOIL HANDLING/DEWATERING PAD TRUCK RAMP, DECON PAD PLAN AND SECTIONS
10	SHDP-III-3	SOIL HANDLING/DEWATERING PAD SECTIONS AND DETAILS
11	2379-C-100	GROUNDWATER TREATMENT PLANT CONCEPTUAL PLOT PLAN
12	TSSP-III-1	TREATED SOIL STORAGE PAD PLAN, SECTION & DETAIL
13	TD-III-1	SITE PLAN
14	TD-III-2	THREE-TRAILER GENERAL CONFIGURATION
15	TD-III-3	PIPING AND INSTRUMENTATION DIAGRAM
16	TD-III-4	PROCESS FLOW DIAGRAM-STP

DRAWING NUMBER	DRAWING TITLE	CLIENT APP'D	DRAWN BY	DESIGN BY	CHK'D	ENGR	REV	REVISED	DATE
			SMH			A.B.O.	-	INITIAL RELEASE	05/17/95

REFERENCE DRAWINGS

Dow Environmental

SITE PLAN

PHASE III -IRA- BURNING GROUND No.3

CLIENT	LHAAP KARNACK, TEXAS	PROJECT NUMBER	2379
SCALE	AS SHOWN	DRAWING NUMBER	SP-III-1

2379-382-C050

The tasks associated with contaminated soils and source materials excavation, treatment and disposal are described in detail in Section 3.0. They are as follows:

Task 1 - Construction of a dewatering and staging pad for ICT excavated soils and contaminated soils and source material.

Task 2 - Construction of a storage pad for treated soils and source material.

Task 3 - The mobilization, setup, and performance testing of a soil treatment system.

Task 4 - Excavation and Treatment of soils and source material.

Task 5 - Disposal/placement of Treated soils and source material.

Task 6 - Drilling 20 soil borings to investigate the potential presence of other source material.

Task 7- Restoring the site by importing clean fill material and backfilling source material excavations, rebuilding damaged or excavated roadways, building drainage structures, and restoring utility lines.

2.0 Groundwater Extraction and Treatment

2.1 Task 1 - Construction of The Interceptor Collection Trench (ICT).

The ICT system will consist of 14 sections ranging in length between 100 feet and 1,300 feet as shown on Drawing ICT-III-1. Each trench section will extend to approximately 25 to 45 feet below existing ground surface and will rest on the first confining layer. The objective of placing the ICT sections on top of this confining layer is to capture, to the extent possible, the suspected dense non-aqueous phase liquid (DNAPL). The construction of the ICT will include the following steps:

2.1.1 Soil Borings and Temporary Groundwater Monitoring Wells

Soil borings will be drilled along the axes of the ICT sections at 50 foot intervals prior to the initiation of trench excavation and construction. The borings will be used to define the subsurface conditions including the depth to the first confining layer. The drilling program will include the collection of continuous samples throughout the depth of the borehole. Soil samples will be obtained for visual, and physical testing and characterization using a three-inch split spoon. A selected number of samples (maximum of 30 samples) will be tested in the laboratory for Atterberg Limits (ASTM D4318), grain size analysis (ASTM D422), and moisture content (ASTM D2216).

The drilling operation at each borehole location will be terminated upon encountering the first confining layer. Temporary groundwater piezometers will be installed in every other borehole. These piezometers will be used to monitor the static water levels prior to proceeding with trench construction. The screen section and riser pipe of each piezometer will be two inches in diameter and will consist of schedule 40 PVC. The piezometers will be installed in accordance with the Specifications Section 02730b that is included in Appendix A. However, these piezometers will not have the protective steel casing, the concrete pad, and the guard posts since they will be temporary and most probably removed during the excavation of ICT sections. In addition, these piezometers shall not be used for groundwater sampling.

Information collected from the boreholes and the piezometers will be used to develop subsurface cross sections. These cross sections will specifically show the potential elevation of the first confining layer on which the ICT will rest, subsurface soil conditions as interpreted from the

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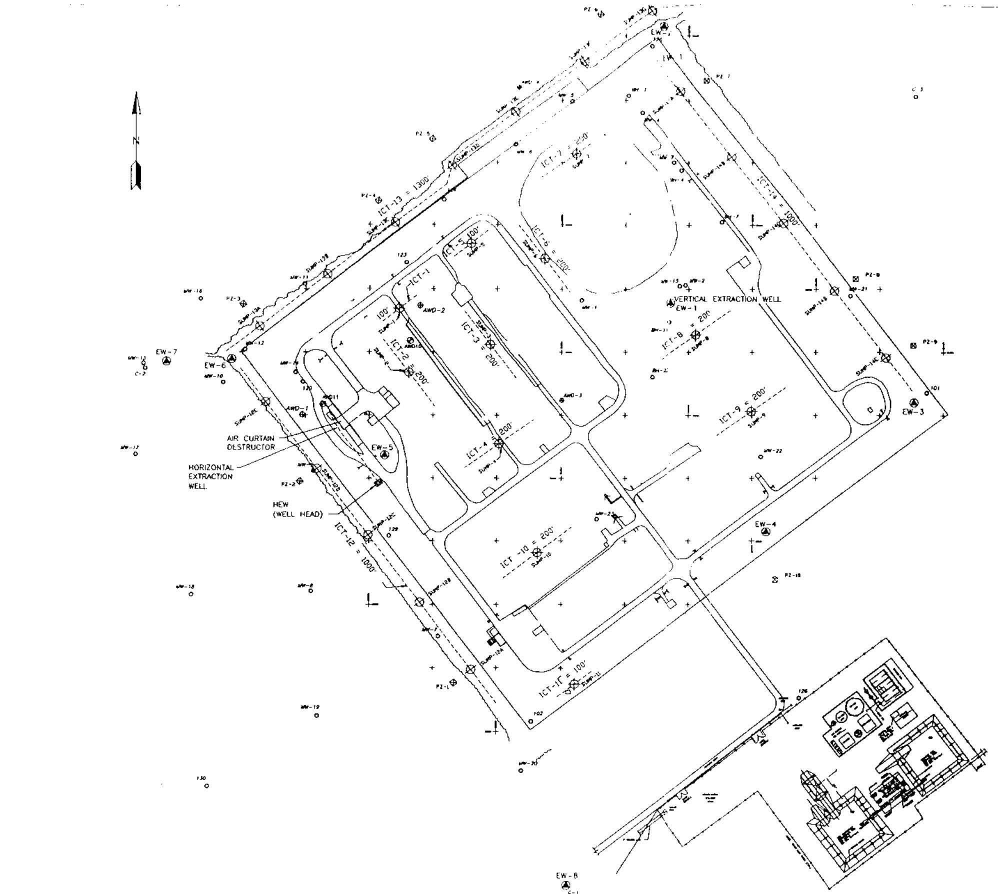


LEGEND:

EXPECTED GROUNDWATER FLOW RATE
PER SUMP OR WELL
(GALLONS PER MINUTE)

	MINIMUM	MAXIMUM
TRENCH SUMP	1	10
EXTRACTION WELL	0.5	5
HORIZONTAL EXTRACTION WELL	0.5	2

MW-7 EXISTING MONITORING WELL

PZ-10 PROPOSED PIEZOMETERS FOR WATER LEVEL MESUREMENTS

US Army Corps
of Engineers
Tulsa District

100' 50' 0 100' 200'
1"=100'

DRAWING NUMBER	DRAWING TITLE	CLIENT APP'D	DRAWN BY	DESIGN BY	CHK'D	ENGR	REV	REVISED	DATE
			CF			ABG	-	INITIAL RELEASE	07/30/94

REFERENCE DRAWINGS

DOW
Dow Environmental

PLAN LAYOUT FOR PHASE III IRA
GROUNDWATER EXTRACTION SYSTEM
MAY 1995

CLIENT: LHAAP KARNACK, TEXAS
PROJECT NUMBER: 2379
SCALE: AS SHOWN
DRAWING NUMBER: ICT-III-1
REV: -

drilling program and existing site information, and water level elevations. The subsurface cross sections for the ICT will be presented to the USACE Fort Worth District Area Office for review and comments prior to proceeding with the mobilization for the installation of any sections of the ICT.

2.1.2 Construction of the ICT

The ICT will be constructed using the Bio-Polymer (BP) slurry trench technology in accordance with the Specifications Section 02410 that is included in Appendix A. This method of drain construction uses basic slurry trench technology, however, instead of bentonite clay slurry, a guar-gum (or a similar material) based slurry is used to maintain the open trench. This type of slurry will break down chemically and biologically following the backfilling of the trench with the desired water collection system. This method of drain construction does not require trench entry by workers since once a trench is dug to the desired depth, the water collection system (i.e. pipe laterals, HDPE liner, sumps, and sand) will be placed under slurry. In addition, the construction of the BP slurry trench does not require any sheeting or shoring.

DEI has been informed by the Corps of Engineers, Tulsa District, that there is no history of disposal of unexploded ordnance at the site. Therefore, DEI will not make any attempt to identify such disposal locations. However, extra care will be taken during the excavation of any ICT section in order to minimize any problem due to encountering buried waste and/or metal objects.

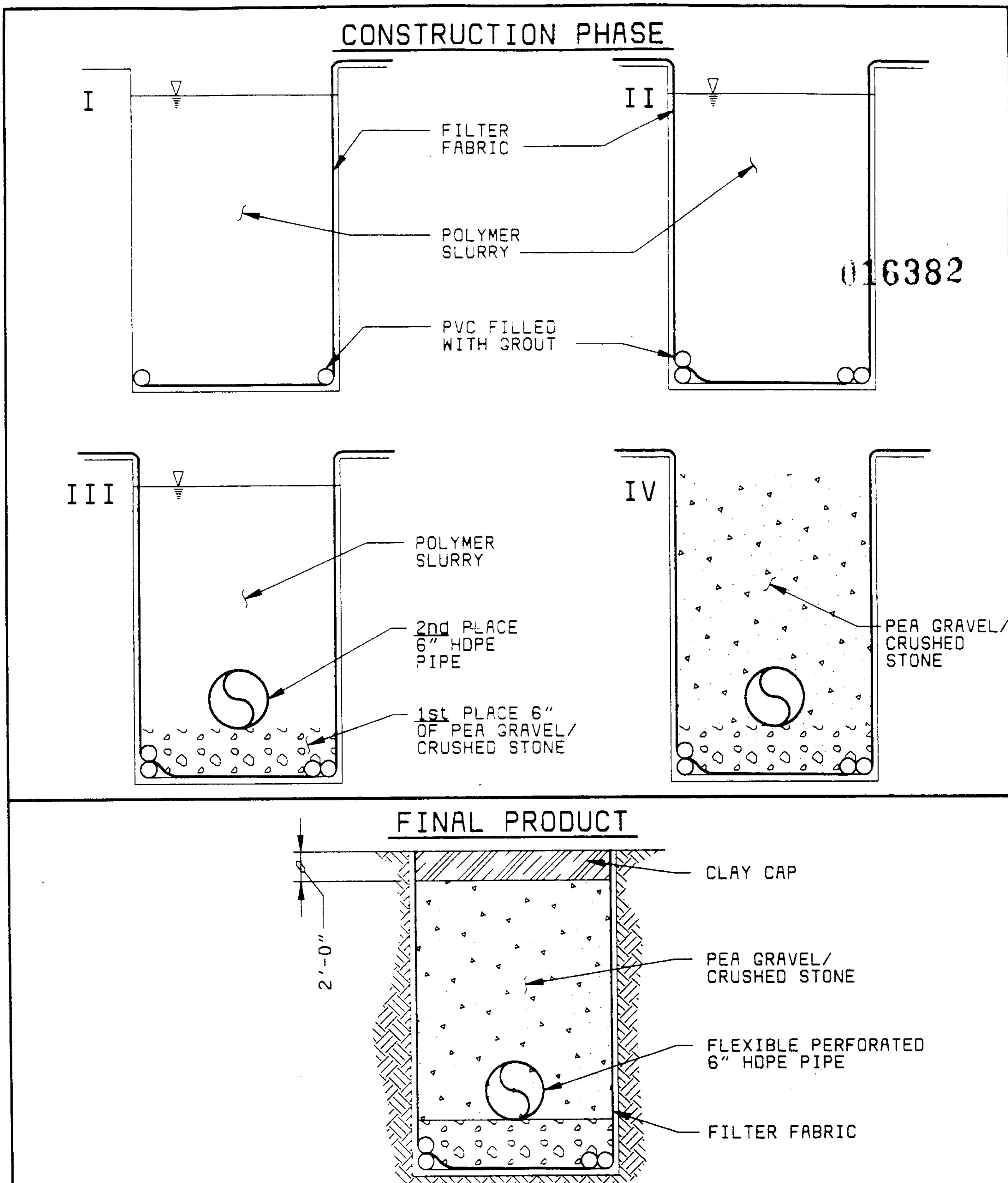
All excavated soil and any liquid or solid waste generated during the construction of the ICT will be handled in accordance with the Waste Management Plan. The excavated soils will be transported to the soil handling and dewatering pad (SHDP) at the TSSA for treatment in the soil treatment plant (STP) as described in detail in Section 3.0. The treated soils from the ICT sections will be used as backfill material in the excavations of the source material within Burning Ground No. 3 also as described in Section 3.0. The liquid waste will be transported in vacuum trucks and placed temporarily in frac tanks to allow for the settlements of solid particles. After settlement, the liquid waste will be taken to the groundwater treatment plant (GWTP) for treatment and the solids will be taken to the SHDP also for dewatering and treatment in the STP.

Spill control measures will be used to prevent the migration of any generated waste beyond the limits of the excavation. In the event of a spill, the procedures outlined in the Waste Management Plan will be followed to minimize impact to the environment.

Each section of trench will be backfilled with pea gravel and or crushed stone , a slotted (10 slot) six inch HDPE drain/collection pipe at the bottom, a six inch HDPE clean-out pipe at each end of the trench, and six-inch stainless steel sumps. Filter fabric will also be installed along the trench walls to minimize the migration of silt into the gravel backfill. Figure 9 presents the sequence of operation that would be followed during trench backfilling. Requirements for trench backfilling are included in Specifications Section 02410. Typical cross sections of an ICT section with one sump and an ICT section with more than one sump are shown on Drawing ICT-III-2. Sections ICT-12 and ICT-13, located as shown on Drawing ICT-III-1, will also have a synthetic geomembrane liner, 40 mil high density polyethylene (HDPE), along the entire outside length of the trench as shown on Drawing ICT-III-2. The synthetic liner would be installed in accordance with the requirements of Specifications Section 02277 included in Appendix A. The objective of placing the liner is to attempt to reduce the drawdown along the adjacent tree line and protect the roots of the trees.

A very important consideration during ICT construction will be trench stability. Depending on the depth of an ICT section, there will be a minimum required distance between the top of slurry in the trench and the level of the water table in order to maintain trench stability during excavation and backfilling. Appendix B includes a method for calculating trench stability and a graph showing the required depth to the water table from the top of the trench for factors of safety of 1.2, 1.1, and 1.0. This graph was developed based on the assumption that the top of slurry will be at 2 feet from the top of trench. A factor of safety of at least 1.2 is desired during the construction of the ICT sections. Therefore, in areas of shallow groundwater table at the site (i.e at the northwest corner) and for areas where the confining layer is deep (i.e deeper than 35 feet) difficulties may be encountered during the construction of the trench sections. To prevent trench collapse several alternatives could be used including:

- Alternative 1 - The dewatering of the subsurface to an acceptable water table level. This alternative may be used following approval from the USACE in some areas were 4-inch diameter wells exist and allow for groundwater pumping. The ability to use this alternative may be limited at the Burning Ground No. 3 site due to the low hydraulic conductivity of the soil which results in very steep cones of depression around a pumping well, as was learned during Phase II of the IRA. Therefore this option may require the pumping of a large number of wells in order to dewater an ICT location to acceptable levels;



2379-382-N001

Dow Environmental

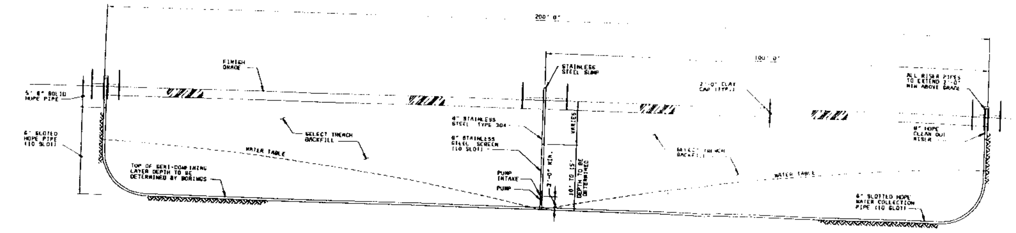
PHASES OF ICT CONSTRUCTION

LONGHORN ARMY AMMUNITION PLANT – KARNACK, TEXAS

CLIENT: USACE TULSA

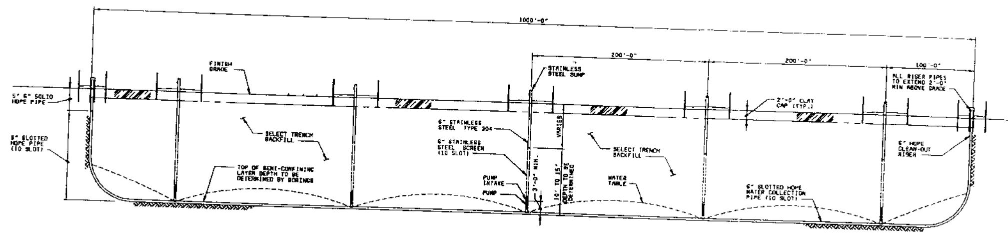
SCALE: N.T.S. | DECEMBER 1995 | PROJECT NUMBER: 2379 | REV 0

FIGURE 9



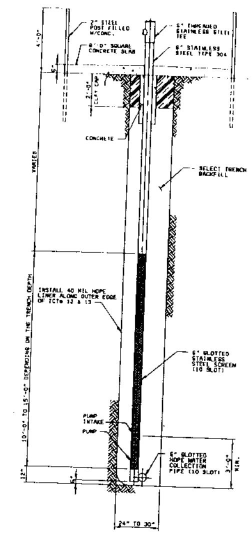
TYPICAL TRENCH CROSS-SECTION
FOR ICT'S WITH ONE SUMP

1"=10'



TYPICAL TRENCH CROSS-SECTION
FOR ICT'S WITH MULTIPLE SUMPS

1"=50'
1"=10'



GROUNDWATER EXTRACTION SUMP

DETAIL

016383

US Army Corps of Engineers Tulsa District

2379-382-C054

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DRAWING NUMBER	DRAWING TITLE	CLIENT APP'D	DRAWN BY	DESIGN BY	CHK'D	ENGR	REV	REVISED	DATE
			EP			A&G	-	INITIAL RELEASE	07/28/94

REFERENCE DRAWINGS

Dow Environmental

TYPICAL TRENCH CROSS-SECTION
FOR ICT's WITH SINGLE OR MULTIPLE SUMPS
MAY 1995

CLIENT	UHAAP KARNACK, TEXAS	PROJECT NUMBER	2379
SCALE	AS SHOWN	DRAWING NUMBER	ICT-III-2

- Alternative 2 - The construction of soil platforms (embankments) along the alignment of the ICT in order to provide the distance required between the level of slurry (or top of trench) and the level of the water table. This option is widely used during the construction of similar ICT sections. However, this alternative requires the excavation and hauling of clean fill material from a LHAAP site (i.e Radio Tower Hill) and/or an offsite location to Burning Ground No. 3. It will also require the proper placement and compaction of the fill material to meet Specifications Section 02200 that is included in Appendix A. The soil platforms shall be removed following the backfilling of the trench section to existing ground surface levels. The excavated platform material shall be hauled to the soil staging and dewatering pad for treatment and disposal as ICT material (i.e placed in source material excavations);

- Alternative 3 - The installation of ICT sections to a shallower depth than the first confining layer that would result in a shorter required distance between the level of slurry and the level of the water table in the trench. This alternative may be used in areas where the first confining layer is deep and/or non-existent and where DNAPL is not suspected to be present and where the ICT would be used to capture the contaminated groundwater plume (dissolved plume) and prevent its migration beyond the limits of the site. The only area where this alternative may be used is at the northwest corner of the site in the vicinity of the ACD; and

- Alternative 4 - The use of a combination of alternatives 2 and 3 and/or installation of ICT sections requiring more than one sump in overlapping sections. The sub-sections would be as long as practical (i.e 200 feet) and the overlap shall be at least 5 feet.

DEI will work very closely with the USACE on this matter and request approval for the use of any of the alternatives prior to the initiation of construction for any ICT section. The issue of stability will also be evaluated following the completion of the soil borings and subsurface profiles described above in Section 2.1.1.

2.1.3 Groundwater Piezometers

The hydraulic effectiveness of the ICT will be evaluated based on field monitoring and contouring of water levels in existing on-site monitoring wells and in a series of new piezometers to be installed in the vicinity of the ICT sections as necessary. The proposed location of ten such piezometers, designated PZ1 through PZ10 are shown on Drawing ICT-III-1. These piezometers will only be used to monitor water levels and will not be used for groundwater sampling. Water level data would be used in the evaluation of the effectiveness of the lateral hydraulic containment of the system. Section 2.9 describes in detail the plan for evaluating the hydraulic effectiveness of the groundwater extraction system.

The piezometers will be installed upon the completion of the ICT sections. They will consist of 2 inch, Schedule 40 PVC casings and screens. The piezometers will be installed in accordance with the Specifications Section 02730b which is included in Appendix A..

2.2 Task 2 - Vertical Extraction Wells Installation

Vertical extraction wells (VEWs) may be installed following the construction and evaluation of the ICT Sections. The location of any VEW will be selected based on the ICT performance. VEW locations shown on the attached drawings and/or figures are preliminary and subject to change. An addendum to this work plan will be issued for review and comments following the decision to use VEWs.

Available project funding allow for the installation of eight VEWS. Each VEW would extend to the depth of the first confining layer (assumed at about 25 feet to 40 feet from the ground surface). The boring in which the well will be installed will have a minimum diameter of 12 inches. The well riser and 20 foot screen will be 6 inches in diameter and consist of Type 304 stainless steel. Detailed well drilling and installation specifications are included in Specifications Section 02730a that is enclosed in Appendix A.

In order to install as efficient a well as possible and avoid delays in defining the depth of each well during the implementation of work, an exploratory borehole would be drilled at the location of each VEW during the soil drilling program for the ICT. These exploratory borings will be sampled continuously in order to collect representative soil samples and define the depth of the first confining layer. Representative soil samples (at least four samples per location) will be tested in the laboratory for grain size analysis (ASTM D422) and the result of this testing will be used to re-evaluate well Specifications Section 02730a mainly the screen slot size and length. Any changes to the specifications will be submitted to the USACE with supporting calculations for review and approval prior to proceeding with the installation of the wells.

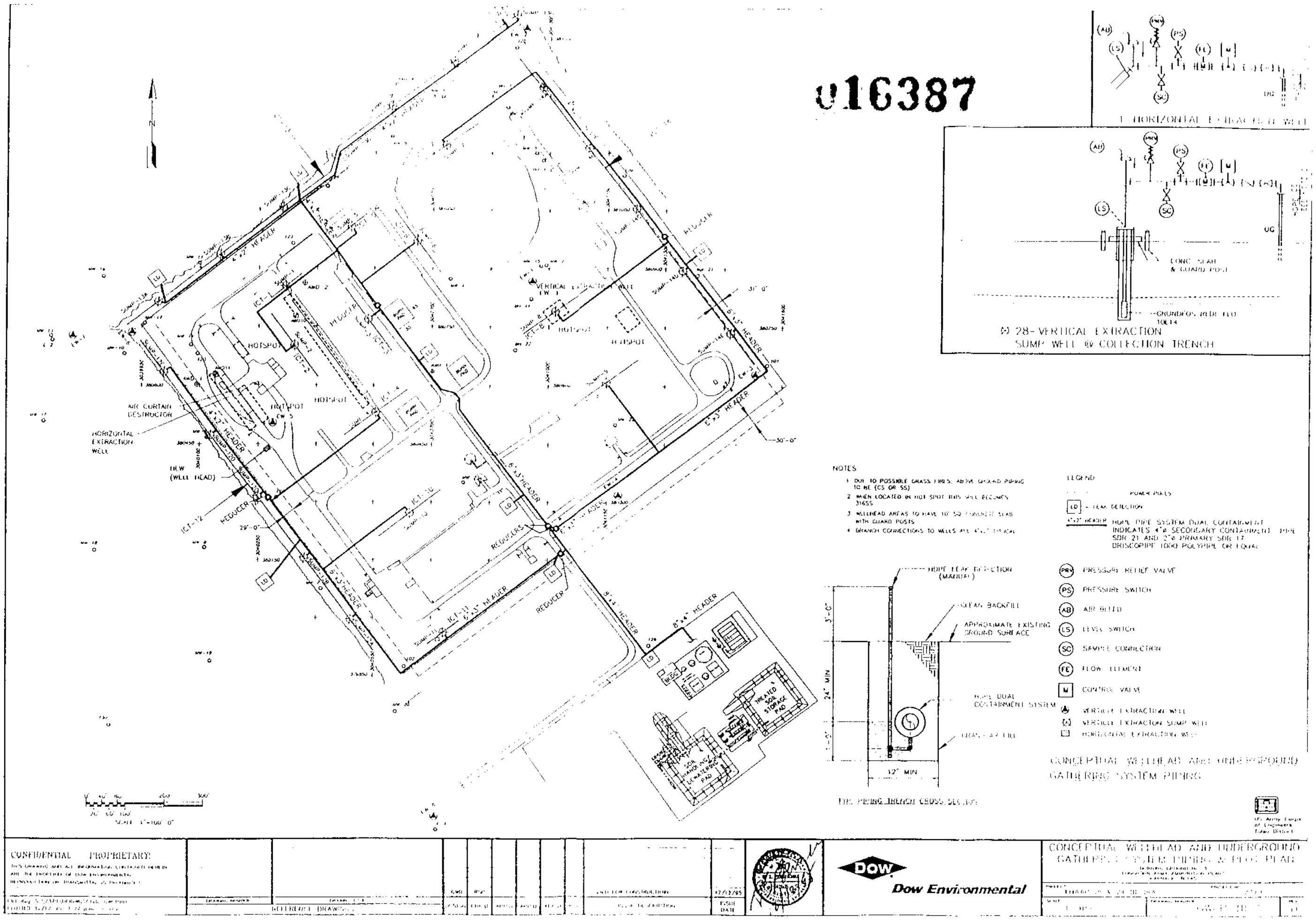
2.3 Task 3 - Installation of Groundwater Collection System

The extracted groundwater from the ICT sumps and VEWs (if necessary) will be collected and conveyed to the groundwater treatment plant via a network of dual containment HDPE piping system. The extraction system would be built such that sumps and/or VEWs may be operated either independently or collectively. Drawing GWCP-III-1 presents a layout and details of the piping system. Except at the well/sump head, the pipes will be installed in trenches excavated and backfilled in accordance with Specifications Section 02222 that is included in Appendix A. All excavated material from the trenches will be taken to the soil staging and dewatering pad for treatment. Following treatment, this material will be stockpiled at the burning ground and later used to backfill source material excavations.

The HDPE piping system shall be installed in accordance with Specifications Section 02660 and 02680 that are included in Appendix A. The system will have several manual leak detection points as detailed on Drawing GWCP-III-1.

The horizontal extraction well (HEW) that was installed in the north western corner of the site, under the (ACD), may be connected to the collection system upon approval from the USACE. The HEW has a dedicated pump that is wired to the ground surface. The pump is also connected to a stainless steel pipe that also extends to the ground surface. However, prior to connecting the HEW to the system, the pump should be withdrawn and inspected along with the wiring and piping assemblies by experienced personnel. This well may require redevelopment prior to its use as part of the groundwater extraction and collection system.

The HEW may contribute to the removal of contaminants from under the ACD. During the Phase II of the IRA, the HEW produced little water. However, it may be worth turning on for a while and monitored to track performance and productivity. If it is found irrelevant to the overall system, it will be taken off line. EPA and TNRCC will be notified of the HEW performance and will be included in the evaluation of its "irrelevancy" in the groundwater collection system. The evaluation and use or abandonment of the well will be thoroughly documented for the record.



016387
28 - VERTICAL EXTRACTION SUMP WELL W/ COLLECTION TRENCH
HOTSPOT
VERTICAL EXTRACTION WELL
AIR CURTAIN DESTRUCTOR
HORIZONTAL EXTRACTION WELL
HEADER
REDUCER
NOTES
1 DUE TO POSSIBLE GRASS FIRES, ABOVE GROUND PIPING TO BE (CS OR SS)
2 WHEN LOCATED IN HOT SPOT THIS WELL BECOMES 316SS
3 WELLHEAD AREAS TO HAVE 10' SQ CONCRETE SLAB WITH GUARD POSTS
LEGEND
POWER POLES
LD = LEAK DETECTION
HDPE PIPE SYSTEM DUAL CONTAINMENT INDICATES 4" SECONDARY CONTAINMENT PIPE SDR 21 AND 2" PRIMARY SDR 17 DRISCOPIPE 1000 POLYPIPE OR EQUAL
PRV PRESSURE RELIEF VALVE
PS PRESSURE SWITCH
AB AIR BLEED
LS LEVEL SWITCH
SC SAMPLE CONNECTION
FE FLOW ELEMENT
M CONTROL VALVE
VERTICAL EXTRACTION WELL
VERTICAL EXTRACTION SUMP WELL
HORIZONTAL EXTRACTION WELL
HDPE LEAK DETECTION (MANUAL)
CLEAN BACKFILL
APPROXIMATE EXISTING GROUND SURFACE
HDPE DUAL CONTAINMENT SYSTEM
24" MIN
12" MIN
PIPING TRENCH CROSS SECTION
CONCEPTUAL WELLHEAD AND UNDERGROUND GATHERING SYSTEM PIPING
TREATED SOIL STORAGE PAD
CONFIDENTIAL PROPRIETARY
REFERENCE DRAWINGS
CONCEPTUAL WELLHEAD AND UNDERGROUND GATHERING SYSTEM PIPING & PLOT PLAN
Dow Environmental

2.4 Task 4 - Construction of a Groundwater Treatment Plant

The contaminated shallow groundwater would be pumped from the sumps installed in the ICT sections, the VEWs (if installed), and possibly the HEW to a GWTP that will be built at the northeast corner of the TSSA as shown on Drawing SP-III-1. The GWTP would be able to accommodate flow rates of 50 gallons per minute (gpm) for a minimum and 300 gpm for a maximum. The estimated groundwater pumping rate from all extraction points is about 100 gpm to 280 gpm.

The extracted groundwater will be treated at the GWTP to the levels established by TNRCC in the project Record of Decision (ROD) that are listed in Table 2.1. The treated water would be discharged to Harrison Bayou and/or Central Creek as detailed in Section 2.5.

The groundwater treatment process would include the following steps:

- Pretreatment and Sludge Conditioning - This step is necessary to remove the excessive scaling and fouling chemicals dissolved in the groundwater as well as heavy metals such as barium and lead that may be present at levels higher than allowable discharge limits. These materials would be removed by conventional alkaline precipitation and chemical adsorption followed by flocculation and filtration. The precipitated metals would be collected in sludge form from the pretreatment unit and allowed to dry on a polyethylene filter drying bed and then taken off-site for disposal at an approved/licensed facility in accordance with Federal, state, and local regulations.

- Air Stripping - An air stripping unit will be used to separate the VOCs from the groundwater following pretreatment. The air stripping technique utilizes a counter-current equilibrium process to extract the VOCs by transferring them to the stripping air. The contaminated groundwater enters the top of the air stripping tower which contains packing material that provides the proper environment for the transfer of VOCs to the air stream to take place. The water flows from the top to the bottom of the air stripping tower by gravity. An air supply line located below the tower packing bed would provide the stripping air which flows upward through the tower.

016389

TABLE 2.1
Effluent Limitations for the Discharge of Remediated Groundwater

Pollutants	Units are (μg/l)		
	Daily Average	Daily Maximum	MAL
Methylene Chloride (Dichloromethane)	803	1699	20
Trichloroethylene	85	181	10
1,1-Dichloroethane	6633	14032	10
1,1-Dichloroethene (1,1-Dichloroethylene)	119	253	-
1,2-Dichloroethane	85	181	10
Vinyl Chloride	34	72	10
Acetone	1132	2395	-
Chloroform	1708	3615	10
Tetrachloroethene (Tetrachloroethylene)	85.4	180.7	10
Ethylbenzene	26954	57025	10
Styrene	2829	5987	-
Toluene	1980	4189	10
Benzene	85	181	10
Xylene	39.5	83.6	-
Carbon Tetrachloride	85	181	10
1,1,1 Trichloroethane	3417	7230	10
1,1,2 Trichloroethane	102.5	216.9	10
Aluminum	777	1644	20
Arsenic (Total)	365	772	10
Barium (Total)	1000	2000	10
Cadmium (Total)	1.6	3.4	1
Chromium (Total)	355	752	5
Chromium (3+)	297	628	10
Chromium (6+)	58	124	10
Cobalt*	5433	11495	-
Iron*	1132	2395	-
Lead (Total)	2.2	4.6	5

TABLE 2.1
(Continued)

016390

Pollutants	Units are (μg/l)		
	Daily Average	Daily Maximum	MAL
Nickel (Total)	87	184	10
Manganese*	7323	15494	-
Silver (total Equivalent)	1.4	3	2
Selenium (Total)	5.7	12	5
Vanadium*	1698	3592	-
Zinc	146	310	5
Chlorobenzene	22300	47180	50
Hexachlorobenzene	0.22	0.47	10
Oil and Grease	N/A	15000	-
Chemical Oxygen Demand	N/A	200000	-
Chloride	See Note Below	N/A	-
Sulfate	See Note Below	N/A	-

*Assumes 100% dissolved

Note: Discharge limits for Chloride and sulfate are to be based on discharge rates using the following formula:

$$C_C \geq \frac{Q_S\, C_A + Q_E\, C_E}{Q_E + Q_S}$$

where:

Q_S = Flow rate in the receiving stream, Harrison Bayou and/or Central Creek, in cubic feet per second (cfs). This flow rate shall be measured at a constant location no less than 100 feet upstream from the point of discharge of treated groundwater. Measurements will be taken daily in Harrison Bayou and Central Creek in accordance with TNRCC's Water Quality Monitoring Manual, August, 1994.

C_A = Chloride/Sulfate (ambient), 10,000 microgram/per liter (μg/l) for chloride and sulfate (from State of Texas Water Quality Inventory)

C_C = Chloride/Sulfate criteria, 100,000 μg/l for chloride and 50,000 μg/l for sulfate (from State of Texas Water Quality Inventory)

Q_E = Treated Groundwater Discharge Rate in cfs. The groundwater pumping and treatment rate shall be adjusted as necessary in order to meet the required effluent concentration C_E.

C_E = Effluent Concentration (discharge limit) in μg/l.

TABLE 2.1
(Continued)

Example: For a discharge rate of 250,000 gallons per day or 0.39 cfs, and a flow rate in the receiving stream of 4 cfs, the discharge limit for chloride would be:

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$$100,000 = \frac{(4.0)(10,000) + (0.39)(C_E)}{0.39 + 4.0}$$

$$C_E = 1,023,000\ \mu g/l$$

DEFINITIONS

Daily average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit within a period of one calendar month, consisting of at least four separate representative measurements. When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values taken during the month shall be utilized as the daily average concentration.

Daily maximum concentration - the maximum concentration measured on a single day, by composite sample, unless otherwise specified elsewhere in the permit.

TAC reference - most of the limitations are based upon water quality standards found at TAC 307 for the protection of human health and aquatic life. The limit for Barium is from TAC 319 - Subchapter B.

MAL - the minimum analytical level. All testing must be completed utilizing EPA approved methods which can detect the pollutant to the referenced MAL. For those effluent limitations set at levels below the MAL, results of analyses which are not-detect at the MAL shall be considered compliant.

N/A - Not Applicable.

- Catalytic Oxidation and Vent Scrubbing - The contaminated air stream from the air stripping tower would be treated in a catalytic oxidizer and scrubber system prior to being discharged into the atmosphere through a stack. The VOCs in the air stream would be catalytically converted to carbon dioxide, water and hydrogen chloride gases. These gases will then be scrubbed using water to produce a very diluted acid stream. This acid will be pumped to and used in the GWTP to prevent scaling in the air stripper.

Appendix C includes detailed calculations and plans for the GWTP. This appendix also includes detailed performance specifications for each component of the GWTP. These specifications are in accordance with the requirements of the ROD.

Influent and effluent groundwater will be monitored at the GWTP on a regular basis to ensure that its meets the appropriate standards. The proposed plan for offsite testing of groundwater quality at the GWTP is listed in Table 2.2 and is detailed in Section 4.0 of the CDAP. Groundwater testing will also be conducted at an onsite mobile laboratory as recommended in the CDAP. The onsite testing program is presented in Table 2.3.

Regulatory compliance for six constituents: chloride and sulfate, barium and lead, methylene chloride and trichloroethylene will be determined by daily on-site analyses. Off-site analyses will determine compliance for the remaining constituents and provide QA/QC for the onsite tested parameters . The onsite and offsite testing conducted during the startup and testing period of the GWTP will result in adjustments and calibrations to the treatment system and testing program. Treated water will not be discharged during the start-up and testing period until both off-site and on-site analyses are available and show appropriate treatment levels.

The level switches in the influent and effluent tanks will be set to account for the potential of water requiring retreatment. Effluent not meeting the discharge limits set in Table 2.1 would be recycled to equalization tank and remain in a closed loop through the air stripping tower until discharge requirements are met. If the equalization tank is at capacity when non-compliance occurs, then the well field will be temporarily shut-down until stored water is properly treated and discharged. All storage tanks will be equipped with secondary containment structures and internal level and back-up switches to prevent overfilling. USACE must notify the EPA and TNRCC in the event of discharging treated water that is not in compliance with the effluent limitations listed in Table 2.1. Notification will occur in accordance with reporting guidance received from TNRCC.

Table 2.2

LHAAP, Burning Ground No. 3, IRA

GWTP, Off-Site Analytical Testing Plan For Groundwater

Description of Activity/Event	Frequency Of Testing	Parameters	Test Method
1. GWTP Start-up and Testing:	One Influent and One Effluent Sample as follows:	VOCs	8240
First Week	None (Potable Water would be used to Test GWTP)	Heavy Metals	6010/7000
Second and Third Week	Daily (If the GWTP is operating)	Oil & Grease	413.1
Fourth and Fifth Week	Weekly (If the GWTP is operating)	COD	410.4
	Note: 24 hours turn around time (TAT) will be	Chloride	325.3
	required.	Sulfate	375.4
2. GWTP Operation:	One Influent and One Effluent Sample as follows:		
1 to 3 Months	Weekly*	VOCs	8240
4 to 6 Months	Bi-Weekly*	Heavy Metals	6010/7000
7 to 12 Months	Monthly**	Oil & Grease	413.1
Remaining Duration of	Monthly **	COD	410.4
Treatment	Note: - * indicates 7 days TAT	Chloride	325.3
	- ** indicates 21 days TAT	Sulfate	375.4

Note: 1. All off-site testing would meet the minimum analytical level requirements listed in Table 2.1

2. In the event that the GWTP is shut down and restarted during the operation period, then the frequency of sampling and testing will be restarted based on the listed frequency under GWTP Operation.

3. If a pollutant is found at an "elevated level", equivalent to 70% of the daily average concentration found in Table 2.1, then testing for the pollutant should be bumped back up to the weekly sampling frequency. If the pollutant were later detected at less than the elevated level, the reduced sampling frequency time line will begin anew.

Table 2.3
LHAAP, Burning Ground No. 3, IRA
GWTP, Onsite Analytical Testing Plan For Groundwater

Description of Activity/Event	Frequency Of Testing	Parameters	Test Method
1. GWTP Start-up and Testing:	Daily (If the GWTP is operating) One Influent and One Effluent Sample	1. Methylene Chloride and Trichloroethylene 2. Barium and Lead 3. Chloride and Sulfate	1. 8010 2. 6010 3. 300.0 series
2. GWTP Operation:	Daily (If the GWTP is operating) One Influent and One Effluent Sample	1. Methylene Chloride and Trichloroethylene 2. Barium and Lead 3. Chloride and Sulfate	1. 8010 2. 6010 3. 300.0 series

Air emissions from the GWTP would meet the requirements of the Standard Exemption List which was incorporated by TNRCC by reference into 30 TAC 116, Control of Air Pollution by Permits for new Construction or Modifications, Section 116.211. The air emission monitoring plan is summarized in Table 2.4 and is detailed in the Air Monitoring Plan that is included in the CDAP as Appendix C.

Monitoring of flow rates in both Harrison Bayou and Central Creek will be conducted upstream from the treated water discharge points daily. This monitoring would be in accordance with TNRCC requirements listed in "Water Quality Monitoring Procedures Manual", August, 1994. In order to monitor flow rate in the receiving stream, a monitoring station will be constructed at a point no less than 100 ft. upstream of a treated water discharge point. Criteria for monitoring station locations will include continuity of streambed and ease of access. Graduated stage gauges mounted on treated lumber will be erected within the stream channel at an acceptable location in order to monitor stage (h). A Flo-Mate Model 2000 electromagnetic flow meter (Marsh-McBriney, Inc.) will be utilized to measure velocity of flow (V). The Flo-Mate Model 2000 utilizes the Faraday Principal in which an electromagnetic field is produced by electrodes within the meter. As a conductor (water) flows through this field, a voltage is produced. The magnitude of this voltage is directly proportional to the velocity of the conductor moving through the electromagnetic field. The Flo-Mate Model 2000 has a range of -0.5 - 19.99 ft/s and a zero tolerance of $\pm$0.05 ft/s. The stream channel will be divided into one foot vertical columns across its entire width, thus the depth of each column will represent the actual area in ft^2 of that column. The sum of the column depths will then represent the cross sectional area of the channel (A). Observations of h on stage gauges and measurements of corresponding AV values with the Flo-Mate Model 2000 will be made daily at approximately the same time each day. These data will be reduced to Q values for each day and plotted against that day's corresponding h value to produce a discharge rating curve. If stage elevation in Harrison Bayou rises above the discharge outlet or falls below acceptable levels, the system will be temporarily shut down.

As stated in Table 2.1, the flow rate in the discharge stream and the existing chloride/sulfate concentrations in the effluent would be used to calculate the allowable discharge rate of treated groundwater. Figure 10 presents a relationship between, chloride/sulfate concentration, flow rate in the receiving stream, and allowable discharge rate from the GWTP.

Table 2.4

LHAAP, Burning Ground No. 3, IRA
Air Monitoring Plan For GWTP

Activity/Event	Parameters	Test Method	Frequency of Sampling
1. Proof of Performance During Start-up and Testing	VOCs/Target Compounds [a]	1. On-site : TOC using 40 CFR 60, Appendix A, Methods 25-A and 2 2. Off-site: Method TO-14	1. Continuous during testing. 2. Daily during Testing Intervals Note: Sampling and testing would start when contaminated water is introduced into the GWTP (i.e Second week of Startup and Testing).
2. Real Time - Onsite	VOCs/Target Compounds	OVA/ per Manufacturer's Information	At Least Once Every Day the GWTP is Operational.
3. Stack Sampling and Monitoring During Operation (one year O&M)	VOCs/Target Compounds [a]	1. On-site : TOC using 40 CFR 60, Appendix A, Methods 25-A and 2 2. Off-site: Method TO-14	1. Continuous during operation. 2. Quarterly during operation

Notes : [a] Samples will be collected and sent to an off-site laboratory for analysis.

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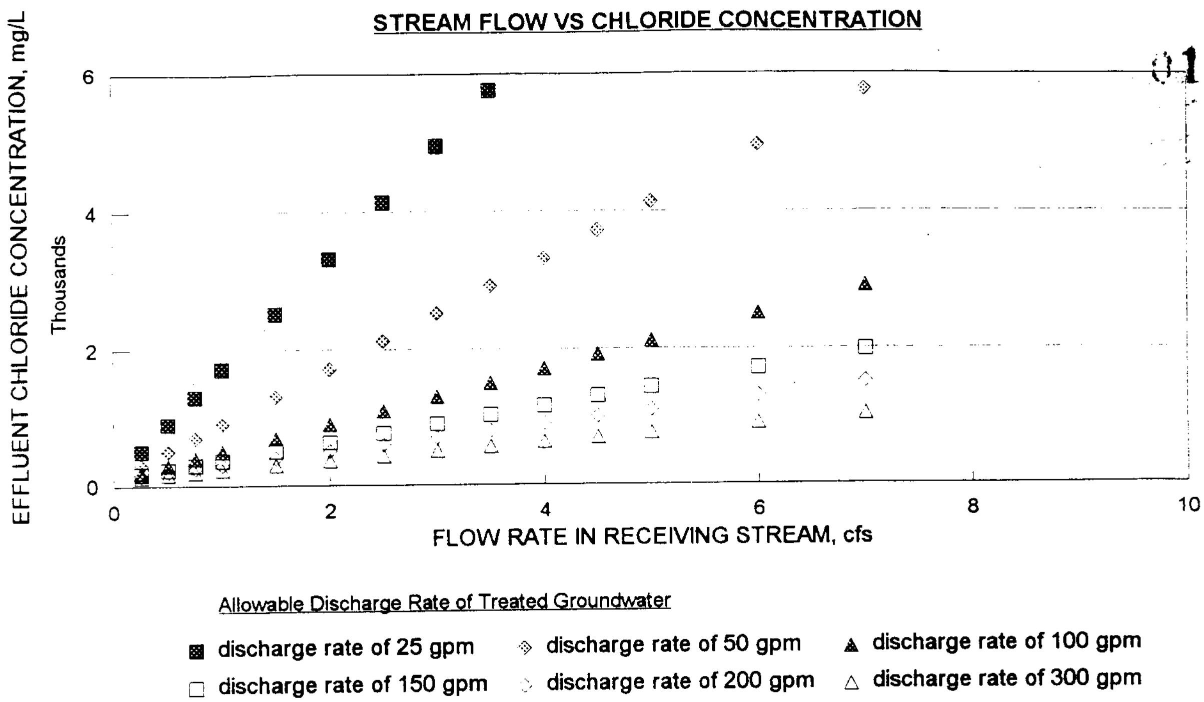

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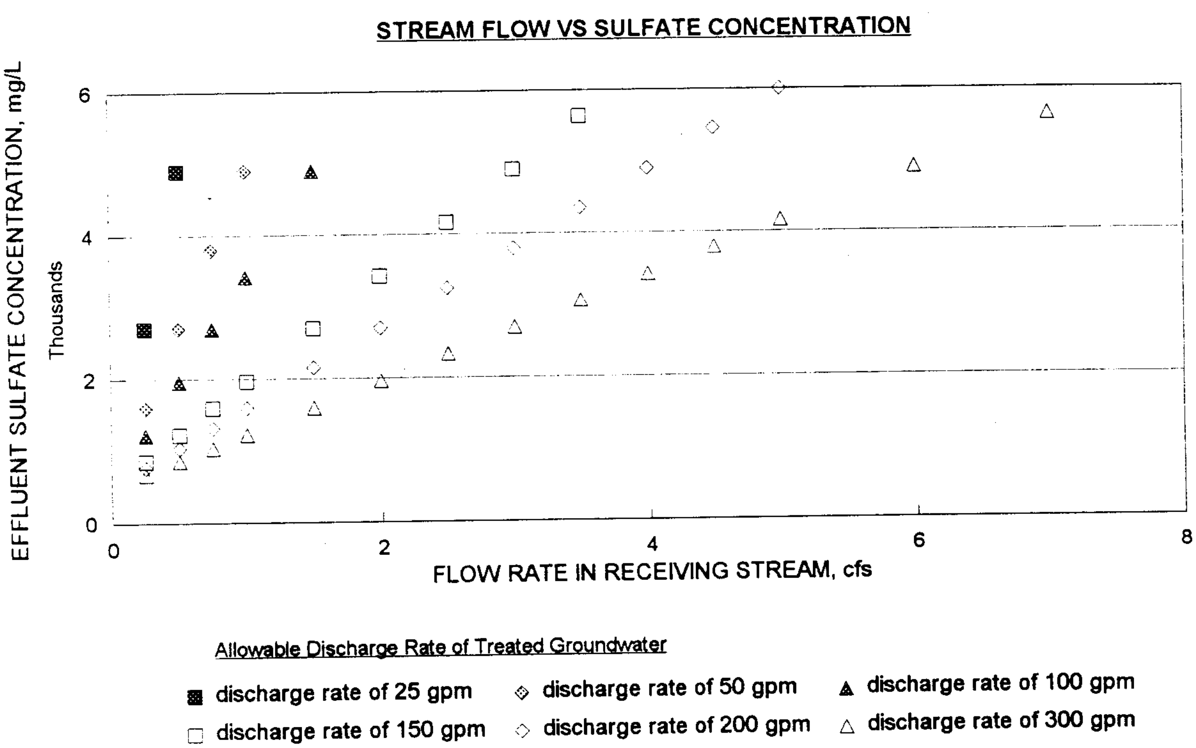

Figure 10: Allowable Effluent Discharge Rate Based on Receiving Stream Flow Rate and Concentration of Chloride and/or Sulfate

2.5 Task 5 - Installation of a Piping System to Convey Treated Groundwater to Harrison Bayou

The treated groundwater will be discharged into Harrison Bayou using a PVC piping system and a discharge structure as indicated on Drawings GWDP-III-1 and GWDP-III-2. The pipe will be buried in a trench to a minimum depth of two feet. The trench would be excavated and backfilled in accordance with Specifications Section 02222. The pipeline will be installed in accordance with Specifications Section 2660.

In order to comply with the effluent requirements for chloride and sulfate, the discharge of treated groundwater may have to be proportioned between Harrison Bayou and Central Creek especially during the dry months of the year (i.e August through October). The discharging of groundwater into either Harrison Bayou and/or Central Creek will depend on the following factors:

- The flow rate in the Harrison Bayou and/or Central Creek,
- The treated groundwater discharge rate, and
- The chloride/sulfate concentration in the treated groundwater.

This workplan does not include details for the installation of a pipeline to Central Creek. A separate plan will be prepared by DEI and submitted for review and approval following the determination for the need of such a pipeline. This determination will be based on the following:

- The flow rates in both Harrison Bayou and Central Creek that will be measured on a daily basis starting early in the summer of 1995, following the establishment of flow measuring locations and methodology that are acceptable to TNRCC. A data base for these rates will be established and maintained onsite by DEI.
- The available pumping rates under gravity conditions from the ICT sumps, VEWs (if installed), and possibly the HEW, and
- The concentrations of influent groundwater in the equalization tank and the concentration of chloride and sulfate in the effluent following three months of pumping and treating groundwater from the entire extraction system.

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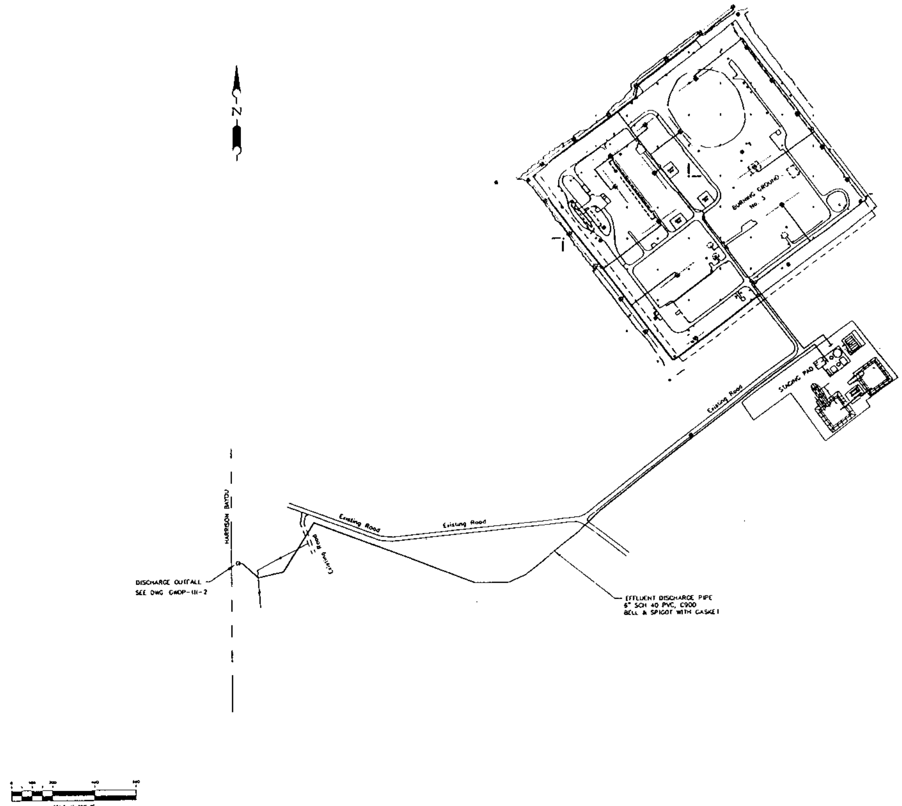

US Army Corps of Engineers Tulsa District

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DRAWING NUMBER	DRAWING TITLE
GWOP-III-2	SECTION AT DISCHARGE AREA
GWOP-III-1	PLOT PLAN

REFERENCE DRAWINGS

DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
GWB	GKW	RSP			0	ISSUED FOR CONSTRUCTION	12/12/95

Dow Environmental

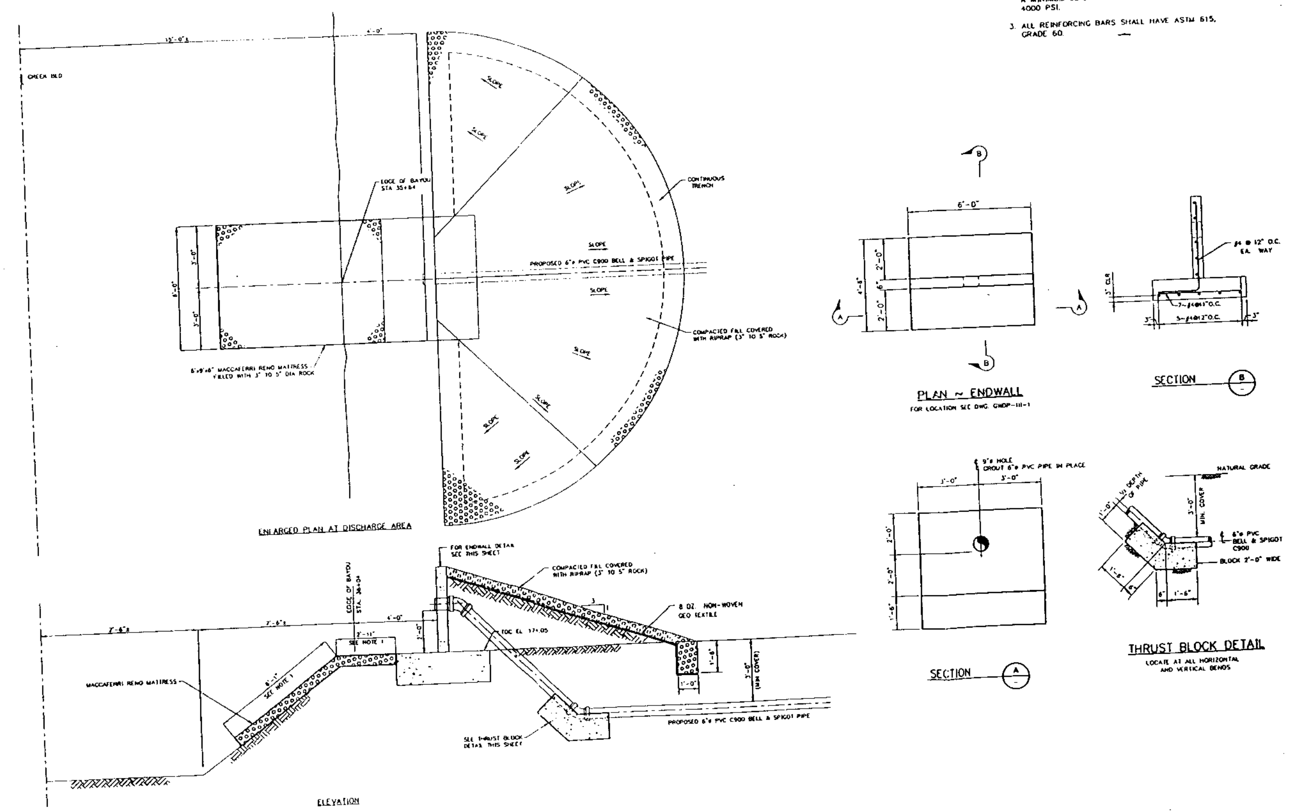
GROUNDWATER TREATMENT PIPING
EFFLUENT DISCHARGE
BURNING GROUND No. 3
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PROJECT: LHAAP 18 & 24 PHASE III, IRA
PROJECT NO. 2379
SCALE 1"=200'
DRAWING NUMBER GWOP-III-1
REV 0

016400

NOTES:

1. FIELD VERIFY DIMENSIONS
2. ALL CONCRETE FOR THIS DWG. SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4000 PSI.
3. ALL REINFORCING BARS SHALL HAVE ASTM 615, GRADE 60.



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DRAWING NUMBER	DRAWING TITLE
C-3017	PLAN & PROFILE SHEET 8
C-3000	PLOT PLAN INDEX

REFERENCE DRAWINGS

REV	ISSUE DESCRIPTION	ISSUE DATE	DESIGN	CHK'D	APP'D	APP'D	APP'D
0	ISSUED FOR CONSTRUCTION	12/12/95	CWB	CKW			

Dow Environmental

HOUSTON TEXAS

EFFULENT DISCHARGE DETAIL
PROPOSED EFFULENT DISCHARGE SYSTEM
AT HARRISON BAYOU

CLIENT: LHAAP 18 & 24 PHASE III, IRA
JOB NUMBER: 2379
SCALE: 1/2"=1'-0"
DRAWING NUMBER: GWDP-III-2
REV: 0

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2.6 Task 6 - Starting up The Groundwater Treatment Plant

The GWTP will be started immediately after completion of installation. The startup and testing period would take about one month. Startup, testing, and trouble shooting will included the following activities:

- Running the GWTP using potable water as an influent stream for a period of at least one week. This activity will allow for the checking of system components prior to the introduction of contaminated groundwater; and

- Running the GWTP using the onsite groundwater collected in frac tanks and drums from activities performed during Phases I and II of the IRA and from subsequent groundwater sampling events. This containerized groundwater would be either pumped to or hauled, using vacuum trucks, to the influent equalization tank at the GWTP. The groundwater containers would be properly decontaminated, triple rinsed, prior to being either taken off LHAAP (i.e. frac tanks) or disposed off/stored (i.e. drums) at a site designated by the USACE for future use. The waste water resulting from the decontamination procedure would also be collected and either hauled or pumped to the influent equalization tank and treated during this startup period.

The effluent resulting from the treatment of contaminated groundwater would be sampled and tested at the frequency and for the parameters indicated in Tables 2.2 and 2.3. Air emissions would also be monitored during this period as indicated in Table 2.4 and in the Air Monitoring Plan. The treated groundwater during this startup and testing period would be stored in the GWTP effluent tank until test results, from both onsite and off-site testing, for collected samples of this water indicate that it meets the requirements of Table 2.1. If either of these results indicate that the stored effluent does not meet the discharge criteria, it would be pumped back to the influent equalization tank and re-treated. This process would be repeated until the discharge criteria is met. The effluent would be discharged to Harrison Bayou following approval from the Army, USACE, EPA, and TNRCC. The re-treatment of the containerized groundwater may be necessary since most of the water in the frac tanks was pumped from the most contaminated portions of the plume especially during the flow testing that took place during Phase II of the IRA.

Training of personnel would also be performed during the startup period. The training would be based on the requirements of the operation and maintenance described in the following section.

2.7 Task 7 - Operating and Maintaining The Groundwater Treatment Plant For One Year

DEI would prepare the operation and maintenance (O&M) manual for the operation of the GWTP upon receiving final approval for the project workplans. The manual would be furnished to the USACE for review and comments prior to being finalized and used at the onsite GWTP. The O&M manual would include detailed description of the following items:

- Overview of the treatment plant
- Operating personnel responsibilities
- Overview of the GWTP including equipment description
- Treatment requirements and effluent limitations
- Process control description
- Start-up preparation procedure
- Start-up procedures
- Routine operation
- Abnormal operating conditions
- Maintenance including:
    - Equipment alternation
    - Routine and preventive maintenance
    - Maintenance materials
    - Recommended spare parts list, and
    - Maintenance records.
- Health and safety requirements and procedures
- Major equipment training documentation, and
- Data forms and process diagrams.

DEI would operate and maintain the GWTP for one year in accordance with the scope of work. DEI specialists would perform onsite training including classroom and hands on for personnel designated to operate the GWTP. Training would entail scheduled proficiency exams to test the retention of the trainees and to ensure that process operating requirements are met.

2.8 Task 8 - Groundwater Flow Testing

2.8.1 Gravity Flow Testing

A gravity flow test would be conducted at each VEW(if installed) and ICT section for a minimum of 72 hours. For ICT sections with more than one sump, flow testing will be conducted only at two sumps of each ICT section. The test will be used to evaluate the potential production rate of each well and ICT section in order to assure the proper pumping equipment selection, and to calibrate the overall extraction and treatment system.

Each flow test will also include the measurements of flow rates, flow volumes and water level readings in surrounding monitoring wells. The flow test, at each of the extraction systems, will be run at a constant flow rate in order to determine aquifer and well/trench performance in response to prolonged pumping. Lessons learned during the Phase II pilot study will be used during the implementation of this task. Data collected from the flow tests will be compiled and presented to the USACE for future use during the development of final remedial action.

Each flow test will be accomplished in three phases:

- Preparation;
- Testing; and
- Evaluation.

The following sections describe in detail the scope of work associated with each phase:

2.8.1.1 Preparation

The preparation phase for the planned gravity flow tests includes office and site tasks. For office/trailer preparation the DEI staff assigned to this testing program will be required to accomplish the following:

- Review project background data including technical reports that have been prepared for the subject site.
- Review the project Site Safety and Health Plan and Waste Management Plan, and

assemble all equipment required for executing the plans.

- Assemble materials and tools which would include but not be limited to:

  - Existing on-site well records;
  - Forms such as pumping well and observation well data sheets, samples of which are included in Appendix D;
  - Field book;
  - Groundwater text book (i.e. *Groundwater and Wells)*;
  - Graph paper including semi-logarithmic (4 and 5 cycle) and arithmetic ;
  - Unit conversion table;
  - Pencils, eraser, ruler, permanent black marking pen, calculator;
  - Watch set to proper time (a digital watch is preferred);
  - Water level indicator (at least 2);
  - Measuring tape;
  - Flow gages;
  - Keys to pumping and observation wells and any gates;
  - Container of known volume for calibrating pumping rate;
  - Appropriate sampling bottles;
  - Conductivity meter;
  - pH meter or paper;
  - Thermometer;
  - Spill control devices as cited in the Spill Control and Prevention Plan which is included in Section 5.0 of the Waste Management Plan; and
  - One-liter glass jars.

For site preparation the following actions will be taken:

- The following measurements and information will be recorded <u>prior to any testing</u>:

  - static water levels in the pumping well/sump and all observation wells measured to a specific reproducible measuring point.

  - height of each measuring point above ground level. This requires surveying-in the new monitoring wells locations and elevations.

- radial distance between the pumping well/sump and observation wells.

- depth of pump intake, top of well screen, and bottom of pumping well.

- local surface water features

- The following records will be prepared <u>prior to any testing:</u>

    - a scaled map showing well locations and ties to buildings, roads, surface water features, etc.

    - pumping well and observation wells data sheets including filling out all the information at the top of the data sheets and identifying the well number on every sheet. Also, numbering consecutive sheets "page 1 of _, page 2 of _, etc. Water level measurements should be recorded directly on the data sheets rather than in the field book. The field book may be used when doing a measurement of a circuit of observation wells, but the data should be transferred to the standard data sheets without delay. The "remarks" column on the data sheets will be used to show pumping rate checks, rainfall, sampling time, etc. Units will always be specified on the data sheets (feet, gallons per minute, etc.)

- The equipment will be assembled, calibrated and checked as necessary.

2.8.1.2 <u>Performance of flow Testing Activities</u>

The pumping rate must be calibrated, monitored and controlled during each test. The pumping rate should remain constant during each pumping period. Since the pumping rates are expected to be low, below 10 gallons per minute (gpm), a circular orifice weir for monitoring and controlling the pumping rate will not be necessary; however, pumping rates must always be calibrated, at the start of the pumping period, and monitored during pumping by checking the rate with a container of known volume and a stop watch.

The planned pumping rate for this test at each extraction system will be based on test results and lessons learned during the performance of the Phase II pilot study. The flow rate must remain constant throughout the pumping period. As the water level in the pumping well is lowered, it will be necessary to adjust the valve which controls the pumping rate. All adjustments should be recorded on the pumping well data sheet when they are made. Flow gages would be used to recorded the amount of extracted water during the test.

Water Level Readings During Pumping - Water levels in the pumping well and observation wells (maximum 6 adjacent wells) will be recorded manually. An automatic data logger may be used to supplement the manually collected data. The manual measurements will allow the field staff to observe the behavior of the pumping well and aquifer on a continuous basis. The water levels in the pumping well and observation wells must be measured from the same measuring point each time. The following list presents suggested elapsed times for readings to be adopted for the subject flow test for measurements of water levels in the pumping well. Each group in the list shows different time intervals which correspond to the logarithmic scale.

- 0 minutes, just as the pumping starts
- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 minutes
- 12, 14, 16, 18,20, 22 minutes
- 25, 30, 35,40, 45, 50, 55, 60 minutes
- 70, 80, 90, 100 minutes
- 120, 140, 160, 180, 200, 220, 240 minutes
- Every 60 minutes from 240 to 720 minutes
- Every 120 minutes from 720 to 1440 minutes
- Every 720 minutes from 1440 to 4320 minutes (72 hours)

For each flow test, water levels should be measured in no more than six observation wells. These wells will be determined in the field. The time intervals between readings will depend on the distances from the pumping well. Elapsed times for readings should be offset from those for the pumping well. It is important to measure water levels in all observation wells just prior to the end of the pumping period.

In the event of failure of pump or related equipment during the first 24 hours of pumping, for a period greater than <u>one percent of the elapsed time</u>, the test will be suspended. After suspension, the water level in the pumping well should then be allowed to recover to its original level prior to restarting the test. If pumping, during the first 24 hours of pumping, is stopped for less than one percent of the elapsed time, the test should continue. The "down-time" should be recorded on the data sheets. If pumping, after the first 24 hours of pumping, is stopped for more than one percent of the elapsed time due to failure of the pump or related equipment, the Field Test Manager will be contacted and briefed on the status of the test. The Project Manager or his designated representative will decide, based on the quality of the data, to either suspend or restart the tests.

Water Level Readings During Recovery - The water level in the pumping well should be monitored after the stoppage of pumping. Water levels are to be recorded from the start of this recovery period and should proceed at the same time intervals as those for the start of pumping. The collection of recovery data should be maintained for at least 24 hours.

WaterDischarge - The pumped groundwater will be collected in frac tanks and taken to the GWTP for treatment. However, if the groundwater collection (piping) system could be used during the performance of any of the flow tests, than the groundwater will be pumped directly through the collection system to the GWTP.

2.8.1.3 Data Evaluation

The evaluation of the pumping test data should start while the test is being conducted and after being completed. Tasks that are considered as part of the data evaluation process include the following:

- Plotting sustainable flow rate versus time; and
- Calculating and plotting graphs of drawdown or recovery versus time.

All data would be recorded clearly on the appropriate forms and graphs.

2.9 Task 9 - Evaluating The Hydraulic Effectiveness of The Extraction System

The hydraulic effectiveness of the extraction system will be evaluated by monitoring groundwater levels and quality in the shallow aquifer during the implementation of the selected remedy.

2.9.1 Groundwater Quality Monitoring

Groundwater quality monitoring in the shallow aquifer will be conducted at the extraction points and at the existing monitoring wells. These wells range in depth from 20 to 40 feet with one well C4-A extending to about 130 feet below ground surface. The objective of this monitoring is as follows:

- Sampling and testing the groundwater at the extraction wells and sumps would allow the evaluation of the impact of pumping on the quality of influent groundwater from individual locations. This information would be useful in the fine tuning of the groundwater extraction, collection, and treatment system. The sampled groundwater at these locations will be tested for VOCs and chloride in accordance with the requirements listed in Table 2.5.

- Sampling and testing the groundwater at the monitoring wells would allow the evaluation of the impact of pumping on the plume in the shallow aquifer. The sampled groundwater from the monitoring wells would be tested for VOCs, metals, and chloride in accordance with the requirements listed in Table 2.5.

The testing results would be validated by DEI and submitted to the USACE as required.

2.9.2 Groundwater Levels and Evaluation of Plume Containment

Water levels from onsite monitoring wells and piezometers would be used to generate groundwater contour maps which would assist in the evaluation of plume containment in the shallow aquifer due to the groundwater extraction system. Water levels in all onsite monitoring wells and piezometers will be collected according to the schedule listed in Table 2.6. Groundwater sampling and water level measurements would be accomplished in accordance with the project CDAP. Data collected for this evaluation and for the treatment plants would be maintained in a database by DEI at the site. This database would be made available to USACE upon request. The data will also be made available to EPA and TNRCC upon approval from the USACE.

A monthly summary report will be provided to EPA and TNRCC in accordance with reporting guidance received. The report will be brief and will include such items as volumes of soils and water treated, summary of analytical data, and any other pertinent information. The report will not include copies of laboratory reports.

TABLE 2.5

IRA - Burning Ground No. 3
Monitoring of Groundwater Quality In The Shallow Aquifer
Testing Requirements at An Off-Site Laboratory
LHAAP, Karnack, Texas

Description of Activity	Parameters	Test Method	Testing Frequency
1.0 Sampling and Testing at The extraction Points, VEWs, HEW, and ICT Sumps.	VOCs Chloride	8240 325.3	1. Every Month for the first three months of system operation, and 2. Every quarter there after.
2.0 Sampling and Testing the network of onsite monitoring wells.	VOCs Metals Chloride	8240 6010/7000 325.3	1. One time prior to the startup of groundwater extraction and treatment; 2. One month after the entire extraction system is operating; 3. Three months after the entire extraction system is operating , and 3. Every six months there after.

TABLE 2.6

IRA - Burning Ground No. 3
Schedule For
Monitoring of Groundwater Levels In The Shallow Aquifer
LHAAP, Karnack, Texas

Corresponding Activity/Event	Requirements/Frequency of Water Level Measurements.
1. Prior to the initiation of onsite activities (i.e. ICT installation).	Water levels would be taken at each monitoring well and piezometer daily for a period of one week.
2. During Flow Testing.	Water levels would be taken only as required by Sections 2.8.
3. During Extraction System Operations.	Water levels would be collected monthly and during sampling as required in Table 2.5

3.0 SOIL AND SOURCE MATERIAL EXCAVATION, TREATMENT AND DISPOSAL

Approximately 50,000 cubic yards of soil and source material, including soil excavated during the construction of the groundwater collection system, will be excavated and treated using low temperature thermal desorption for removal of VOCs. The excavated soil and source material will be treated according to the requirements of the Land Disposal Restrictions (LDRs) (40 CFR Part 268) under RCRA. The remedy will comply with the LDRs through a Treatability Variance (40 CFR 268.44) for the wastes. The treatment level range that will be established through the treatability variance is a 90 to 99.9 percent reduction in the concentration of the contaminants upon the completion of the treatment process. The EPA Superfund LDR Guide #6A "Obtaining a Soil and Debris Treatability Variance for Remedial Actions" will be used as a guideline during the IRA. Table 3.1 presents the alternate treatability variance levels, as listed in Highlight 5 of Guide #6A, for the VOCs detected in the Burning Ground soils and source material. It includes values for concentration range, threshold concentration, and percent reduction range. The concentration of each constituent in the waste feed will be compared to the threshold concentration listed in Table 3.1 in order to select the appropriate concentration or percent reduction range. If the concentration of the constituent in the waste feed is less than the threshold concentration, the waste should be treated to within the concentration range. If the waste concentration is above the threshold, the waste should be treated to reduce the concentration of the constituent in the waste to within the specified reduction range. Air emissions from the treatment process must meet the requirements of TNRCC Standard Exemption 118(b),(c), and (d). Standard Exemption 118 states that new or increased emissions, including fugitives, of chemicals shall not be emitted from the control equipment in a quantity greater than 5 tons per year (TPY) or in a quantity that is greater than the maximum allowable hourly emission (calculated based on distance to the nearest off-site receptor and TNRCC limits for parameters of concern) which never exceeds 6 pounds per hour. The Air Monitoring Plan for the IRA, which is included as Appendix C of the CDAP, describes in detail the air monitoring procedures that will be implemented during the IRA.

The VOCs separated from the soil and source material will be catalytically converted to carbon dioxide, water, and hydrogen chloride gases. The gases will be scrubbed using water and sodium hydroxide (if needed) to produce a very diluted acid stream. The acid stream will be neutralized to produce sodium chloride that is dissolved in the water used to scrub the acid. This water will be discharged to Harrison Bayou and/or Central Creek if it meets the requirements of Table 2.1 If it does not meet the requirements of Table 2.1, this water shall be processed through the GWTP, and discharged once the requirements of Table 2.1 are met. The following sections detail

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Table 3.1
LHAAP, Burning Ground No. 3, IRA
Alternate Treatability Variance levels For
Soil and Source Material Treatment
In Accordance With EPA Superfund LDR Guide #6A.

Structural Functional Groups	Soil Treatment Requirements		
	Concentration Range (ppm)	Threshold Concentration (ppm)	Percent Reduction Range
Halogenated Aliphatics	0.5-2	40	95 - 99.9
Methylene Chloride			
Trichloroethylene			
Vinyl Chloride			
1,2-Dichloroethene			
1,1-Dichloroethane			
1,1-Dichloroethane			
Tetrachloroethane			
Chloroform			
1,1-Dichloroethene			
1,1,1-Trichloroethane			
Trichlorofluoromethane			
Other Polar Organics	0.5-10	100	90-99.9
Acetone			
Slightly Polar Organics	0.5-10	100	90-99.9
Toluene			
Ethylbenzene			
Xylene			
Styrene			
Benzene			

the activities related to soil/source material excavation, treatment, disposal, and site restoration.

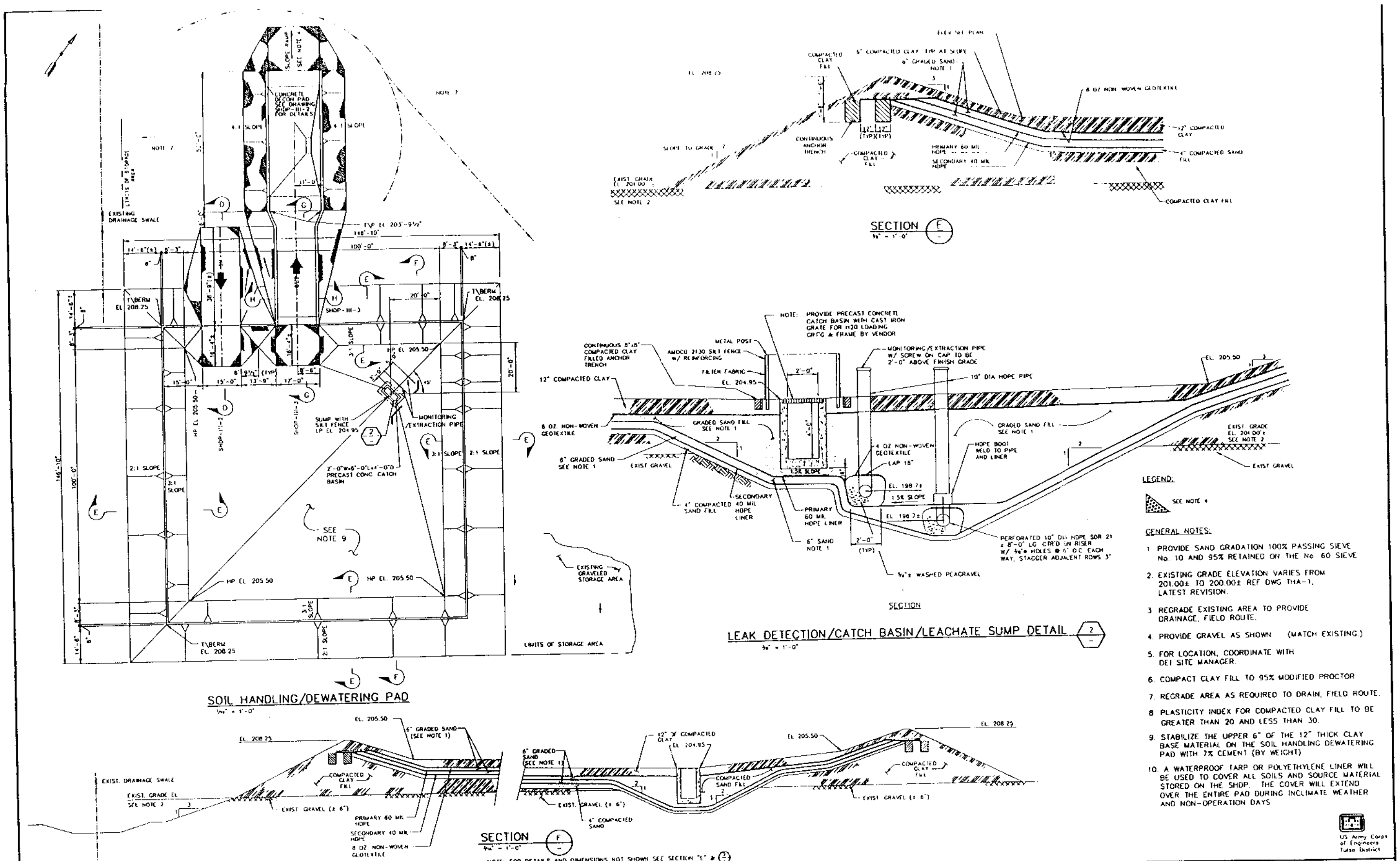
3.1 Task 1 - Construction of Soil Handling and Dewatering Pad

A soil handling and dewatering pad (SHDP) will be constructed at the southwestern corner of the TSSA as shown on Drawing SP-III-1. Details for the SHDP are shown on Drawings SHDP-III-1, SHDP-III-2, and SHDP-III-3. Major features of this pad include:

- The placement of the pad over the existing TSSA surface;
- The use of two HDPE layers with leak monitoring points;
- The use of a clay working surface which would be easier to handle than a concrete slab after treatment is completed;
- The use of earth berms to prevent spillage and assure containment of waste, and
- The use of a concrete sump that is equipped with a pump in order to collected liquid waste from the pad and discharge it to the equalization tank and/or frac tank for treatment at the GWTP.

The SHDP will be constructed in accordance with the appropriate specifications which are included in Appendix A including grading - Section 02211 and synthetic geomembrane - Section 02277.

The sand material that remained in a stock pile at the burning ground site from the Phase II activities will be hauled to the TSSA and used where sand is specified for the SHDP (i.e. under and over the HDPE liners). If the existing stock pile is not large enough to complete the work then clean sand will be imported from an off-site location as necessary. Other specified soil material including the clay would be hauled to the site from the LHAAP borrow pit located at the Radio Tower Hill site. Required gravel will be imported from an off site location. This gravel source would most likely be the same as the one used for the gravel that was placed on the TSSA.



LEGEND:

SEE NOTE 4

GENERAL NOTES:

1. PROVIDE SAND GRADATION 100% PASSING SIEVE No. 10 AND 95% RETAINED ON THE No. 60 SIEVE
2. EXISTING GRADE ELEVATION VARIES FROM 201.00± TO 200.00± REF DWG THA-1, LATEST REVISION.
3. REGRADE EXISTING AREA TO PROVIDE DRAINAGE, FIELD ROUTE.
4. PROVIDE GRAVEL AS SHOWN (MATCH EXISTING.)
5. FOR LOCATION, COORDINATE WITH DEI SITE MANAGER.
6. COMPACT CLAY FILL TO 95% MODIFIED PROCTOR
7. REGRADE AREA AS REQUIRED TO DRAIN, FIELD ROUTE.
8. PLASTICITY INDEX FOR COMPACTED CLAY FILL TO BE GREATER THAN 20 AND LESS THAN 30.
9. STABILIZE THE UPPER 6" OF THE 12" THICK CLAY BASE MATERIAL ON THE SOIL HANDLING DEWATERING PAD WITH 7% CEMENT (BY WEIGHT)
10. A WATERPROOF TARP OR POLYETHYLENE LINER WILL BE USED TO COVER ALL SOILS AND SOURCE MATERIAL STORED ON THE SHOP. THE COVER WILL EXTEND OVER THE ENTIRE PAD DURING INCLIMATE WEATHER AND NON-OPERATION DAYS

US Army Corps of Engineers Tulsa District

DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
DBC	RSP	RSP			E	ISSUED FOR COMMENTS	08/08/95
GWB	RSP	RSP			D	ISSUED FOR COMMENTS	07/18/95
GWB	RSP	RSP			C	ISSUED FOR COMMENTS	06/22/95
GWB	RSP	RSP			B	ISSUED FOR COMMENTS	06/12/95
GWB	RSP	RSP			F	ISSUED FOR COMMENTS	08/17/95
EP					-	INITIAL RELEASE	07/26/94

DRAWING NUMBER	DRAWING TITLE
C050	TRUCK RAMP, DECON PAD PLAN & SECTIONS

REFERENCE DRAWINGS

FILE dwg. S:\2379\DEIDWG\CIVIL\C050.DWG
PLOTTED: 08/17/95 PM

Dow Environmental

SOIL HANDLING/DEWATERING PAD
PLAN SECTIONS AND DETAIL
BURNING GROUND No. 3
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PROJECT: LHAAP 18 & 24 IIL IRA
PROJECT NO: 2379
SCALE: AS SHOWN
DRAWING NUMBER: SHDP-III-1
REV: F

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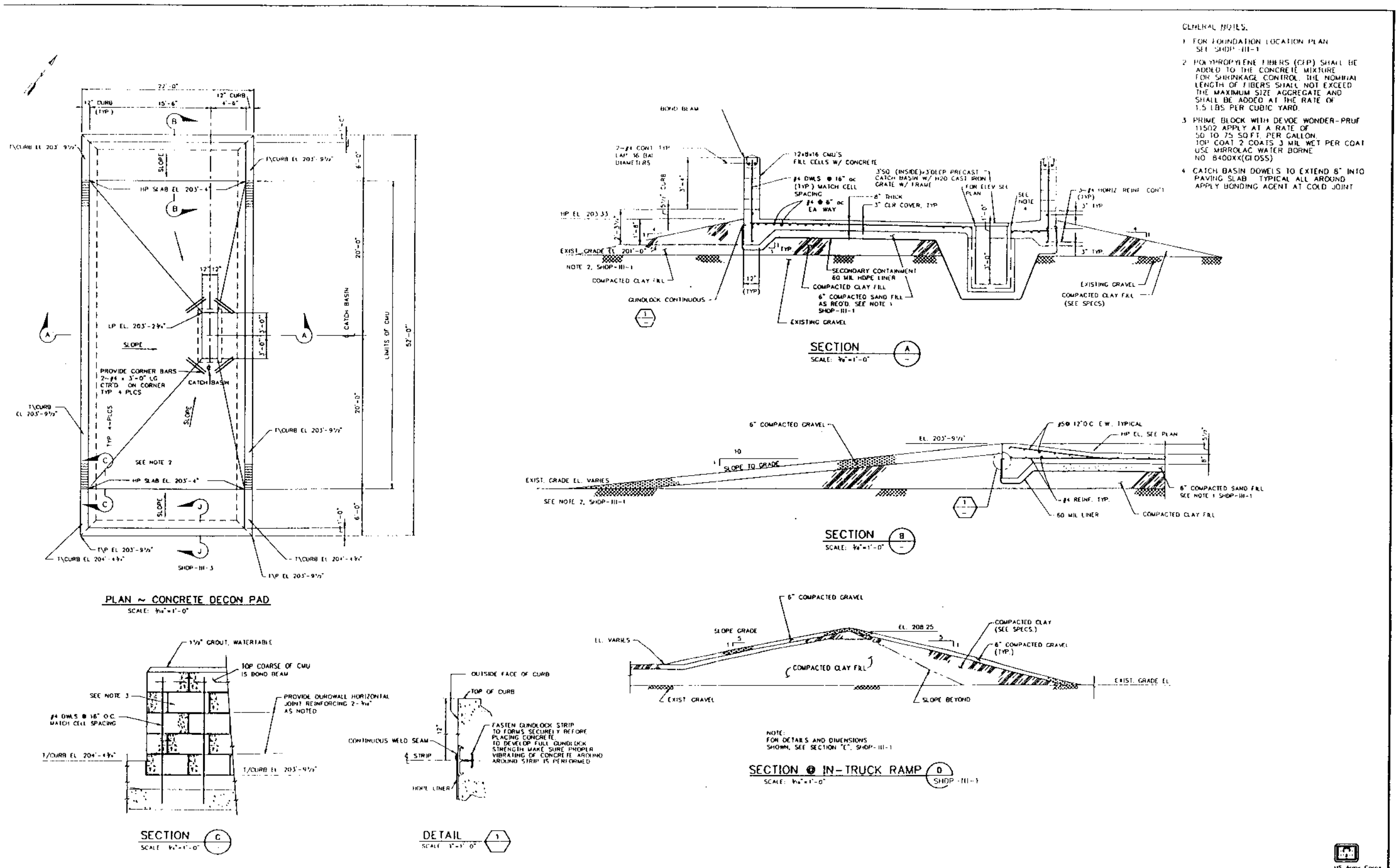


GENERAL NOTES:

1. FOR FOUNDATION LOCATION PLAN SEE SHDP-III-1
2. POLYPROPYLENE FIBERS (CFP) SHALL BE ADDED TO THE CONCRETE MIXTURE FOR SHRINKAGE CONTROL. THE NOMINAL LENGTH OF FIBERS SHALL NOT EXCEED THE MAXIMUM SIZE AGGREGATE AND SHALL BE ADDED AT THE RATE OF 1.5 LBS PER CUBIC YARD.
3. PRIME BLOCK WITH DEVOE WONDER-PRUF 11502 APPLY AT A RATE OF 50 TO 75 SQ.FT. PER GALLON. TOP COAT 2 COATS 3 MIL WET PER COAT USE MIRROLAC WATER BORNE NO. 8400XX(GLOSS)
4. CATCH BASIN DOWELS TO EXTEND 8" INTO PAVING SLAB. TYPICAL ALL AROUND. APPLY BONDING AGENT AT COLD JOINT

DRAWING NUMBER	DRAWING TITLE
SHDP-III-1	PLAN, SECTIONS & DETAILS

REFERENCE DRAWINGS

DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
DBC	RSP	RSP			D	ISSUED FOR COMMENTS	08/08/95
GWB	RSP	RSP			C	ISSUED FOR COMMENTS	07/18/95
DBC	GWB	RSP			B	ISSUED FOR COMMENTS	06/22/95
DBC	GWB	RSP			A	ISSUED FOR COMMENTS	06/12/95

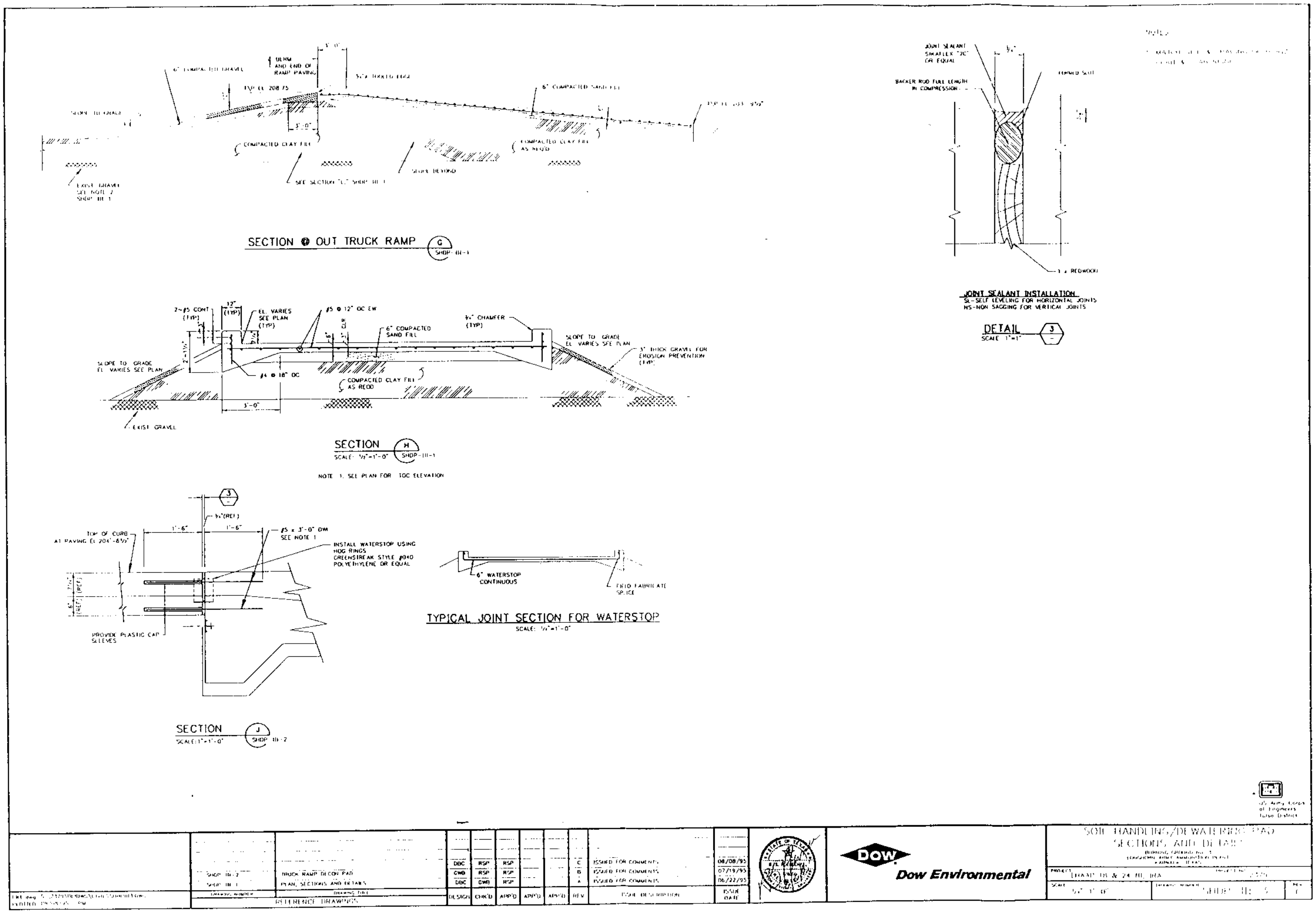
FILE dwg S:\2379\DFDWG\CIVIL\C050.DWG
PLOTTED 08/08/95 PM

Dow Environmental

SOIL HANDLING/DEWATERING PAD
TRUCK RAMP, DECON PAD PLAN AND SECTS
BURNING GROUND No. 3
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PROJECT: LHAAP PHASE II PILOT STUDY FOR IRA — PROJECT NO. 2379

SCALE: 3/16"=1'-0" — DRAWING NUMBER: SHDP-III-2 — REV: D


SECTION @ OUT TRUCK RAMP
6" COMPACTED GRAVEL
BERM AND END OF RAMP PAVING
TOP EL 208.75
6" COMPACTED SAND FILL
COMPACTED CLAY FILL
COMPACTED CLAY FILL AS REQD
EXIST GRAVEL
SECTION
SCALE: 1/2"=1'-0"
2-#5 CONT (TYP)
EL VARIES SEE PLAN (TYP)
#5 @ 12" OC EW
6" COMPACTED SAND FILL
3/4" CHAMFER (TYP)
SLOPE TO GRADE EL VARIES SEE PLAN
3" THICK GRAVEL FOR EROSION PREVENTION (TYP)
#4 @ 18" OC
COMPACTED CLAY FILL AS REQD
3'-0"
EXIST GRAVEL
NOTE 1. SEE PLAN FOR TOC ELEVATION
TOP OF CURB AT PAVING EL 204'-8 1/2"
#5 x 3'-0" DW SEE NOTE 1
INSTALL WATERSTOP USING HOG RINGS GREENSTREAK STYLE #040 POLYETHYLENE OR EQUAL
PROVIDE PLASTIC CAP SLEEVES
SECTION
SCALE: 1"=1'-0"
6" WATERSTOP CONTINUOUS
FIELD FABRICATE SPLICE
TYPICAL JOINT SECTION FOR WATERSTOP
JOINT SEALANT SIKAFLEX "2C" OR EQUAL
BACKER ROD FULL LENGTH IN COMPRESSION
1 x REDWOOD
JOINT SEALANT INSTALLATION
SL-SELF LEVELING FOR HORIZONTAL JOINTS
NS-NON SAGGING FOR VERTICAL JOINTS
DETAIL
SCALE: 1"=1"
US Army Corps of Engineers Tulsa District
SHOP III-2
SHOP III-1
TRUCK RAMP DECON PAD
PLAN, SECTIONS AND DETAILS
REFERENCE DRAWINGS
DBC RSP RSP C ISSUED FOR COMMENTS 08/08/95
CWB RSP RSP B ISSUED FOR COMMENTS 07/19/95
DBC CWB RSP A ISSUED FOR COMMENTS 06/22/95
DESIGN CHK'D APP'D APP'D APP'D REV ISSUE DESCRIPTION ISSUE DATE
DOW
Dow Environmental
SOIL HANDLING/DEWATERING PAD
SECTIONS AND DETAILS

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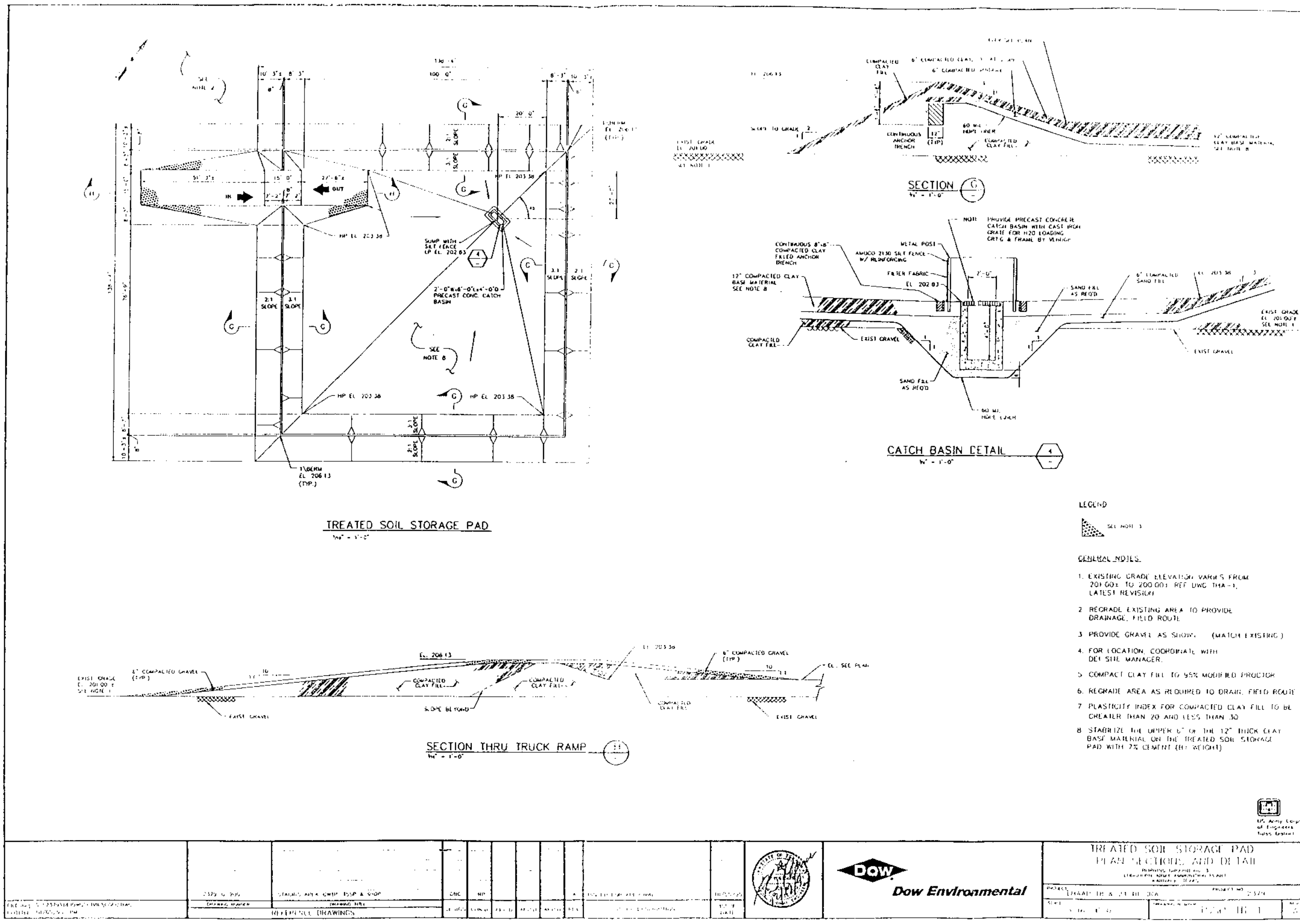
A high density tarp or a polyethylene liner will be used to cover all soils and source material staged at the SHDP and TSSP. This cover will also extend over the entire pads during any precipitation and during non-operation days (i.e. Sunday). However, a temporary structure (approximately 100 ft. by 80 ft.) may, upon approval by the USACE be placed on each pad, instead of the tarp, to protect pretreatment and post treatment activities from precipitation and wind. The covered area will also be used to house the power screen and conveyor to the Low Temperature Thermal Desorption (LTTD) unit feed hopper along with any other equipment such as a shredder or a crusher that may be required and as a place to carry out pretreatment activities that may cause fugitive particulate emissions.

The working clay surface and all the soils associated with the pad will be treated in the STP upon completion of treatment for soils and source material. The HDPE liners will be power washed and decontaminated prior to disposal at an appropriate off-site location in compliance with regulatory requirements. The clean up of debris described below will be conducted in a small area located next to the sump of the SHDP.

A concrete decontamination pad (DP) would be built next to the SHDP as shown on Drawings SHDP-III-1, SHDP-III-2, and SHDP-III-3. The DP will be built in accordance to applicable specifications included in Appendix A. The pad will be used to decontaminate trucks after they empty their load of soil and/or source material on the SHDP. Soil and/or source material will be generated during construction of the ICT sections, excavation and installation of the groundwater collection system, and excavation and treatment of source material. The DP will also be used to decontaminate drums, rolloff boxes, construction and drilling equipment, and other equipment as needed. Liquid waste from decontamination activities will be collected in a concrete sump and pumped to the GWTP for treatment. Any solid waste generated during decontamination operations it will be collected in appropriate containers and placed on the SHDP for treatment at the STP. The concrete DP will not be removed following the completion of the IRA.

3.2 Task 2 - Construction of Treated Soil Staging Pad

A treated soil staging pad (TSSP) will be built in the southeastern corner of the TSSA as shown on Drawing SP-III-1 and as detailed on Drawing TSSP-III-1. This pad will be built the same as



TREATED SOIL STORAGE PAD
SECTION THRU TRUCK RAMP
SECTION G
CATCH BASIN DETAIL
SUMP WITH SILT FENCE
2'-0"x8'-0"x4'-0"D PRECAST CONC. CATCH BASIN
HP EL 203.38
IN
OUT
SEE NOTE 8
2:1 SLOPE
3:1 SLOPE
NOTE: PROVIDE PRECAST CONCRETE CATCH BASIN WITH CAST IRON GRATE FOR H20 LOADING
METAL POST
FILTER FABRIC
EL 202.83
12" COMPACTED CLAY BASE MATERIAL SEE NOTE 8
COMPACTED CLAY FILL
EXIST GRAVEL
SAND FILL AS REQ'D
6" COMPACTED SAND FILL
EL 206.13
6" COMPACTED GRAVEL (TYP)
COMPACTED CLAY FILL
SLOPE BEYOND
LEGEND
SEE NOTE 3
GENERAL NOTES:
1. EXISTING GRADE ELEVATION VARIES FROM 201.00± TO 200.00± REF DWG THA-1, LATEST REVISION
2. REGRADE EXISTING AREA TO PROVIDE DRAINAGE, FIELD ROUTE
3. PROVIDE GRAVEL AS SHOWN. (MATCH EXISTING)
4. FOR LOCATION, COORDINATE WITH DEI SITE MANAGER.
5. COMPACT CLAY FILL TO 95% MODIFIED PROCTOR
6. REGRADE AREA AS REQUIRED TO DRAIN, FIELD ROUTE
7. PLASTICITY INDEX FOR COMPACTED CLAY FILL TO BE GREATER THAN 20 AND LESS THAN 30
8. STABILIZE THE UPPER 6" OF THE 12" THICK CLAY BASE MATERIAL ON THE TREATED SOIL STORAGE PAD WITH 2% CEMENT (BY WEIGHT)
US Army Corps of Engineers Tulsa District
REFERENCE DRAWINGS
Dow Environmental
TREATED SOIL STORAGE PAD
PLAN SECTIONS AND DETAIL

016419

the SHDP. However, it will have only one HDPE liner as shown on Drawing TSSP-III-1. The pad will be used to store treated soils and source material until laboratory test results on samples collected from these materials become available. If the test results indicate that the treated soils and/or source materials meet the remedial objectives then the treated material would be either hauled to the burning ground to be used as backfill or it would be hauled to LHAAP 12 for disposal as described above.

The working clay surface and all the soils associated with the pad will be treated at the STP upon completion of treatment for soils and source material similar to the SHDP. The HDPE liner will be power washed and decontaminated prior to disposal at an appropriate off-site location.

3.3 Task 3 - Mobilization, Setup, and Performance Testing of Soil Treatment Plant

3.3.1 General

The Soil Treatment Plant (STP) to be utilized at Burning Ground No. 3 for Low Temperature Thermal Desorption (LTTD) will consist of three primary trailers, one thermal desorbtion/particulate removal trailer (47 ft. long by 8 ft., 6 in. wide) and two identical catalytic oxidizer trailers (48 ft., 7 in. long by 8 ft., 6 in. wide) each equipped with a chlorinated hydrocarbon catalyst a multi-stage thermal quench and an acid-gas scrubber along with various ancillary equipment and structures. The particulate-free gases exiting the baghouse on the thermal desorption/particulate removal trailer are split into two equal volumes with each air stream routed to a separate catalytic oxidation/scrubber trailer.

A portion of the SHDP will be designated for thermal desorption operations. An area of 100 ft. by 100 ft. will be set aside for placement of the primary thermal desorption equipment. It is anticipated that 1 week to 10 days will be required to spot the system units and to complete hookup of the utilities. This will also include placement of ancillary equipment and structures such as the discharge moisturizing auger, a small dust suppression structure at the auger discharge and an enclosure around the control panels. Drawing TD-III-1 shows the location of the area at the TSSA designated for thermal desorption operations. Drawing TD-III-2 shows the general configuration of the three trailer system and ancillary equipment.

While placement and setup of the Thermal Desorption System are taking place, portions of the

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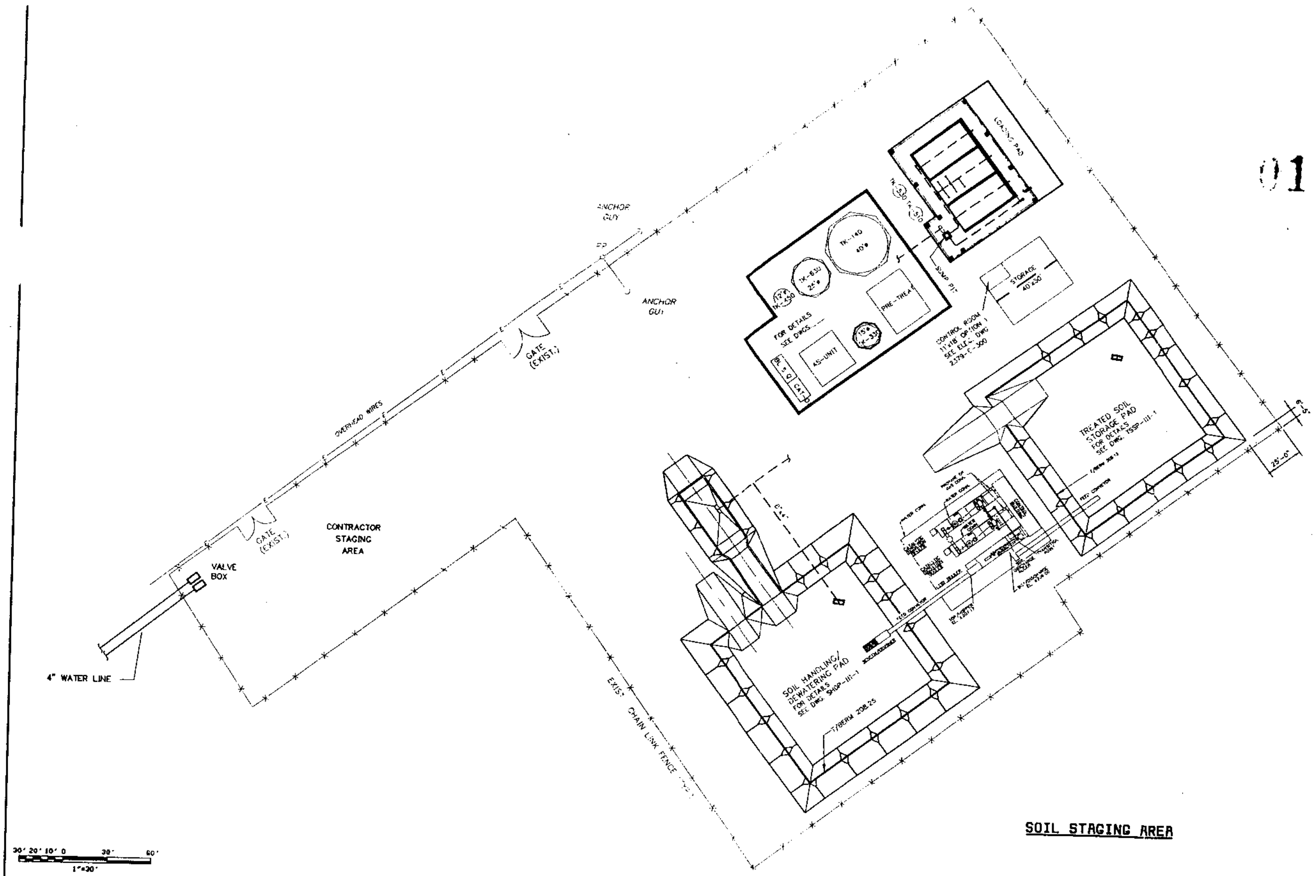

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Dow Environmental

SOIL TREATMENT PLANT
SITE PLAN
PHASE III –IRA– BURNING GROUND No.3

CLIENT: LHAAP KARNACK, TEXAS
PROJECT NUMBER: 2379
SCALE: AS SHOWN
DRAWING NUMBER: TD-III-1
REV: –

US Army Corps of Engineers Tulsa District

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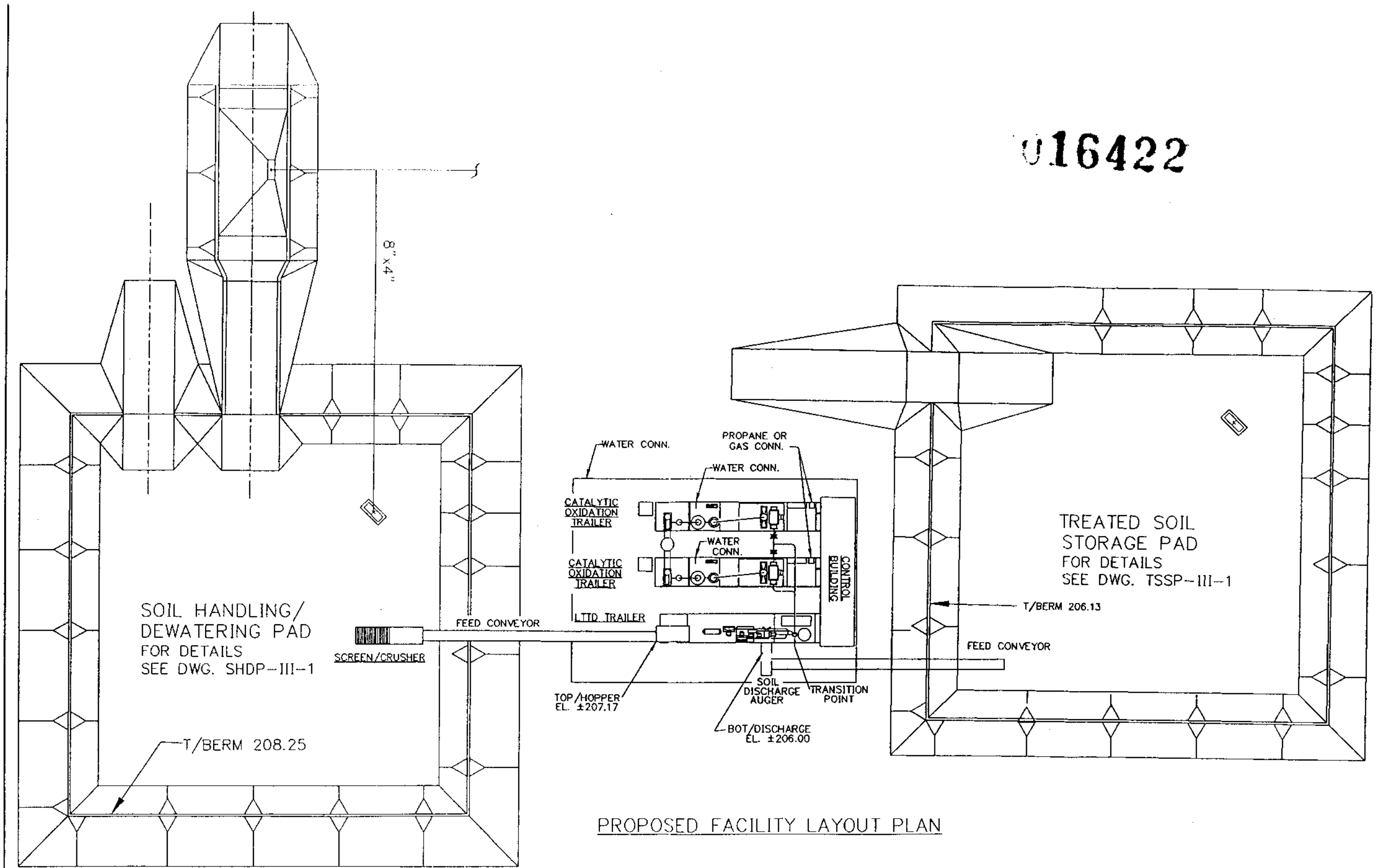

PROPOSED FACILITY LAYOUT PLAN

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DOW
Dow Environmental
HOUSTON TEXAS

PLOT PLAN
LOW TEMP. THERMAL DESORPTION WITH
CHLORINATED CATALYTIC OXID. & SCRUB.

CLIENT LHAAP KARNACK, TEXAS — JOB NUMBER 2379
SCALE NOT TO SCALE — DRAWING NUMBER TD-III-2 — REV

Site Health and Safety Plan relevant to STP operations will be implemented. This will include education and orientation of workers to health and safety concerns relative to thermal desorption operations.

3.3.2 Set-Up (First Week)

Equipment set-up is expected to require about 1 week and will include the following tasks:

a. Place and secure the single desorber trailer and the two catalytic oxidizer/scrubber trailers and any ancillary equipment on site in their designated operating locations

b. Assemble connecting ducting and piping between all trailers and above the shipping break on the two catalytic oxidizer/scrubber trailers

c. Locate the power screen and conveyor on the contaminated soils pad in such a manner that the conveyor will feed into the LTTD trailer cold feed hopper

d. Connect trailer and ancillary control systems via interconnecting control cables

e. Connect utilities (ie. natural gas, electricity and water supply)

f. Place and connect the discharge moisturizing auger and the power screen with connecting conveyor

g. Construct temporary dust suppression housing around the exit port on the discharge moisturizing auger, a temporary enclosure around the control panels located at the ends of the trailers and an enclosure to protect the conveyor between the power screen and the desorber trailer hopper from precipitation and wind

h. Construct a secondary containment structure under the desorber unit cold feed conveyor belt and the continuous weigh conveyor belt to retain any spillage that might occur from the conveyor belts

I. Locate scrubber blowdown holding tank (frac tank) next to trailers and construct connecting piping to the GWTP

3.3.3 Start-up and Shakedown

Shakedown of the system is expected to begin during the second week that the thermal desorption equipment is on site. Shakedown operations will consist of "dry" running (ie. operating each unit without the presence of contaminated soils) of all LTTD trailer and catalytic oxidizer/scrubber trailer systems. This will confirm the appropriate functioning of each separate system unit and unit operations as a combined system. During this period all safety interlocks and shutdown devices within all systems including the PLC (Process Logic Computer) system will be thoroughly checked for proper operation.

The third week will be used to "fine-tune" the STP under actual operating conditions. During this period soils will be processed, providing the opportunity to make any adjustments necessary to optimize operations. At any time that soils are being processed all systems will be operated utilizing operating parameters that are expected to be successful in meeting all regulatory requirements including destruction and removal efficiencies. This short period of "fine-tuning" will assure that the system operates over the long run in a manner that will consistently achieve the required performance criteria.

3.3.4 Performance Testing

During the fourth week, prior to full scale implementation of the STP operations, a complete system performance evaluation will be conducted on site. This Proof of Performance (POP) test will be performed in accordance with procedures and standards required by the EPA and the TNRCC. The POP test will be conducted to verify the STP can meet the specified criteria for soil and source material treatment and air emissions requirement. The POP test will be performed by personnel experienced with evaluation of performance parameters generally included with thermal systems performance testing. The POP test will include characterization of the following waste streams, residuals and air emissions: , stack gases (including organic air emissions, metal air emissions and acid gas emissions), treated solids, scrubber blow-down water and baghouse fines. A general soil/sediment and residue sampling plan to monitor the performance of the STP for the treatment of the contaminated soil and source material appears below. Table 3.2 outlines the POP test sampling and analysis procedure.

Table 3.2
LHAAP, Burning Ground No. 3, IRA
STP Proof of Performance (POP) Test Procedure

Description of Material To Be Tested	Frequency of Onsite Testing	Frequency of Offsite Testing	Parameters	Test Method(s) 40 CFR 60 Appendix A
Waste Feed	One Grab Sample Per Run*	One Grab Sample Per Run*	VOCs	Method 8010 (Onsite Testing) Method 8240 (Offsite Testing)
			Total Metals	Method 6010 (for onsite lab) Method 6010/7000 (for offsite lab)
			Total Chlorides	Method 325.3
	None	One Composite Sample Per Run*	Moisture Content	ASTM D2216
			Atterberg Limit	ASTM D4318
			Particle Size	ASTM D422
	One Time Or If Drum Angle or Rotation Changes	None	Residence Time In Drum (Average)	Actual Measured Time
Operational Parameters	Continuous	None	Soils Discharge Temp.	STP Instrument
			Catalyst Inlet. Temp.	STP Instrument
			Catalyst Exit Temp.	STP Instrument
			Drum Draft	STP Instrument

*POP testing will include one test for each of 2 conditions (high temperature feed rate and low temperature feed rate). Each test will consist of 3 one hour runs from which results of each test will be averaged. Depending on the results of initial POP testing, additional test conditions may be added to the testing program. A new test condition may be added to the testing program. Each new test will consist of 3 one hour runs.

Table 3.2 (Continue)
LHAAP, Burning Ground No. 3, IRA
STP Proof of Performance (POP) Test Procedure

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Description of Material To Be Tested	Frequency of Onsite Testing	Frequency of Offsite Testing	Parameters	Test Methods 40 CFR 60 Appendix A
Stack Emissions Monitoring	Continuous Emissions Monitors (CEMs)	None	TOC's	Method 25
			Carbon Dioxide	Method 3
			Oxygen	Method 3
			Nitrogen Oxides	Method 7
			Carbon Monoxide	Method 10
	None	One Sample Per Run**	VOCs	Method TO-14
			Heavy Metals	Modified Method 5
			Acid Gas (HCl)	Method 26
			Total Particulates	Method 5
			Chlorine Gas	Method 26A
			Dioxins & Furans	Method 23
			Moisture Content	Method 4
			Stack Gas Velocity and Volumetric Flow Rate	Method 2

*POP testing will include one test for each of 2 conditions (high temperature feed rate and low temperature feed rate). Each test will consist of 3 one hour runs from which results of each test will be averaged. Depending on the results of initial POP testing, additional test conditions may be added to the testing program. A new test condition may be added to the testing program. Each new test will consist of 3 one hour runs.

** VOST and Method 0010 will be used to sample for organic compounds.

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Table 3.2 (Continue)
LHAAP, Burning Ground No. 3, IRA
STP Proof of Performance (POP) Test Procedure

Description of Material To Be Tested		Frequency of Onsite Testing	Frequency of Offsite Testing	Parameters	Test Methods 40 CFR 60 Appendix A
Residuals	Treated Soils	One Grab Sample Per Run*	One Grab Sample Per Run*	VOCs/Target Compounds	Method 8010 (Onsite Testing) Method 8240 (Offsite Testing)
				Total Metals	Method 6010 (for onsite lab) Met 6010/7000 (for offsite lab)
	Scrubber Blowdown Water	One Grab Sample Per Day	One Grab Sample Per Day	As required in Table 2.2 and Table 2.3	As required in Table 2.2 for Offsite Testing and Table 2.3 for On Site Testing
Residuals (continued)	Baghouse Fines	One Grab Sample Per Run*	One Grab Sample Per Run*	VOCs/Target Compounds	Method 8010 (Onsite Testing) Method 8240 (Offsite Testing)
				Total Metals	Method 6010 (for onsite lab) Met 6010/7000 (for offsite lab)

*POP testing will include one test for each of 2 conditions (high temperature feed rate and low temperature feed rate). Each test will consist of 3 one hour runs from which results of each test will be averaged. Depending on the results of initial POP testing, additional test conditions may be added to the testing program. A new test condition may be added to the testing program. Each new test will consist of 3 one hour runs.

3.3.4.1 Waste Feed

Waste feed sampling will be conducted to characterize physical and chemical properties and the rate to allow adjustment of STP parameters to accommodate potentially differing conditions and provide documentation of reasons for any operational changes. This sampling program will include an analysis of each waste or mixture of wastes to be treated including:

<u>Physical</u>	<u>Chemical</u>
Plasticity	VOCs/Target Compounds
Moisture Content	Heavy Metals
Particle Size	Total Chloride

A grab sample for analysis of the physical and chemical parameters described above will be collected at a minimum of every 4 hours from discrete piles of materials immediately prior to their introduction into the STP. Samples shall be collected in accordance with the CDAP.

3.3.4.2 Stack Emissions

Continuous Emissions Monitors (CEMs) will be used to assess stack emissions for total hydrocarbons (TOCs), carbon dioxide, oxygen, nitrogen oxides and carbon monoxide. Stack testing will also include testing for organic air emissions, metal air emissions and acid gas emissions. In addition, stack gases will be monitored for total particulate matter, chlorine gas, dioxins and furans, moisture and gas volume. Details of the stack monitoring procedures for the POP test appear in Appendix C of the CDAP - Air Monitoring Plan.

3.3.4.3 Residues

During each performance test run, grab samples of treated soils, scrubber blow-down water and baghouse fines will be collected and analyzed to determine the effectiveness of the treatment process. The samples will be collected in accordance with the residue sample protocol presented in the CDAP. The residue grab samples will be submitted to the laboratory for VOCs and metals analysis.

3.3.4.4 Operational Parameters

During the POP test the following operational parameters will be monitored and recorded:

1) feed rate,
2) temperature of treated soils at point of discharge,
3) temperature of gases at catalyst inlet,
4) temperature of gases at catalyst exit, and
5) pressure in LTTD treatment chamber.

The performance test will aid the STP operator in adjusting the treatment operating parameters for optimal efficiency. During the POP Test, additional operational parameters will be monitored and recorded as described in EPA's draft guidance on LTTD (USEPA, OSWER, Pub. 9355.08FS, July 1994), May 8, 1995 Draft, Highlight 4 with only one exception. Dust collected in the baghouse is mixed with treated soils for cooling and remoisterization prior to discharge and sampling.

3.3.5 Description of Soil Treatment Plant and Treatment Operations

3.3.5.1 Equipment Description

The soil treatment plant that will be provided by Dow Environmental for the Interim Remedial Action at Longhorn Army Ammunition Plant, Burning Ground No. 3 has been designed to effectively remediate soils contaminated with certain chlorinated hydrocarbons including methylene chloride, trichloroethylene and other compounds found at Burning Ground No. 3. The STP utilizes a non-contact, counter-current, low-temperature, thermal desorption process which first volatilizes target organic contaminants from the soil into the air within the system and then catalytically oxidizes these airborne contaminants in a specially designed low-temperature, catalytic oxidation system used for chlorinated organics. Dow Environmental's STP has been designed as a stand alone, mobile processing unit for treating solid materials contaminated with chlorinated and non-chlorinated hydrocarbons.

3.3.5.1.1 Pretreatment Soil Conditioning Equipment

All contaminated feed material will be passed through a commercial construction type of vibrating screen, with a capacity of 20 tons per hour or greater. The screen will remove all materials greater than 3 inches from the contaminated soil waste stream. Contaminated materials 3 inches or less in diameter will pass through the screen and be conveyed via an enclosed belt conveyor to the feed hopper on the thermal desorption trailer. Materials greater than 3 inches in diameter will be steamed cleaned on a daily basis and then taken to LHAAP 12 for disposal. There will be no sampling or testing of debris. If the consistency of contaminated materials is such that it inhibits a consistent feed to the desorber then the use of secondary pretreatment equipment such as a crusher or a shredder may become necessary prior to thermal treatment. Feed materials may be blended using a front end loader prior to placement on the power screen. Blending is commonly used to even out concentration of contaminants or debris such vegetable matter in feed material. On occasion, the hot processed soils may be blended with difficult to feed soils in order to enhance handling characteristics, for instance, reducing plasticity and/or reducing moisture content of feed materials.

3.3.5.1.2 Primary Thermal Desorption Trailer

The thermal desorption trailer is 8.5 ft. wide by 47 ft. long, with an integrated control panel. It consists of a 3 yd^3 feed hopper, a contaminated soil cold-feed conveyor, a weigh conveyor with a continuous sensing weigh scale, a rotary drum equipped with a gas fired low NOx burner, a propane vaporizer, a high-temperature/high-efficiency baghouse, a 4,600 SCFM induced draft (ID) system fan, and an ancillary discharge moisturizing auger. System controls include a microprocessor burner controller with manual operation and automatic safety controls, a fan damper position control, variable speed controls for components such as the cold feed conveyor and the discharge auger and overall power controls. All electrical and burner systems are interlocked for safety and start-up protection. Data readouts located on the control panel show the burner opening position, conveyor speeds, damper position, exit soil temperature, baghouse temperature, differential pressure across the baghouse, process rate by weight (tons per hour), cumulative tons processed and drum draft.

Hopper and Cold Feed System - The feed hopper is equipped with a vibrator to keep "difficult to feed" materials from plugging the opening to the cold feed conveyor. A temporary cover will be constructed over the feed hopper to protect feed material from excess precipitation. The cold feed conveyor has a variable speed control and drops material onto the continuous weigh scale conveyor belt. The weigh belt in turn weighs the contaminated materials being processed and delivers these materials into the rotary drum.

Rotary Drum - Desorption is accomplished in the counter-current designed rotary drum which is equipped with a 10 million BTU per hour low NOx emission burner. This burner is jacketed so that the flame cannot impinge directly on feed materials or volatilized contaminants, thereby, using only the heated products of combustion and not an open flame to accomplish the desorption process.

Discharge Moisturizing Auger and Processed Soils Conveyor Belt - Processed/desorbed soils and particulates from the baghouse are ejected into the 12 ft. long discharge moisturizing auger. The moisturizing auger is used to mix processed soils with baghouse fines; to wet processed materials for cooling, control dust, remoisturizing soils for enhanced compaction when backfilling; and to convey processed materials away from the trailer onto another conveyor belt. Processed materials from the auger are dropped onto the conveyor belt though a dust suppression housing. The belt conveyor is used to transfer processed materials/soils to a temporary storage pile.

Baghouse - The baghouse is designed to remove particulates greater than 5 microns in size, operate at high temperatures (up to 450°F) and uses an automatic pulse-jet system to clear the bags and recover filtered particulates. The trailer is supplied with a 10 HP air compressor for the pulse-jet system. The baghouse is equipped with 78 Nomex filter cloth bags possessing a total area of 900 ft^2, an air to cloth ratio of 5.0 to 1.0, and a permeability of 20 to 40 SCFM/ft^2 at 0.5 in. WC pressure drop. The collected baghouse fines are transferred via a closed auger system to the discharge moisturizing auger where it is mixed and rehydrated with the processed soil. One of the reasons that feed materials may require blending before treatment is that excess organic materials such as vegetable matter and/or very long-chain hydrocarbons may attach to or recondense on the bags in amounts sufficient to cause a potential fire hazard.

3.3.5.1.3 Secondary Treatment Trailers (Oxidizer/Scrubber Units)

The secondary treatment trailers are each 8.5-ft wide by 48-ft long. The process gas stream will be split in two with each trailer receiving 50 percent of the flow. Both trailers are identical and consist of a cross exchanger, a catalyst preheater, a five-layer catalyst bed, a flow sensor, a quench elbow, an acid gas scrubber, a system fan, and an exhaust stack.

Cross Exchanger - A shell and tube 48 percent efficient heat exchanger is supplied to preheat the incoming air stream and reduce auxiliary fuel consumption. The heat exchanger is constructed of 316 L stainless steel with each welded seam leak tested to assure no cross contamination. After leaving the baghouse at less than 450 degrees F, VOC laden air passes through the tube side of the exchanger while the hot catalytically oxidized air passes through the shell side at temperatures from 780 degrees F to 850 degrees F. There are two passes on the shell side to approach true counter flow conditions within the exchanger.

Preheater/Gas Train - The catalyst preheater gas train is fabricated to FM/IRI specifications and has a low NOx burner with a sleeve extension to provide no direct flame contact with the hydrocarbon laden air stream. The gas burner has a maximum firing rate of 3,000,000 BTUs/hour and can be operated on either natural gas or propane. At Burning Ground No. 3 the burner will be operated using natural gas. The burner is mounted to allow the flame to fire in the direction of air flow. To achieve uniform temperatures entering the catalyst the gas train is designed to mix the hot gases downstream of the burner. Uniform temperatures entering the catalyst are achieved by proper air distribution over the burner with hot gas mixing downstream of the burner. The burner also has the capacity to maintain operating temperatures during VOC-free, full air flow conditions. The system contains a direct fired liquified petroleum gas (LPG) vaporizer that is mechanically and electrically integrated into the trailer system. The vaporizer is only used when liquified gases are utilized to operate the STP, and therefore, will be bypassed at the Burning Ground No. 3 site.

Catalytic Reactor - The reactor interior on each of the catalytic oxidizer trailers is constructed of 316 L stainless steel. High-density mineral wool is placed between the inner and outer shells to maintain external skin temperature at safe levels. The catalyst is contained in a fully welded 316 L stainless steel bed and sealed with high-temperature gasketing to ensure that no VOCs bypass the catalyst. The catalyst bed configuration on each catalyst trailer consists of 30 full blocks and 15 three-quarter blocks of catalyst per unit. Each of the five facial areas consist of 6 full blocks and 3 three-quarter blocks. Dow Environmental intends to use 45 ft^3 of Johnson Matthey Ceramic Monolith HaloCat-LTC catalyst in each of the two catalyst/trailer units to destroy VOCs desorbed from contaminated soils and source material. Each catalyst was designed to treat the complete air stream from the LTTD trailer at a destruction efficiency (DE) of 99%. This DE is based on the catalyst manufacturers calculation of the airflow across the catalyst relative to the average concentration of contaminants present at Burning Ground No. 3 and the catalyst surface area referred to as the gas hour space velocity (GHSV). However, when the air stream from the LTTD trailer is split between the 2 catalyst trailers the GHSV calculation indicates a DE of 99.99%. Air stream temperature sensors are located before and after the catalyst bed on each trailer for proper control of temperature within the reactors.

Quench/Scrubber System - The oxidizer-to-scrubber connection is constructed of 316 L stainless steel and contains sampling ports. The outlet from the catalytic oxidizer is directed into a multi-stage quench on its way to the scrubber modules. A recirculation pump injects water from a sump into the Hastelloy quench which is equipped with Hastelloy spray nozzles. The gases exit the quench and enter the packed bed counter-current absorption column for removal of 99.9 percent or greater of HCl vapors from the oxidizer exhaust. The tower is packed with polypropylene packing and contains a demister to remove entrained water droplets. An FRP sump, common to both the quench and the scrubber towers, and a corrosion resistant FRP pump are provided to recirculate the scrubber/quench water to the quench and scrubber columns. Dual quench recirculation loops are located with two nozzles in the quench tower. Sump water is also recirculated to one nozzle near the gas outlet from the scrubber tower. The 7.5 HP recirculation pump is monitored for proper water flow by a mechanical rotometer. Fresh water flow to the quench is also indicated via a mechanical rotometer within the piping. Sump water will be maintained at a near neutral condition by the addition of caustic as required.

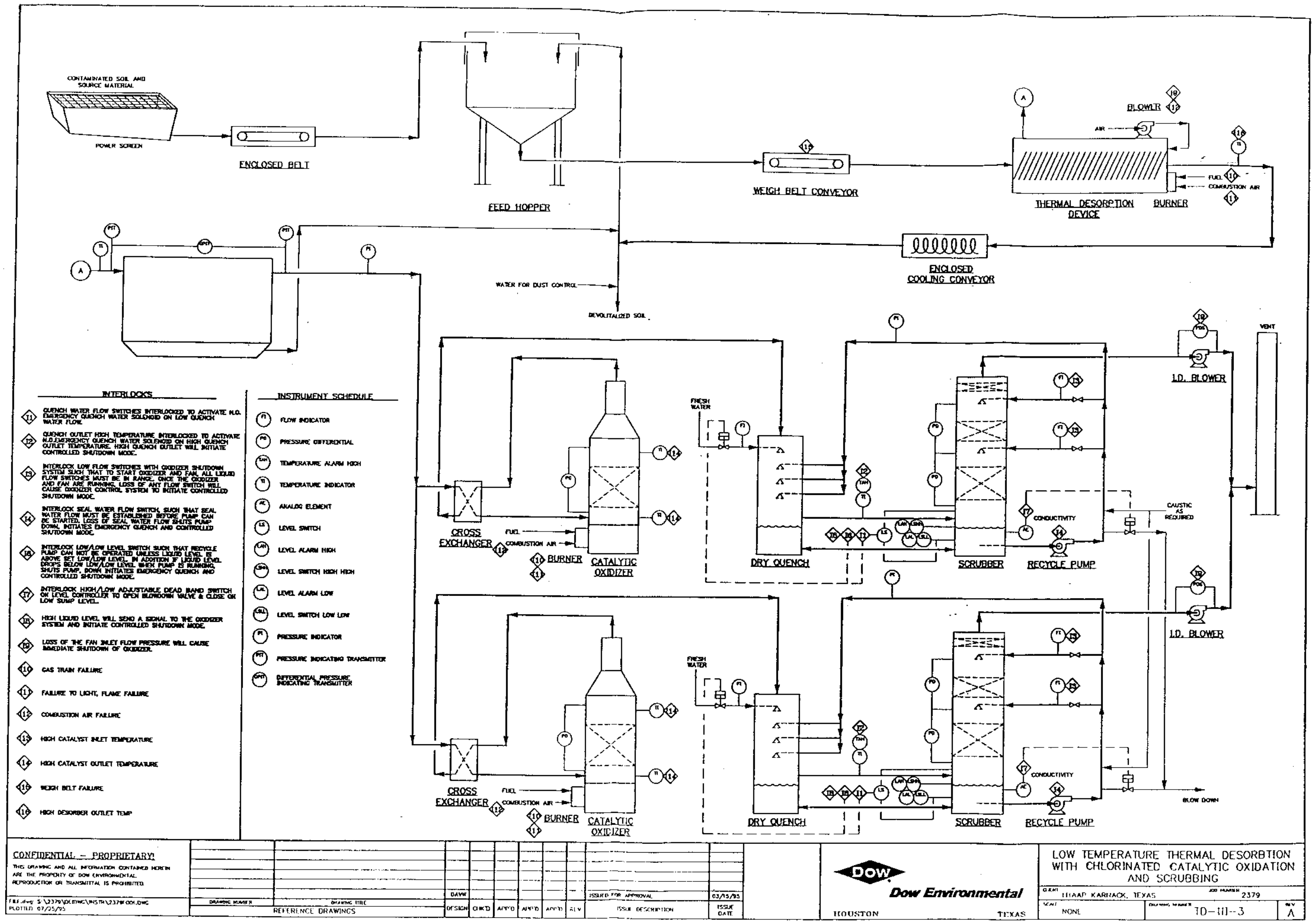
System Fan and Stack - The air stream is pulled through the scrubber and forced from the stack via a system, induced draft fan. The system fan is constructed of fiberglass reinforced plastic and is statically and dynamically balanced. The fan is powered by a 60 HP motor. The stack is mounted over the system fan and is 18-ft long, 22-in. in diameter and constructed of fiberglass reinforced plastic.

3.3.5.1.4 Piping and Instrumentation Diagrams

Piping and Instrumentation Diagram of the STP to be used at Burning Ground No. 3 appears in Drawing TD-III-3. Descriptions of the equipment and control systems appear in the following sections.

3.3.5.2 Control Systems Description

Primary Controls - The control system for the STP has been designed to permit safe and efficient operation throughout the desorption and effluent control processes. Primary controls consist of state-of-the-art programmable logic controllers (PLCs) on each trailer. These PLCs facilitate troubleshooting via first-out detection systems. LCD displays indicate the reason for system



CONTAMINATED SOIL AND SOURCE MATERIAL
POWER SCREEN
ENCLOSED BELT
FEED HOPPER
WEIGH BELT CONVEYOR
BLOWER
AIR
FUEL
COMBUSTION AIR
THERMAL DESORPTION DEVICE
BURNER
ENCLOSED COOLING CONVEYOR
WATER FOR DUST CONTROL
DEVOLATILIZED SOIL
FRESH WATER
CROSS EXCHANGER
BURNER
CATALYTIC OXIDIZER
DRY QUENCH
SCRUBBER
CONDUCTIVITY
CAUSTIC AS REQUIRED
RECYCLE PUMP
I.D. BLOWER
VENT
BLOW DOWN
INTERLOCKS
QUENCH WATER FLOW SWITCHES INTERLOCKED TO ACTIVATE N.O. EMERGENCY QUENCH WATER SOLENOID ON LOW QUENCH WATER FLOW.
QUENCH OUTLET HIGH TEMPERATURE INTERLOCKED TO ACTIVATE N.O.EMERGENCY QUENCH WATER SOLENOID ON HIGH QUENCH OUTLET TEMPERATURE. HIGH QUENCH OUTLET WILL INITIATE CONTROLLED SHUTDOWN MODE.
INTERLOCK LOW FLOW SWITCHES WITH OXIDIZER SHUTDOWN SYSTEM SUCH THAT TO START OXIDIZER AND FAN, ALL LIQUID FLOW SWITCHES MUST BE IN RANGE. ONCE THE OXIDIZER AND FAN ARE RUNNING, LOSS OF ANY FLOW SWITCH WILL CAUSE OXIDIZER CONTROL SYSTEM TO INITIATE CONTROLLED SHUTDOWN MODE.
INTERLOCK SEAL WATER FLOW SWITCH, SUCH THAT SEAL WATER FLOW MUST BE ESTABLISHED BEFORE PUMP CAN BE STARTED. LOSS OF SEAL WATER FLOW SHUTS PUMP DOWN, INITIATES EMERGENCY QUENCH AND CONTROLLED SHUTDOWN MODE.
INTERLOCK LOW/LOW LEVEL SWITCH SUCH THAT RECYCLE PUMP CAN NOT BE OPERATED UNLESS LIQUID LEVEL IS ABOVE SET LOW/LOW LEVEL. IN ADDITION IF LIQUID LEVEL DROPS BELOW LOW/LOW LEVEL WHEN PUMP IS RUNNING, SHUTS PUMP, DOWN INITIATES EMERGENCY QUENCH AND CONTROLLED SHUTDOWN MODE.
INTERLOCK HIGH/LOW ADJUSTABLE DEAD BAND SWITCH ON LEVEL CONTROLLER TO OPEN BLOWDOWN VALVE & CLOSE ON LOW SUMP LEVEL.
HIGH LIQUID LEVEL WILL SEND A SIGNAL TO THE OXIDIZER SYSTEM AND INITIATE CONTROLLED SHUTDOWN MODE.
LOSS OF THE FAN INLET FLOW PRESSURE WILL CAUSE IMMEDIATE SHUTDOWN OF OXIDIZER.
GAS TRAIN FAILURE
FAILURE TO LIGHT, FLAME FAILURE
COMBUSTION AIR FAILURE
HIGH CATALYST INLET TEMPERATURE
HIGH CATALYST OUTLET TEMPERATURE
WEIGH BELT FAILURE
HIGH DESORBER OUTLET TEMP
INSTRUMENT SCHEDULE
FI FLOW INDICATOR
PD PRESSURE DIFFERENTIAL
TAH TEMPERATURE ALARM HIGH
TI TEMPERATURE INDICATOR
AE ANALOG ELEMENT
LS LEVEL SWITCH
LAH LEVEL ALARM HIGH
LSHH LEVEL SWITCH HIGH HIGH
LAL LEVEL ALARM LOW
LSLL LEVEL SWITCH LOW LOW
PI PRESSURE INDICATOR
PIT PRESSURE INDICATING TRANSMITTER
DPIT DIFFERENTIAL PRESSURE INDICATING TRANSMITTER
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TEXAS
LOW TEMPERATURE THERMAL DESORBTION WITH CHLORINATED CATALYTIC OXIDATION AND SCRUBBING
CLIENT LHAAP KARNACK, TEXAS
JOB NUMBER 2379
SCALE NONE
DRAWING NUMBER TD-III-3
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shutdowns (i.e., high/low gas pressure, loss of air flow, high catalyst outlet temperature, low catalyst inlet temperature, high conductivity of the scrubber solution, loss of scrubber air flow, high scrubber outlet temperature, etc.). The PLCs also "walk" the operator through system start-ups by displaying such messages as "trial for ignition", "pilot on", "burner on", "caustic pump on", "recirculation pump operating", "OK to process fumes", and "push start button". The control panel includes displays for system status indication including LCD displays, conductivity meters, pH controllers, temperature gauges, and high-temperature shut-off controllers. A three-pen hard copy temperature recorder/controller for each of the air pollution control trailers controls and monitors the inlet and outlet temperatures for the catalytic oxidizer along with air flow. Flame strength meters indicate the strength of the flame signals to indicate any burner service needs. Following is a description of the function, operational settings and operator responses for process control systems.

Waste Feed Cutoff System - The units that are interlocked with the waste feed system and which can trigger a waste feed cutoff in case of failure are those that have the potential to cause uncontrolled emissions to the environment if they should fail. Most of these units, when operating outside of set limits, cut off the waste feed by causing a full, controlled system shutdown. Tables 3.3 and 3.4 identify specific interlocks and set limits that will cause system shutdowns when those limits are violated.

The waste feed system is not interlocked to drum temperature because drum temperature because drum temperature is not monitored. However, many other units when operating outside of set parameters can automatically shut down the waste feed system by causing a controlled, full system shutdown. These interlocks are also identified in Tables 3.3 and 3.4.

Unit operating conditions are fed into a Process Logic Computer (PLC) which, in turn, analyzes the data for set points and activates interlocks as required. All interlocks, as shown in Table 3.3 and 3.4, are immediate when set limits are exceeded. A diagrammatic description of specific interlocks appears on drawing TD-III-3.

A three pen chart recorder continuously records the catalyst outlet temperature and the air flow through the system. The following STP parameters will be recorded hourly on a log sheet completed by one of the Thermal Desorption Operators:

1. Baghouse inlet air temperature (Fahrenheit)
2. Rotary drum burner setting (% open)
3. Drum draft measured at discharge end of drum housing
4. Catalyst inlet temperature (Fahrenheit)
5. Catalyst outlet temperature (Fahrenheit)
6. Air flow at exit of catalyst (scfm)
7. Hour meter on weigh belt (total hours)
8. Time and date recording
9. Feed Rate and TPH concentration (average) of feed
10. Total weight of soils processed for current day
11. Ambient air temperature (Fahrenheit)
12. Discharge temperature of soil (Fahrenheit)
13. Baghouse differential pressure (inches (WC))

All strip recordings and logs will be retained with the plant and available upon request for the duration of the project. After completion of STP operations at Burning Ground No. 3, all records will be included as part of the project files, with all pertinent data being included in the Phase III Report.

3.3.5.2.1 Main Control Panel

Cold-Feed Conveyor - The Cold Feed Conveyor is activated/deactivated by the cold feed ON/OFF control. The conveyor speed can be changed by rotating the feed rate potentiometer. The digital readout on the Cold Feed Conveyor indicates speed. The Cold Feed Conveyor serves to establish and maintain a steady flow of material to the Weigh Scale Conveyor. The Cold Feed Conveyor is normally adjusted to equal the speed of the Weigh Scale Conveyor which in turn feeds soils into the rotary drum desorption chamber.

Weigh Scale Conveyor - The Weigh Scale Conveyor speed is fixed. If necessary the speed can be changed by reducing the sheave ratio on the drive unit. The conveyor weighs the material as it is transported into the rotary drum desorption chamber.

Emergency Stop Switch - This red colored palm button instructs the PLC to execute an emergency shut down of the entire unit.

Table 3.3 LHAAP, Burning Ground No. 3, IRA TRAILER 1 (DESORPTION TRAILER) INTERLOCKS			
SYSTEM UNIT	**PARAMETER**	**SET LIMIT**	**INTERLOCKS**
Weigh Belt	Operation	Loss	Alarm Only
Drum Burner	Flame	Loss of Flame	Alarm/Controlled System Shutdown[1]
	Low Gas Pressure	4"(WC)	Alarm/Fuel Feed and Burner Shutdown
	High Gas Pressure	17"(WC)	Alarm/Fuel Feed and Burner Shutdown
	Combustion Air	Loss Of Air Flow	Alarm/Drum Burner Shutdown
Baghouse	Inlet Temperature	≥470°F	Prealarm/Alarm/Drum Burner Shutdown
Compressor	Air Pressure	≤ 80 psi	Controlled System Shutdown[1]

1 Controlled System Shutdown refers to shutdown of the Waste Feed System, all Burner Systems and System Fans on all three STP trailers. The Genset continues to run to provide power, the instrumentation is left functional and the Scrubber Sump Recirculation System (loop) is left running.

Table 3.4
LHAAP, Burning Ground No. 3, IRA
TRAILERS 2 AND 3 (AIR POLLUTION CONTROL TRAILERS) INTERLOCKS

SYSTEM UNIT	PARAMETER	SET LIMIT	INTERLOCK
Catalyst Preheater Burner	Low Gas Pressure	4"(WC)	Alarm/Controlled Sys. Shutdown[1]
	High Gas Pressure	17"(WC)	Alarm/Controlled Sys. Shutdown[1]
	Combustion Air	Loss	Alarm/Controlled Sys. Shutdown[1]
Catalyst	Inlet Temperature	≤750°F	Alarm/Controlled Sys. Shutdown[1]
	Outlet Temperature	≥830°F	Alarm/Controlled Sys. Shutdown[1]
Quench	Water Flow	≤60 gpm (total)	Emergency Quench Activation
	Exit Gas Temp.	≥180°F	Controlled System Shutdown[1]
Scrubber	Recirc. Water Flow	Loss of Flow	Alarm/Controlled Sys. Shutdown[1]
Scrubber/ Quench Sump	Liquid Level	Low	Close Blowdown Valve
		Low/Low	1) Alarm 2) Activate Emer. Quench Water 3) Shuts Down Recyc. Pump 4) Controlled System Shutdown[1]
		High	Open Blowdown Valve
		High/High	Alarm/Controlled Sys. Shutdown[1]
System Fan	Air Flow	Loss Of Inlet Flow Pressure	Controlled System Shutdown[1]

1 Controlled System Shutdown refers to shutdown of the Waste Feed System, all Burner Systems and System Fans on all three STP trailers. The Genset continues to run to provide power, the instrumentation is left functional and the Scrubber Sump Recirculation System (loop) is left running.

Scale - The scale is located on the Weigh Scale Conveyor and weighs the soil as it traverses into the rotary drum desorption chamber. The weigh scale is tested for accuracy on a daily basis using a known calibration weight. A complete manual for the scale is kept with the desorber trailer at all times during operation.

Baghouse Damper - The Baghouse Damper adjusts the air flow between the baghouse and the heat exchanger on the catalytic oxidizer/scrubber trailer. The Baghouse Damper has a digital readout which indicates the percent opening of the passageway from the baghouse to the catalytic oxidizer unit. By controlling the damper position the amount of air flowing through the system is controlled. The temperature in the baghouse can be adjusted by adjusting the flow of air through the system.

Pulse Controls - The Pulse Controls activate a burst of air from the compressor to the bags in the baghouse. The pulse should be "On" only when the desorber unit is running. Pulse rate can be adjusted by manual means or set on "Auto" to operate under the control of the Baghouse Differential Pressure Gauge.

Baghouse Differential Pressure Gauge - The Differential Pressure Gauge reads the difference in pressure across the baghouse. Normal indication should be between 3 and 6 in. of water. The differential pressure should not drop below 2 inches WC.

Rotary Drum Desorption Chamber Temperature Controller - The Rotary Drum Temperature is controlled by the Operator in accordance with target temperatures for desorption of known contaminants. Soil leaving the desorption chamber is generally maintained at 400 to 650°F. The desorption process is driven primarily by the temperature achieved in the soil while it is being treated. The temperature of the air in the rotary drum does not give an accurate indication of the temperature of the soil in the drum. The soil temperature is dependent on the ability of the soil to absorb heat. For instance, a load of soil containing a greater amount of gravel generally absorbs heat much more readily than fine silty types of soil. To achieve the same soil exit temperature in each of these cases, the required temperature of the air in the rotary drum would generally need to be significantly higher when processing the silty soil than the drum temperature that is required when processing soil which contains more gravel. Since the ability of soils to absorb heat can and often does vary greatly in the soils found on a particular project, it is not useful to track drum temperature. A more useful temperature indicator is that of the soil exiting the desorption chamber. The soil exit temperature is an indicator of whether or not the soil has achieved the temperature deemed necessary to volatilize target contaminants.

The temperature of the air exiting the rotary drum is monitored in the short duct located between the drum and the baghouse. The temperature of air entering the baghouse is generally maintained at less than 470 degrees Fahrenheit, depending on the temperature rating of the filter bags used in the baghouse. Because the STP is designated as a counter-flow system, the temperature of the air within the rotary drum varies greatly. The temperature of the air at the burner of soil exit end of the drum is much higher than that of the air exiting the drum into the baghouse. As the air travels from the hot zone at the soil exit end of the drum, heat is absorbed by the cooler soil entering at the top end of the drum.

It is the operator's job to maintain required soil exit temperatures at a high enough level while assuring that the temperature of the air exiting the rotary drum is low enough to prevent damage in the baghouse. The operator achieves this balance by adjusting burner intensity, soil feed rate, and system air flow.

The exit temperature of treated soils is continuously monitored via a digital temperature redout located on the control panel. The soil exit temperature thermocouple is located in the soil discharge port. The primary parameter affecting soil exit temperature is intensity of the burner in the rotary drum. The operator adjusts the burner control from the control panel via a rotary rheostat which remotely controls a modular a(modutrol) motor at the burner. The Modutorl motor, in turn, modulates the fuel-to-air mixture in the burner. Soil feed rate is adjusted remotely by controlling the speed of the cold feed belt from the control panel. System air flow is controlled remotely by adjusting the position of the main air flow damper from the control panel, which is also equipped with a continuous percent open readout.

Baghouse-Entry Temperature Controller - The Baghouse-Entry Temperature digital readout on the control panel monitors the temperature of desorption gases entering baghouse. Interlock mechanisms are tripped causing a warning alarm and then a system shutdown when temperatures exceed set limits. A thermocouple is located in the baghouse inlet plenum to monitor temperature. The limit is generally set at 400°F or less to protect the filter bags from heat damage. The baghouse is actually designed to accept up to 450°F which is the maximum recommended temperature for the Nomex bags.

Catalyst - Inlet Temperature Controller - The Catalyst-Inlet Temperature Controller monitors the temperature of gases entering the catalyst. This unit controls the catalyst preheater which serves to maintain temperatures of gases entering the catalyst above the limit set as the minimum operating temperature for the catalyst. The catalyst operates within a defined temperature window. The lower temperature limit is the minimum inlet temperature required to activate the oxidation reaction. This temperature can vary according to which hydrocarbons are in the application and other characteristics such as the BTU value of the waste material being treated. When more than one hydrocarbons are in the application and other characteristics such as the BTU value of the waste material being treated. When more than one hydrocarbon is present in a given application, the required operating temperature will be the temperature required to oxidize the most stable (i.e. most difficult to oxidize) compound identified int he application. The minimum outlet temperature for methylene chloride and PCE is 780°F (415°C). Operating the catalytic oxidation unit below this outlet temperature can result in shortened catalyst life. The upper temperature limit is the maximum temperature at which the catalyst can be operated without possible thermal degradation. The maximum operating temperature of the Halocat LTC-20 catalyst is 850°F. For this reason, a high temperature shutdown set at 830 F is employed to prevent the catalyst from being exposed to excessive temperatures.

The catalyst inlet temperature is then set at whatever temperature is determined to be required to maintain the minimum outlet temperature. Because the oxidation reaction in the catalyst is an exothermic reaction, heat is released in the catalyst. Therefore, the catalyst inlet temperature required to maintain the appropriate catalyst outlet temperature will vary depending on the heat added during the oxidation reaction in the catalyst. The catalyst low-temperature interlock will be set at about 750°F to begin testing. This will allow for the additional release of heat in the catalyst.

Catalyst - Differential Pressure Control - Differential pressure is measured across the catalyst bed. If differential pressure indicates a plugging condition, the unit is shut down.

Make-Up Water Flow - Make-Up Water Flow is measured and monitored by flow indicators. If flow is lost, high-temperature results and the unit shuts down automatically.

Recirculation Water Flow and pH Control - Water Recirculation Flow is measured and monitored by flow indicators. If flow is lost, high-temperature will result and the unit will shut down. A digital pH controller is provided to control caustic addition and maintain scrubber water at a near neutral condition by controlling a caustic metering pump. The caustic metering pump adds a 25%

caustic solution from a 500 gallon caustic storage tank located adjacent to the trailer as needed. The pH controller also provides a high and low pH alarm/shutdown.

Quench Gas Temperature Controller - The Quench Gas Temperature is monitored and if temperatures high enough to adversely effect the quench or scrubber systems are detected then the unit is automatically shut down.

Scrubber - Differential Pressure Control - Differential pressure is measured across the scrubber. If differential pressure indicates a plugging condition, the unit is shut down.

3.3.5.2.2 STP Safety Interlock System

The STP safety interlock circuit is designed to progressively interact with each successive operation. The Baghouse Fan must be in operation before power is made available to start rotation of the drum, the drum burner system, baghouse, auger or incline auger to remove particulates recovered in the baghouse.

The catalyst system startup/automatic selector switch overrides the catalyst inlet low temperature shutdown set point for the startup sequence only. The selector is moved to the auto position once the minimum preheat temperature (650 degrees F) is obtained.

Once all operating parameters for temperature are reached and the cold feed is activated, any component subsystem failure or excursion from operating temperature high and low set-points will cause a shutdown of any specific component system necessary to prevent unsafe or out of compliance operation of the STP.

Interlock to the LTTD unit from the scrubber unit is established by setting the selector switch to the scrubber position. If any limit is lost, the STP is shut down due to loss of exhaust fan operation. The following limits must be met before the exhaust fan can be started:

- Reservoir level must be within high and low limits and water pressure must be available for makeup or system will shut down.

- Scrubber water pump must supply pressure within parameters or system will shut down.

- Wet scrubber discharge blower must maintain sufficient air pressure or system will shut down.

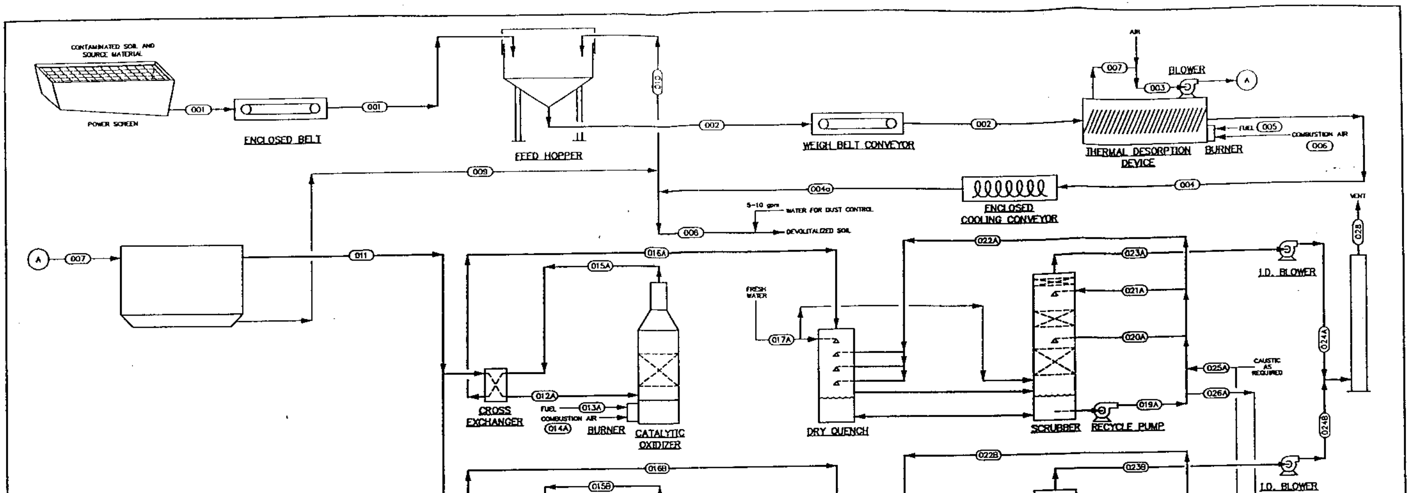
- Temperature of the air stream between the quench and the scrubber must be within set parameters.

- The temperature inlet to the catalyst bed must be maintained within set limits.

3.4 Task 4 - Excavation and Treatment of Soils and Source Material.

As stated above approximately 50,000 cubic yards of soil and source material, including soil excavated during the construction of the groundwater collection system will be hauled to the SHDP and treated at the STP. A Process Flow Diagram for the STP to be used at Burning Ground No. 3 appears on Drawing TD-III-4. Drawing TD-III-4 also includes a STP mass balance specific to materials to be treated at Burning Ground No. 3.

Figure 5 shows the approximate locations of source material that would be excavated, hauled and treated at the STP. These locations where delineated by the USACE, Tulsa District based on historical investigations at Burning Ground No. 3. During excavation and treatment, source material will consist of all visually observed buried industrial waste and the surrounding three feet of native soil and/or soil cover. All other excavated soil from the vicinity of source material burial locations will be considered contaminated soils that will be treated at the STP and hauled back to the burning ground to be used as backfill material for source material excavations. Excavation of source material will be conducted in accordance with the requirements of the SSHP and all applicable Federal, state, and local regulations and guidelines. Structures that may potentially get damaged will be properly shored by DEI in accordance with specific plans to be developed as the situation arises. If a potential exists for damaging a structure (i.e. ACD and or fence) then the excavation would not proceed next to the structure until appropriate shoring has taken place. Since the exact locations of source materials are not known at the present time, it is difficult to predict which onsite structure would require shoring. DEI will proceed with the excavation at the center of each potential area of source material shown on Figure 5 and determine shoring requirements based on encountered conditions.



NOTES:
1. FLOW RATES ARE TO BE UTILIZED AS DESIGN RATES ONLY. ACTUAL FIELD VERIFICATION WILL GENERATE ACTUAL FLOWS. FLOW RATE DESIGNS WERE CALCULATED BASED ON AVERAGE SOIL CONCENTRATIONS AND MAXIMUM SOIL MOISTURE (10.5%). FEED RATE IS EQUAL TO 8.86 TONS PER HOUR (001).

• A & B STREAMS ARE IDENTICAL

	001	002	003	004	004a	005	006	007	008
Methylene Chloride	2.2428	2.2428	2.2428	0.0000563	0.0000563			2.2427	
Trichloroethane	0.5018	0.5018	0.5018	0.0000133	0.0000133			0.5018	
Vinyl Chloride	0.0148	0.0148	0.0148	0.0000004	0.0000004			0.0148	
1,2 DCE	0.4233	0.4233	0.4233	0.0000112	0.0000112			0.4233	
1,2 DCA	0.0217	0.0217	0.0217	0.0000006	0.0000006			0.0217	
1,1 DCA	0.0087	0.0087	0.0087	0.0000002	0.0000002			0.0087	
1,1,2,2 Tetrachloroethane	0.0218	0.0218	0.0218	0.0000006	0.0000006			0.0218	
Toluene	0.0867	0.0867	0.0867	0.0000023	0.0000023			0.0867	
Ethylbenzene	0.0431	0.0431	0.0431	0.0000011	0.0000011			0.0431	
m-Xylene	0.0198	0.0198	0.0198	0.0000005	0.0000005			0.0198	
Acetone	0.0398	0.0398	0.0398	0.0000011	0.0000011			0.0398	
Chloroform	0.0033	0.0033	0.0033	0.0000001	0.0000001			0.0033	
1,1 DCE	0.0083	0.0083	0.0083	0.0000002	0.0000002			0.0083	
Styrene	0.3220	0.3220	0.3220	0.0000085	0.0000085			0.3220	
Benzene	0.0224	0.0224	0.0224	0.0000006	0.0000006			0.0224	
1,1,1 Trichloroethane	0.0006	0.0006	0.0006	0.0000000	0.0000000			0.0006	
Trichlorofluoromethane (R-11)	0.0020	0.0020	0.0020	0.0000001	0.0000001			0.0020	
Propane						507.24			
Nitrogen			13754.49				1782.62	15537.31	
Oxygen			2336.00				541.27	2877.27	
HCL									
CO2			1518.70					1518.70	
H2O	2766.14	2766.14	3811.88		447.44		28.11	3840.00	
HF									
NaOH									
NaCL									
Solids	14852.11	14852.11		14914.73	14,914.73			37.38	14852.11
TEMPERATURE Deg. F	80	80	450	454	200	85	90	454	200
PRESSURE PSIA	14.70	14.70	15.07	14.70	14.70	14.59	14.7	16.15	14.70
FLOW gpm/acfm						73	500	9124	
TOTAL lbs/hr	17722	17722	21425	14915	15362	507	2352	23814	14852

	009	010	011	012 •	013 •	014 •	015 •	016 •	017 •
Methylene Chloride			2.2427	1.1214			0.0001	0.0001	
Trichloroethane			0.5018	0.2509			0.0000	0.0000	
Vinyl Chloride			0.0148	0.0074			0.0000	0.0000	
1,2 DCE			0.4233	0.2117			0.0000	0.0000	
1,2 DCA			0.0217	0.0109			0.0000	0.0000	
1,1 DCA			0.0087	0.0044			0.0000	0.0000	
1,1,2,2 Tetrachloroethane		AS	0.0218	0.0109			0.0000	0.0000	
Toluene		NEEDED	0.0867	0.0434			0.0000	0.0000	
Ethylbenzene		FOR	0.0431	0.0216			0.0000	0.0000	
m-Xylene		MOISTURE	0.0198	0.0099			0.0000	0.0000	
Acetone		CONTROL	0.0398	0.0199			0.0000	0.0000	
Chloroform			0.0033	0.0017			0.0000	0.0000	
1,1 DCE			0.0083	0.0042			0.0000	0.0000	
Styrene			0.3220	0.1610			0.0000	0.0000	
Benzene			0.0224	0.0112			0.0000	0.0000	
1,1,1 Trichloroethane			0.0006	0.0003			0.0000	0.0000	
Trichlorofluoromethane (R-11)			0.0020	0.0010			0.0000	0.0000	
Propane					48.12				
Nitrogen			15537.31	7768.66		632.43	8401.00	8401.00	
Oxygen			2877.27	1438.64		192.03	1454.57	1454.57	
HCL							1.36	1.36	
CO2			1518.70	759.35			905.28	905.28	
H2O			3840.00	1920.00		9.97	2008.78	2008.78	8235.2
HF							0.0001	0.0001	
NaOH									
NaCL									
Solids	37.38								
TEMPERATURE Deg. F			464	834	85	85	830	847	85
PRESSURE PSIA			16.15	14.59	14.59	14.59	14.21	14.14	34.70
FLOW gpm/acfm			9932	5986	0	195	2553	6800	19
TOTAL lbs/hr	37	0	23777	11889	48	834	12008	12771	8235

	018 •	021 •	022 •	023 •	024 •	025	026	027	028
Methylene Chloride	0.0000	0.0000	0.0001	0.0001	0.0001		0.0001	0.0002	0.0002
Trichloroethane	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Vinyl Chloride	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
1,2 DCE	0.0000	0.0000	0.0002	0.0000	0.0000		0.0000	0.0000	0.0000
1,2 DCA	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
1,1 DCA	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
1,1,2,2 Tetrachloroethane	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Toluene	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Ethylbenzene	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
m-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Acetone	0.0000	0.0000	0.0001	0.0000	0.0000		0.0000	0.0000	0.0000
Chloroform	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
1,1 DCE	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Styrene	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
1,1,1 Trichloroethane	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Trichlorofluoromethane (R-11)	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
Propane									
Nitrogen	0.72	0.72	0.45	8400.82	8400.82		0.27	0.53	16801.65
Oxygen	0.30	0.30	0.19	1454.46	1454.46		0.11	0.22	2908.93
HCL	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
CO2	2.74	2.74	1.72	904.36	904.36		1.02	2.04	1808.53
H2O	79351.44	49805.03	29546.41	2064.28	2064.28	618.00	2050.09	4118.18	4128.57
HF	0.000	0.000	0.000	.0001	.0001		0.00	0.00	0.00
NaOH	546.96	343.11	205.87	0.00	0.00	206.00	0.00	0.01	0.00
NaCL	6.20	3.89	2.31	0.00	0.00		6.20	12.40	0.00
Solids									
TEMPERATURE Deg. F	144	156	146	146	146	85	146	155	148
PRESSURE PSIA	34.7	14.12	14.12	14.12	14.12	24.70	34.70	34.70	14.12
FLOW gpm/acfm	160	100	60	3685	3685	1.4306	4	8	7486
TOTAL lbs/hr	79910	50156	29757	12824	12824	824	2067	4133	25648

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PLOTTED: 08/31/95

DRAWING NUMBER	DRAWING TITLE
	REFERENCE DRAWINGS

DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
DVW	–	–	–	–	C	SCOPE CHANGE	08/31/95
DVW	–	–	–	–	B	UPDATE REVISION	6/25/95
DVW	–	–	–	–	A	ISSUED FOR APPROVAL	03/15/95

Dow Environmental
HOUSTON TEXAS

LOW TEMPERATURE THERMAL DESORBTION WITH CHLORINATED CATALYTIC OXIDATION AND SCRUBBING

CLIENT: LHAAP KARNACK, TEXAS
JOB NUMBER: 2379
SCALE: NONE
DRAWING NUMBER: TD-III-4
REV: C

016444

Composite samples from the boundaries (a minimum of one sample per boundary) of each excavation will be collected for testing following the removal of source material and prior to backfilling. The objective of this testing program is to document subsurface conditions following the removal of source material. The samples will be mainly tested in the field using a portable GC. Ten percent of the samples will be sent to an offsite laboratory for confirmation of field results. Available funding allows for up to 50 samples to be sent to the offsite laboratory. These samples will be tested for VOCs content in accordance with Test Method 8240. The backfilling of source materials excavations will proceed following the completion of the sampling validated by DEI. Also backfilling will not start until approval is received from the USACE. Backfilling will be in accordance with Sections 3.5 and 3.6 described below.

Groundwater and any runon surface water encountered during excavation and backfilling will be collected in appropriate containers and taken to the GWTP for treatment. Runoff controls will be built around each excavation to minimize the runon of surface water to the excavation. Air monitoring during excavation and backfilling will be in accordance with the Air Monitoring Plan which is included in Appendix C of the CDAP.

3.4.1 Hours of Operation and Staffing

It is anticipated that the STP will be operated 24 hours per day for 6 days per week with Sundays off. Operating on a 24-hour basis increases production by decreasing unproductive down time. For instance, if the system is operated for only 20 hours per day then at least one hour must be allowed for cool-down and another hour for warm-up. This would allow only 18 hrs of actual operations. When down time for maintenance and trouble shooting is added in at an estimated 20% of operating time then only 14.4 hours can be expected to be productive time. Operation of the STP normally requires 3 to 4 personnel - a Lead Thermal Desorption Unit Operator, a Thermal Desorption Unit Operator and a Materials Feed Equipment Operator. Occasionally, an additional Operator is required, usually on a temporary basis, when there are difficulties, usually related to materials handling.

The Lead Thermal Desorption Operator is normally the most experienced operator on site and is capable of performing normal trouble shooting on mechanical and control systems. The Lead Operator is responsible for operating the Unit within set parameters, safe operations and for obtaining production.

The Thermal Desorption Operator is generally an experienced Operator, but can sometimes be in training. This Operator is normally required to perform periodic maintenance inspections and operations. He/she will be or will become familiar enough with operation of the STP to operate the controls periodically and to assist the Lead Operator in most situations.

The Materials Feed Operator is will operate the front end loader in the contaminated soils area. This Operator is responsible for screening contaminated materials, providing to the STP, steam-cleaning debris, and for transferring processed materials and cleaned debris to the clean materials temporary storage area.

3.4.2 Preparation of Contaminated Materials For Processing

Soils excavated from the ICT sections and the hot zones will be transported directly to the SHDP. These materials may be placed either inside of the temporary structure or on the pad outside of the structure depending on weather conditions and processing requirements. Blending of contaminated soils may be required to even out concentration of contaminants or debris such as vegetable matter in the contaminated feed material. On occasion, the hot processed soils may be blended with difficult to feed soils in order to enhance handling characteristics by reducing plasticity and/or moisture content of feed materials. Contaminated materials movement and/or their blending and placement into processing equipment will be performed with a front end loader.

Before being transferred to the desorber, contaminated soils will be placed on a power screen to separate particles larger than 3 inches in diameter. Materials greater than 3 inches in diameter will be set aside for cleaning at a later time or possibly for further processing if a crusher or shredder is utilized. If further processing for size reduction is performed the processed materials will be rescreened as they were originally. Materials less than 3 inches in diameter will drop through the screen onto a conveyor belt. This conveyor will transfer the screened material to the desorption trailer's feed hopper.

3.4.3 Cleaning of Debris

Once enough debris (usually 1 to 3 tons) greater than 3 inches in diameter is accumulated adjacent to the screen the operator will remove it to the outside of the structure to a debris cleaning area. Material greater than 3 inches will be steam cleaned on a daily basis and then taken to LHAAP 12 for disposal. There will be no sampling or testing of debris. The debris cleaning area will consist of an impermeable pad located next to the contaminated soils pad sump and designed to drain to the sump. Debris will be leveled out on this pad to about 6 to 12 inches deep and then steam cleaned using a portable steam power washer. Contaminated liquid residue from this cleaning will be allowed to drain into the pad sump from which it will be pumped to the GWTP. After cleaning the debris will be transported to the clean soils storage area backfilling along with treated soils.

3.4.4 Cold Feed and Weigh Belt

Screened contaminated soils will be dropped from the power screen belt conveyor into the LTTD Unit hopper. The hopper will direct the feed materials onto the variable speed cold feed conveyor belt. The speed of the cold feed and the power screen conveyors will be coordinated to provide an even feed to the fixed speed continuous weigh conveyor. Here the material is weighed, with the continuous real-time and cumulative weights recorded at the control panel, immediately prior to its discharge into the rotary drum desorption chamber. The weigh scale is recalibrated daily using a known weight.

3.4.5 Primary Treatment (Desorption)

Contaminated materials are fed into the primary treatment unit from the continuous weigh belt. The primary treatment unit (ie. the rotary drum desorption chamber) special flighting mixes contaminated feed materials with hot air as the drum rotates. As the soil moves down the drum, toward the hot air inlet, there is a distinct rise in the air temperature. The speed of soils movement through the drum is mainly dependent on drum rake, loading and the type of flights used. Soil temperature continues to increase as the soil is cascaded down the rotating drum and through the heated air stream. As the temperature of the soil rises, the moisture and lighter hydrocarbons volatilize from the soil particles. The system ID fan pulls the gases from the desorption chamber into the baghouse. This causes the desorption chamber to be maintained under a slight negative pressure to preclude fugitive emissions during desorption operations. Soils residence time in the rotary drum is generally 4 to 8 minutes while temperature is maximized during the final 1 to 3 minutes of the process. The primary treatment unit is designed to achieve soil exit temperatures ranging from 350°F to 650°F. The actual feed rate for contaminated materials is dependent primarily on soil type, moisture content and contaminant loading. The feed rate is estimated to be 10 to 15 tons per hour.

3.4.6 Treated Materials Discharge

The treated soil discharges from the rotary drum into the moisturizing/mixing auger unit. The moisturizing auger uses water injection at several points along its length to cool processed soil and to reduce fugitive particulate emissions (FPEs) or dust. Once the soil is cooled it can then be re-moisturized as more water is added. Rehydration is also necessary to achieve proper compaction when backfilling cleaned soils. Materials discharged from the auger are dropped through a small dust suppression housing onto a clean soils discharge belt conveyor for temporary stockpiling. The clean/rehydrated soil stockpile is then moved away via a backhoe or loader for storage and sampling on the TSSP.

3.4.7 Particulates Removal

Exhaust gases are pulled from the rotary drum desorption chamber and through a high-efficiency baghouse. Gases exiting the desorption chamber contain some particulate materials as well as uncombusted hydrocarbons and/or chlorinated hydrocarbons. Due to the rotary drum's counter-current design, exhaust gases from the rotary drum have a lower exit temperature than that of the soil being discharged from the unit. These gases are moved by an ID fan which causes the drum and baghouse system to operate at a negative pressure. Process gases are maintained at high temperatures (up to 450 degrees F) to avoid recondensation of hydrocarbons after leaving the desorption chamber.

The baghouse contains a pulse-jet, filter bag collection device used to capture particulates that remain in the exhaust gases. Fine grained particles collected in the baghouse are auger conveyed to the discharge moisturizing auger where they are combined with the treated materials discharged from the desorption chamber for blending and rehydration.

3.4.8 Catalytic Oxidation

When the VOC laden gas from the baghouse arrives at the either of the catalytic oxidation trailers it is forced into the tube side of a heat exchanger where it is preheated with hot exit gases from the catalytic oxidizer. The gas then moves through the catalyst preheater section where it is heated to approximately 680°F and sent through the catalyst bed. In the catalyst bed, hydrocarbons and chlorinated hydrocarbons undergo a catalytically driven oxidation reaction. The hot gases exiting the catalyst then pass through the shell side of the cross exchanger where it preheats the incoming air as mentioned previously. The air stream that exits the catalytic oxidizer contains essentially carbon dioxide, water vapor and acid gases from the oxidation of halogenated VOC's.

3.4.9 Process Gas Cooling and Scrubbing

The air stream is then directed to a scrubber module containing a multi-stage thermal quench and an absorption column. Fresh water followed by large volumes of sump recirculation water are pumped into a Hastelloy quench section. The quench section reduces oxidizer exhaust to approximately 130°F through evaporative cooling while it also absorbs a portion of the acid gas (i.e., hydrochloric acid vapor). A high-temperature shutdown is provided to protect the fiberglass reenforced plastic (FRP) portions of the scrubber and the scrubber packing. The gases exit the quench and enter a counter-current acid absorption column scrubber. Liquid collected in the quench/scrubber sump is recirculated through the absorption column where the remaining hydrochloric acid vapors are absorbed into the solution.

$$NaOH + HCl \text{ ---->} NaCl + HOH$$

Sodium hydroxide (ie. caustic) is metered into the sump solution to control pH. The scrubber column provides a minimum of 99 % removal of the hydrochloric acid formed in the oxidation of chlorinated compounds. Finally, the remaining gas is passed through a mist eliminator to remove entrained water droplets after which the airstream exits the system via an exhaust stack. The exhaust stack is mounted over a 60 HP system fan which keeps an induced draft on the rest of the catalyst/scrubber system while forcing exhaust gases from the stack.

3.4.10 Treatment System Performance Monitoring

This section presents an outline of treated soils and stack gas monitoring to confirm efficiency of the treatment process. Prior to full scale implementation of LTTD operations, an initial testing program will be conducted to verify that the STP can meet the soil action levels and that it can conform to the air emission requirements. Sampling during the performance test is discussed in Section 3.3.4. Table 3.5- STP Verification Monitoring During Normal Operations shows the testing activities, frequency of testing, parameters to be tested and test methods used during normal operations.

3.4.10.1 Pretreatment Soils Sampling and Analysis

Subsequent to the performance test the will be sampled once every 6 hours and analyzed daily via the onsite mobile laboratory for VOCs/methylene chloride and trichloroethene (Target compounds) in order to determine if the remediation goals have been met. Samples of feed material will also be sent to an off-site laboratory for testing and confirmation of onsite laboratory results. Monitoring requirements during STP normal operations are listed in detail in Table 3.5. Sampling and analysis procedures for contaminated soils and source material are also described in the CDAP.

3.4.10.2 Residue Sampling and Analysis

Treated soils and source material will be sampled and analyzed daily via the onsite mobile laboratory for VOCs/Target compounds in order to determine if remediation requirements listed in Table 3.1 have been met. Samples of treated material will also be sent to an off-site laboratory for testing and confirmation of onsite laboratory results. Table 3.5 details the required STP verification monitoring during normal operation including: a description of material to be tested, frequency of onsite testing, frequency of offsite testing, parameters, and test methods.

A minimum of one grab sample of contaminated material (pre-treatment) and one grab sample of treated soils (post-treatment) will be collected for every six hours of STP operation. The treated material from each six hours batch will be stored separately on the TSSP until testing results for the batch are evaluated. Samples will be tested separately and the results will neither be averaged nor combined.

If the test results from a batch of treated material indicate that VOC contamination has been reduced to meet the requirements of Table 3.1 than this material will be considered treated and will be disposed off as required. However, if a batch of treated material does not meet the cleanup objectives listed in Table 3.1, two grab samples will be collected from this material and tested for confirmation. If the results from either of the additional samples indicate that the batch does not meet cleanup requirements, then it will be handled as contaminated material and will be retreated until the cleanup requirements are met.

Table 3.5
LHAAP, Burning Ground No. 3, IRA
STP Verification Monitoring During Normal Operations

Description of Material To Be Tested	Frequency of Onsite Testing	Frequency of Offsite Testing	Parameters	Test Methods 40 CFR 60 Appendix A
Waste Feed	One Grab Sample Every 6 Hours Batch (4 samples per 24 hours of treatment)	Week 1 1 Grab Sample/day Week 2 to 4 1 Grab Sample/72hrs of Treatment Week 5 to End 1 Sample/2weeks of Treatment	VOC's/Target Compounds	Method 8010 (for onsite lab) Method 8240 (for offsite lab)
			Total Metals	Method 6010 (for onsite lab) Method 6010/7000 (for offsite lab)
			Total Chlorides	Method 325.3
	Continuous Control Panel Display		Rate	STP Monitor
Stack Emissions Monitoring	Continuous Emissions Monitors (CEMs)	None	TOCs	Method 25
			Carbon Dioxide	Method 3
			Oxygen	Method 3
			Carbon Monoxide	Method 10
	None	Week 1 One Sample/day Week 2 to 4 One Sample/ 48 hrs of Treatment Week 5 to End 1 Sample/2weeks of Treatment	VOCs*	Method TO-14
			Acid Gas (HCl)	Method 26
			Total Particulates	Method 5
			Chlorine Gas	Method 26A

* VOST and Method 0010 will be used to sample for organic Compounds.

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Table 3.5 (Continue)

LHAAP, Burning Ground No. 3, IRA
STP Verification Monitoring During Normal Operations

Description of Material To Be Tested	Frequency of Onsite Testing	Frequency of Offsite Testing	Parameters	Test Methods 40 CFR 60 Appendix A
Treated Material	One Grab Sample Every 6 Hours Batch (4 samples per 24 hours of treatment)**	Week 1 1 Grab Sample/day Week 2 to 4 1 Grab Sample/72hrs of Treatment Week 5 to End 1 Sample/2weeks of Treatment	VOC's/Target Compounds	Method 8010 (for onsite lab) Method 8240 (for offsite lab)
			Total Metals	Method 6010 (for onsite lab) Method 6010/7000 (for offsite lab)
Operational Parameters	Displays Continuously on Control Panel	None	Soils Discharge Temperature	STP Instrument
			Catalyst Inlet Gas Temperature	
			Catalyst Exit Gas Temperature	
			Drum Draft	

** If the test results from a batch of treated material indicate that VOC contamination has been reduced to meet the requirements of Table 3.1 than this material will be considered treated and will be disposed off as required. However, if a batch of treated material does not meet the cleanup objectives listed in Table 3.1, two grab samples will be collected from this material and tested for confirmation. If the results from either of the additional samples indicate that the batch does not meet cleanup requirements, then it will be handled as contaminated material and will be retreated until the cleanup requirements are met.

3.4.10.3 Continuous Emissions Monitoring of Stack Gases

Continuous Emissions Monitors (CEMs) will be used to assess stack emissions for total hydrocarbons (TOCs), carbon dioxide, oxygen and carbon monoxide. This will confirm that operating parameters are maintained to ensure on-going compliance with all applicable air regulations Additional stack sampling will be performed daily for VOCs/Target Compounds.

3.4.10.4 Operational Parameters

The STP will be operated utilizing the parameters shown to effect the required performance standards as demonstrated in the POP test. The critical parameters are rate, soil discharge temperature, drum draft, differential pressure across the baghouse, catalyst inlet temperature, catalyst exit temperature, carbon dioxide and oxygen in the stack, and pH of the scrubber sump water.

3.5 <u>Task 5 - Disposal/Placement of Treated Soils and Source Material</u>

The treated soil from the ICT excavations, collection and discharge pipe networks excavations, and from site investigations including Phase I and Phase II of the IRA will be used as backfill material for the excavations of source material on Burning Ground No. 3. If the excavations are not ready to receive material then, the treated soils may be stockpiled at the burning ground site after being cleared for use as backfill by laboratory test results. The backfilling will be in accordance with specification Sections 02211 - Grading and 02222 - Excavation, Trenching and Backfilling for Utility Systems.

The treated source material will be placed on a landfill at site LHAAP 12 until the maximum capacity (approximately 65,000 to 70,000 cubic yards) for the foundation of the landfill cap is reached. If additional materials remain to be disposed, they will be transported to landfill LHAAP 16. The material will be covered with a tarp or flexible liner during and after placement until the planned permanent landfill cover is placed.

3.6 Task 6 - Drilling 20 Soils Borings

Twenty soil borings will be completed to an approximate depth of 20 feet during excavation of the source material. The objective of these borings is to define potential new source material locations other then what is defined on Figure 5. These borings may be also used to define the extent of known source material locations. The boring locations will be based on existing site data, air photos, and recommendations by the USACE, Tulsa District, Environmental Design Division.

Samples would be collected continuously for visual inspection and field testing using a portable GC. The "hottest" soil sample from each boring, based on field monitoring, will be sent to an off site laboratory for testing for VOCs, metals, and explosives in accordance with the CDAP.

The borings will be backfilled in accordance with 30 TAC 338, Water Well Driller Rules. Static water levels will be taken from each open borehole after completion of drilling and immediately prior to grouting.

The EPA and TNRCC will be informed of the process for the identification of additional source areas and will be informed if additional source areas are located. Volume of source material to be treated in excess of what is specified in the ROD will depend upon funding availability.

Applicable sections of the drilling and well installation specifications Section 02730b included in Appendix A will be adhered to during the implementation of this task. In addition, the work will be done in accordance with the project CDAP and SSHP.

3.7 Task 7 - Site Restoration

Site restoration due to excavation of source material and other IRA activities will be conducted by DEI as soon as work has been completed at each related site. The restoration will be to original conditions to the extent possible including the rebuilding of damaged and/or removed access roads and other structures. The restoration work will be coordinated with the USACE. In order to document existing conditions, DEI will take photographs of the entire site, prior to the initiation of construction and/or source material excavation activities. DEI would also conduct surveying of all structure that would potentially be damaged and/or removed due to the required IRA work. These structure would include but not limited to the following:

- Air Curtain Destructor,
- Burn Cages,
- Access Roads,
- Utility Lines, and
- The Fence.

DEI will submit to the USACE detailed plans for review and comments including specifications for the restoration of damaged and/or removed structures and excavated areas of source material. Restoration at a particular area will proceed only after receiving approval from the USACE on the approach to be taken by DEI.

The hauling of fill material from an off site location will most probably be required for site restoration. The source for this material will be the borrow pit at LHAAP located at the Radio Tower Hill site. Backfilling activities will be conducted in accordance with specifications Sections 02211 and 02222 as applicable.

4.0 PROJECT ORGANIZATION

4.1 Project Organization and Schedule

DEI will use a multi-disciplinary project team to oversee all project activities. Project management and activities will be performed by DEI, under contract to the U.S. Army Corps of Engineers, Tulsa District. Figure 4-1 presents the project organization structure. The names of subcontractors will be provided to the USACE upon selection by DEI. The analytical testing for groundwater and soil will be conducted by PDP Analytical Services of Spring, Texas under subcontract to DEI. A Corps of Engineers approved laboratory will be selected and used for air and vapor testing. A preliminary project schedule is presented on Figure 4-2.

4.2 Key Project Personnel

The Organizational Chart is shown on Figure 4-1. Resumes for key personnel will be sent separately to the USACE for approval. The DEI Project Manager (PM) for this Phase III work is Mr. Amine Bou Onk. The PM is responsible for the overall conformance of the work to the USACE requirements and specifications. This responsibility includes the preparation and timely submission of all required work plans, designation of project personnel, and see that the project schedule and budget allow sufficient resources to properly construct and document the required elements of the work in accordance with the approved workplans. The PM will be the primary contact with the USACE, Fort Worth and Tulsa Districts and will report to the project director, Mr. James Hall. Mr. Bou Onk will also act as the onsite civil/geotechnical engineer.

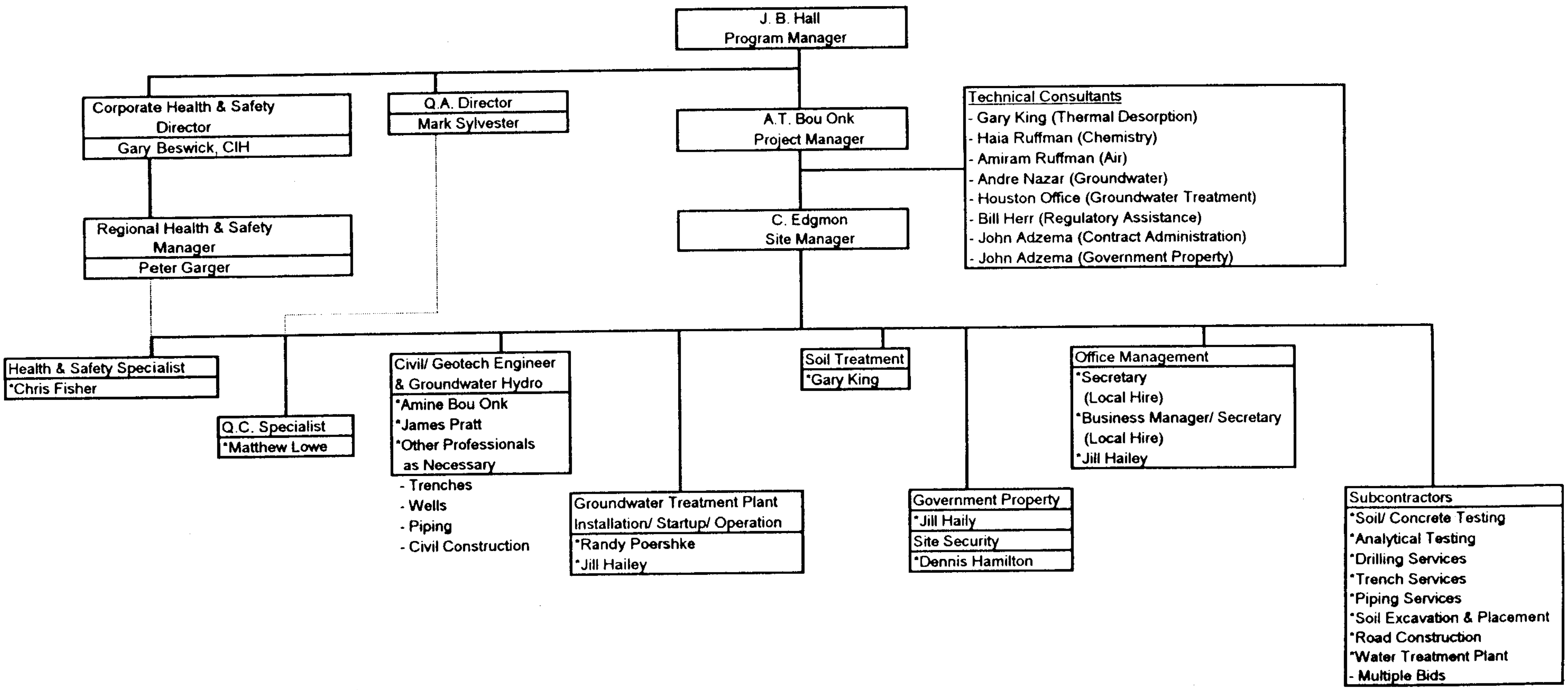
Mr. Chris Edgmon will act as the site manager. He will be responsible for implementing the requirements of the workplans in the field. Mr. Edgmon will report to the project manager Mr. Amine Bou Onk. Mr. Edgmon will act as project manager in the absence of Mr. Bou Onk.

Mr. Matthew Lowe will act as the Project Construction Quality Control (CQC) Manager. His functions are detailed in the CQCP.

Mr. Chris Fisher will act as the Health and Safety Specialist. His functions are described in detail in the SSHP.

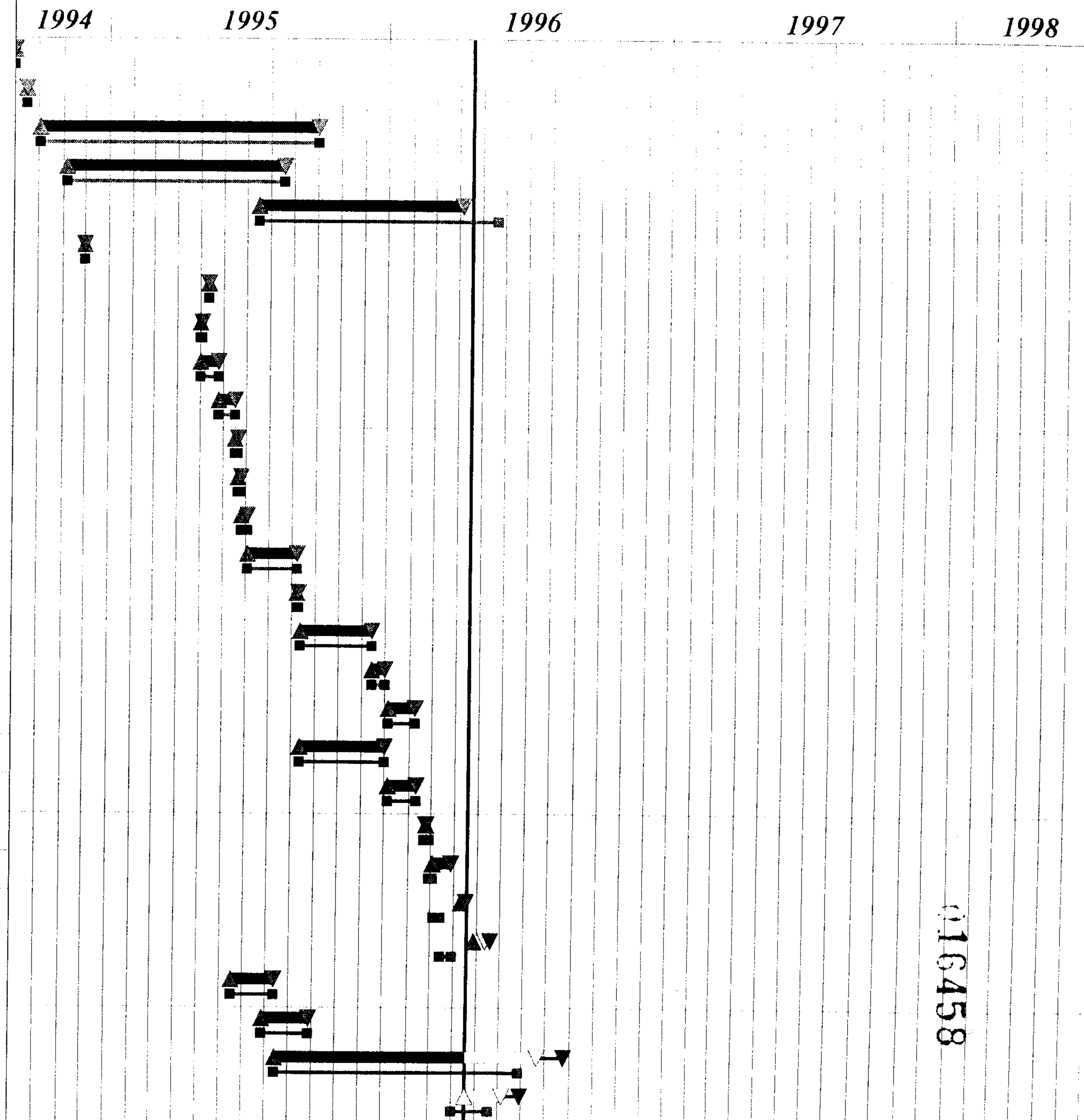
Figure 11

DOW ENVIRONMENTAL INC.
PROJECT ORGANIZATION
Burning Ground No. 3
Interim Remedial Action
Longhorn Army Ammunition Plant
Karnack, Texas



016457

Activity Description
ISSUE DELIVERY ORDER
ISSUE OF FIRST WAD BY THE USACE
PHASES I & II PILOT STUDY REPORT
COMPLETE STAGING AREA AND SET UP TRAILERS
BUILD SOIL HANDLING PADS
ORIGINAL REQUIRED DATE FOR ROD TO BE ISSUED
ACTUAL DATE ROD WAS ISSUED BY EPA
TECH DIRECTION GIVEN TO FINALIZE PRELIM WORKPLAN
DEI COMPLETES PRELIMINARY WORKPLANS
USACE REVIEW/COMMENT ON PRELIM. WORKPLANS
DEI PREPARES ANNOTED RESPONSES TO COE COMMENTS
USACE/DEI COMMENT RESOLUTION
DEI PREPARES DRAFT WORKPLANS
USACE/ARMY/REGULATORS REVIEW DRAFT WORKPLAN
DEI ANNOTATED RESPONSES TO REVIEW COMMENTS
USACE/ARMY/REGULATORS/DEI COMMENT RESOLUTION
DEI PREPARES FINAL WORKPLAN (EXCLUDING AMP)
REGULATORY ACCEPTANCE REVIEW (EXCLUDING AMP)
DEI PREPARES UPDATED DRAFT AIR MONITORING PLAN
USACE/ARMY/REGULATORS DRAFT AMP REVIEW/COMMENT
DEI ANNOTADE RESPONSES TO AMP COMMENTS
USACE/ARMY/REGULATORS/DEI COMMENT RESOLUTION
DEI PREPARES FINAL AIR MONITORING PLAN
REGULATORY ACCEPTANCE REVIEW OF AMP
INSTALL ACCESS ROAD
COMPLETE SOIL BORINGS TO DEFINE ICT BOTTOM
GWTP PROCUREMENT AND INSTALLATION
INSTALLATION OF TREATED WATER DISCHARGE LINE



016458

Project Start	31AUG94
Project Finish	24APR98
Data Date	17APR96
Plot Date	29APR96

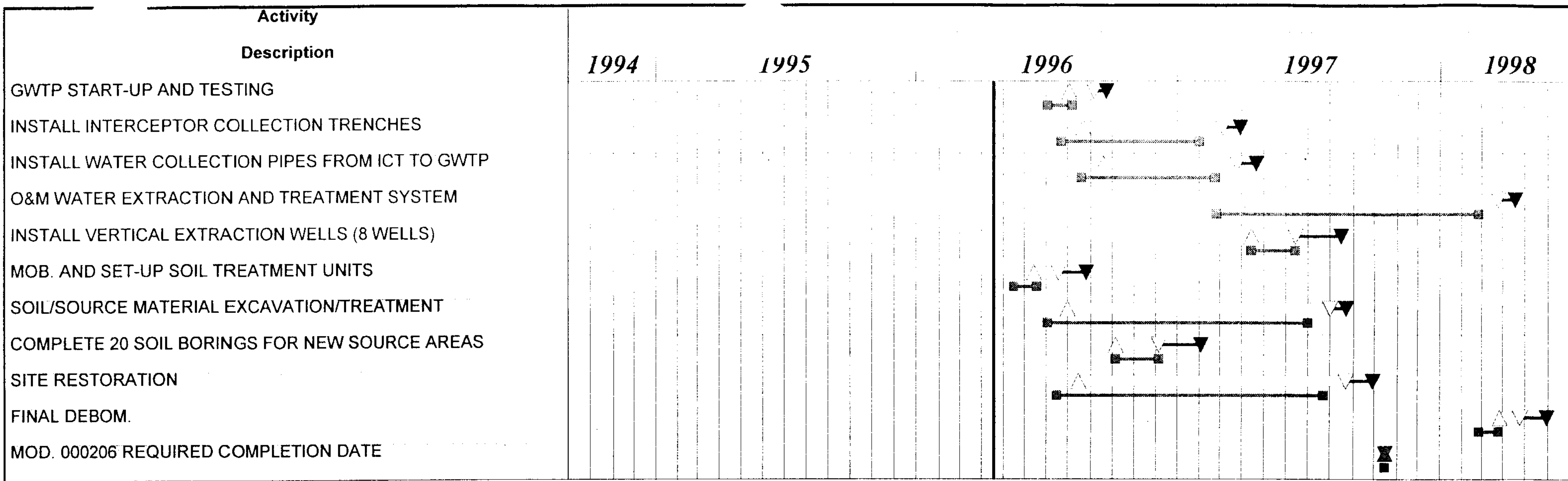
Early Bar
Late Finish Bar
Target Early Fin
Progress Bar
Critical Activity

AP17

Sheet 1 of 2

DOW ENVIRONMENTAL INC.
LHAAP 18&24, BURNING GROUND 3, IRA

Date	Revision	Checked	Approv


Activity
Description
GWTP START-UP AND TESTING
INSTALL INTERCEPTOR COLLECTION TRENCHES
INSTALL WATER COLLECTION PIPES FROM ICT TO GWTP
O&M WATER EXTRACTION AND TREATMENT SYSTEM
INSTALL VERTICAL EXTRACTION WELLS (8 WELLS)
MOB. AND SET-UP SOIL TREATMENT UNITS
SOIL/SOURCE MATERIAL EXCAVATION/TREATMENT
COMPLETE 20 SOIL BORINGS FOR NEW SOURCE AREAS
SITE RESTORATION
FINAL DEBOM.
MOD. 000206 REQUIRED COMPLETION DATE
1994
1995
1996
1997
1998

016459

APPENDIX A

PROJECT SPECIFICATIONS

016461

SPECIFICATIONS

TABLE OF CONTENTS

SECTION 01565
TEMPORARY SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes provision of temporary measures to control soil erosion, check dams, berms, sediment, basins, fiber mats, erosion control matting, stone, mulches, grasses, slope drains, silt fencing, hay bales, and other erosion control devices as required.

1.02 SUBMITTALS

A. Submit product data, samples, specifications and manufacturer's installation procedures for approval as required by the Contractor prior to use.

PART 2 - PRODUCTS

A. Mulch - Hay, straw, wood chips or other material reasonably clean of noxious weeds and deleterious material.

B. Grasses - Rye grass, cereal grasses, or other quick-growing species suitable to the area and as a temporary cover, which will not compete with the grasses specified for permanent cover.

C. Slope drains - Pipe, stone, asphalt, concrete or plastic sheets.

D. Silt Fencing - "Envirofence" by Mirafi, "Propex Silt Stop" by Amoco, or equivalent. Posts shall be two-inch square oak posts, with a minimum length of five feet.

E. Hay Bales - Hay bales, 2 inch by 2 inch stakes.

F. Floating Silt Barrier - "Mark I Silt Curtain" by American Boom and Barrier, or equivalent.

PART 3 - EXECUTION

3.01 GENERAL

A. All Work under this contract shall be performed in such a manner that objectionable conditions shall not be created in water courses through or adjacent to the project area.

B. The Subcontractor shall be responsible for the selection of appropriate temporary erosion control measures to suit the intended construction methods. The Subcontractor shall submit a scheme of control measures for each potentially impacted area prior to construction for approval by the Contractor and QAR.

3.02 EROSION CONTROL

A. In conditions require, the Contractor or QAR may limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations and direct the Subcontractor to provide immediate, permanent or temporary pollution control measures to minimize damage to adjacent property and to minimize contamination of adjacent streams or other watercourses, lakes, ponds or other areas of water impoundment.

B. The Subcontractor shall incorporate all permanent erosion control features into the project at the earliest practical time as outlined in his accepted schedule. Temporary control measures shall be those that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction activities, but are not associated with permanent control features on the project.

3.03 INSTALLATION AND MAINTENANCE OF SILT FENCING

A. Install posts a maximum of six feet apart and drive a minimum of 12 inches into the ground.

B. Excavate four-inch wide by four-inch deep trench along line of posts.

C. Fasten fabric to upstream side of posts using heavy-duty wire staples at least one inch long, tie wires or hog rings. Eight inches of the fabric shall extend into the trench.

D. Backfill trench and compact soil over the fabric.

E. Inspect after each rainfall event. Make required repairs immediately.

F. Remove sediment deposits when deposits reach approximately one-half the height of the barrier. Move sediment into the soil staging area for treatment.

G. Replace fabric when it has deteriorated to the extent that it reduces the effectiveness of the fence.

H. Remove silt fencing upon completion of excavation and/or backfilling activities.

I. Any sediment deposits remaining after silt fence is removed shall be dressed to conform with the existing grade, prepared, and seeded.

3.04 APPLICATION OF TEMPORARY GRASS AND MULCH

A. Comply with Section 02930.

3.05 INSTALLATION OF OTHER EROSION CONTROL MEASURES

A. Install according to manufacturer's recommendations and standard local practice.

END OF SECTION

SECTION 02211
GRADING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes removal of topsoil, excavating, placement of fill, grading and rough contouring areas within the Interceptor Collection Trench, Source Material Areas, at the Temporary Staging and Storage Pad, and At site LHAAP 12 if required by USACE.

1.02 QUALITY ASSURANCE

A. Grading work shall be performed in a manner that does not disturb existing monuments, monitoring wells, or other of the Owner's facilities within the project limits.

B. Reference Standards

1. American Society for Testing and Materials (ASTM)

   a. ASTM D 698, Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-pound Rammer and 12-inch Drop.

   b. ASTM D 1556, Test Method for Density of Soil in Place by the Sand-Cone Method.

   c. ASTM D 2157, Test Method for Density of Soil in Place by the Rubber-Balloon Method.

   d. ASTM D 2487, Classification of Soils for Engineering Purposes.

   e. ASTM D 2488, Recommended Practice for Description of Soils Visual-Manual Procedure)

   f. ASTM D 2922, Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths)

C. DEI shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications.

1.03 PROJECT CONDITIONS

A. Work may involve disturbance of hazardous material.

B. Perform work in accordance with OSHA 29 1920.120, Site Health and Safety Plan, and Waste Management Plan.

C. Protection of Persons and Property

1. Barricade open holes and depressions occurring as part of the Work.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

D. Dewatering

1. Remove water, including rain water, encountered during excavation of source material to a Contractor and/or QAR approved location by pumps, drains, and other approved methods.

2. Keep excavations and site construction area free from water.

E. Use means necessary to prevent dust becoming a nuisance to the public and to other work being performed on or near the site.

F. Control erosion and siltation in area of work in accordance with Section 01565.

PART 2 - PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Proposed clean fill materials shall be approved for use on this project by the USACE QAR as specified, prior to use of the material in the construction.

B. Treated contaminated and interceptor trench soils shall be used to backfill source material excavations only.

2.02 COMPACTED FILL

A. The clean fill shall consist of sand (SP, SW, SM, SC), clay (CL) or silt (ML, MH), or blends of these materials as defined by the Unified Soil Classification System. The soil shall be substantially free of organic matter or other perishable matter, rocks larger than two inches in greatest dimension, pavement material, frozen soil, snow, and topsoil.

B. Testing of Soil

1. Soil type (ASTM D 2487): Minimum of one test from borrow source for every 5000 cubic yards of loose soil and for each visible change in soil color or consistency.

2. Proctor Moisture - Density Curve (ASTM D 698): Minimum of one test from borrow source for every 5000 cubic yards of loose soil and for each visible change in soil color or consistency. Also, one test from every 5,000 cubic yards of treated soils.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Tests are required during construction of each soil layer during backfilling of excavations and/or construction of any required earth structure.

B. Testing of Compacted Fill - Compaction/Density tests, using ASTM D 1556, D 2167, D 2922, or D 2937: Minimum of one test for each 12 inch compacted thickness and for each 2,500 square feet of fill paced.

C. If, in the QAR's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing at not additional cost to the USACE.

3.02 PREPARATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Identify required lines, levels, contours and datum.

3.03 FILLING AND BACKFILLING

A. Ground Surface Preparation

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from the ground surface prior to placement of fills.

2. Plow, strip, or break up surfaces steeper than one vertical to four horizontal so that fill material will bond with existing surface.

3. At exposed soils in areas to be paved, scarify to a minimum depth of 6 inches, and recompact at a moisture content that will permit proper compaction as specified for fill.

B. Placing

1. Place backfill and fill materials in layers not more than eight inches loose depth.

2. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice.

3.04 GRADING

A. General

1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.

2. Smooth the finished surfaces within specified tolerance.

B. Grading Outside Structure Lines (Air Curtain Destructor)

1. Grade areas adjacent to structures to achieve drainage away from the structures, and to prevent ponding.

2. Finish the surfaces to be free from irregular surface changes, and shape the surface of areas scheduled to be under pavement to line, grade, and cross-section, with finished surface not more than 0.05 feet above or below the required subgrade elevation.

3.05 COMPACTION

A. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D 698.

B. Provide not less than the following maximum density of soil material compacted at optimum moisture content for the actual density of each layer of soil material in place.

1. Unpaved Areas: Compact each layer of fill material or backfill material to 90 percent of maximum density.

2. Pavements: Compact the top eight inches of subgrade and each layer of fill material or backfill material at 95 percent of maximum density.

C. Moisture Control

1. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compacting operations.

2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting of the specified density.

3.06 MAINTENANCE

A. Protection of Newly Graded Areas:

1. Protect newly graded areas from erosion, and keep free from trash and weeds.

2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

END OF SECTION

SECTION 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle Size Analysis of Soils
ASTM D 1556	(1990) Density of Soil in Place by the Sand Cone Method
ASTM D 698	(1978; R 1990) Moisture Density Relations of Soils and Soil Aggregate Mixtures Using a 5.5 lb (2.49 kg) Rammer and 12 in. (305 mm) Drop (Standard Compaction Test)
ASTM D 2167	(1984; R 1990) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
ASTM D 2922	(1981; R 1990) Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

1.3.1 Degree of Compaction - Degree of compaction shall be expressed as a percentage of the maximum density obtained by standard compaction test procedures.

1.3.2 Excavation - Excavation is all material excavated, whether earth or rock, in performance of work.

1.3.3 Fill Material - Fill material is job excavated material or material obtained from an approved off-site source used to backfill trenches, as specified herein.

1.3.4 Waste Material - Waste material is the portion of the materials excavated in performance of the work, whether from permanent construction sites, foundation excavation, or temporary access roads that can not be made or processed to meet the specification requirements for fill material, this material shall be disposed of off-site at an approved licensed disposal facility.

1.4 QUALITY CONTROL

1.4.1 General - All work covered here under "Quality Control" will be provided by the Subcontractor as a subsidiary obligation of the Subcontract. SECTION 01440 - QUALITY CONTROL, provides requirements for establishing and implementing the Subcontractor's Quality Control Program.

1.4.2 Testing Laboratory - All tests to ensure that fill and backfill materials and their placement comply with specified requirements shall be made by an independent testing laboratory.

1.4.3 Test Procedures - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The latest version/revision of each publication shall be apply.

ASTM C 33	Quality and Soundness
ASTM D 422	Particle-Size Analysis of Soils
ASTM D 423	Test for Liquid Limit of Soils
ASTM D 424	Test for Plastic Limit and Plasticity Index of Soils
ASTM D 1556	Density of Soil In-Place by the Sand-Cone Method
ASTM D 698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 5.5 lb (2.49 kg) Rammer and 12 in. (305 mm) Drop
ASTM D 2049	Relative Density of Cohesionless Soil
ASTM D 2167	Density and Unit Weight of Soil In-Place by the Rubber Balloon Method
ASTM D 2216	Laboratory Determination of Moisture Content of Soil
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2922	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

ASTM D 3017	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

1.5 SUBMITTALS - Submittals shall be in accordance with SECTION 01300 - SUBMITTALS.

1. Submit certified laboratory test results on all aggregates, borrow materials, and topsoil obtained from off-site sources to be incorporated into the work, as specified herein, before production or delivery materials.

2. Submit quality control field and laboratory data in accordance with SECTION 01440 - QUALITY CONTROL.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials - Satisfactory materials shall consist of any material classified by ASTM D 2487 as GW, GP, SW, SP, SM, CL, and ML, or as approved by the Contractor.

2.1.2 Unsatisfactory Materials - Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 2 inches, and materials classified in ASTM D 2487, as PT, OH, and OL. Unsatisfactory materials also include manmade fills, refuse, or backfills from previous construction.

2.1.3 Cohesionless and Cohesive Materials - Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.4 Unyielding Material - Unyielding material shall consist of rock and gravelly soils with stones greater than 4 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.5 Unstable Material - Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.6 Select Granular Material - Select granular material shall consist of wellgraded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1 inch sieve. The maximum allowable aggregate size shall be 1 inch, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.7 Initial Backfill Material - Initial backfill shall consist of select granular material or satisfactory materials free from rocks 1 inch or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than ½ inch in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Plastic Marking Tape - Plastic marking tape shall be acid and alkali-resistant polyethylene film, six inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities and shall identify the utility being protected. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Should marking tape from existing utilities be damaged during excavation the contractor shall repair or replace to ensure continuity of the marking tape. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

Table 1 - Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 - EXECUTION

3.1 EXCAVATION - After topsoil removal has been completed, excavation of every description, regardless of material encountered, within the grading limits of the project shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site shall be disposed of by the Subcontractor. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Contractor.

3.1.1 Trench Excavation - The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such minimum width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 5 feet high shall be shored or suitable shielding installed. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Subcontractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Subcontractor without any additional cost to the Contractor.

3.1.1.1 Bottom Preparation - The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material - Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material - Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Subcontractor in the performance of the work, the resulting material shall be excavated and replaced by the Subcontractor without additional cost to the Contractor.

3.1.1.4 Excavation for Appurtenances - Excavation for manholes, catchbasins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling - Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contractor's On-site Representative, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections. The Subcontractor shall jack under the roadways, and railways as indicated on the drawings. These borings shall be sleeved for a minimum of five feet on either side of the roadway or railway. Railway sleeves shall have a minimum of 4 feet of cover and roadway sleeves shall have a minimum of 3 feet of cover.

3.1.1.6 Stockpiles - Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Subcontractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Contractor. Locations of stockpiles of satisfactory materials shall be as shown subject to prior approval of the Contractor's On-site Representative.

3.2 BACKFILLING AND COMPACTION - Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill - Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 12 inches above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test. The trench shall not be backfilled until all specified tests are performed.

3.2.1.1 Replacement of Unyielding Material - Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material - Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Bedding and Initial Backfill - Bedding shall be of the type and thickness recommended by the pipe manufacturer. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill - The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways and Railroads: Pipe under roadways and railways shall be jacked under the roads and shall be blocked in the sleeves and shall have sand floated into the sleeve up to the springline of the pipe.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Water flooding or jetting methods of compaction will be permitted for granular noncohesive backfill material. Water jetting shall not be allowed to penetrate the initial backfill. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances - After the manhole, catch-basin, inlet, thrust block, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS - Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Water Lines - Trenches shall be of a depth to provide a minimum cover of 24 inches from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For railroad crossings an additional 24 inches of cover is required and for a road crossing and additional 12 inches of cover is required.

3.3.5 Plastic Marking Tape - Warning tapes shall be installed directly above the pipe, at a depth of 12 inches below finished grade unless otherwise shown. Warning tapes shall be terminated above grade and shall be tightly adhered to the piping a minimum of 6 inches above grade.

3.4 TESTING - Testing shall be the responsibility of the Subcontractor and shall be performed at no additional cost to the Contractor.

3.4.1 Testing Facilities - Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Subcontractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contractor's On-site Representative. The first inspection shall be at the expense of the Contractor. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Subcontractor.

3.4.2 Testing of Backfill Materials - Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture density relations of soils ASTM D 698. A minimum of one particle size analysis and one moisture density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests - Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 1000 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used and a minimum of 1 for each type of backfill material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contractor's On-site Representative. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contractor. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Contractor.

END OF SECTION

INTERIM REMEDIAL ACTION
Burning Ground No. 3
LHAAP 18 & 24
Longhorn Army Ammunition Plan
Karnack, Texas
PHASE III

SECTION 02277 - SYNTHETIC MEMBRANE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes furnishing and installing a synthetic membrane as part of the Interceptor Collection Trench Construction.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.

B. The Subcontractor shall furnish all labor, materials, equipment, services, incidentals and other items necessary for the placement and installation of the 40 mil line (HDPE geomembrane) as shown on the Contract Drawings and as specified.

C. Manufacturer's Qualifications: The manufacturer shall be a specialist in the manufacture of HDPE geomembrane and shall have at least five years experience in the manufacture of HDPE geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 10,000,000 square feet of HDPE geomembrane during the last five years.

D. Installer's Qualifications

1. The geomembrane installer shall be the manufacturer or an approved contractor trained and licensed to install the manufacturer's geomembrane.

2. The geomembrane installer shall be a specialist in the installation of HDPE geomembranes and shall have at least five years experience in the installation of HDPE geomembranes. The geomembrane installer shall have installed at least 10,000,000 square feet of HDPE geomembrane during the last five years.

3. Installation shall be performed under the constant direction of a single Field Installation Supervisor who shall remain on site and be in responsible charge, throughout the liner installation, for liner layout, seaming, patching, testing, repairs and all other activities by the Installer. This Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 1,000,000 square feet of HDPE geomembrane.

4. Seaming shall be performed under the direction of a Master Seamer (who may also be the Installation Supervisor) who has seamed a minimum of 1,000,000 square feet of HDPE geomembrane, using the same type of seaming apparatus specified in the current project. This Installation Supervisor and/or Master Seamer shall be present whenever seaming is performed.

E. Reference Standards

1. American Society for Testing and Materials (ASTM):

   a. ASTM D 570, Test Method for Water Absorption of Plastics.

   b. ASTM D 638, Test Method for Tensile Properties of Plastics.

   c. ASTM D 696, Test Method for Coefficient of Linear Thermal Expansion of Plastics.

   d. ASTM D 746, Test Method for Brittleness, Temperature of Plastics and Elastomers by Impact.

   e. ASTM D 792, Test Methods for Specific Gravity and Density of Plastics by Displacement.

   f. ASTM D 1004, Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

   g. ASTM D 1149, Test Method of Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimens).

   h. ASTM D 1204, Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.

   i. ASTM D 1238, Test Method for Flow Rates of Thermoplastics by Extrusion Plastomer.

j. ASTM D 1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.

k. ASTM D 2103, Specification for Polyethylene Film and Sheeting.

l. ASTM D 3083, Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining.

m. ASTM D 4437, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

n. FTMS 101B, Method 2065, Test Method for Determination of Puncture Resistance.

1.03 DELIVERY, STORAGE AND HANDLING

A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall clearly state the manufacturer's name, product identification, batch number, roll number and roll dimensions.

B. Geomembrane shall be protected for ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

C. The Subcontractor shall provide all labor and equipment required to assist the Engineer in the observation of materials delivered to this site. The Subcontractor shall be responsible for generating, updating and submitting an inventory of HDPE rolls received on-site from the manufacturer/distributer which shall include all the information appearing on the label of each roll to the Engineer.

D. Rolls shall be stored in a manner which protects them from the elements. Rolls shall be stored on a prepared surface (not wooden pallets) and shall not be stacked more than two rolls high.

1.04 SUBMITTALS

A. Manufacturer

1. The Subcontractor shall submit four copies of manufacturer's qualifications, certifications, data, specifications, installation instructions and dimensions.

2. Information provided by the manufacturer shall include the following:

   a. Quality control program and manual, or descriptive documentation.

   b. List of material properties and samples of liner.

   c. Indicate the origin of raw materials used to manufacture the liner.

   d. Certification that all resin used in the manufacture of geomembrane for this job meets the requirements specified herein.

   e. Quality control certificates issued by the resin supplier.

   f. Quality control certificates and certification that the geomembrane furnished complies with all requirements specified herein.

   g. Certification that the geomembrane and extrudate produced have the same properties.

3. No geomembrane shall be shipped until the certifications and quality control certificates are submitted to the Contractor.

B. Installer

1. The Subcontractor shall submit four copies of background information and qualifications of proof for the geomembrane installer.

2. Information provided by the installer shall include the following:

   a. Certification that both the Installation Supervisor and the Master Seamer have reviewed the Quality Assurance Plan and the Project Plans.

   b. Brief historical background, installation capabilities and information on the personnel.

   c. Reference at least 6 completed facilities, totaling a minimum of 6,000,000 square feet for which the Installer has installed a HDPE geomembrane. For each installation, the installer shall provide the name and purpose of the facility, its location, the date of installation, name of Owner, Design Engineer, Manufacturer, Fabricator, if applicable, name and telephone number of contact at the facility; thickness of geomembrane and surface area of the installed geomembrane; type of seaming, patching and tacking equipment; a copy of the Manufacturer's and/or Fabricator's approval letter(s) and/or license(s), if applicable; and Resume of the qualifications of the Installation Supervisor and Master Seamer to be assigned to this Project.

d. Certification of welding proficiency and total square footage of HDPE geomembrane installed per seamer assigned to weld during this project.

C. Shop Drawings

1. The Subcontractor shall submit six copies of shop drawings for approval as soon as possible after award of contract.

2. Shop Drawings shall show a proposed installation panel layout identifying seams and details. The layout diagram shall indicate the location of preassembled panels and shall identify each sheet and panel by number.

3. Shop drawings shall include a complete description of field seaming procedures, a work plan for liner installation including manpower and equipment, and a detailed description of field testing methods to be performed.

4. Any proposed deviation from these documents shall be submitted in writing to the Contractor On-Site Representative a minimum of seven working days prior to the scheduled start of geomembrane installation and will be accepted/rejected by the Contractor On-Site Representative prior to start of installation activities.

1.05 MATERIAL WARRANTY

A. Membrane manufacturer shall warrant the membrane material against manufacturing defects and material degradation in the outdoor exposure for a period of 20 years from the date of installation.

B. The membrane manufacturer shall warrant the membrane against degradation due to exposure to sunlight for a period of three years.

C. The manufacturer shall provide new material to replace on a prorated basis over the remaining life of the membrane any material which fails from the above causes within the warranty period.

D. The manufacturer shall furnish the Contractor On-Site Representative with a written warranty covering the requirements of this paragraph.

1.06 LINER INSTALLATION GUARANTEE

A. Guarantee the membrane installation against defects in installation and workmanship for one year commencing with the date of final acceptance.

B. The guarantee shall include the services of qualified service technicians and all material required for the repairs at no expense to the Contractor.

PART 2 - PRODUCTS

A. The geomembrane shall consist of new, first quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated by prior testing to be suitable and durable for such purposes. The geomembrane shall be an unmodified seamless, high density polyethylene (HDPE) containing no plasticizer, fillers, chemical additives, or extenders. Approximately 2 percent carbon black shall be added to the resin for ultra-violet resistance. The geomembrane shall be supplied as a continuous sheet with no factory seams, in rolls. The roll length and width shall be maximized to provide the largest manageable sheet for the fewest field seams.

B. Acceptable Manufacturers:

1. Gundle Lining Systems, Inc.
2. Schlegel Lining Technology, Inc.
3. National Seal Company
4. Poly-America, Inc.

C. Membrane material shall be produced free of holes, blisters, undispersed raw materials or any signs of contamination by foreign matter. Defects shall be repaired by replacement and by using the extrudate welding technique in accordance with the manufacturer's recommendations.

D. Finished product shall be supplied as a continuous sheet with no factory seams. Labels on the roll shall identify the thickness of the material, the length and width of the roll, roll weight, manufacturer's mark number, and the direction to unroll the material.

E. Physical Properties

1. HDPE geomembrane shall meet or exceed the following minimum requirements.

Property	Test Method	Value Required
Thickness (mils, nominal)	ASTM D 751, Section 9 (as modified by NSF 54-1991)	40
Specific gravity (g/cm^3)	ASTM D 792, Method A	0.94
Melt Flow Index (g/10 min) (max)	ASTM D 1238, Condition E	0.3
Minimum Tensile Properties	ASTM D 638, Type IV (as modified by NSF 54-1991)	
1. Tensile Strength at Yield (lbs/inch width)		84
2. Tensile Strength at break (lbs/inch width)		152
3. Elongation at Yield (percent)		12
4. Elongation at Break (percent)		560
Tear Resistance Initiation (lbs/in thickness, minimum)	ASTM D 1004, Die C	26
Low Temperature/Max. Allowable Failure temperature (°C)	ASTM D 746	-60
Dimensional Stability (each direction, percent change (maximum)	ASTM D 1204 100°C, 1 hour	±2.0
Volatile Loss (Max. %)	ASTM D 1203, Method A	0.1
Puncture Resistance (pounds)	FTMS 101B, Method 2065	48
Bonded Seam Strength Minimum Shear, lbs./in width	ASTM D 4437 (as modified by NSF 54-1991)	80
Seam Peel Adhesion Minimum Peel, lbs/in width	ASTM D 4437 (as modified by NSF 54-1991)	FTB(1) and 52

NOTE: (1) FTB = Film Tear Bond

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. The geomembrane shall be installed as soon as practical after the installation is completed in the section of slurry trench.

3.02 MEMBRANE PLACEMENT

A. Panel Placement

1. The geomembrane shall be installed as shown on the Drawings. No membrane material shall be placed when air temperature is less than 32 degrees F and decreasing, or more than 100 degrees F, when relative humidity is more than 90 percent, when it is raining, or when there is frost on the ground. All geomembrane handling and installation procedures shall be performed by workers wearing shoes with bonded soles and heels without heavy tread or lug surfaces. No foot traffic shall be allowed on the geomembrane without approved shoes. No vehicular traffic shall travel on the geomembrane. Only panels which will be anchored or seamed together in one day shall be unrolled or unfolded.

2. Pulling geomembrane panels shall be minimized to reduce permanent tension.

3. Sand bags shall be used as necessary to hold the geomembrane material in position during installation. Sand bags shall be sufficiently close-knit to preclude fines from working through the bags. Paper bags, whether or not lined with plastic, shall not be used. Burlap bags, if used, must be lined with plastic. Bags shall contain not less than 40 or more than 60 pounds of sand, and shall be securely closed after filling to prevent sand loss. Bags that are split, torn or otherwise losing their contents shall be immediately removed from the work area and any spills immediately cleaned up.

4. Any panels which become seriously damaged (torn or twisted permanently), shall be replaced. Less serious damage shall be repaired according to requirements herein.

5. The geomembrane roll shall be installed so that there will be neither tension nor wrinkles at the average expected temperature of the final use condition (ground temperature).

6. Damaged panels or portions of the damaged panels which have been rejected, shall be marked and their removal from the work area recorded.

B. Considerations of Trench Geometry: Seams shall be oriented perpendicular to the bottom of trench. In corners and odd shaped geometric locations, the total length of field seams shall be minimized.

C. Overlapping: The panels shall be overlapped prior to seaming to whatever is necessary to effect a good weld. In no case shall this overlap be less than three inches. This specification shall apply to panel placement only.

3.03 SEAMING PROCEDURES

A. Panels shall be placed in an effort to reduce wrinkles and subsequent fishmouths at the seam interface. "Lyster" welds or "tack" welds shall not be used to temporarily hold sheets in position. Seaming shall extend to the outside edge of panels to be placed or as otherwise approved in writing by the manufacturer and deemed acceptable by the QA Firm.

B. Seams shall be free of dirt, dust, moisture or other foreign materials.

C. Seaming shall be performed using an automatic fusion welding or extrusion welding system, equipment, and techniques. The surface of the seam edges shall be prepared as recommended by the manufacturer to provide a seam to equal or exceed the Bonded Seam Strength requirement specified previously. The extrusion welding process shall bond the exposed edge of the panel to the underlying membrane.

D. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkles back into the panel so as to effect a flat overlap. The cut fishmouths or wrinkles shall be seamed as well as possible, and shall then be patched with an oval or round patch of the same HDPE extending a minimum of six inches beyond the cut in all directions.

3.04 FIELD QUALITY CONTROL

A. Prequalification Test Seams

1. Test seams shall be performed to verify that seaming conditions are adequate. Test seams shall be conducted at least two times each day (at the beginning of the morning and the beginning of the afternoon), for each seaming equipment used that day. Also, each seamer shall perform at least one test seam each day. Test seaming shall be performed under the same conditions as production seaming. The test seam shall be at least two feet long.

2. Specimens shall be cut from the test seam. These specimens shall be 0.5 inch wide. Specimens shall be tested by hand in shear and peel, and shall not fail in the joint. If a test seam fails an additional test seam shall be immediately conducted. If the additional test seam fails the seaming

equipment or product shall be rejected and not used for production seaming until the deficiencies are corrected and a successful full test seam is produced.

3. The Contractor On-Site Representative will observe test seams. A sample from each test seam shall be retained and labeled with the date, ambient temperature, number of seaming unit, seamer, and pass or fail description. One half of the sample shall be given to the Geomembrane Installer for subsequent laboratory testing with the destructive seam tests, and the other half retained by the Contractor On-Site Representative.

B. Non-Destructive Field Seam Testing

1. All field seams shall be non-destructively tested over their full length. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester, and outcome of all non-destructive testing shall be recorded by the Geomembrane Installer.

2. The Contractor On-Site Representative will observe all testing. Testing shall be done as the seaming work progresses, not at the completion of all field seaming. All defects found during testing shall be numbered and marked immediately after detection. All defects found shall be repaired, retested and remarked to indicate completion of the repair and acceptability. The test unit shall be a vacuum test unit.

3. The tests mentioned above shall be supplemented by a visual inspection. Any areas that appear suspect shall be probed utilizing a flat, thin, round edged metal probe to check the seams for continuity of the sheets and extruded bead.

C. Destructive Field Seam Testing

1. A minimum of one destructive test sample per 300 feet of seam length shall be provided from a location specified by the Contractor On-Site Representative. The Subcontractor shall not be informed in advance of the sample location. In order to obtain test results prior to completion of geomembrane installation, samples shall be cut by the Subcontractor as the seaming progresses.

2. Sampling times and locations shall be determined by the Contractor On-Site Representative. The Contractor On-Site Representative shall witness the obtainment of all field samples and the Subcontractor shall mark all samples with their location roll and seam number. The Subcontractor

shall also record in written form the date, time, location, roll seam number, ambient temperatures, and pass or fail description. A copy of the information must be attached to each sample portion. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested.

3. The sample shall be 12 inches wide by 24 inches long with the seam centered lengthwise. The sample shall be cut into two equal pieces, one-half given to the Contractor On-Site Representative and the other half to the QAR. If the Subcontractor desires a sample, the size should be increased to 12 inches wide by 36 inches long.

4. For Field Laboratory Testing. Not Applicable.

5. For laboratory analysis, geomembrane seam samples shall be examined and tested in an independent testing laboratory retained by the Subcontractor approved by the Contractor. The samples shall be examined for holds, grooves, melt through, wavering welds, small welds, and any other unusual characteristics. The laboratory tests to be performed include "Bonded Seam Strength" and "Peel Adhesion" as recommended in the National Sanitation Foundation's (NSF) Standard Number 54 for Flexible Membrane Liners. At least three sub-samples transverse to the seam shall be tested for each laboratory test. A report or a series of reports shall be prepared by the laboratory of the results of the examination and testing. This report or reports shall be submitted to the Contractor On-Site Representative on a timely basis for review and consideration of further action.

D. Identification of Defects

1. All seams and non-seam areas of the geomembrane shall be inspected for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter.

2. The surface of the geomembrane shall be clean at the time of inspection. Brooming and/or washing of the geomembrane surface shall be required if the amount of surface dust or mud inhibits inspection.

E. Evaluation of Defects: Each suspect location both in seam and non-seam areas shall be non-destructively tested using the methods described herein. Each location which fails the non-destructive testing shall be marked and repaired.

F. Repair Procedures on Seams: Defective seams shall be repaired by reseaming or applying a cap-strip. Tears or holes shall be repaired by seaming or patching. Blisters, larger holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches. Each patch shall be numbered. Patches shall be round or oval in shape, made of the same generic geomembrane, and extend a minimum of six inches beyond the edge of defects.

G. Verification of Repairs on Seams: Each repair shall be non-destructively tested using the methods described herein. Tests which pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests shall be reseamed and retested until a passing test results. The Contractor On-Site Representative will observe all non-destructive testing of repairs. The Subcontractor shall record the number of each patch, date, location, patcher and test outcome.

H. Daily Field Installation Reports: The geomembrane installer shall provide the Contractor On-Site Representative with daily reports of: the total amount and location of geomembrane placed; total amount and location of seams completed and names of individuals doing seaming and units used; changes in layout drawings; results of test seams; location and results of non-destructive testing; location and results of repairs; and location of destructive test samples.

3.06 LINER ACCEPTANCE

A. The geomembrane liner will be accepted when: the installation is finished; all documentation of installation is completed; and verification of the adequacy of all field seams and repairs, and associated testing is complete.

B. A passing test seam shall be an indicator of the adequacy of the seaming unit and seamer working under prevailing site conditions, but not necessarily an indicator of field seam adequacy. The test seam must also pass the laboratory tests under the destructive testing criteria.

C. For field seams, if the laboratory test fail, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test seam. More destructive test portions shall then be taken by the geomembrane installer at locations indicated by the Contractor On-Site Representative and the same laboratory tests required of the test seams shall be performed. Passing test shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip. The cap-strip shall be non-destructively tested and repaired, as required, until adequacy of the seams is achieved.

D. A passing non-destructive test of field seams and repairs shall be considered to indicate the adequacy of field seams and repairs.

3.07 ANCHOR TRENCH

Not Used.

3.08 DISPOSAL OF SCRAP MATERIALS

A. On completion of installation, the membrane installation supervisor shall dispose of all trash and scrap material in a location approved by the Contractor, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner.

END OF SECTION

INTERIM REMEDIAL ACTION
BURNING GROUND No. 3, LHAAP 18&24
LONGHORN ARMY AMMUNITION PLANT, KARNACK, TEXAS

Section 02410
INTERCEPTOR COLLECTION TRENCH

PART 1 - GENERAL

1.1 Definitions:

1.1.1 Government - U.S. Army Corps of Engineers, Fort Worth District

1.1.2 Contracting Officer - Government Authorized Representative

1.1.3 Quality Assurance Representative (QAR) - Contracting Officer's Representative

1.1.4 Contractor - Dow Environmental Inc.

1.1.5 Subcontractor - Bio-polymer Specialty Subcontractor to be selected by Contractor.

1.1.6 Satisfactory Materials - Satisfactory materials shall comprise any materials classified by ASTM D 2487-90 as GW, GP, GC, GM, SW, SP, SP-SM, SM, SC, CL, CH, ML, and MH.

1.1.7 Unsatisfactory Materials - Unsatisfactory materials shall comprise any materials classified by ASTM D 2487-90 as PT, OH, OL, or any material containing organic matter or other deleterious materials, metallic debris, waste, and visible contamination.

1.1.8 Cohesionless and Cohesive Materials - Cohesionless materials include materials classified in ASTM D 2487-90 as GW, GP, SW, and SP. Cohesionless materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.1.9 Bio-polymer Trenching - Bio-polymer trenching technique consists of the use of guar gum based or equivalent bio-degrading slurry to maintain the stability of the vertical-walled trench. When the trench is backfilled with the specified materials, the slurry must be chemically and biologically degraded, so that the trench can collect groundwater.

1.1.10 First Confining Layer - The relatively impermeable soil unit on or into which the bottom of the Interceptor Collection Trench (ICT) is located.

1.2 Summary of Work - The work described herein consists of providing all plant, labor, equipment, materials to construct 5,000 feet long ICT sections by the bio-polymer trenching method to collect contaminated groundwater. Also included in the work are the installation of stainless steel sumps, HDPE clean-out pipes, and HDPE drain pipes as shown on Drawing ICT-2.

1.3 Applicable Publications - The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by basic designation only.

1.3.1 American Society for Testing and Materials (ASTM) Publications:

ASTM A-490	Stainless Steel Casing
ASTM C-150	Portland Cement
ASTM C-39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C-88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C-94	Ready-Mixed Concrete
ASTM C-97	Absorption and Bulk Specific Gravity of Natural Building Stone
ASTM C-131	Resistance to Degradation of Small Size Coarse Aggregates by Abrasion and Impact in the Los Angeles Machine
ASTM C-136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C-150	Portland Cement
ASTM D-422	Particle-Size Analysis of Soils
ASTM D-1140	Amount of Material in Soils Finer than the No. 200 (75 um) Sieve
ASTM D-1248	Polyethylene Plastic Molding and Extrusion Materials
ASTM D-1586	Penetration Tests and Split-Barrel Sampling of Soils

ASTM D-2487	Classification of Soils for Engineering Purposes
ASTM D-3350	Standard Specifications for Polyethylene Pipe and Fittings
ASTM F-405	Corrugated Polyethylene (PE) Tubing and Fittings

1.3.2 American Petroleum Institute (API) Standard Specifications

Code 13 B	Standard Procedure for Testing Drilling Fluid

1.3.3 American Water Works Association (AWWA) Standards:

AWWA A100-84	Water Wells

1.4 Measurement and Payment:

1.4.1 Trench Construction - The unit of measurement for the trench construction shall be the square foot. Trench construction to be paid for will be the number of square feet of trench excavated and backfilled according to the Contract documents. Additional excavation beyond the grades shown on the plans will not be paid for unless authorized in writing by the Contractor. The Subcontractor will not be compensated for additional materials used as a consequence of a trench excavated wider than shown on the Contract documents.

1.4.2 Sump/clean-out Installation - Each sump/clean-out constructed according to the Contract documents will be paid for as part of the overall ICT excavation and installation cost. No additional compensation will be provided for sumps/clean-outs excavated deeper or larger than shown on the Contract drawings unless authorized in writing by the Contractor.

1.5 Submittals:

1.5.1 Qualification of Subcontractor - The Subcontractor shall submit evidence with their bid that they are experienced and competent in the construction of bio-polymer interceptor trenches. The evidence shall include as a minimum the following:

- Documentation of a minimum of **five** projects successfully completed by the Subcontractor using the bio-polymer technique for the construction of contaminated groundwater interceptor trenches. The documentation shall include length and depth of the trench, nature of contamination, and name and phone number of owner's representative.
- Resumes of slurry trench specialist(s) demonstrating experience as a slurry trench specialist with at least three bio-polymer trench installations. The slurry trench

specialist should be experienced (on three projects) in controlling the composition, mixing, placing, cleaning, and maintaining bio-polymer slurry. The slurry trench specialist shall be approved by the Contractor.

1.5.2 Workplan - The Subcontractor shall submit, for review and approval by the Contractor, a workplan describing in detail the following:

- Methods and equipment used in mixing, stirring and pumping the slurry from the subcontractor staging area to the trench;
- Methods and equipment used in excavating the trench, maintaining the slurry, installing the clean-out pipes, the sumps, HDPE liner, and backfilling the trench;
- Layout of operations including yet not limited to drawings depicting guar gum storage area, slurry preparation area, slurry storage area, backfill storage area, location and size of all stationary equipment, and water storage tanks.
- Shop drawing showing the details of trench clean-out pipes and sumps assembly; and
- Sequence of work and schedule.

1.5.3 Select Trench Backfill - Certified reports and analyses performed by an independent laboratory certifying that the material proposed as select trench backfill meets the specifications. The Subcontractor shall identify the source of the material in their submittal. The testing on the material must be recent (not longer than one month old) and performed for the sole purpose of this submittal. A 50-pound sample shall be submitted with the certified test reports. The material shall be approved by the Contractor.

1.5.4 Drain Pipe - Manufacturer's catalog cuts of all pipes to be used for the ICT shall be submitted to the Contractor for approval prior to shipment of the material. The catalog cuts shall include detail specifications and recommended method of pipe length fitting. A sample of pipe and fitting shall be submitted with all pipe documentation submittals.

1.5.5 Synthetic Membrane - The HDPE geomembrane liner requirements shall be as listed in Specifications Section 02277.

1.5.6 Shop Drawing - A shop drawing shall be submitted by the Subcontractor for approval by the Contractor showing the detailed construction of the sump. Manufacturer's catalog cut for all the elements used in the construction of the sump shall be submitted. These include, but are not limited sand pack, high density polyethylene (HDPE) liner, stainless steel riser pipe/sump , stainless steel riser screen, and bentonite pellets. The shop drawing shall also include a description of the method used in the construction of the sump. The shop drawing and the materials to be used in the sump/clean-out construction are subject to approval by the Contractor.

1.5.7 Material Safety Data Sheets - The Subcontractor shall submit Material Safety Data Sheets (MSDSs), to the Contractor, for all material brought onsite by the Subcontractor. As a minimum, MSDSs for the following shall be submitted:

- Bentonite pellets;
- Guar-gum and any additive(s) used; and

The Subcontractor must comply with OSHA requirements and make all required MSDSs available to all site personnel through the Contractor.

1.5.8 Water - An on-site potable water supply will be made available to the Subcontractor by the contractor. The subcontractor shall be responsible for conveying the potable water from the source to the work areas as needed.

1.6 Environmental Protection - The Subcontractor shall take all precautions as may be required to prevent contaminated water or water having undesirable physical or chemical characteristics and contaminated slurry, from spilling on the ground surface (thereby increasing the volume of contaminated soils), from entering the water supply stratum through the trench or by seepage from the ground surface. The Subcontractor shall take all precautions necessary to prevent spillage and contamination of the ground surface or of surface waters resulting from the installation of the ICT. The Subcontractor shall submit, as part of the work plan required by paragraph 1.5, submittals, details of specific methods to be employed to control potential contamination or pollution arising from the construction of the ICT. All activities shall comply with the requirements of the approved Waste Management Plan. The Subcontractor shall also submit a plan for ICT runon control during construction.

PART 2 - PRODUCTS

2.1 Select Trench Backfill - Select trench backfill shall consist of clean washed gravel such as pea gravel or crushed stone. The backfill material shall meet the following gradation requirements when tested according to ASTM C 136:

Sieve No.	Percent Passing by Weight
1"	100
3/8"	40 - 50
No. 10	2 - 5
No. 16	0 - 2

The material shall not contain foreign material, clay lumps, organic matter, and other deleterious material.

2.2 Filter Fabric - A filter fabric envelope must be installed along the walls and bottom of the trench prior to the placement of selected backfill material and or drain pipe. The filter fabric must be selected based on the site subsurface conditions that will be provided by the contractor.

2.3 Drain Pipe - The drain pipe installed in the interceptor trench shall consist of a slotted (10 slot) <u>six</u>-inch flexible corrugated HDPE pipe as manufactured by Advanced Drainage Systems, Inc. or approved equal. The pipe and fittings shall meet the requirements of ASTM F 405. The proposed pipe must be able to sustain the weight of the backfill without loss of structural integrity. In addition, the pipe shall contain sufficient amounts of carbon black such that the pipe can be stored outside without damage from UV rays.

Alternately, the trench drain pipe shall consist of <u>six</u>-inch perforated fiberglass drain pipe with a HDPE filter fabric sleeve. If the Subcontractor proposes to use this option, detailed technical information on the fiberglass pipe and chemical resistant filter fabric sleeve shall be submitted to the Contractor for approval prior to use.

2.4 Slurry - Slurry shall be a stable colloidal suspension of powdered guar-gum in water, meeting the requirements shown on Table 1.

2.5 Water - The Subcontractor shall furnish all water required for producing slurry, an on-site source will be made available if such water meets the requirements of this section based on tests conducted by the subcontractor. Fresh, uncontaminated water, free of excessive amounts of deleterious substances that adversely affect the properties of the guar-gum slurry shall be used to produce the slurry. The Subcontractor shall perform any required testing to ensure that the water used does not degrade the slurry prematurely or effect the slurry in any adverse manner. As a minimum, the water used in the preparation of the slurry shall meet the following requirements:

$$6.5 \leq pH \leq 7.5$$

$$\text{Hardness} \leq 150 \text{ ppm}$$

$$\text{Total dissolved solids} \leq 500 \text{ ppm}$$

Oil, organics, acids, alkali, or other deleterious substances not greater than 50 ppm.

2.6 Guar Gum and Additives - Guar gum shall be natural ground guar gum. Additives such as pH adjuster shall be added to the slurry to adjust its properties as required.

2.7 Common Backfill - Common backfill shall consist of satisfactory cohesive materials. Trench spoils cannot be used as common backfill and must be containerized and stored as described in the Waste Management plan. Unsatisfactory material as described in section 1.1.6 shall not be used.

2.8 Clay Cap - Materials used in the clay cap shall be cohesive satisfactory material, classified as CL in accordance with ASTM D-2487.

2.9 Stainless Steel Sumps:

2.9.1 Riser Pipe - The sump shall be six inches in diameter and constructed of Type 304 stainless steel. All riser pipes shall be connected by threaded couplings. The sump riser pipe shall be threaded into the top of the well screen. A Type 304 stainless steel tee shall be threaded to the top of the riser pipe as shown on Drawing ICT-2. The tee caps shall be Type 304 stainless steel and shall be threaded to the tee.

2.9.2 Sump Screen - The sump screen shall be Type 304 stainless steel wire-wound screen, minimum six inch nominal diameter. The screen shall be directly threaded to the riser pipe. The screen and all accessories required for satisfactory operation shall be essentially standard products of reliable manufacturer regularly engaged in the production of such equipment. Field constructed screen shall not be acceptable.

Each sump screen shall be provided with continuous slot openings which shall have smooth, sharp-edged openings free of burrs, clipped edges, or broken pieces on the interior and exterior surfaces of the pipe. The openings shall be uniformly spaced spiral around the periphery of the sump screen. Slot size of the screen shall be 0.01 inch.

2.9.3 Blank Section - A one foot long stainless steel blank pipe with a diameter equivalent to that of the well screen shall be threaded into the bottom of the screen of each sump. The bottom of each sump shall be sealed using a stainless steel Type 304 bottom plate which shall be welded to the bottom of the pipe or a Type 304 stainless steel threaded cap securely sealed to the blank pipe.

2.10 Gravel Packs - Gravel packs used around the sump screen shall be select trench backfill.

2.11 Bentonite Seal - Bentonite used for well seals shall be either pelletized or chip form as supplied for use in water well construction.

2.12 Cement-Bentonite Grout - Cement-bentonite grout shall consist of portland cement conforming to ASTM C 150 Type I or II, bentonite, and water. Cement grout shall be proportioned with approximately seven pounds of powdered bentonite per 94-pound sack of cement and not more than six to eight gallons of water per 94-pound sack of cement.

2.13 Concrete - Concrete shall consist of ready mix concrete meeting the requirements of ASTM C 94. The cement used in the mix shall consist of portland cement conforming to ASTM C 150 Type I or II. The concrete compressive strength shall be a minimum of 3,000 pounds per square inch at 28 days when tested according to ASTM C 39.

PART 3 - EXECUTION

3.1 Trench Working Surface and Stability Platforms:

The Subcontractor is encouraged to utilize the existing ground surface as the trench working surface. If the Subcontractor requires additional fill to be placed along the alignment of the trench, then a plan shall be submitted to the Contractor showing such grading. The trench working surface grading plan shall be subject to approval by the Contractor and the Contracting Officer. No additional compensation shall be made to the Subcontractor for the construction of a higher level working surface, and no additional payment will be made to the Subcontractor for trench excavation as a result of a higher working surface required by the Subcontractor.

The construction of earth platforms along the alignment of a trench section for the purpose of maintaining trench stability during construction shall be the responsibility of the Subcontractor. The Subcontractor shall prepare and submit a plan to the contractor showing such platforms based on the subsurface information provided with the bid package. The earth platforms shall be built of Satisfactory materials in accordance with Specifications Section 02210. The earth platforms shall be subject to approval by the Contractor and the Contracting Officer. No additional compensation shall be made to the Subcontractor for the construction of an earth platform for the purpose of maintaining trench stability during construction. No additional payment will be made to the Subcontractor for trench excavation as a result of a higher working surface required by the Subcontractor.

Berms and other structures constructed by the Subcontractor to control slurry spillage and surface water shall be considered part of the work and no additional compensation shall be provided for their construction. Stockpiles and excavated material shall be placed at a safe distance from the trench, not less than 15 feet from the edge of the trench.

The Subcontractor shall remove, at no additional cost to the Contractor, all trench working surfaces, stability platforms, berms and other structures upon the backfilling of the trench section. The interceptor collection trenches must be completed at the original ground surface. The removed soils from these structures must be treated as contaminated soils and hauled by the Subcontractor, at no additional cost to the Contractor, to the soil dewatering and staging pad for treatment by others.

3.2 Trench Excavation:

3.2.1 Equipment - Excavation of the ICT sections shall be accomplished by use of any suitable earth-moving equipment such as a backhoe or trackhoe, so that the trench can be excavated to its final depth. The excavation shall be done with a bucket such that only one pass would be required to achieve the minimum required width of the trench.

3.2.2 Excavation Procedures - The trench for the ICT sections shall be excavated by the bio-polymer slurry method of excavation. Excavation shall be carried to the full depth shown on the drawings immediately at the point where excavation is started. The entire depth of excavation shall then be carried along the trench line. Excavation shall proceed continuously form the starting point to the finishing point. The Subcontractor shall excavate the slurry trench from the existing ground surface or if necessary a working platform. Slurry shall be introduced into the trench at the same time trenching is begun and shall be maintained in the trench during excavation and until backfilled. The Subcontractor shall maintain the stability of the excavated trench at all times for its full depth. Trench overlapping shall be proposed by the Subcontractor and approved by the Contractor. Beginning and terminal ends of the trench shall be vertical unless other wise approved by the Contractor.

The level of slurry shall always be maintained as required for trench stability above groundwater level and shall not be permitted to drop more than one foot below the surface of the slurry trench. Dilution of slurry by surface water shall be prevented by constructing the appropriate berms and or ditches, at no additional cost to the Contractor. The Subcontractor shall have personnel, equipment, and materials ready to raise the slurry level or replace the slurry if needed due to slurry degradation. To this end, the Subcontractor shall have personnel on call to raise or replace the slurry at any time it is required; weekends and/or holidays included.

Upon completion of excavation, any loose material or cuttings shall be removed from the bottom of the trench with the excavating backhoe or other suitable means approved by the Contractor. The bottom of the trench shall be sounded in the presence of the Contractor's representative to determine the nature of material on the bottom of the trench before backfilling operations. All loosened and settled material shall be removed and the final elevation of the bottom of the trench shall be approved by the Contractor.

3.2.3 Excavated Materials - Materials excavated from the trench shall not be used as common backfill. All excavated material shall be placed hauled to the soil dewatering and staging pad, at no additional cost to the Contractor. The handling of the excavated material shall also be in accordance with the project Waste Management Plan..

3.3 Slurry Mixing and Placing:

3.3.1 Slurry Mixing and Placing Equipment - The slurry mixing plant shall be equipped with a high-speed/high-shear colloidal mixer or a high-velocity/high-pressure vent or jet mixer used in conjunction with a high-speed/high-shear configural pump. Alternate plant and equipment proposed by the Subcontractor shall be approved by the Contractor. The plant shall be equipped with tanks, pumps, valves, hoses, supply lines, tools, and other equipment and materials required to prepare the slurry and deliver it in a continuous supply from the slurry plant to the trench. No slurry is to be made in the trench.

3.3.2 Slurry Operations - The Subcontractor shall have sufficient tank volume for storage of hydrated slurry. The tanks shall be mechanically or hydraulically agitated. Bio-polymer slurry shall be introduced into the trench at the time excavating begins. The level of the slurry in the trench shall be maintained a minimum of three feet above the groundwater level and generally within three feet of the top of the trench at all times. Dilution of the slurry by surface waters shall be prevented. The Subcontractor shall take all precautionary measures necessary to minimize damage to the work from groundwater and surface water. The slurry shall be maintained at all times in a condition which meets the requirements of these specifications by the use of approved additives.

3.4 Trench Pipe and Trench Pipe Bedding Installation:

Pipe laying equipment shall allow the placement of the trench pipe through the slurry while simultaneously bedding and backfilling around the drain pipe through a tremie. Laying of trench pipe using weighted sections is not allowed. The equipment used shall follow the placement of the pipe at the design grade shown on the plans in a continuous manner. Interruption of the continuity of the pipe shall not be allowed, except at the locations approved by the Contractor prior to the start of the work. The Subcontractor shall submit for approval by the Contractor a plan with detail on their proposed method of pipe and bedding placement.

3.5 Installation of Synthetic Membrane:

The installation of the 40 mil liner, HDPE geomembrane, as required shall be in accordance with Specifications Section 02277.

3.6 Construction of the Sump and Clean-outs:

Construction of the sump/clean-outs shall be in accordance with the approved shop drawing submitted by the Subcontractor, as described in section 1.5.6. Work on the sumps/clean-outs shall not begin until the shop drawing is approved by the Contractor. Once approved, deviation from the shop drawing shall not be permitted unless approved by the Contractor.

3.7 Backfill Placement:

3.7.1 Backfill Placement Equipment - Backfill shall be placed using conventional earth moving equipment such as loaders, backhoes, trackhoes, etc. In addition, tremie equipment shall be used to achieve the requirements of this specification.

3.7.2 Backfill Placement Method - Backfill shall be placed through the slurry in such a manner that segregation of the material does not occur. The backfill shall be placed by backfilling continuously from the beginning of the trench in the direction of excavation to the end of the trench. Alternately, tremie pipe can be used for the placement of the backfill. Tremie pipe shall be used around sumps and other structures. Free dropping of backfill will not be permitted. Initial backfilling shall proceed by tremie pipe until the surface of the backfill reaches the design grade. Additional backfill shall be placed with approved equipment and method by sliding the backfill down the slope of the previously placed backfill to displace the slurry and minimize segregation. The toe of excavation and the toe of the backfill shall be between 30 feet and 100 feet apart. The subcontractor shall submit, for approval by the Contractor, a plan detailing the Subcontractor equipment and method of backfill placement.

3.8 Bio-Polymer Slurry Degradation - For each section of ICT, at the completion of trench backfill placement, the Subcontractor shall initiate the bio-polymer slurry degradation process. The Subcontractor shall install temporary PVC wells at a strategic location to allow access to the slurry in the trench. Installation of these temporary wells will be considered part of the work and no additional compensation will be provided for their installation.

The subcontractor shall thoroughly flush and develop the ICT to achieve sand-free and slurry-free conditions. As a minimum, at least three pore volumes of the trench shall be pumped and recirculated. In addition, the flushing and development shall continue until Biological Oxygen Demand (BOD) decreases to 1,000 mg/l or lower.

3.9 Interceptor Collection Trench Completion - The top of each ICT section shall be covered within three working days after the backfill reaches the top of each 100-foot length of the trench. The cover shall consist of a minimum two-foot thick layer of non-expansive clay placed such that a permeability of $1x10^{-6}$ cm/sec is achieved. The first foot of clay shall be placed in a one lift and the succeeding foot of clay shall be placed in two six inches lifts. Compaction shall be carried out for all lifts with a pad-foot compactor with a minimum operating weight of 10 tons.

3.10 Waste Material Handling - All excavated spoils, excess slurry, and pumped water shall be handled according to the approved Waste Management Plan. After completion of backfill and capping, all remaining excavated spoil material shall be placed in appropriate containers and hauled to the Temporary Storage and Staging Area (TSSA) for treatment. Treatment shall be accomplished by the Contractor. Excess slurry shall be removed, hauled to the TSSA, and placed in containers provided by the Contractor.

PART 4 - QUALITY CONTROL

The Subcontractor shall be responsible for project quality control (QC) and quality control records. Observations, measurements, and tests described in these specifications shall be performed for quality control. In addition to the Slurry Trench Specialist, the Subcontractor shall provide at least one inspector during ICT construction operation to carry out QC functions. All QC records, routine testing procedures, observations, and measurements shall be available for inspection by the Contractor at any time. Quality control testing methods and frequencies are listed in Table 2.

4.1 Excavation and Backfill Soundings - The Subcontractor shall make excavation and backfill soundings along the trench centerline, in the presence of a Contractor representative, at the beginning of excavation and at the end of the excavation for each shift and, at frequencies no greater than 50 feet apart, using a weighted tape, cable, or other devices approved by the Contractor. The soundings shall record the following:

4.1.1 Elevation of the Top of the first confining Layer - the top of the stratum will be confirmed by the Subcontractor based on an examination of bucket cuttings during trench excavation. The Subcontractor shall also use the subsurface profiles for each ICT section that are furnished in the Bid package for the project.

4.1.2 Elevation of Bottom Excavation - The determination of the bottom elevation of excavation will be made by the Subcontractor in the presence of a Contractor representative. The minimum excavation line is shown on the subsurface profiles provided with the Bid package. The Contractor representative shall determine the final elevation.

4.1.3 Elevation of Bottom of Trench Prior to Backfilling - This sounding shall record the thickness of sediments accumulated at the trench bottom. The Subcontractor shall remove these sediments from the trench bottom prior to backfilling. This sounding shall not precede the toe of the backfill slope more than 100 feet.

4.1.4 Profile of Backfill Slope - The backfill slope shall be sounded by the Subcontractor in the presence of a Contractor representative to determine its profile. The backfill slope shall be sounded at the beginning and end of each shift and at additional times as directed by the Contractor.

4.2 Records:

Records shall be maintained by the Subcontractor for all testing, measurements, and inspections performed to ascertain that the ICT construction meets the specifications. Required reports, records, and documentation shall be furnished to the Contractor representative daily prior to leaving the site. The Subcontractor's required records are outlined as follows:

4.2.1 As-built profile of the trench bottom, including descriptions of materials encountered on the trench bottom and backfill slopes, shall be continuously maintained by the Subcontractor. This profile shall indicate the extent of excavation and the backfill profile at the end of each work day as determined by soundings.

4.2.2 Results of all construction control testing required in these specifications, including water tests, slurry tests, backfill tests, synthetic geomembrane tests as required per Specifications Section 02277, and depth soundings shall be furnished by the Subcontractor. The Subcontractor shall furnish records of all observations, measurements, and tests performed, identified with the location and time of testing. These records shall be furnished no later than 24 hours after the tests, measurements, and/or observations were made.

4.2.3 Slurry mix quantities, proportions of all additives utilized, and placement locations into the trench shall be recorded by the Contractor. Any adjustments in the slurry mix shall also be recorded.

4.2.4 Construction Log - The Subcontractor shall maintain a construction log of daily activities which shall include delays encountered during construction, causes of delays, locations of affected areas, and extent of delays. The log shall also record unusual conditions or problems encountered and the dispositions made. The log shall be signed by the Subcontractor, the Contractor, and the QAR at the end of each day.

4.3 Laboratory Equipment:

The Subcontractor shall provide an onsite laboratory containing, as a minimum, the following equipment:

- 2 - Marsh funnel sets
- 2 - Mud balances (direct reading of density)
- 1 - Slurry sampler
- 1 - Standard filter press
- 1 - pH meter
- \- Supply of pH paper

4.4 Lines and Grades - The ICT and associated trench piping, synthetic geomembrane, and sumps shall be constructed to the elevations, lines, grades, and cross sections shown on the drawings, unless otherwise direct by the Contractor. The Contractor may modify the dimensions and guarantees of the work as determined necessary. The Subcontractor QC personnel shall be responsible for survey control of all grades including trench bottom, trench drain pipe, and sumps.

4.5 Quality Assurance:

The Contractor and the QAR may perform quality assurance (QA) testing on the biopolymer slurry and backfill materials using the laboratory and equipment furnished by the Subcontractor. The Contractor and/or QAR testing will in no way relieve the Subcontractor of the responsibility of performing tests necessary to meet the construction requirements. The Subcontractor shall provide the equipment and laboratory space to the Contractor personnel and/or QAR on demand and these services shall be considered a subsidiary obligation of the biopolymer trench construction. All routine testing procedures being conducted by the Subcontractor shall be available for inspection by the Contractor at any time.

Table 1
Bio-Polymer Slurry Properties

Type of Test	**Method**	**Value**
Viscosity	API RP-13B	≥ 30 sec.
pH	API RP-13B	≥ 8.5
Density**	API RP-13B	≥ 63 pcf
Filtrate Loss	API RP-13B	≤ 30 ml

Note - ** The density of the slurry shall always be sufficient to prevent sloughing of the trench. Adjustments to slurry properties should be completed at no expense to the Government and/or contractor.

Table 2

Bio-Polymer Interceptor Collection Trench Quality Control Testing

Subject	TEST		
	STANDARD	SPECIFIC TEST	FREQUENCY
Chemical Analysis of Water	EPA-600	a. pH b. Hardness c. TDS	1 per water supply source or as supply changes occur
Initial Slurry Properties	API RP-13B	a. Density b. Viscosity c. pH d. Filtrate Loss	3 per shift (See Note 1)
Degraded Slurry Properties	API RP-13B	a. Viscosity b. Density c. BOD	3 per shift (See Note 1) one/250 ft. for BOD
Synthetic Geomembrane	As Required in Specifications Section 02277	As Required in Specifications Section 02277	As Required in Specifications Section 02277

Note: 1) If more than one (1) batching plant is being used, these frequencies shall apply to each batching plant separately.

SECTION 02660

WATERLINES

016507

PART 1 - GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI B1.20.1	(1983) Pipe Threads, General Purpose (Inch)
ANSI B16.1	(1975) Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B16.3	(1985) Malleable-Iron Threaded Fittings, Classes 150 and 300

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA-03	(1988) Manual for Railway Engineering (Fixed Properties): Chapter 1, Roadway and Ballast

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1988 Rev. a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM D 1599	(1988) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1981) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D 2241	(1988) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1988) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1988) Pocket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1988) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D 2855	(1983) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM F 477	(1976; R 1985) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1987) Hypochlorites
AWWA B301	(1987) Liquid Chlorine
AWWA C104	(1985) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1982) Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	(1987) Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids
AWWA C111	(1985) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

AWWA C115	(1983) Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	(1986) Ductile-Iron Pipe, Centrifugally Cast and in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153	(1988) Ductile-Iron Compact Fitting, 3 In. through 6 In. for Water and Other Liquids
AWWA C203	(1986) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape-Hot-Applied
AWWA C205	(1985) Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger--Shop Applied
AWWA C207	(1986) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In.
AWWA C208	(1983) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C500	(1986) Gate Valves for Water and Sewage Systems
AWWA C502	(1985) Dry-Barrel Fire Hydrants
AWWA C503	(1982) Wet-Barrel Fire Hydrants
AWWA C509	(1987) Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems
AWWA C600	(1987) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1986) Disinfecting Water Mains
AWWA C700	(1977) Cold Water Meters--Displacement Type

AWWA C701	(1978) Cold Water Meters--Turbine Type for Customer Service
AWWA C800	(1984) Underground Service Line Valves and Fittings
AWWA C900	(1981; Errata) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In. for Water
AWWA M23	(1980) PVC Pipe -- Design and Installation

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-01	(1986, 2nd Ed.) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY
OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1975) Hazardous Chemicals Data
NFPA 325M	(1984) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1985) Identification of the Fire Hazards of Materials

NATIONAL SANITATION FOUNDATION (NSF)

NSF Std 14	(Oct. 1965, Rev. thru Oct. 1987) Plastic Piping System Components and Related Materials

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-Paint 21	(1982) White or Colored Silicone Alkyd Paint

SSPC-Paint 25	(1982)	Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.3 GENERAL - This section covers water supply distribution service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required.

1.3.1 Piping for Water Service Lines - Piping for water service lines less than three inches in diameter shall be galvanized steel, Polyvinyl Chloride (PVC) plastic, polyethylene, polybutylene, or copper tubing, unless otherwise shown or specified. Piping for water service lines for sizes 3 inches and larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic through 12-inch nominal diameter, filament-wound reinforced or centrifugally cast reinforced, thermosetting resin, thermosetting reinforced plastic mortar pressure pipe, or steel, unless otherwise shown or specified.

1.3.2 Piping for Water Distribution Lines Three Inches or Larger - Piping for water distribution lines three inches or larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic through 12-inch nominal diameter, filament-wound reinforced or centrifugally cast reinforced, thermosetting resin, thermosetting reinforced plastic mortar pressure pipe, or reinforced concrete, unless otherwise shown or specified.

1.3.3 Piping for Water Supply Lines Three Inches or Larger - Piping for water supply lines 3 inches or larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic through 12-inch nominal diameter, filament-wound reinforced or centrifugally cast reinforced, thermosetting resin, thermosetting reinforced plastic mortar pressure pipe, steel, or reinforced concrete, unless otherwise shown or specified.

1.3.4 Plastic Pipe - All thermoplastic piping system components (PVC, polyethylene and polybutylene) intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

1.3.5 Excavation, Trenching, and Backfilling for Water Lines - Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02222, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.4 SUBMITTALS

1.4.1 Installation Instructions - Submit the manufacturer's recommendations for each material or procedure to be utilized. The Subcontractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless otherwise directed by the Contractor. Submittals shall be in accordance with SECTION 01300 - SUBMITTALS.

1.4.2 Materials and Equipment - Submit manufacturer's descriptive data and technical literature for pipe, fittings, valves, valve boxes, gaskets, prefabricated concrete vaults, backflow preventer, jointing materials and other appurtenances. Submittals shall be in accordance with SECTION 01300 - SUBMITTALS.

1.4.3 Records - Deficiency Items - The Subcontractor will maintain a chronological record throughout the course of the subcontract of all uncorrected deficiency items.

1.4.4 Road and Railroad Jacking Procedures - The Subcontractor shall provide a written description of the procedures that will be used to jack and sleeve the pipe runs under roads and railroads. Specify the type of equipment that will be used.

1.4.5 Hangers and Bridge Crossing Procedures - The Subcontractor shall provide a written description of the procedures that will be used to jack and sleeve the pipe runs under roads and railroads. Specify the type of equipment that will be used.

1.4.6 Hydrostatic Testing and Flushing and Testing - The Subcontractor shall submit descriptions and results of all test procedures and the flushing and decontamination procedures used with all results.

1.5 HANDLING - Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Contractor.

Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place. Polyvinyl Chloride, pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49- and NFPA 325M.

1.5.1 Coated and Wrapped Steel Pipe - Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

PART 2 - MATERIALS

2.1 Materials - All pipe and related products shall conform to ANSI/NSF Standard 61. Materials shall conform to the respective specifications and other requirements specified below.

2.1.1 Pipe

2.1.1.1 Ductile-Iron Pipe - Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be encased with 6 mil thick polyethylene in accordance with AWWA C105. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Pipe - All pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4-Inch Diameter:

(1) Screw-Joint - Pipe to dimensional requirements of ASTM D 1785 Schedule 80, with joints and appurtenance meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, must be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint - Pipe shall be to dimensional requirements of ASTM D 1785, Schedule 40 with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure	Minimum Hydrostatic Pressure
26	100	133
21	120	160
17	150	200
13.5	200	266

In addition to the above requirements, the pipe, couplings and fittings must be hydrostatically tested as required by AWWA C900, and must be to iron pipe (I.P.S.) or cast iron outside diameter (CIOD) size dimensions.

(3) Solvent Cement Joint - Pipe to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

b. Pipe 4-Inch through 12-Inch Diameter - Pipe, couplings and fittings 4-inch through 12-inch diameter shall conform to the requirements of AWWA C900, Class 150, SDR 26, CIOD pipe dimensions only, elastomeric-gasket joint only, unless otherwise shown or specified.

2.1.1.3 Galvanized-Steel Pipe, Less Than Three Inches - ASTM A 53, standard weight.

2.1.1.4 Protective Materials for Steel Pipe - Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of one of the following the following for the indicated pipe material and size:

a. Steel pipe and fittings less than three inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203; threaded ends of pipe and fittings shall be adequately protected prior to coating.

b. Steel Pipe Three Inches or Larger, Not Galvanized:

(1) Cement-mortar coating and lining shall conform to and shall be applied in conformity with AWWA C205. Cement-mortar coating and lining shall not be used for pipe less than 4 inches in diameter.

(2) Coal-tar enamel lining, coating and wrapping shall conform to AWWA C203 for materials, method of application, tests and handling. Pipe shall be coated with coal-tar primer followed by a hot coat of coal-tar enamel, and a wrapper of kraft paper or a coat of water-resistant whitewash.

(3) Cement-mortar lining, in lieu of coal-tar enamel lining, may be used with coal-tar enamel coating and wrapping. Cement-mortar lining shall conform to and shall be applied in conformity with AWWA C205.

2.1.2 Joints

2.1.2.1 Ductile-Iron Pipe

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricant shall conform to the applicable requirements of AWWA C111.

2.1.2.2 Polyvinyl Chloride Pipe - Joints, fittings, and couplings shall be as specified for PVC pipe and comply with AWWA M23, AWWA C900. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contractor.

2.1.2.3 Insulating Joints - Insulating joints shall be installed between non-threaded ferrous and nonferrous metallic pipe, fittings and valves. Insulating joints shall consist of a sandwich-type flange insulating gasket of the dielectric type, insulating washers, and insulating sleeves for flange bolts. Insulating gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt insulating sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.1.2.4 Connections - Connections between fittings, valves or hydrants shall be made with jointing materials conforming to AWWA C603.

2.1.3 Fittings and Specials

2.1.3.1 Ductile-Iron Pipe - Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard thickness. Ductile-iron compact fittings shall be accordance with AWWA C153.

2.1.3.2 Polyvinyl Chloride (PVC) Pipe

a. For pipe less than 4-inch diameter, fittings for threaded pipe shall conform to the requirements of ASTM D 2464, threaded to conform to the requirements of ANSI B1.20.1 for use with Schedule 80 pipe and fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467 fittings for elastomeric-gasket joint pipe shall be ductile iron conforming to AWWA C110 or AWWA C111.

b. For pipe 4-inch through 12-inch diameter, fittings and specials shall be cast iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with the requirements of AWWA C900. Cast-iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

2.1.3.3 Dielectric Fittings - Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.1.4 Couplings

2.1.4.1 Mechanical Couplings - Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.1.5 Valves

2.1.5.1 Check Valves - Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to -MSS SP-80-, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the 125-pound type conforming to ANSI B16.1.

2.1.5.2 Gate Valves - Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than three inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves three inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient Seated Gate Valves - For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

2.1.5.3 Pressure Reducing Valves - Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for 150 psi operating pressure on the inlet side, with outlet pressure set for 70 psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.1.5.4 Vacuum and Air Relief Valves - Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float. Vacuum and Relief valves shall be installed at high and low spots in the line as recommended by the valve manufacturer.

2.1.5.5 Shut-off Valves - Shut-off valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than three inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves three inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

2.1.5.6 Indicator Post for Valves - Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by wrench. One wrench shall be provided for valve operation.

2.1.6 Valve Boxes - Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location.

2.1.7 Valve Pits - Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with the requirements of the American Concrete Institute.

2.1.8 Back Flow Preventers - Back flow preventers shall be installed at locations as shown on the plans. Preventer assembly shall be of brass containing two check valves, ball valves, full-port, and test cocks. It shall provide cross connection control subject to back pressure and shall be capable of operating under maximum pressure of 175 psi and maximum temperature of 140°F. Back flow preventer type valves shall conform to the performance requirements of AWWA C504.

2.1.9 Miscellaneous Items

2.1.9.1 Service Clamps - Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.1.9.2 Corporation Stops - Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.1.9.3 Goosenecks - Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections be in accordance with standard practice.

2.1.9.4 Service Stops - Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.1.9.5 Tapping Sleeves - Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable-iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound. Tapping sleeves shall of a type capable of performing a wet tap in the size and type of pipe indicated on the drawings.

2.1.9.6 Service Boxes - Service boxes shall be cast iron or concrete. Extension service boxes of the required length and having either screw or slide-type adjustment shall be installed at all service box locations. The boxes shall have housings of sufficient size to completely cover the service stop and shall be complete with identifying covers.

2.1.9.7 Disinfection - Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301

Hypochlorite, Calcium and Sodium: AWWA B300

2.1.9.8 Meters - Meters shall be of the displacement type conforming to AWWA C700 or turbine type conforming to AWWA C701. Registers may be round or straight reading type. Connection to the water line shall be as required for the particular installation. All meters used for the same system shall be of one type and manufacturer.

2.1.9.9 Meter Boxes - Meter boxes shall be of cast iron or concrete of sufficient size to completely enclose the meter and shut-off valve or service stop. Box height shall extend from invert of the meter to final grade at the meter location. Cover shall be cast iron with the word "WATER" cast in it.

2.1.9.10 Pipe Insulation and Cover - The section of pipe suspended from the bridge to make river and bayou crossing shall be insulated against freezing with 1 inch heavy density pre-formed fiberglass insulation with an aluminum jacket approved for exterior service. The jacket shall be a heavy weight jacket with minimum thickness of 0.016 inch with 3/16 inch corrugations and shall equipped with a moisture barrier.

2.1.9.11 Freeze-proof Yard Hydrant - Freeze-proof yard hydrants shall be installed at locations shown on the plans, with adequate concrete support. The hydrant shall be designed to extend two feet above grade and will be fitted with appropriate hose assemblies. Signs shall be placed adjacent to the hydrants advising that the water is dispensed by the hydrant is "Non-potable Water". Sign lettering shall be a minimum of 3 inches high. Hydrants shall be installed on water line with 3/4" FPT and 1" MPT inlets. Hydrants will have a lever for flow control, shut-off valve, 3/4" brass garden hose thread outlets, and pipe column. The hydrant shall be installed so that the partial pipe column and the shut-off are below the frost line for maintaining water flow during the winter. Freeze-proof yard hydrant shall be McMaster-Carr Model Number 4728K22 or approved equal.

2.1.9.12 Expansion Control Joints- The aboveground lengths of ductile iron pipe traversing bridges and other structures shall be equipped with flexible expansion/contraction joints. One expansion joints shall be installed on each straight run of pipe to minimize the potential for pipe damage due to expansion and contraction. Expansion joint shall be a minimum of 150 lb. and shall have ASA companion flanged connectors, or an approved equivalent. Slip on expansion joints shall not be allowed, without prior approval. The expansion joints shall be supported with pipe hangers on both sides of the joint.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe - Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contractor, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable and all pipe shall be cut square, reamed to full diameter and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines - Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 9 feet in all directions from a sewer line except where the bottom of the water pipe will be at least 24 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 4 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 9 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 4 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than two feet above the sewer main. Joints in the sewer main, closer horizontally than 4 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines - Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Nonferrous Metallic Pipe - Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches must be maintained between pipes.

3.1.2.4 Roads & Railroads - Water pipe shall be encased in a sleeve of rigid conduit extending a minimum of 5 feet on either side of the road or railroad. Sleeves under railroads shall be in accordance with the railroad company requirements the criteria contained in AREA-03, Part 5 and shall have a minimum cover of 4 feet. Where sleeves are required, in all other cases, the pipe sleeve shall be of rigid construction and shall have a minimum of 3 feet of cover. The sleeves under A minimum clearance of at least two inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with corrosion protection as required for the conditions encountered at the site of installation.

3.1.2.5 Bridges - Pipe runs traversing bridges shall be suspended from the structure using non-binding roller (Harvard) type support system or an approved equivalent. Above grade piping shall be ductile iron or an approved equivalent. Should different piping material be used for below grade work the transitions shall be made a minimum of one full pipe length before rising above grade and one full pipe length after returning to subsurface elevation. The aboveground section shall be insulated and jacketed with aluminum and shall be protected at the hanger by a minimum of 12 inches of formed steel hanger protector. Hanger spacing shall as a minimum will comply with the requirements of the BOCA Plumbing Code and the pipe manufacturers recommendations.

3.1.2.6 Structures - Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required for roads, railroads, and airfields. Care shall be exercised and proper precautions taken during installation of the water pipe and sleeve to assure that there will be no damage to the structures and no settlement or movement of foundations or footings. Any damage occurring as a result of the Subcontractor's operation shall be corrected and all costs connected therewith shall be borne by the Subcontractor.

3.1.3 Joint Deflection

3.1.3.1 Ductile-Iron Pipe - The maximum allowable deflection will be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.3.2 Flexible Plastic Pipe. Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contractor, but in no case shall it exceed 5°.

3.1.3.3 Steel Pipe - For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be 5° unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified hereinbefore.

3.1.4 Placing and Laying - Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contractor, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joining is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Subcontractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Connections - Connections between new work and existing mains shall be made by using fittings and procedures suitable to the actual conditions and material of construction identified in the field. Standard methods shall be used for making connections to various types of pipe, either under pressure (wet tap) or in dewatered condition (dry tap). Where made under pressure, these connections shall be installed as approved by the Contractor. Where possible connections shall be made without discontinuing service in existing lines.

3.1.4.2 Penetrations - Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic or caulk and shall be watertight.

3.1.4.3 Flanged Pipe - Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 Ductile-Iron Pipe - Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits. Aboveground ductile iron pipe shall be equipped with restrained joints.

3.1.5.2 Polyvinyl Chloride (PVC) Plastic Pipe

a. Pipe Less Than 4-Inch Diameter - Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. Care shall be exercised to assure the gasket and ring groove in the bell or coupling match. The manufacturer of the pipe or fitting must also supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall utilize sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4-Inch through 12-Inch Diameter - Joints shall be elastomeric-gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4-inch diameter with configuration utilizing elastomeric ring gasket.

3.1.5.3 Steel Pipe, Not Galvanized

a. Mechanical Couplings - Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.

b. Rubber Gaskets - Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the recommendations of the pipe manufacturer.

3.1.5.4 Galvanized-Steel Pipe - Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

3.1.5.6 Bonded Joints - Bonded joints shall be installed in accordance with details specified for joints under paragraph "MATERIALS."

3.1.5.7 Insulating Joints Dielectric Fittings - Insulating joints Dielectric fittings shall be installed in accordance with details specified for joints under paragraph "MATERIALS." Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8-inch thickness of coal tar over all fitting surfaces.

3.1.5.7 Connections - Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contractor.

3.1.6 Service Lines - Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately five feet outside the building where such building service exists. Where building services are not installed, the Subcontractor shall terminate the service lines approximately five feet from the site of the proposed building at a point designated by the Contractor. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with extension service boxes of the lengths required. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 2 Inches and Smaller - Service lines two inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in Table I. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

a. Connections to Mains - Heavy couplings may be utilized for connecting service lines smaller than two inches to new water mains. Couplings shall have factory threaded outlets. Threads may be either iron-pipe thread or AWWA type. A corporation stop and a gooseneck shall be provided with the connection. Maximum sizes for outlets shall be as follows:

Pipe Size Inches	Outlet Sizes Inches
3 and 4	3/4, 1, 1-1/4
6 and larger	3/4, 1, 1-1/4, 1-1/2

(1) Service lines 1-1/2 inches and smaller shall have a service stop.

(2) Service lines 2 inches in size shall have a gate valve.

(3) Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Three-inch and larger lines may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.7 Field Coating and Lining of Pipe

3.1.7.1 Steel Pipe 3 Inches and Larger, Not Galvanized

a. Cement-Mortar Coating and Lining - Field jointing shall conform to Appendix, AWWA C205. Any defective area found in the coating and/or lining of pipe and joints shall be removed to the pipe wall, and the area shall be repaired in a manner such that the repaired areas will be at least equal in thickness to the minimum coating and/or lining required for the pipe. Steel reinforcement in the coating shall be repaired or replaced as necessary to assure a complete and soundly reinforced coating.

b. Coal-Tar Enamel Coating, Lining and Wrapping - Field jointing shall conform to AWWA C203. The applied materials shall be tested by means of a spark-type electrical inspection device in accordance with the requirements of AWWA C203. Any flaws or holidays found in the coating and/or lining of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating and/or lining required for the pipe.

3.1.7.2 Galvanized-Steel Pipe - Field joints shall be given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203. The tests of the coating shall conform to -AWWA C203-, and any flaws or holidays found in the coating of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating required for the pipe.

3.1.8 Setting of Valves and Valve Boxes

3.1.8.1 Valves and Valve Boxes - Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8.3 Valves - Valves after delivery shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the hydrant or valve shall be fully opened and fully closed to insure that all parts are in working condition.

3.1.8.4 Service Boxes - Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.8.5 Valves - Check valves, Pressure reducing valves, Vacuum and air relief valves shall be installed in valve pits as shown.

3.1.9 Tapped Tees and Crosses - Tapped tees and crosses for future connections shall be installed where shown.

3.1.10 Thrust Restraint plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, shall be provided with thrust blocking, or metal tie rods and clamps or lugs, as directed. Valves shall be securely anchored or shall be provided with thrust blocking to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks - Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid undisturbed earth and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps shall be protected by galvanizing or by coating with bituminous paint.

3.1.10.2 Restrained Joints - For ductile-iron pipe, restrained joints shall be designed by the Subcontractor or the pipe manufacturer in accordance with DIPRA-01.

3.2 HYDROSTATIC TESTS - Where any section of a water line is provided with concrete thrust blocking for fitting or hydrants, the hydrostatic tests shall not be made until at least five days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test - After the pipe is laid, the joints completed, hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contractor when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the contract.

d. An unforeseeable cause which would result in excess cost.

The Subcontractor may request the waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02222 - EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test - Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to 200 psi pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

L = 0.0001351ND(P raised to 1/2 power) for pipe materials

In which L equals the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the foregoing table, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Contractor.

3.2.3 Time for Making Test - Except for joint material setting or where concrete reaction backing necessitates a 3-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

3.2.4 Concurrent Hydrostatic Tests - The Subcontractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Subcontractor at no additional cost to the Contractor.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be re-accomplished.

3.3 DISINFECTION - Before acceptance of potable water operation, each unit of completed water-line shall be disinfected as prescribed by AWWA C651 as specified herein. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph "MATERIALS." The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner.

Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case will the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each valve on the line shall be opened and closed several times. From several points in the unit, the Subcontractor shall take the indicated number of samples of water in proper sterilized containers for bacterial examination. Water samples will be collected and submitted to a laboratory approved by the State of Texas Department of Health. A minimum of 1 sample per 1,000 linear feet of installed pipe shall be collected and submitted for bacteriological analysis. The system will not be placed into service until the samples indicate that the facility is free from microbial contamination. The disinfection shall be repeated until tests indicate the absence of pollution for at least two full days. The facility will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP - Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

END OF SECTION

SECTION 02680
HDPE PIPE

016530

High Density Polyethylene (HDPE)/High Density Polyethylene (HDPE) Double Containment Piping System

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to install HDPE, PE 3408 (Primary/HDPE, PE 3408 (Secondary Containment) double containment piping, valves and appurtenances for complete systems as shown on the drawings and as specified herein, SDR rating as specified.

1.02 SUBMITTALS

Shop drawings shall be submitted to the engineer, and shall include details of pipe fabrications (Including supporting devices, method of attachment, spacing, etc), pre-fabricated double containment fitting dimensions, starting and terminating connections, high point vent and low point drain details for the secondary containment, valves and accessories. Submit joint details, methods and location of supports, and all other pertinent technical data for all piping to be furnished.

1.03 QUALIFICATIONS

The double containment piping system shall be a pre-fabricated system as manufactured by Guardian Systems, Div. of NIBCO Inc or approved equal. The system shall be designed, fabricated, installed and tested in accordance with manufacturer's recommendations and as specified herein and shall be suitable for the intended service. Manufacturer shall have a minimum of five (5) years experience. Contractor shall not design and or fabricate the piping system.

PART 2: PRODUCTS

2.01 GENERAL

Each contained piping system shall consist of HDPE primary piping system supported within a HDPE secondary containment housing. Each system shall be provided with suitable drains and vents and be designed to provide complete drainage of both the primary and secondary containment piping. Interstitial supporting devices shall be made from Polypropylene and shall be provided within the secondary containment pipe, they shall be designed to allow continuous drainage in the annular space to the low point drains. Drain fittings shall be designed to allow a valve attachment to be made so that the secondary containment compartment may be readily drained and manually checked for leaks.

016531

2.02 MATERIALS

2.02.1 The primary pipe and fittings shall be manufactured from HDPE materials as listed by PE 3408.

2.02. The secondary containment pipe and fittings shall be manufactured from HDPE materials, as listed by PE 3408.

2.02.3 All listed primary and containment pipe shall be HDPE materials, and shall have SDR series wall thickness as specified. All listed pressure fittings shall be SDR rated as specified and manufactured according to ANSI. All other unlisted components that are intended for use as pressure retaining components shall have sufficient thickness and reinforcement so as to be able to maintain the same pressure ratings as specified.

2.02.4 Interstitial supporting devices, used to center and support the primary piping within the secondary containment piping, shall be manufactured from Polypropylene according to ASTM and ANSI.

2.02.5 All listed secondary containment pipe and components shall be PE 3408 HDPE materials, and shall have SDR series wall thickness as specified. All other unlisted components that are intended for use as pressure retaining components shall have sufficient thickness and reinforcement so as to be able to maintain the same pressure ratings as specified.

2.02.6 All fittings shall be pre-assembled and pre-tested by the manufacturer.

PART 3: EXECUTION

3.01 INSTALLATION

3.01.1 All installation procedures shall be according to the manufacturer's specific recommendations. [The manufacturer shall furnish the services of a competent representative to supervise the contractor's personnel during the start of installation.]

3.01.2 All primary and secondary piping welds shall be made using simultaneous thermal butt fusion techniques according to ASME B 31.3 standard. All fusion welding shall be performed in accordance to manufacturers recommendations and shall be subject to 100% visual inspection prior to testing.

3.01.3 The splitting and re-welding of fitting shall not be permitted. The use of hot gas welding for pressure retaining joints shall be kept to those locations where it is deemed necessary by manufacturer, and in any event shall not be permitted on pressure retaining joints of the primary piping system. Flanges, unions, couplings or other methods of disassembly shall be provided at connections to equipment, dissimilar piping, and at other locations suitable for inspection or dismantling of a system.

3.01.4 All contractor personnel that will prepare butt fusion field welds shall be qualified to do so according to the requirements of the ASME B 31.1, by sufficient experience, or by some other agreed to method, as determined suitable by manufacturer.

3.02 CLEANING AND TESTING

3.02.1 Upon completion of installation, the primary piping system shall be pressure tested at 150% of the system design pressure for a period of one hour. Additionally, the system may be tested during the installation at intervals to be determined by the manufacturer. Both the preliminary and final tests shall be done in strict accordance with the recommendations of the manufacturer, including the sequence and duration of such tests.

3.02.2 Upon completion of the installation, the secondary containment piping system shall be pneumatically tested at a minimum duration of 2-1/2 hours. The external joints should be soaped and visually inspected for leaks. It is imperative that a working pressure regulator be used during the pneumatic test to insure that overpressurization of the system, beyond 10 PSI cannot occur. Also, all precautions should be taken to protect against the hazards of a possible brittle fracture of pipe under compressed gas. Both the preliminary and final tests shall be done in strict accordance with the recommendations of the manufacturer, including the sequence and duration of such test.

3.02.3 Following installation of the systems, the primary piping system shall be flushed clean. The contractor shall check the operation of all valves, leak detection devices and appurtenances.

3.02.4 The annular space shall be purged of moisture containing air by replacing the volume of air with clean, dry nitrogen.

INTERIM REMEDIAL ACTION
BURNING GROUND No. 3, LHAAP 18&24
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

16533

PHASE III

Section 02730a

VERTICAL EXTRACTION WELL DRILLING AND INSTALLATION SPECIFICATIONS

1. GENERAL:

1.1 Definitions:

1.1.1 Government: U.S. Army Corps of Engineers, Fort Worth District

1.1.2 Administrative Contracting Officer: Government authorized representative

1.1.3 Quality Assurance Representative (QAR): Authorized representative of Administrative Contracting Officer.

1.1.4 Contractor: Dow Environmental Inc. (DEI)

1.1.5 Subcontractor: Drilling subcontractor who is licensed to drill wells in the state of Texas, to be selected by Contractor.

1.2 Applicable Publications: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.2.1 American Society for Testing Materials (ASTM) Publications:

ASTM A-490	Stainless Steel Casing
ASTM C-150	Portland Cement
ASTM D-422	Grain Size Tests

1.2.2 American Water Works Association (AWWA) Standards:

AWWA A100-84	Water Wells

1.2.3 Texas Natural Resource Conservation Commission (TNRCC):

30 TAC 338	Water Well Driller Rules

1.3 General Requirements: This section covers the drilling and installation of extraction wells. These wells shall be constructed as shown on Figure VEWD-1.

1.4 Submittals:

1.4.1 Drilling Plan: Before beginning work, the Subcontractor shall submit for approval their proposed plan for drilling and constructing the extraction wells. The plan shall include, but not be limited to, the proposed method of drilling and equipment to be used, standard operating procedures for drilling, well screen specifications, grouting materials, sand pack material, decontamination procedures, and methods for placing sand pack and grout. No work shall be performed until the drilling plan has been approved by the contractor and no deviation from the approved drilling plan will be permitted without approval of the Contractor.

1.4.2 Permits and Well Registration: The Subcontractor shall be responsible for obtaining all state permits, licenses, or other requirements necessary for execution of the work. The Subcontractor shall also be responsible for preparing and submitting the required well completion reports to the Texas Natural Resources Conservation Commission (TNRCC). A copy of all such documents shall be furnished to the Contractor.

1.4.3 Logs of Wells: During the drilling of each well, a Contractor assigned supervising geologist/environmental scientist shall maintain an accurate log. At a minimum, the log shall include depths, elevations, and descriptions of all formations encountered, identification of each stratum, and depths at which groundwater is encountered. Copies of all well logs shall be provided to the Administrative Contracting Officer as applicable.

1.5 Environmental Protection: The Subcontractor shall take all precautions as may be required to prevent contaminated water or water having undesirable physical or chemical characteristics from entering the water supply stratum through the well bore or by seepage from the ground surface. The Subcontractor also shall take all precautions necessary to prevent contamination of the ground surface or of surface waters resulting from drilling of the wells. The Subcontractor shall submit, as part of the drilling plan required by Paragraph 1.4.1: Drilling Plan, details of specific methods to be employed to control potential contamination or pollution arising from well installation activities.

2. PRODUCTS:

2.1 Riser Pipes: The well riser pipe, which shall be threaded into the top of the well screen, shall be <u>six</u> inches in diameter and constructed of Type 304 stainless steel. All riser pipe sections shall be connected by threaded couplings.

2.2 Well Screens: The well screen shall be Type 304 stainless steel wire - wound screen, minimum <u>six</u> inch nominal diameter, and shall be directly threaded to the riser pipe. The screen and all accessories required for satisfactory operation shall be essentially standard products of reliable manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable.

Each well screen shall be provided with continuous slot openings which shall have smooth, sharp-edged openings free of burrs, clipped edges, or broken pieces on the interior and exterior surfaces of the pipe. The openings shall be uniformly spaced spiral around the periphery of the well screen. Slot size of screen shall be 0.01 inch. However, prior to installation, subcontractor must consider grain size of formation in relation to screen size. Any modification, must be approved by contractor.

A two-foot long stainless steel blank pipe with a diameter equivalent to that of the wells screen shall be threaded into the bottom of the screen of each extraction well. The bottom of each well shall be sealed using a stainless steel Type 304 bottom plate which shall be welded to the bottom of the pipe or a Type 304 stainless steel threaded cap securely sealed to the blank pipe.

2.3 Sand pack shall be a product of a commercial sand and gravel manufacturer, shall be silica sand. This sand shall be composed of round, hard, waterworn sand, free of flat or elongated pieces, organic matter, or other foreign matter, properly sized and graded. The sand pack shall have an effective grain size of 0.015 inch and a uniformity coefficient of 2.5. The sand gradation shall be such that no more than ten percent of the sand grains are finer than the screen slot size. However, prior to installation, subcontractor must consider grain size of formation in relation to sand packing material. Any modification, must be approved by contractor.

2.4 Concrete grout shall consist of ready mix concrete mixed with potable water. The cement used in the mix shall consist of portland cement conforming to ASTM C 150 Type I or II. The concrete compressive strength shall be minimum 3,000 pounds per square inch at 28 days.

2.5 Bentonite Seal: Bentonite used for well bore seals shall be either pelletized or chip form as supplied for use in water well construction.

2.6 Cement-Bentonite grout shall consist of portland cement conforming to ASTM C 150 Type I or II, sand and water. Cement grout shall be proportioned with approximately seven pounds of powdered bentonite per 94 pound sack of cement and not more than six gallons of clean water per 94 pound sack of cement.

2.7 A six foot-square, six inches thick, concrete pad shall be poured around the protective casing of each well at the ground surface as shown on Figure VEWD-1. A steel guard post, 2-inch in diameter, that is filled with concrete shall be placed at each corner of the concrete slab. Each post shall extend to at least three feet below ground surface and four feet above the ground surface. The above ground portion of the well casing and the guard posts shall be painted yellow. A brass survey cap shall be installed in the concrete pad for each VEW.

2.8 Water: Water used in drilling and decontamination, including cleaning grouting or other activities, shall be obtained from a potable supply source.

3. EXECUTION

3.1 Groundwater Extraction Well Construction:

3.1.1 General Requirements: The method of drilling shall be by hollow stem auger (HSA). The drilling method must prevent the collapse of formation material against the well screen or casing during installation. Drilling shall conform to all state and local standards. The execution of the work shall be by competent workpersons and performed under the direct supervision of an experienced well driller. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall be drilled from the ground surface to the depth of interest as directed by the supervising geologist/environmental scientist. The depth of the completed borehole shall be measured with a fiberglass tape having a stainless-steel weight on the end.

Representative soil samples shall be collected for every stratum encountered and for every five feet, whichever occurs first, using a three inch O.D. split spoon.

3.1.2 Construction of Well Riser and Screen: The entire well shall be drilled to the diameter of the sand pack, as shown on Figure VEWD-1. The well screen and riser pipes shall be lowered into the hole, through the augers, by a method which will allow for control of the rate of fall of the well screen and riser pipe at all times. Well screen and riser pipe shall not be dropped or allowed to fall uncontrolled into the hole.

Prior to the lowering of the well assembly, the auger casing shall be slowly withdrawn about one foot and the borehole depth remeasured.

3.1.3 Construction of Sand Pack: After the screen and riser pipe have been centered, the approved sand pack shall be constructed around the screen by filling the entire space between the screen and the wall of the hole with filter sand. Sand conductor pipe having an inside nominal diameter of not less than one and one-half inches shall be lowered to the bottom of the well between the soil and screen. The sand conductor shall be raised at a rate that will keep the bottom of the conductor between one and three feet below the sand level in the borehole at all times. The sand pack shall be installed continuously and without interruption until the sand has been placed to the depth shown on Figure VEWD-1. The augers shall be withdrawn at a slow rate during the construction of the sand pack.

3.1.4 Placing Bentonite Seal, Cement-Bentonite Grout, and Concrete Grout: After the riser pipe well screen and sand pack have been installed, the annular space between the well casing and the borehole shall be sealed by use of bentonite seal, cement-bentonite grout, and concrete grout, as shown on Figure VEWD-1.

The Bentonite Seal shall be installed by slowly adding the pellets or granules to avoid bridging. The pellets or granules shall be tamped with a stainless-steel weight suspended on a fiberglass measuring tape. The completed Bentonite Seal shall be allowed to hydrate for approximately four hours before proceeding with the installation.

The Cement-Bentonite grout shall be placed using a segmented PVC grout pipe lowered to the top of the bentonite seal. Pumping of grout shall continue until a return is observed from the top of the auger casing. The grout level shall not be allowed to fall below the bottom of the auger casing during casing withdrawal.

The Concrete Grout shall be poured in the top 3 feet open annulus following the removal of the last auger section. The steel protective cover shall be centered on the well casing and inserted into the concrete prior to the setting of this grout.

3.1.5 A six-foot-square concrete pad, minimum six inches thick, shall be poured around the protective casing at the ground surface. The pad shall be sloped away from the well in order to promote drainage as shown on Figure VEWD-1. A steel guard post, 2-inch in diameter, that is filled with concrete shall be placed at each corner of the concrete slab. Each post shall extend to at least <u>three</u> feet below ground surface and four feet above the ground surface. The above ground portion of the well casing and the guard posts shall be painted yellow.

3.2 Acceptance, Abandonment, and Surveying: Wells which cannot be properly installed due to breakage of well components, plugging of screens with grout, or collapse of the borehole shall be replaced by the Subcontractor. The Subcontractor may salvage whatever materials may be removed from the boring. The Contractor shall provide to the Government a survey of the as-installed locations of the extraction wells. Well abandonment shall be performed in accordance with the following TNRCC procedures which supersede the Water Well Drillers Rules as specified in 31 TAC, Chapter 338, Subchapter C, 338.49 and 338.50. All other Water Well Drillers Rules apply:

a. All surface casing and well casing shall be removed from the well borehole. This may be achieved either through pulling the casing or over-drilling the casing. Exceptions may be for steel surface casing. In the event the entire length of steel surface casing cannot be pulled free the steel casing should be cut at a depth of at least three feet below surface and this section is to be pulled free.

b. The borehole shall be redrilled with a bit diameter at least equal to diameter of the borehole at the time of inception in order to remove the sand pack, bentonite plug, and grout seal. In the event the steel surface casing cannot be removed the bit diameter for redrilling of the borehole shall be at least equal to the internal steel casing diameter minus one inch.

c. The borehole shall be pressure filled through the use of a tremie pipe from termination depth to surface using a bentonite cement slurry (i.e., 94lb. Sack of Portland type II cement, 7.5 to 8 gallons of water, and 3 to 5 percent bentonite powder).

d. The well pad, protective steel casing for the well, guard posts, and any other ancillary well features/materials shall be removed. In addition, the ground level at the well bore will be restored to original grade.

3.3 Well Development: Groundwater extraction wells shall be developed by the Subcontractor to a sand-free condition after being completed. Development of any well shall only start after a minimum of 24 hours from the placement of the cement-bentonite grout. Development shall be accomplished by bailing, surging using a surge block, pumping, and a combination of these three methods until the discharge color, turbidity, temperature, pH and conductance have stabilized. Stability is defined as three consecutive sets of temperature and conductance values within ± 0.5 units for pH, ± 10 percent for conductivity, and ± 1°C for temperature. These measurements should be taken after the removal of each well volume.. In all cases, a minimum of five and a maximum of ten well volumes shall be removed. A well volume is defined as the volume of water in the casing and the filter pack at the static water level. If the return water does not meet the above criteria after removal of ten well volumes, development will continue unless otherwise directed by the USACE onsite representative.

Air shall not be used to develop any of the wells. It is preferable not to introduce water into the well during development. The volume of any fluids introduced into the well during construction must first be removed during development. Development water shall be stored in an above ground tank for subsequent treatment at the onsite groundwater treatment plant by Contractor.

3.4 Decontamination: Drill rig and associated equipment shall be decontaminated prior to conducting any drilling at the site, following completion of each borehole and prior to demobilization. Additional decontamination requirements for the project are provided in the Waste Management Plan. These requirements shall be followed during the implementation of work.

3.5 Clean-up: Upon completion of the well construction and other incidentals, all debris and surplus materials resulting from the work shall be removed from the jobsite. Drill cuttings shall be considered to be contaminated material and shall be properly drummed and sealed by the Subcontractor for treatment by the Contractor.

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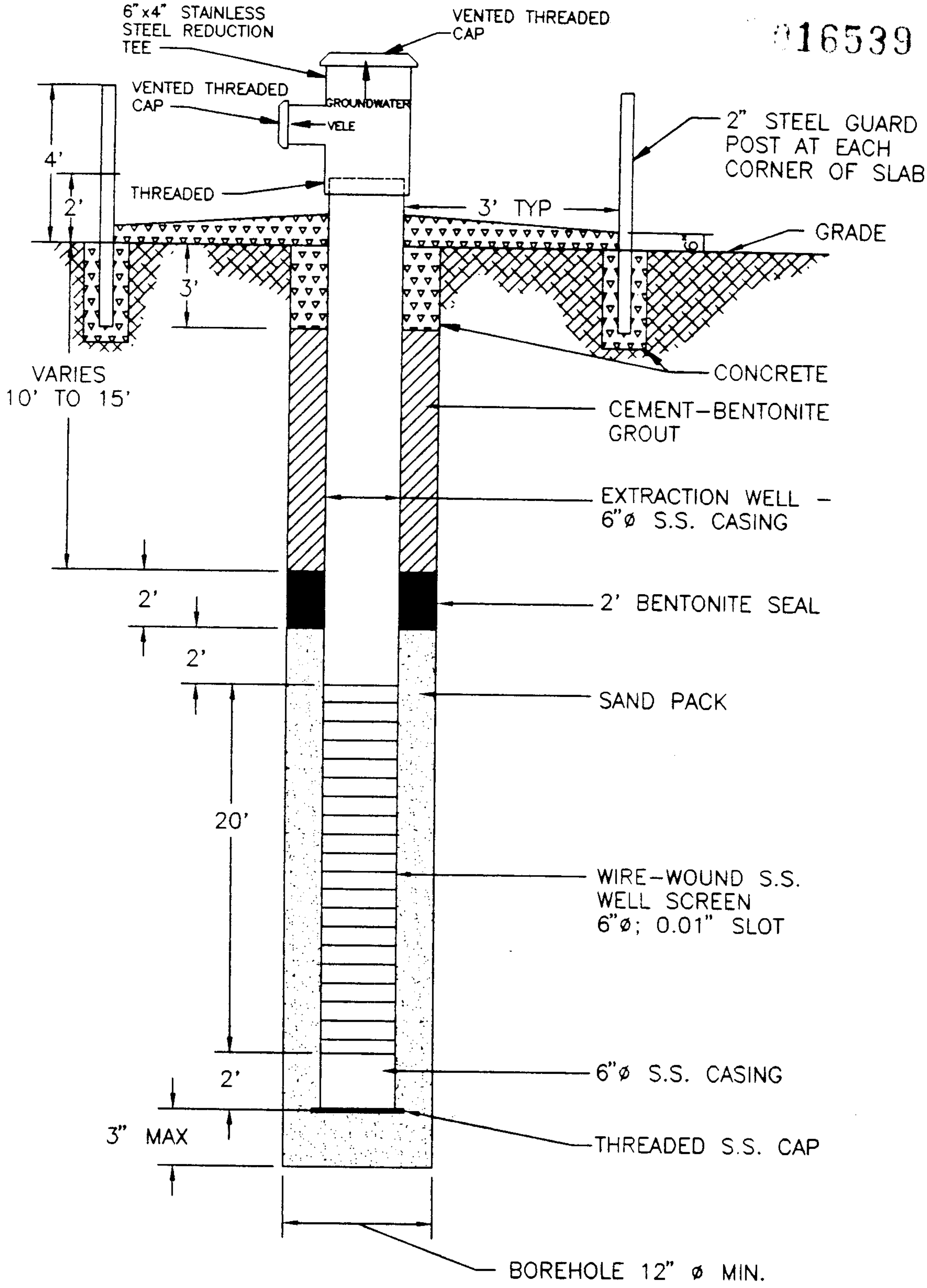

2379-382-LHAAPOLD-FIG_3

DOW
Dow Environmental

GROUNDWATER EXTRACTION WELL DETAIL
BURNING GROUND NO. 3
LHAAP KARNACK, TEXAS

US ARMY CORP. OF ENGINEERS, FORT WORTH DISTRICT

DATE: MAY 11, 1995	JOB NUMBER: 2379
SCALE: NOT TO SCALE	FIGURE NUMBER VEWD-1 REV 0

INTERIM REMEDIAL ACTION
BURNING GROUND No. 3
LHAAP 18 & 24
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

016540

PHASE III

Section 02730b
MONITORING WELL/PIEZOMETERS DRILLING AND INSTALLATION SPECIFICATION

1. GENERAL:

1.1 Definitions:

1.1.1 Government: U.S. Army Corps of Engineers, Fort Worth District

1.1.2 Administrative Contracting Officer: Government authorized representative

1.1.3 Quality Assurance Representative (QAR) : Authorized representative of Administrative Contracting Officer.

1.1.4 Contractor: Dow Environmental Inc. (DEI)

1.1.5 Subcontractor: Drilling subcontractor who is licensed to drill wells in the state of Texas, to be selected by Contractor.

1.2 Applicable Publications: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.2.1 American Society for Testing Materials (ASTM) Publications:

ASTM D-1785	Polyvinyl Chloride (PVC) plastic pipe
ASTM C-150	Portland Cement
ASTM D-422	Grain Size Tests

1.2.2 American Water Works Association (AWWA) Standards:

AWWA A100-84	Water Wells

1.2.3 Texas Natural Resource Conservation Commission (TNRCC):

30 TAC 358	Water Well Driller Rules

1.3 General Requirements: This section covers the drilling and installation of temporary monitoring wells which shall be constructed as shown on Figure MWP-1.

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1.4 Submittals:

1.4.1 Drilling Plan: Before beginning work, the Subcontractor shall submit for approval their proposed plan for drilling and constructing the monitoring wells. The plan shall include, but not be limited to, the proposed method of drilling and equipment to be used, standard operating procedures for drilling, well screen specifications, grouting materials, sand pack material, decontamination procedures, and methods for placing sand pack and grout. No work shall be performed until the drilling plan has been approved and no deviation from the approved drilling plan will be permitted without approval of the Contractor.

1.4.2 Permits and Well Registration: The Subcontractor shall be responsible for obtaining all state permits, licenses, or other requirements necessary for execution of the work. The Subcontractor shall also be responsible for preparing and submitting the required well completion reports to the Texas Natural Resources Conservation Commission (TNRCC). A copy of all such documents shall be furnished to the Contractor.

1.4.3 Logs of Wells: During the drilling of each well, a Contractor assigned supervising geologist/environmental scientist shall maintain an accurate log. At a minimum, the log shall include depths, elevations, and descriptions of all formations encountered, identification of each stratum, and depths at which groundwater is encountered. Copies of all well logs shall be provided to the Administrative Contracting Officer as applicable.

1.5 Environmental Protection: The Subcontractor shall take all precautions as may be required to prevent contaminated water or water having undesirable physical or chemical characteristics from entering the water supply stratum through the well bore or by seepage from the ground surface. The Subcontractor also shall take all precautions necessary to prevent contamination of the ground surface or of surface waters resulting from drilling of the wells. The Subcontractor shall submit, as part of the drilling plan required by Paragraph 1.4: Submittals, details of specific methods to be employed to control potential contamination or pollution arising from well installation activities.

2. PRODUCTS:

2.1 Riser Pipes:

The monitoring well riser pipe, which shall be threaded into the top of the well screen, shall be <u>two</u> inches in diameter and constructed of Schedule 40 PVC in accordance with ASTM D-1785. All riser pipe sections shall be connected by threaded couplings.

2.2 Well Screens:

The monitoring well screens shall be Schedule 40 PVC slotted screen, minimum <u>two</u> inch nominal diameter, constructed in accordance with ASTM D-1785, and shall be directly threaded to the riser pipe. The slot for the screen shall be 0.01 inch (10 slot). The screen and all accessories required for satisfactory operation shall be essentially standard products of reliable manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable. A two-foot long Schedule 40 PVC blank pipe with a diameter equivalent to that of the wells screen shall be threaded into the bottom of the screen of each monitoring well. The bottom of each well shall be sealed using a schedule 40 PVC threaded cap securely sealed to the blank pipe.

2.3 Sand pack shall be a product of a commercial sand and gravel manufacturer, shall be silica sand. This sand shall be composed of round, hard, waterworn sand, free of flat or elongated pieces, organic matter, or other foreign matter, properly sized and graded. The sand pack for the groundwater monitoring wells shall have an effective grain size of 0.015 inch and a uniformity coefficient of 2.5. The sand gradation shall be such that no more than ten percent of the sand grains are finer than the screen slot size.

2.4 Concrete grout shall consist of ready mix concrete mixed with potable water. The cement used in the mix shall consist of portland cement conforming to ASTM C 150 Type I or II. The concrete compressive strength shall be minimum 3,000 pounds per square inch at 28 days.

2.5 Bentonite Seal: Bentonite used for well bore seals shall be either pelletized or chip form as supplied for use in water well construction.

2.6 Cement-Bentonite grout shall consist of portland cement conforming to ASTM C 150 Type I or II, sand and water. Cement grout shall be proportioned with approximately seven pounds of powdered bentonite per 94 pound sack of cement and not more than six gallons of clean water per 94 pound sack of cement.

2.7 Monitoring well protective covers shall be constructed as shown on Figure MWP-1 and 3.

2.8 A six foot-square, six inches thick, concrete pad shall be poured around the protective casing of each monitoring well at the ground surface as shown on Figure MWP-1. A steel guard post, 2-inch in diameter, that is filled with concrete shall be placed at each corner of the concrete slab. Each post shall extend to at least 2 feet below ground surface and four feet above the ground surface. The above ground portion of the well casing and the guard posts shall be painted yellow. A brass survey cap shall be installed in the concrete pad for each monitoring well. This section does not apply to piezometers.

2.9 Water: Water used in drilling and decontamination,including cleaning grouting or other activities, shall be obtained from a potable supply source.

3. EXECUTION

3.1 Groundwater Monitoring Well Construction:

3.1.1 General Requirements: The method of drilling shall be by hollow stem auger (HSA). The drilling method must prevent the collapse of formation material against the well screen or casing during installation. Drilling shall conform to all state and local standards. The execution of the work shall be by competent workpersons and performed under the direct supervision of an experienced well driller. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall be drilled from the ground surface to the depth of interest as directed by the supervising geologist/environmental scientist. The depth of the completed borehole shall be measured with a fiberglass tape having a stainless-steel weight on the end.

Representative soil samples shall be collected for every stratum encountered and for every five feet, whichever occurs first, using a three inch O.D. split spoon.

3.1.2 Construction of Well Riser and Screen: The entire well shall be drilled to the diameter of the sand pack, as shown on Figure MWP-1 . The well screen and riser pipes shall be lowered into the hole, through the augers, by a method which will allow for control of the rate of fall of the well screen and riser pipe at all times. Well screen and riser pipe shall not be dropped or allowed to fall uncontrolled into the hole.

Prior to the lowering of the well assembly, the auger casing shall be slowly withdrawn about one foot and the borehole depth remeasured. If the hole remains open, a six to 12 inch thick layer of sand pack material shall be placed at the bottom of the well. The well assembly shall then be lowered until it rests on the layer of sand pack.

3.1.3 Construction of Sand Pack: After the screen and riser pipe have been centered, the approved sand pack shall be constructed around the screen by filling the entire space between the screen and the wall of the hole with filter sand. Sand conductor pipe having an inside nominal diameter of not less than one and one-half inches shall be lowered to the bottom of the well between the soil and screen. The sand conductor shall be raised at a rate that will keep the bottom of the conductor between one and three feet below the sand level in the borehole at all times. The sand pack shall be installed continuously and without interruption until the sand has been placed to the depth shown on Figure MWP-1. The augers shall be withdrawn at a slow rate during the construction of the sand pack.

3.1.4 Placing Bentonite Seal, Cement-Bentonite Grout, and Concrete Grout: After the riser pipe well screen and sand pack have been installed, the annular space between the well casing and the borehole shall be sealed by use of bentonite seal, cement-bentonite grout, and concrete grout, as shown on Figure MWP-1.

The Bentonite Seal shall be installed by slowly adding the pellets or granules to avoid bridging. The pellets or granules shall be tamped with a stainless-steel weight suspended on a fiberglass measuring tape. The completed Bentonite Seal shall be allowed to hydrate for approximately four hours before proceeding with the installation.

The Cement-Bentonite grout shall be placed using a segmented PVC grout pipe lowered to the top of the bentonite seal. Pumping of grout shall continue until a return is observed from the top of the auger casing. The grout level shall not be allowed to fall below the bottom of the auger casing during casing withdrawal.

The Concrete Grout shall be poured in the top 3 feet open annulus following the removal of the last auger section. The steel protective cover shall be centered on the well casing and inserted into the concrete prior to the setting of this grout.

3.1.5 A six-foot-square concrete pad, minimum six inches thick, shall be poured around the protective casing at the ground surface. The pad shall be sloped away from the well in order to promote drainage as shown on Figure MWP-1. A steel guard post, 2-inch in diameter, that is filled with concrete shall be placed at each corner of the concrete slab. Each post shall extend to at least 2 feet below ground surface and four feet above the ground surface. The above ground portion of the well casing and the guard posts shall be painted yellow

3.2 Acceptance, Abandonment, and Surveying: Wells which cannot be properly installed due to breakage of well components, plugging of screens with grout, or collapse of the borehole shall be replaced by the Subcontractor. The Subcontractor may salvage whatever materials may be removed from the boring and shall grout the boring to the ground surface along with whatever screen and pipe which remains in place. Grouting shall be in accordance with applicable sections of the local regulations for drilling and abandonment of water wells. The Contractor shall provide to the Government a survey of the as-installed locations of the monitoring wells. Well/Borehole abandonment shall be performed in accordance with 30 TAC 338, Water Well Driller Rules.

3.3 Well Development: Groundwater extraction and monitoring wells shall be developed by the Subcontractor to a sand-free condition immediately after being completed. Development of any well shall only start after <u>a minimum of 24 hours</u> from the placement of the cement-bentonite grout. Development shall be accomplished by bailing, surging and/or pumping until the discharge color, turbidity, temperature, pH and conductance have stabilized. Stability is defined as three consecutive sets of temperature and conductance values within 10 percent of each other, and pH within 0.1. The minimum volume of water removed between measurements sets is 5 gallons. In all cases, a minimum of five well casing volumes shall be removed. Development water shall be stored in 55-gallon drums for handling by Contractor in accordance with the Waste Management Plan.

3.4 Decontamination: Drill rig and associated equipment shall be decontaminated following completion of each borehole and prior to demobilization. Additional decontamination requirements for the project are provided in the Chemical Data Acquisition Plan. These requirements shall be followed during the implementation of work.

3.5 Clean-up: Upon completion of the well construction and other incidentals, all debris and surplus materials resulting from the work shall be removed from the jobsite. Drill cuttings shall be considered to be contaminated material and shall be properly drummed and sealed by the Subcontractor for storage by the Contractor in accordance with the Waste Management Plan.

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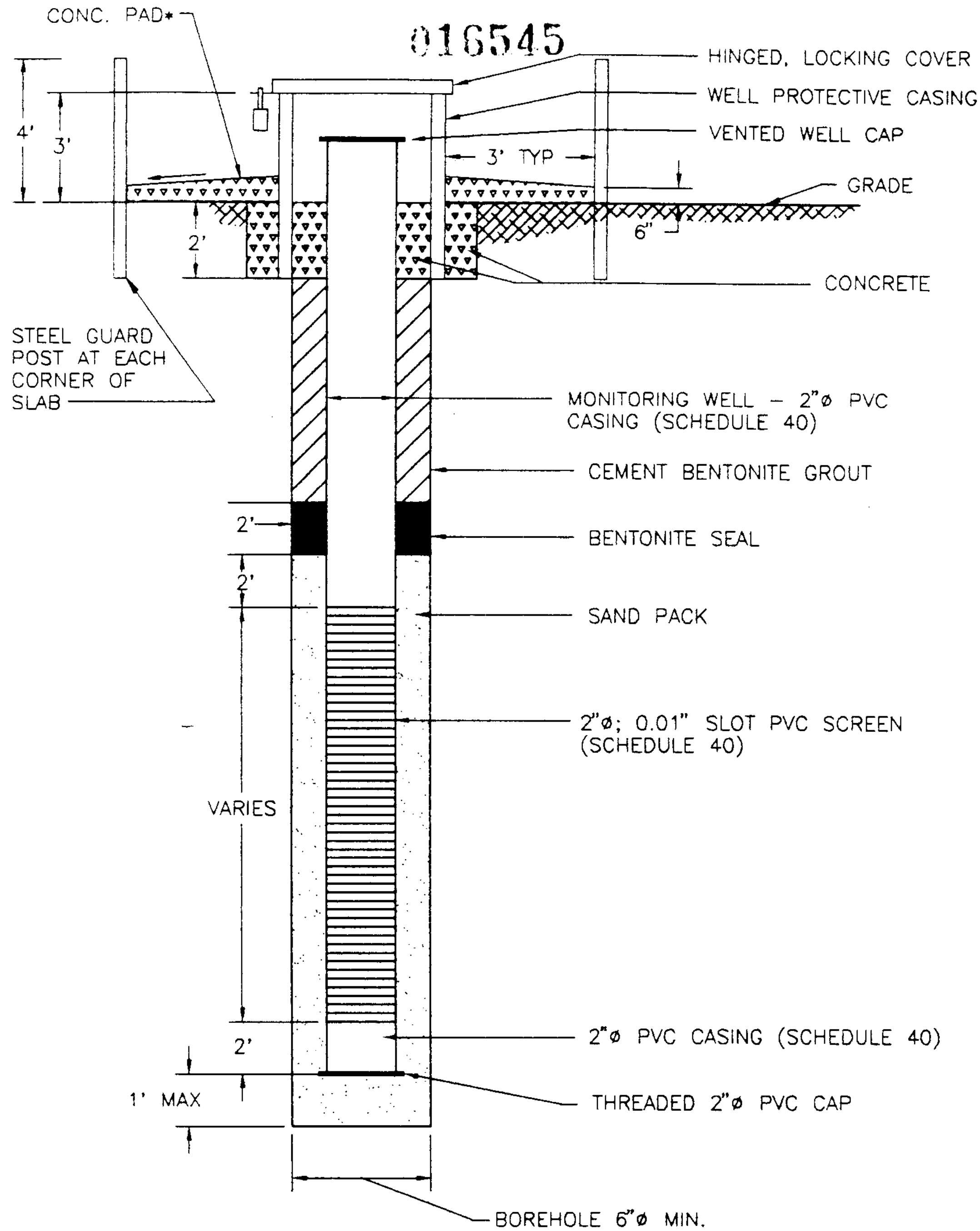


NOTE:

THE PIEZOMETERS WILL NOT HAVE A CONCRETE PAD, STEEL GUARD POSTS, AND PROTECTIVE CASING.

DOW Dow Environmental	GROUNDWATER PIEZOMETER/MONITORING WELL DETAIL BURNING GROUND NO. 3
	LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS
	PROJECT: LHAAP PHASE III, IRA — PROJECT NO.: 2379
	SCALE: NTS — FIGURE NUMBER MWD-1 — REV –

2379-382-LHAAPOLD-LH019

SECTION 03200

CONCRETE REINFORCEMENT

016546

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(1989; 318R-89) Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1989a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 82	(1988) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184	(1988) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1988) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	(1989) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 499	(1981; R 1988) Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A 615	(1989) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675	(1988) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706	(1989) Low-Alloy Steel Deformed Bars for Concrete Reinforcement

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1979) Structural Welding Code-Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI DA4 (1990; 25th Ed) Manual of Standard Practice

1.3 SUBMITTALS - Indicate submittal classification in the blank space using "GA" when the submittal requires Contractor approval or "FIO" when the submittal is for information only.

SD-04 Drawings

Concrete Reinforcement System; FIO.

Detail drawings showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

1.5 DELIVERY AND STORAGE - Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 REINFORCING STEEL - Reinforcing steel shall be deformed bars conforming to ASTM A 615 or ASTM A 706, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82.

2.2 WELDED WIRE FABRIC - Welded wire fabric shall conform to ASTM A 185 or ASTM A 497.

2.3 WIRE TIES - Wire ties shall be 16-gauge or heavier black annealed steel wire.

2.4 SUPPORTS - Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI DA4 and shall be steel or precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT - Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.

3.1.1 Placement - Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing - Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by a mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC - Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

END OF SECTION

SECTION 03250

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS 11/88

PART 1 GENERAL

1.1 SUMMARY - (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1982; R 1988) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 17511983	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752 (1984)	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2628 (1981)	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835 (1989)	Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

CORPS OF ENGINEERS (COE)

COE CRD-C 513	(1974) Rubber Waterstops
COE CRD-C 572 (1974)	Polyvinylchloride Waterstops

FEDERAL SPECIFICATIONS (FS)

FS SS-S-200	(Rev E; Am 1) Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

FS SS-S-1401 — (Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

FS SS-S-1614 — (Rev A; Notice 1) Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements

1.3 SUBMITTALS - Contractor approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 1300 SUBMITTAL DESCRIPTIONS:

SD-01 Data Materials; _____.

Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

SD-13 Certificates Materials; _____.

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.4 DELIVERY AND STORAGE - Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION-JOINT STRIPS - Contraction-joint strips shall be 1/8-inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 EXPANSION-JOINT FILLER - Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8-inch thick and of a width applicable for the joint formed.

2.3 JOINT SEALANT - Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Joint Seals - ASTM D 2628

2.3.2 Lubricant for Installation of Preformed Compression Seals - ASTM D 2835

2.3.3 Hot-Poured Type - FS SS-S-1401

2.3.4 Cold-Applied Jet-Fuel Resistant Type - FS SS-S-200, Type M

2.3.5 Hot-Applied Jet-Fuel Resistant Type - FS SS-S-1614

2.4 WATERSTOPS. Waterstops shall conform to COE CRD-C 513 or COE CRD-C572.

PART 3 EXECUTION

3.1 JOINTS - Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

3.1.1.1 Joint Strips - Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC strips shall be discarded and the insert left in place. Means shall be provided to insure true alignment of the strips is maintained during insertion.

3.1.1.2 Sawed Joints - Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete-sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC insert strips into the plastic concrete or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8-inch wide and shall extend into the slab approximately one-fourth the slab thickness but not less than 1 inch.

3.1.2 Expansion Joints - Premolded expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.

3.1.3 Joint Sealant - Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Types and locations of sealants shall be as indicated. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant. Joints sealed with field molded sealant shall be completely filled with sealant.

3.2 WATERSTOPS - Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Splices shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL - This section includes specifications for cast-in-place concrete work as shown on the Subcontract Drawings.

1.2 ITEMS - The principle items of work are as follows:

1.2.1 General - Providing normal weight cast-in-place concrete, including reinforcement and appurtenant materials, to the sizes and shapes and at the locations indicated, in accordance with ACI 301, as modified and supplemented herein, and in accordance with the Subcontract Documents.

1.3 QUALITY CONTROL

1.3.1 General - All work covered here under "Quality Control" will be provided by the Subcontractor as a subsidiary obligation of the Contract. SECTION 01400 - QUALITY CONTROL provides requirements for establishing and implementing the Subcontractor's Quality Control Program.

1.4 TESTING LABORATORY - All required laboratory tests to ensure that cast-in-place concrete and their placement comply with the specification shall be made by an independent testing laboratory.

1.5 TEST PROCEDURES - Tests for slump shall be made on concrete sampled from each truck load delivered to the site. Slump shall be determined using ASTM C 143.

1.6 SUBMITTALS

1. Submit certified concrete mix designs including proposed admixtures.

2. Submit certified test reports before delivery of materials as specified in SECTION 01300 - SUBMITTALS for each item listed below:

   - Admixtures
   - Aggregate
   - Cement
   - Reinforcing and accessories
   - Materials for curing concrete
   - Joint sealing materials

- Expansion joint materials

3. Submit reinforcing placement drawings and reinforcement steel schedules for all cast-in-place concrete work.

PART 2 - MATERIALS

2.1 REINFORCEMENT - Reinforcing bars shall comply with the requirements of ASTM A 615, minimum yield strength of 60,000 psi unless otherwise indicated. Reinforcing accessories shall conform to the requirements of CRSI Manual of Standard Practice.

2.2 ADMIXTURES

1. Concrete shall be 3000 psi (28-day) and higher and shall be air entrained unless otherwise indicated.

2. Water reducing and retarding admixtures may be used with the permission of the Engineer. The Subcontractor is responsible for the compatibility of admixtures.

3. The use of calcium chloride will not be permitted without approval.

2.3 APPURTENANT MATERIALS

2.3.1 Vapor Barrier - Polyethylene film shall be Product Standard PS17, 6 mil, or equal.

2.3.2 CURING MATERIALS

1. Curing paper shall conform to requirements of ASTM C 171, waterproof, clear or white polyethylene sheeting, or polyethylene-coated burlap. Use only non-staining material over all surfaces to remain permanently exposed.

2. Curing compound shall conform to requirements of ASTM C 309, white-pigmented, Type 2, free of paraffin or petroleum.

2.4 JOINT SEALER

1. Sealer hot applied shall conform to requirements of ASTM D 1190.

2. Sealer cold applied shall conform to requirements of ASTM D 1850.

2.5 MIX DESIGN

1. Concrete shall have a minimum 7-day compressive strength of 2500 psi and a minimum 28-day compressive strength of 3000 psi.

2. Cement shall be ASTM C 150 Type I.

3. Slump shall be between 1 and 3 inches in accordance with ASTM C 143.

4. Provide ASTM C 33 aggregate Size No. 57 or 67.

5. Air entrainment between 4 to 6 percent.

6. Maintain a maximum water cement ration of 0.45.

2.6 WATER - Water shall be potable.

PART 3 - EXECUTION

3.1 FORMS - Set forms true to line and grade and make mortar tight. Chamfer above grade exposed joints, edges, and external corners of concrete 3/4 inch, unless otherwise indicated. Before concrete placement, coat the contact surfaces of forms with a nonstaining form coating compound. Prevent concrete damage during form removal. Maintain forms for slabs in place until the concrete has attained 25 percent of the concrete's 28-day design strength, as approved by the Contractor.

3.2 REINFORCEMENTS -

1. Reinforcements shall be accurately formed and shall be free from loose rust, scale, and contaminates which reduce bond. Unless otherwise indicated on the Subcontract Drawings or specified herein, the details of fabrication shall conform to ACI 315 and 318.

2. Reinforcements shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips.

3. Splices shall conform to the requirements indicated on the Subcontract Drawings. Welding or tack welding of reinforcement is prohibited unless specified herein. Reinforcement upon which improper or unauthorized welding has been done shall be removed and replaced.

4. For slabs, a vapor barrier shall be placed above the compacted aggregate base material.

3.3 EMBEDMENTS

1. Anchor bolts, castings, steel shapes, conduit, sleeves, masonry anchorage, and other materials that are to be embedded in the concrete shall be accurately positioned in the forms and securely anchored.

2. Unless installed in pipe sleeves, anchor bolts shall have sufficient threads to permit a nut to be installed on the concrete side of the form or template. A second nut shall be installed on the other side of the form or template, and the two nuts shall be adjusted so that the bolt will be held rigidly in proper position.

3. Embedments shall be clean when installed. After concrete placement, surfaces not in contact with concrete shall be cleaned of concrete splatter and other foreign substances.

3.4 BATCHING AND MIXING

1. Concrete shall be furnished by an acceptable ready-mix concrete supplier and shall conform to ASTM C 94.

2. The consistency of the concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

3. A delivery ticket shall be prepared for each load of ready-mix concrete. A copy of each ticket shall be handed to the Subcontractor by the truck operator at the time of delivery. Tickets shall show the mix identification, quantity delivered, the amount of each material in the batch, the time at which the cement was added, the numerical sequence of the delivery, maximum amount of mixing water which can be added at job site to obtain specified water/cement ratio. Copies of all delivery tickets shall be submitted to the Contractor after completion of the pour.

3.5 CONCRETE PLACEMENT

1. Notify the Contractor before placing concrete. The limits of the concrete pour shall be predetermined by the Subcontractor and shall be acceptable to the Contractor. All concrete within such limits shall be placed in one continuous operation.

2. Wet down formwork and reinforcement before placing concrete so as to prevent leaching of water from concrete, but do not allow free water standing in the forms.

3. Before concrete is placed, forms, reinforcements, water stops, anchor bolts, and embedments shall be rigidly secured in proper position; all dirt, mud, water, and debris shall be removed from the space to be occupied by concrete; all surfaces encrusted with dried concrete from previous placement operations shall be cleaned; and the entire installation shall be acceptable to the Contractor.

4. Place concrete within 90 minutes after cement has been mixed with aggregate and within 45 minutes after addition of water and admixtures. Concrete which has not been placed within these time limits shall not be incorporated into the Work and shall be discarded off-site at no cost to the Contractor.

5. Concrete shall be conveyed to the point of final deposit by methods which will prevent separation or loss of ingredients. Concrete shall be placed in final position without being moved laterally in the forms more than 5 feet.

6. Concrete shall be thoroughly settled when top finished. All laitance, debris, and surplus water shall be removed from concrete surfaces at tops of forms by screeding, scraping, or other effective means. For all concrete pours, the forms shall be overfilled and after the concrete has settled, the excess shall be screeded off.

7. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcements and embedments and into the corners of the forms. Mechanical vibrators shall be used which maintain at least 9,000 cycles per minute when immersed in the concrete.

8. Cold weather concreting shall comply with ACI 306. Hot weather concreting shall comply with ACI 305.

3.6 FINISHING UNFORMED SURFACES

1. Buried concrete and encasement will require no finishing except that necessary to obtain the required surface elevations or contours. The unformed surfaces of all other concrete shall be screeded and given an initial float finish followed by additional floating, and troweling where required.

2. Unless specified to be beveled, exposed edges of floated or troweled surfaces shall be edged with a tool having 3/4 inch corner radius.

3. Exterior slabs shall be broom finished unless indicated. Provide a float finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3. CURING - Concrete shall be protected from loss of moisture for at least 7 days after placement. Curing shall be performed by one of the following methods:

3.8.1 Moist Curing - Continually wet the concrete throughout the curing period by ponding, immersion, fog spraying or sprinkling, or by use of wetted mats.

3.8.2 Impervious - Sheeting Curing - Wet the entire exposed surface thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting.

3.9 PROTECTION OF FINISHED SURFACES - Prohibit foot and vehicular traffic and other sources of abrasion during the curing period.

3.10 REPAIR AND/OR REMOVAL OF DEFECTIVE CONCRETE

1. Defects in formed concrete surfaces shall be repaired within 24 hours, to the satisfaction of the Contractor.

2. Concrete not repaired to the satisfaction of the Contractor or not meeting the requirements specified herein shall be removed, disposed of and replaced by the Subcontractor at no cost to the Contractor.

END OF SECTION

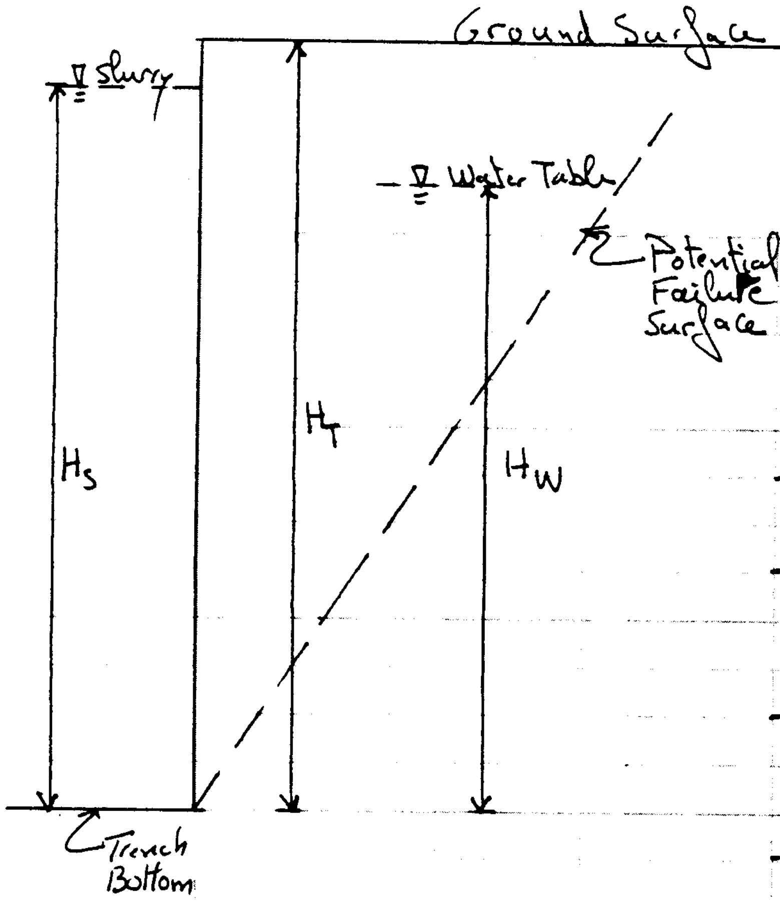
APPENDIX B

ICT STABILITY DURING CONSTRUCTION

CALCULATION WORKSHEET

CLIENT: USACE	FILE NO.: 2379	BY: ABo	PAGE 1 OF 3
SUBJECT: JCT Stability During Construction.		CHECKED BY:	DATE: 5/8/95

016560



- Assume Fine Sand Subsurface
- Assume a Total Unit Weight for Subsurface material $\gamma_T = 106$ pcf.
- Assume a Friction Angle $\phi = 35°$
- Assume an active earth pressure coefficient $K_a =$ ~~0.33~~ ABo 0.27
- Assume that Cohesion $C = 0$

H_T = Total Height of Trench

H_W = Distance Between water Table and Bottom of Trench

H_S = Height of slurry in Trench

γ_s = Unit weight of slurry, Assume 64 pcf

γ_w = Unit weight of water, 62.4 pcf.

Dow Environmental

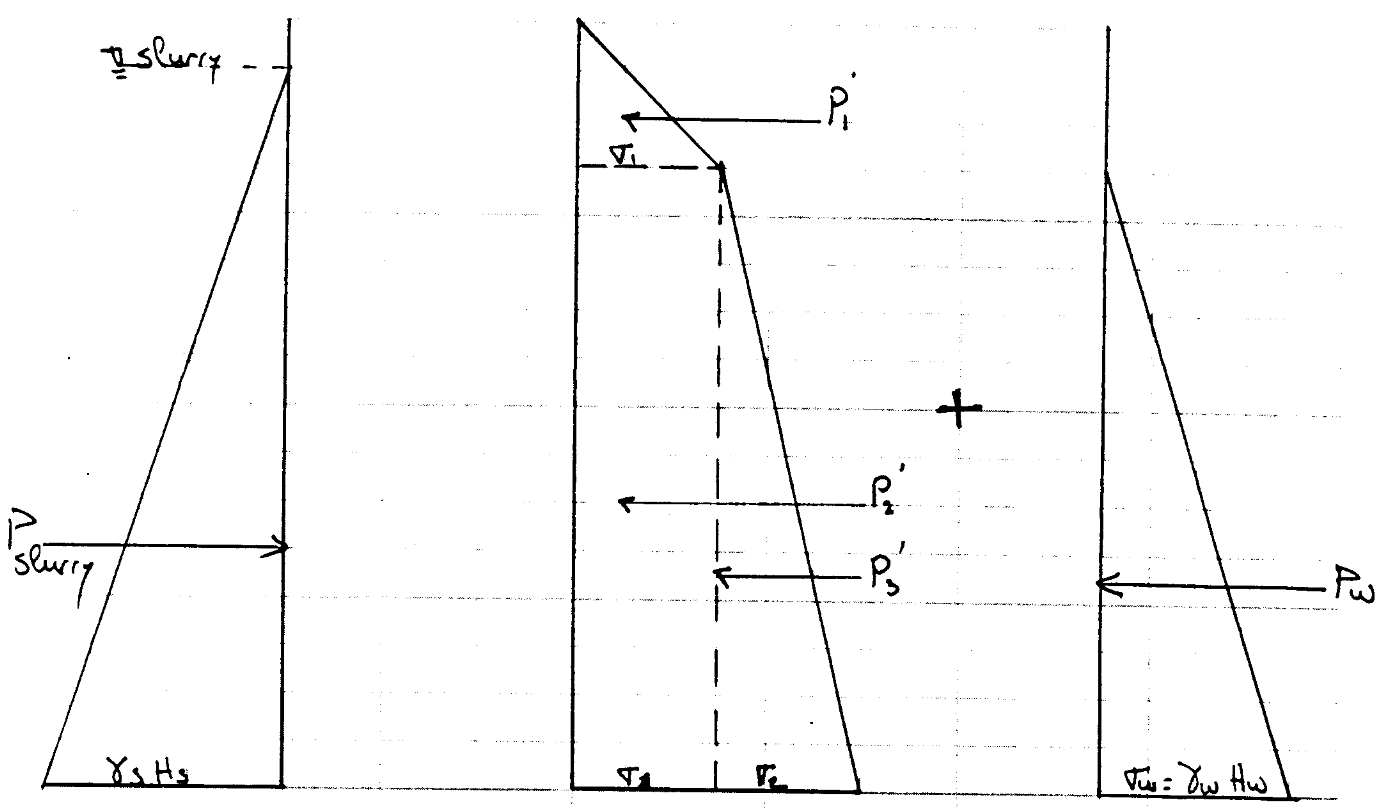
CALCULATION WORKSHEET

CLIENT: USACE	FILE NO.: 2379	BY: ABo	PAGE 2 OF 3
SUBJECT: ICT stability During Construction		CHECKED BY:	DATE: 5/8/95

016561

Resistant Force — Exerted Force

P_{slurry} — $P_{effective} + P_{water}$



$$P_{slurry} = (\gamma_s\ H_s)\frac{H_s}{2}$$

$$\sigma_1 = \gamma_T\,(H_T - H_w)\,K_a$$

$$P_w = (\gamma_w\ H_w)\frac{H_w}{2}$$

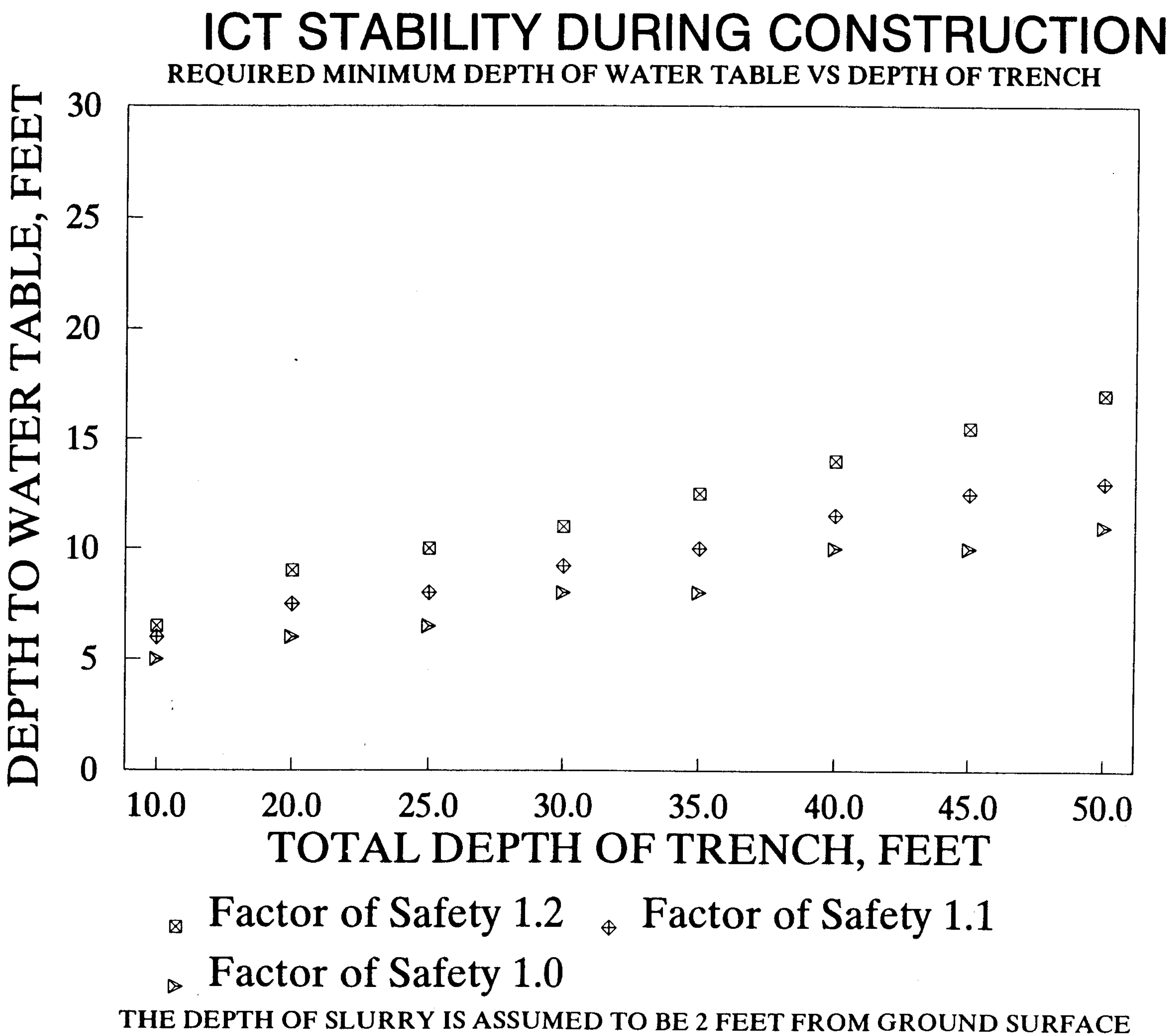
$$\sigma_2 = (\gamma_T - \gamma_w)(H_w)K_a$$

$$P_{effective} = \left[\sigma_1 \times (H_T - H_w)\frac{1}{2}\right] + \left[\sigma_1 \times H_w\right] + \left[\sigma_2 \times \frac{H_w}{2}\right]$$

$$P_{effective} = P_1' + P_2' + P_3'$$

$$\text{Factor of safety} = \frac{P_s}{P_{effective} + P_w}$$

Dow Environmental


ICT STABILITY DURING CONSTRUCTION
REQUIRED MINIMUM DEPTH OF WATER TABLE VS DEPTH OF TRENCH
DEPTH TO WATER TABLE, FEET
30
25
20
15
10
5
0
10.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
TOTAL DEPTH OF TRENCH, FEET
Factor of Safety 1.2
Factor of Safety 1.1
Factor of Safety 1.0
THE DEPTH OF SLURRY IS ASSUMED TO BE 2 FEET FROM GROUND SURFACE

016562

APPENDIX C

GROUNDWATER TREATMENT PLANT

CALCULATIONS AND PLANS

016564

TABLE OF CONTENTS

016565

EXECUTIVE SUMMARY

16566

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This document presents plans prepared by Dow Environmental Inc. (DEI) for the United States Army Corps of Engineers (USACE) under contract number DACA56-93-D-0016. The contract addresses interim remediation activities at Burning Ground No. 3 which is located at the Longhorn Army Ammunition Plant (LHAAP) in Karnack, Texas.

High concentrations of solvents (primarily methylene chloride or MEC, and trichloroethylene or TCE) and heavy metals (primarily barium and lead) have been detected in the buried waste and upper saturated zone of the aquifer at LHAAP 18 & 24. DEI will provide and operate a plant designed to remove targeted constituents (See Section 1, Project Planning and Specification Basis, Attachment A, Table 1). The Work Plan and Specifications prepared by DEI will outline the processes that will be used to treat the groundwater matrices that are extracted from the shallow aquifer at the site.

1.2 GWTP OVERVIEW

- According to USACE serial letter No. CE-0016-02-33, WORK ITEM 5.4.7, the groundwater treatment plant (GWTP) will be constructed to treat 432,000 gallons per day of groundwater. The total volume of water to be treated is 471.3 million gallons. The groundwater, collected from a system of site wells and trenches is pumped to the GWTP. The GWTP separates and manages site-specific components of concern, heavy metals and solvents. First, the heavy metals (barium and lead) are separated by alkaline precipitation and chemical adsorption followed by flocculation and filtration. Then, the solvents (methylene chloride, trichloroethylene) are separated from the groundwater by air stripping (AS). The treated groundwater is discharged in compliance with the requirements of the Texas Natural Resources Conservation Commission, as outlined in Attachment A. The GWTP will meet more stringent effluent discharge levels than the state requirements (see Attachment A). The heavy metals are treated to reduce site specific solids, then thickened and dewatered for landfill at an approved location in a non-leachable form. The contaminated AS tower vent is treated in a catalytic oxidizer that converts at least 99% of the hydrocarbons to carbon dioxide, water and hydrochloric acid or HCl (for chlorinated hydrocarbon compounds). These gases exit the catalytic oxidizer and pass through an aqueous quench and an acid gas scrubber to remove and slightly concentrate the HCl. The clean gases vent to atmosphere. The HCl is recycled to the AS tower to control scaling.

016567

PROJECT PLANNING AND

SPECIFICATION BASIS

Dow Environmental

Project Planning and Specification Basis

016568

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

I. Preface

This document and its attachments include the project information which will be utilized for the planning and specification basis of all facilities within the project scope. This document will be utilized extensively throughout the project by all project personnel for calculations, plans and drawings. It is therefore imperative that this document be given thorough review by Dow Environmental Incorporated and the Client at all of the issue points listed below to avoid project cost increases and schedule delays.

II. Document Issue Record

Issue			Approvals	
Rev.	Type	Date	DEI Project Manager	Client Project Manager
A	Pre-Bid or Information			
B	Quote			
C	Contract (Phase 1 Engineering Start)			
0	Phase 1 Engineering Completion			
1	Phase 2 Engineering Completion			
2	Phase 3 Engineering Completion			

III. Document Contents

A. Project Stream Data
   1. Planned Influent Stream Data Sheet(s)
      a. Aqueous Streams
      b. Non-Aqueous Streams

   2. Planned Effluent Stream Data Sheet(s)
      a. Aqueous Streams
      b. Non-Aqueous Streams
      c. Vapor Streams
      d. Solids

B. Project Utility Data
C. Project Operating Philosophy
D. Project Site Planning Conditions
E. Misc. Project Planning Data

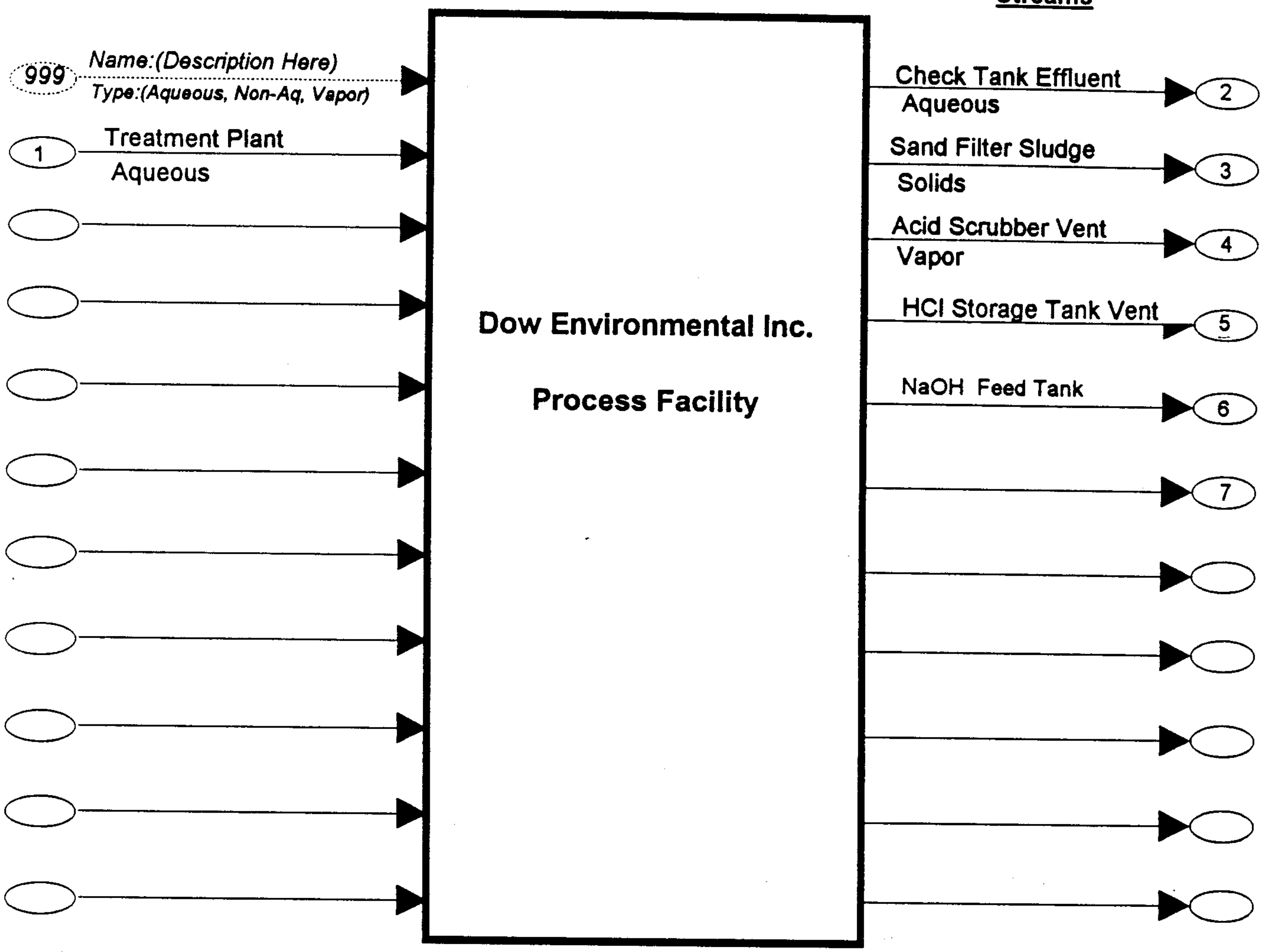
III.A. Project Stream Data

Instructions:

Fill in all inlet and outlet streams to the Dow Environmental Process Facility. Include a stream nunber from 0-999, a stream description and a stream type (Aqueous, Non-Aq, Vapor, Solid). Do not include utility stream data in this section. Utility data should be filled in in section III.B.

1. Process Influent Streams

2. Process Effluent Streams



Dow Environmental

Project Planning and Specification Basis

Aqueous Influent Stream Data

016570

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

III.A.1.a Aqueous Influent Stream

1 — Treatment Plant Feed Stream

(Stream No.) (Stream Name)

1. General Characteristics

	Min.	Normal	Max	Design Min	Design Max
Flow Rate (gpm)	50		300	50	300
Temperature (°F)	65		90	65	90
Pressure (psig)	1		1		1.0
pH		7.0		6.0	8.0
Oil & Grease (mg/l)			20		20
Bacteria Level (CFU/ml)					
BOD-Biological Oxygen Demand			N/A		N/A
COD-Chemical Oxygen Demand			200		200
TOD -Total Oxygen Demand			N/A		N/A
TOC-Total Organic Carbon			N/A		N/A
TKN -Total Kjeldahl Nitrogen					
Turbidity (NTU)					
TSS-Total Suspended Solids(mg/l)			150		150
TDS-Total Dissolved Solids(mg/l)			1750		1750

2. Inorganic Characteristics

	Min.	Normal	Max	Design Min	Design Max
Methyl Orange Alkalinity - $CaCO_3$ (mg/l)			200		200
Phenolpthalene Alkalinity - $CaCO_3$ (mg/l)					
Total Hardness - $CaCO_3$ (mg/l)			400		400
Total Calcium as Ca (mg/l)			42.281		
Soluble Calcium as Ca (mg/l)					
Total Magnesium as Mg (mg/l)			32.792		
Soluble Magnesium as Mg (mg/l)					
Total Manganese as Mn (mg/l)			0.644		
Soluble Managanses as Mn (mg/l)					
Total Iron as Fe (mg/l)			14.057		
Soluble Iron as Fe (mg/l)					
Soluble Ammonia as NH_4^+ (mg/l)			N/A		
Soluble Nitrate as NO_3^{-1} (mg/l)			15		
Soluble Phosphate as PO_4^{-3} (mg/l)					
Soluble Sulfate as SO_4^{-2} (mg/l)			31		
Total Sulfide as S^{-2} (mg/l)					
Soluble Sulfide as S^{-2} (mg/l)					
Total Silicate as $Si_2O_7^{-2}$ (mg/l)					
Soluble Silicate as $Si_2O_7^{-2}$ (mg/l)					
Soluble Chloride as Cl^{-1} (mg/l)			650		

Dow Environmental

Project Planning and Specification Basis

016571

Aqueous Influent Stream Data

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

See Attachment A

3. Organic Components

	Min.	Normal	Max	Design Min	Design Max
Total Volatile Organics (mg/l)					
Methelyene Chloride			300		300
TCE			40		40
1,1 Dichloroethene			0.005		0.005
1,2 Dichloroethane			0.035		0.035
Vinyl chloride			0.02		0.02
1,2 Dichloroethene			0.941		0.941
Acetone			3.274**		3.274**
See Attachment "A" for other					
compounds present in trace quantities.					

4. Solids Distribution*

	Design
> 100μ (wt%)	N/A
100-80μ (wt%)	N/A
80-60μ (wt%)	N/A
60-40μ (wt%)	N/A
40-20μ (wt%)	N/A
< 20μ (wt%)	N/A

5. Other Data

RCRA Classification (Attach)	
Biotoxicity Results (Attach)	
Hazard Rating	Hazardous - CERCLA

6. Notes

*System will produce solids, primarily as $Mg(OH)_2$
**Client has instructed DEI not to install a unit operation for removal of acetone prior to making sure it exists. However, a unit operation for acetone will be indicated on the Index Flowsheet Sheet and a performace specification written with the original planning for purchase of the unit at a later date if required.

Dow Environmental

Project Planning and Specification Basis

016572

Non-Aqueous Influent Stream Data

Project Number: 2379
Project Name: Longhom A A P

Date: 5/19/95
Revision: C

III.A.1.b Non-Aqueous Influent Stream

(Stream No.) — N/A (Stream Name)

1. General Characteristics

	Min.	Normal	Max	Design Min	Design Max
Flow Rate (gpm)					
Temperature (°F)					
Pressure (psig)					
Density* (lb/ft³)					
Viscosity* (cp)					
Vapor Pres.* (psia)					

* Tables or charts may be provided in place of these entries.

2. Organic Components

	Min.	Normal	Max	Design Min	Design Max

Project Planning and Specification Basis

016573

Non-Aqueous Influent Stream Data

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

3. Solids Distribution

	Design
> 100μ (wt%)	
100-80μ (wt%)	
80-60μ (wt%)	
60-40μ (wt%)	
40-20μ (wt%)	
< 20μ (wt%)	

4. Other Data

RCRA Classification (Attach)	
Biotoxicity Results (Attach)	
Hazard Rating	

5. Notes

Dow Environmental

Project Planning and Specification Basis

Aqueous Effluent Stream Data

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

016574

III.A.2.a Aqueous Effluent Stream

2 — Check Tank Effluent

(Stream No.) (Stream Name)

1. General Characteristics

	Design Min	Design Max
Flow Rate (gpm)	50	350
Temperature (°F)	40	90
Pressure (psig)	0	0
pH	6	9
Oil & Grease (mg/l)		15
Bacteria Level (CFU/ml)		No Limit
BOD-Biological Oxygen Demand		N/A
COD-Chemical Oxygen Demand		N/A
TOD -Total Oxygen Demand		N/A
TOC-Total Organic Carbon		N/A
TKN -Total Kjeldahl Nitrogen		N/A
Turbidity (NTU)		<1 NTV
TSS-Total Suspended Solids(mg/l)		<10
TDS-Total Dissolved Solids(mg/l)		~3,000

2. Inorganic Characteristics

	Design Max
Methyl Orange Alkalinity - $CaCO_3$ (mg/l)	N/A*
Phenolpthalene Alkalinity - $CaCO_3$ (mg/l)	N/A*
Total Hardness - $CaCO_3$ (mg/l)	N/A*
Total Calcium as Ca (mg/l)	N/A*
Soluble Calcium as Ca (mg/l)	N/A*
Total Magnesium as Mg (mg/l)	N/A*
Soluble Magnesium as Mg (mg/l)	N/A*
Total Manganese as Mn (mg/l)	N/A*
Soluble Managanses as Mn (mg/l)	N/A*
Total Iron as Fe (mg/l)	N/A*
Soluble Iron as Fe (mg/l)	1.10
Soluble Ammonia as NH_4^+ (mg/l)	N/A*
Soluble Nitrate as NO_3^{-1} (mg/l)	44
Soluble Phosphate as PO_4^{-3} (mg/l)	N/A*
Soluble Sulfate as SO_4^{-2} (mg/l)	N/A*
Total Sulfide as S^{-2} (mg/l)	N/A*
Soluble Sulfide as S^{-2} (mg/l)	N/A*
Total Silicate as $Si_2O_7^{-2}$ (mg/l)	N/A*
Soluble Silicate as $Si_2O_7^{-2}$ (mg/l)	N/A*
Soluble Chloride as Cl^{-1} (mg/l)	N/A*

*No Regulatory Requirement

Project Planning and Specification Basis

016575

Aqueous Effluent Stream Data

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

3. Organic Components

	Design Max
Total Volatile Organics (mg/l)	
Methylene Chloride	0.005
TCE	0.005
1, 1 Dichloroethene	0.007
1,2 Dichloroethane	0.005
Vinyl chloride	0.002
1,2 Dichloroethene	0.07
Acetone	3.274**
See Attachment "A" for other compounds present in trace quantities.	

4. Notes

Planning Maximum as set by Attachment "A" with the following exceptions:

TDS (mg/l) = 3000 Max
Chlorides (mg/l) = 1500 Max

**See 6. Notes, page 4 of 18.

Dow Environmental

Project Planning and Specification Basis

016576

Non-Aqueous Effluent Stream Data

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

III.A.2.b Non-Aqueous Effluent Stream

— N/A

(Stream No.) (Stream Name)

1. General Characteristics

	Design Min	Design Max
Flow Rate (gpm)		
Temperature (°F)		
Pressure (psig)		
Density* (lb/ft^3)		
Viscosity* (cp)		
Vapor Pres.* (psia)		
Total Suspended Solids TSS (ppm)		

* Tables or charts may be provided in place of these entries.

2. Organic Components

	Design Max

3. Notes

Dow Environmental

Project Planning and Specification Basis

Vapor Effluent Stream Data

016578

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

III.A.2.c Vapor Effluent Stream

4 — Acid Scrubber Vent

(Stream No.) (Stream Name)

1. General Characteristics

	Design Min	Design Max
Flow Rate (gpm)		
Temperature (°F)	65	125
Pressure (psig)		0
Density* (lb/ft³)		
Solids (ppm)		N/A
Annual HCL Discharge (tons/yr)		

2. Composition

	Design Max
Methylene Chloride (% Removal based upon conc. in stripper overload)	99.99
TCE (% Removal based upon conc. in stripper overload)	99.99
1,1 Dichloroethene (% Removal based upon conc. in stripper overload)	99.99
1,2 Dichloroethane (% Removal based upon conc. in stripper overload)	99.99
Vinyl Chloride (% Removal based upon conc. in stripper overload)	99.99
1,2 Dichloroethene (% Removal based upon conc. in stripper overload)	99.99
HCL (% Removal based upon conc. in acid scrubber inlet)	99.9
All other organic compounds presented in Attachment "A"	
1% Removal based upon conc. in stripper overload	99.99

3. Notes

Limit total emissions to 2 tons per year.

Project Planning and Specification Basis

Vapor Influent Stream Data

016579

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

III.A.1.c Vapor Influent Stream

N/A

(Stream Name)

(Stream No.)

1. General Characteristics

	Min.	Normal	Max	Design Min	Design Max
Flow Rate (gpm)					
Tempterature (°F)					
Pressure (psig)					
Density* (lb/ft^3)					
Solids (ppm)					

2. Composition

	Min.	Normal	Max	Design Min	Design Max
$Mg(OH)_2$					
Metals - See Attachment A					
Exceptions - Calcium, Potassium, Sodium					

3. Solids Distribution

	Design
> 100m (wt%)	
100-80m (wt%)	
80-60m (wt%)	
60-40m (wt%)	
40-20m (wt%)	
< 20m (wt%)	

Dow Environmental

Project Planning and Specification Basis

Vapor Influent Stream Data

016580

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

4. Notes

Dow Environmental

Project Planning and Specification Basis

016581

Solid Effluent Stream Data

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

III.A.2.d Solid Effluent Stream

3 — Sand Filter Sludge/Cake

(Stream No.) (Stream Name)

1. General Characteristics

	Design Min	Design Max
Bulk Density (lb/ft^3)	N/A	62.4
% Moisture		50

2. Inorganic Characteristics

	Design Min	Design Max
$Mg(OH)_2$		
Metals - See Attachment A		
Exceptions - Calcium, Potassium, Sodium		

3. Organic Characteristics

	Design Min	Design Max
N/A		

4. Solid Distributions

	Min.	Normal	Max	Design Min	Design Max
N/A					

5. Notes

Disposal - Class 1 Haz Landfill
Land disposal restrictions RCRA 40 CFR 268
However, it may be possible to de-list the cake due to the alkalinity of the $Mg(OH)_2$.
We expect the cake to pass the TCLP test.

Project Planning and Specification Basis

Utilities

016582

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

III.B. Project Utility Data

1. Utility Streams

	Check if required	Available	Required Capacity	Design Min	Temperature Design Max	Temperature Design Min	Pressure Design Max	Plant Value ($/Unit)
HP Steam (lbs/hr)		No						
MP Steam (lbs/hr)		No						
LP Steam (lbs/hr)		No						
Nitrogen (lbs/hr)		No						
Fuel Gas (BTU/hr)	x	Yes	$2x10^6$					
CW Supply (lbs/hr)		No						
CW Return (lbs/hr)		No						
Service Water (gpm)	x	Yes	200 gpm					
City Potable Water	x	Yes	*					
Fire Water (lbs/hr)		No						
Flare System (SCFM)		No						
Plant Air (SCFM)	x	No						
Inst Air (SCFM)	x	No						

2. Notes on Utility Stream Contamination

* 4 inch main from Central Plant

3. Electrical Power

Voltage	Freq (Hz)	Check if required	Available Capacity (amps)	Required Capacity (amps)	Plant Value ($/kW)
110	60	x			
220	60	x			
480	60	x			
2400	60				
4160	60				
13800	60				

* Available -7200 volts @ short circuit 120amps

4. Plant Fuel

Fuel Type	
BTUs per ________	

Project Planning and Specification Basis 016583

Operating Philosophy

Project Number: 2379
Project Name: Longhorn A A P

Date: 5/19/95
Revision: C

III.C. Project Operating Philosophy

Mode of Operation	☐ Batch	■ Continuous	☐ Other
Maintenance Philosophy	☐ "On the Fly"	■ Unit Shutdown	☐ Other
Spare Pump Philosophy	☐ Provide Spares	■ No Spares	☐ Other
Flaring Philosophy	■ To Atmosphere	☐ Everything to Flare	☐ Other
Demolition Philosophy	☐ Demo & Remove	☐ Abandon in Place	☐ Other N/A
Insulation Philosophy	☐ Freeze Protection	☐ Electric Tracing	☐ Steam Tracing
Automation Philosophy	☐ Fully Automatic	■ Semi Automatic	☐ Manual
Operating Factor	78%		
Downtime Allowed for Repairs	Yes		
Are Hot Taps Allowable	☐ YES	☐ NO	☐ Sometimes

Operating Labor

	Day	Night	Grave
Supervisory:	x		
Operating:	x	x	x
Maintenance:	x		
Laboratory:	x		
Guard:		x	x

Dow Environmental

Project Planning and Design Basis

016584

Site Conditions

Project Number:	2379	Date:	5/19/95
Project Name:	Longhorn A A P	Revision:	C

III.D. Project Site Conditions

1. Soil Bearing Capacity:	Permanent (DL + Sustained Loads)	2000 lb/sqft	0 ft below grade
	Total Loads (DL + Sustain + Wind/Seismic)	3000 lb/sqft	
2. Wind Velocity/Direction:	Insulation Design Vel.	MPH	
	UBC - Minimum Basis	70 MPH	
	Prevailing Direction	S. @ 8.3 MPH (Yearly Avg.)	
3. Rainfall (Drainage):	Maximum	4 inches/hr	
	Yearly Avg.	47 inches	
4. Relative Humidity:	Maximum	100 %	
	Normal	72 %	
	Minimum	58 %	
5. Ambient Temperature:	Maximum	107 °F (1962)	
	Summer Average:	71 - 92 °F (Low & High)	
	Winter Average:	37 - 58 °F (Low and High)	
	Minimum:	3 °F (1962)	
6. Seismic Zone:	Design	Zone 0 per UBC Code	
7. Site Elevation:	170 - 335	ft AMSL	
8. Plot Size	200 ft x	250 ft	
9. Max Equipment Height :	No limitations	ft above grade	
10. Frost Depth	0	ft	
11. Groundwater Depth	4	ft	
12. 100 Year Flood Plain Elev.	180	ft AMSL	
13. National Weather Bureau	Shreveport 1-318-631-3669		

Attachment A

Table 1
LHAAP 18/24, Burning Ground No. 3
Groundwater Treatment Concentrations to be used in the Planning of
Water Treatment Plant - December 16, 1994
Rev A- 5/19/95

016585

Chemical Constituent	Planned Max Influent Concentration (mg/l)	Planned Max Effluent Concentration (mg/l)	TNRCC Discharge Limits (mg/l) Daily Maximum/Average
A. Volatile Organics			
Methylene Chloride	300	0.005	1.699/.803
Trichloroethylene	40	0.005	0.181/.085
1,1-Dichloroethane	0.005		14.032/6.633
1,1-Dichloroethene	0.055	0.007	0.253/.119
1,2-Dichloroethane	0.035	0.005	0.181/.085
Vinylchloride	0.020	0.002	0.072/.034
Acetone	3.274	2.395	2.395/1.132
Chloroform	0.016	1.000	3.615/1.708
Tetrachloroethene	0.001	0.005	0.181/.0854
Total 1-,2-Dichloroethene	0.941	0.070	-
Ethylbenzene	0.021	0.700	57.025/26.954
Styrene	0.004	0.100	5.987/2.829
Toluene	0.002	1.000	4.189/1.98
Benzene	0.001	0.005	0.181/.085
Total Xylenes	0.001	0.010	0.0836/.0395
Carbon Tetrachloride	0.001	0.005	0.181/.085
1,1,1-Trichloroethane	0.006	0.200	7.23/3.417
1,1,2-Trichloroethane	0.002	0.005	0.2169/.1025
B. Metals:			
Aluminum	4.340	0.700	1.644/.777
Arsenic	0.001	0.001	0.772/.365
Barium	1.126	1.000	2.000/1.000
Cadmium	<0.001	0.001	0.0034/.0016
Calcium	42.281	-	-
Chromium	0.091	0.100	0.752/.355
Cobalt	0.016	5.40	11.495/5.433
Iron	14.057	1.10	2.395/1.132
Lead	0.002	0.002	0.0046/.0022
Magnesium	32.792		-
Manganese	0.644	7.300	15.494/7.323
Nickel	0.063	0.050	0.184/.087
Potassium	0.436	-	-
Selenium	<0.001	0.050	0.012/.0057
Silver	0.001	0.001	0.003/.0014
Sodium	195.311	-	-
Thalium	<0.001	0.002	-
Vanadium	0.009	1.500	3.592/1.698
Zinc	0.146	0.100	0.31/.146
C. Other:			
Chloride	650	See State Requirements	N/A/See Note Below
Nitrate	15	10 (as Nitrogen)	-
Nitrite	2	1 (as Nitrogen)	-
Sulfate	31	See State Requirement	N/A/See Note Below
Alkalinity	200		-
Hardness	400		-
Silica	50		-
TDS	1,750		-
TSS	150		-
Oil and Grease	20	15	15/NA
Chemical Oxygen Demand	200	200	200/NA
S:2379\Process\EGJOBDAT.xls	Page 18 of 18		
Note: In accordance with the Rod			

PERFORMANCE SPECIFICATIONS

PERFORMANCE SPECIFICATIONS

Request for Proposal - Overview

INTRODUCTION

The following Section, entitled "Performance Specification", will be used to prepare bid documents in requesting quotes from vendor furnished engineered process equipment packages. This section will give the vendors a complete overview of the process and how their equipment, specific to their engineered process, will interface with the entire process flow for the Groundwater Treatment Plant. Bids for vendor engineered process equipment packages will be requested for the following unit operations.

- Pretreatment
- Air Stripping
- Catalytic Oxidation & Quenching

The vendors selected for the bidding process will be pre-approved and bid only on their specific engineered process. After the bids have been received, DEI will prepare technical evaluations of each vendor's bid. This technical evaluation along with DEI's recommendations will be forwarded for USACE approval. Once approved, purchase orders, one for each unit operation will be issued by DEI. Vendor furnished P&IDs will be requested for submittal to DEI four weeks after receipt of purchase order by vendor.

Once the vendor furnished P&IDs are received by DEI, they will be incorporated into the overall project PI&Ds that are being prepared by DEI. DEI will also prepare the P&IDs for the Well Field and the Solids Concentration & Conditioning unit operations. The individual equipment components for the Well Field and Solids Concentration & Conditioning unit operations will be planned and bid separately by DEI.

Completion of the overall project P&IDs will conclude the workplans and specification for this portion of the project. The next phase of the project will begin the execution phase.

016588

Introduction:

The Groundwater Remediation Processing for Burning Ground No.3 at LHAAP will consist of five (5) operable units:

- Extraction wells/Interceptor Collection Trenches (Well Field)
- Pretreatment
- Solids Concentration & Conditioning
- Air Stripping, and
- Catalytic Oxidation & Quenching

The burner management system for the Catalytic Oxidizer will require fairly sophisticated control logic and will be equipped with a Programmable Logic Control (PLC). Other unit operations may not require this sophistication and will be automated sufficiently to run unattended using control devices and interlocks.

To provide the integration necessary for proper process management, a stand-alone master PLC will be used for:

- controlling the Extraction Well/Interceptor Collection Trench pumps (Well Field)
- controlling the influent water feed pump for the Pretreatment Unit
- controlling the Pretreatment Unit (may have own PLC with interface)
- controlling Solids Concentration & Conditioning
- controlling the feed pump and flow to the Air Stripper, and
- controlling the effluent water discharge from the site

Some of the operating units will be furnished as a module. Each module will be equipped with a control panel and motor starter enclosure. The motor starters will be mounted in a separate enclosure from the instrumentation. The control panel will contain a transformer, run indication lights, alarm condition lights, and in those so supplied, the PLC. The enclosures will be "rain tight" (NEMA 4X) boxes. The control panel will be equipped with relays. These contacts will be wired, once the unit has been installed, to the central control PLC that will indicate the status of each module, as to whether it is operating, in alarm or off. Each operating unit will contain sufficient monitors and/or logic to monitor the operating parameters and determine when these conditions occur. At such an action, the relay will de-energize indicating that there is a problem within the unit. The central PLC controller will provide the logic for the proper action required for that specific set of circumstances. In general, the action taken by the central PLC will be to terminate water flow to the Pretreatment Unit and the Air Stripper

016589

Unit. The central PLC will maintain the total throughput of well water from the Equalization tank to the outfall and position the recycle/discharge block valves located on the Effluent tank pump discharge line.

General Vessel Requirements

- All vessels will be covered and will be required to operate under less than 5 inches of water back pressure. The vent piping from each vessel (by others) will be connected in common to the vent recovery system which supplies air to the Catalytic Oxidizer Unit. The vapor inlet supply pressure will be maintained at 1 inch of water.
- The steel vessels will be required to be coated for abrasion and exposure to the chemicals being utilized in the vessels unless non-ferrous units are offered. Vendors standard coating procedures are to be used for coatings in the bid and may be used upon prior approval from DEI, depending upon the deviation from USCAE requirements.
- The vessels are to be primed and coated with Vendor's standard coatings - color to be supplied by DEI following USACE approval
- The modules will be designed to withstand 80 MPH winds and Seismic Zone 1 structural requirements.
- Module structural steel, platforms & ladders are to be hot dipped galvanized

General Mechanical Requirements

- All mixers to be Lightnin' or equivalent
- Slurry or Sludge pumps may be pneumatic driven Wilden, double diaphragm or equivalent
- Metering pumps to be Milton Roy or equivalent with 4 - 20 ma electronic stroke positioners
- Centrifugal pumps to be Goulds or equivalent

General Electrical Requirements

- Electrical classification - non-classified
- 3 phase, 480 volt A.C., unless otherwise specified
- Main fused disconnects/circuit breaker required for each Module
- field junction box (weather tight)
- local START/STOP switches or HAND-OFF-AUTO switches where applicable
- alarm indicators where appropriate with ACKNOWLEDGE and RESET button

016590

- Electrical components to UL listed.

General Instrumentation Requirements

- Vendor's standard transmitters and/or controllers, pH probes and level switches
- Control Components to be Factory Mutual (FM) and Canadian Standards Association (CSA)
- PLC to be Allen-Bradley

016591

Introduction

The well field will consist of a number of wells located at strategic spots over the site in order to extract the contaminated water from the aquifer. To accomplish this task, well pumps are required. These pumps will be supplied power from a local disconnect where power may be isolated from the pump motor in the event that the pump or the well piping requires maintenance or replacement. The pump motor will be equipped with a manual **HAND-OFF-AUTO** switch located at each well that will enable the well pump motor to be started and stopped locally, or from the control room when the switch is placed in the **AUTO** position and the well has been selected from the operator console and all appropriate constraints are satisfied.

The well discharge piping will have an indicating flow transmitter and flow control valve communicating to the central PLC. In addition, each well water depth will be measured and will automatically shut down any pump if the well draw-down becomes greater than the aquifer can replenish so that the pump is not operated without sufficient water for cooling.

The discharge from each well will be collected in one or more headers piped into the Ground Water Treatment Plant (GWTP) Equalization tank. The header system(s) will be designed for collection of each well as it enters the collection pipe and sized for the maximum flow of all the connected wells to that point. The piping size will allow the maximum flow of water from all wells without creating interference to flow due to excessive pressure drop or fluid velocities and transfer the water into the equalization tank.

The Equalization tank will be equipped with an electronic differential pressure (D/P) transmitter which will indicate the tank water level and transmit the input to the operator console located in the control room. In addition, the tank will be equipped with a High-High Level switch. This switch will be interlocked via the central PLC into the well motor starter circuit that will automatically shut off the well pumps operating if the level in the tank reaches 98%. In normal operation, the Programmable Logic Controller (PLC) will automatically shut off the well pumps at a preset level of 97%. Once the level has decreased below 75%, the pumps will automatically be restarted by the PLC.

016592

Specific Vessel Requirements

- Equalization tank will be 300,000 gallon lined, carbon steel field erected tank for a maximum hold-up of sixteen (16) hours

Specific Mechanical Requirements

- Vertical well pumps are to be Grundfos Environmental type submersible, stainless steel construction or equivalent
- Horizontal well pumps are to be Goulds or equal

Specific Electrical Requirements

- Well pump motors are 1 phase, 208/230 volt AC

Specific Instrumentation Requirements

- Warrick water level sensors or approved equivalent

OPERATIONS

Operator Action

It will be the responsibility of the operating personnel to line up the well piping manual block valves, set the local disconnect switch to the **ON** position and place the hand start-stop switch in the **AUTO** position. It will also be necessary that the main disconnect for the well pump starter be turned **ON**. Since the influent water header will be piped into the equalization tank, the inlet block valve into the tank must be opened. Once the well field piping block valves and pump motor switches have been properly positioned, the operator may return to the control center to place the well field in operation.

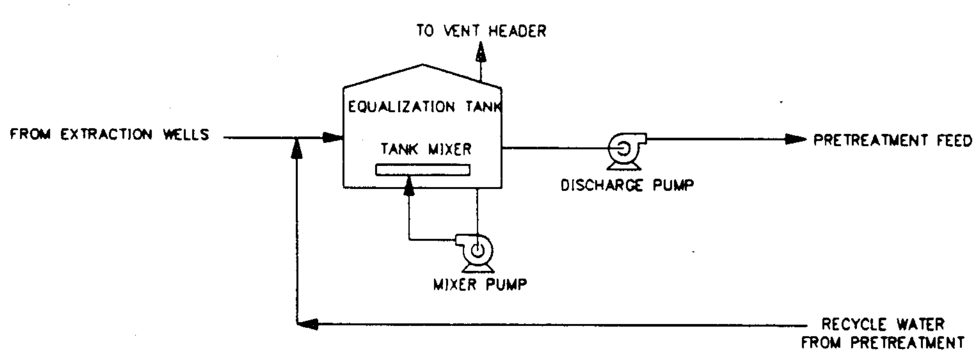
The operator console, consisting of a computer, CRT and keyboard, will be located in the control center where the operator will be able to select the wells that will be turned **ON** when the well field start up is requested by the operator. The well pumps that are selected at this time will remain the selected ones until the operator "de-selects" a pump. With wells selected and the operator confident that all valves and switches are in their proper position, the operator will be able to request the wells to start operation. If the well water level is sufficient, each well pump selected will **START** and the water will begin flowing into the Equalization tank. Once the operator has the plant effluent water to the discharge quality required, he will be required to set the flowrate through the plant at a volume derived by the flowrate of the river. This may require more than the preset 150 GPM amount or it may be less.

016593

PLC Action

Once the PLC power supply has been turned on and the operator console is on-line, any alarms that have been enabled and alarm conditions existing in the well field or Equalization tank will be indicated on the console CRT. Any alarm condition that has been programmed to shut the well field down will not permit the operation to begin until that condition has been eliminated. For example, if the Equalization tank Low-low level switch/alarm is activated, the PLC will prevent the Equalization tank discharge pump motor starter from turning **ON**. If the Equalization tank level is adequate so the Low level alarm point is not activated, the feed pump will turn **ON** when the operator request the pump. Water will begin to flow to the Pretreatment Unit at a preset flow rate of 150 GPM. This rate is selected to provide ample time for the operator to check the **HAND-OFF-AUTO** hand switches in the Pretreatment Unit module to assure they are in the **AUTO** position.

The Equalization tank level will be monitored by the central PLC and will shut **OFF** the discharge pump if the Low level alarm is activated, which occurs if the tank level drops to 7%. In addition, the tank will be equipped with a Low-Low Level Switch that will be Interlocked via the central PLC into the Equalization tank discharge pump starter circuit that will shut off the pump at 4% to prevent operating the pump without sufficient water supply. The central PLC will also warn the operator of any level condition, high or low, that is necessary to give ample time for the operator to address the problem creating the alarm. The Equalization tank piping arrangement is shown below. The tank will be equipped with an internal mixer to prevent the extracted groundwater from partitioning or stratifying within the tank as well as providing a means of keeping any precipitation that may be present from dropping out in the vessel



EQUALIZATION TANK DIAGRAM

016594

Introduction

Treatment of the extracted water is necessary to remove certain dissolved heavy metals that may exceed the discharge concentrations allowed. Table 1 includes the inorganic constituents that will set the design criteria for the Pretreatment Unit. These metals are removed by conventional alkaline precipitation, chemical adsorption, followed by flocculation and filtration. All these unit operations are to be assembled and delivered, as much as is practical, in a single module. A maximum well flow rate of 300 GPM with a normal average flow rate of 150 GPM of contaminated water should be used for design. A minimum flowrate of 50 GPM is required from the Well Field. *TABLE 1* is provided for the design and performance basis of the Pretreatment Unit .

TABLE 1

Inorganic Constituent	Planned Max. Influent Concentration (mg/l)	Design Max. Effluent Concentration (mg/l)
Aluminum	4.34	0.700
Arsenic	0.001	0.001
Barium	1.126	1.000
Cadmium	<0.001	0.001
Calcium	42.281	-
Chromium	0.091	0.100
Cobalt	0.016	5.40
Iron	14.057	1.10
Lead	0.002	0.002
Magnesium	32.792	-
Manganese	0.644	7.300
Nickel	0.063	0.050
Potassium	0.436	-
Selenium	<0.001	0.050
Silver	0.001	0.001
Sodium	195.311	-
Thallium	<0.001	0.002
Vanadium	0.009	1.500
Zinc	0.146	0.100
Total solids	30.0	-
Temperature, °F	45 - 65	

The preferred flowpath through the Oxidation-Reduction Potential (ORP) tank, Caustic Adjustment tank, Inclined Plate Separator (IPS) and Sand filter is to be by gravity where the Equalization tank discharge pump will lift the water into the ORP vessel and then have the water overflow from one vessel to another until the water from the Sand filter overflows into the Overflow/Stripper Feed Tank. If the equipment proposed does not lend itself to this type of arrangement and is to be located at the same level, an additional pump will be required to pump the water from the IPS through the Sand filter where it will overflow into the Overflow/Stripper Feed Tank. In that case, a High-high level and Low-low level switch will be required on the Overflow/Stripper Feed Tank in order to protect the discharge pump. An additional **HAND-OFF-AUTO** selection switch will be required on the local control panel. The tank will also require level connections for a level controller and level valve on the pump discharge to maintain constant flow from the IPS to the Air Stripper Unit module.

Each of the reaction vessels is to be equipped with a normal level measurement switch to be used for control of the operation of mixers installed on the vessels. The addition of magnesium hydroxide (60% wt.) solution and polymer is to be controlled based upon a constant unit ratio between the chemical feed addition rate and the total well water flowing through the vessel.

UNIT RATIOS FOR CHEMICAL ADDITION

Chemical	Unit Ratio Lbs/Lb Feed
$MgOH_2$	0.0003
Polymer	0.0030

Caustic (30% wt.) addition will be based upon pH and will require the use of pH probes in the vessel to maintain the pH between 10 and 10.5. The polymer is supplied from a tote bin connected to a metering pumps. The caustic and magnesium hydroxide will be supplied from bulk storage tanks through a metering pump. The mixers on the reaction vessels will be automatically started and stopped depending upon the vessel water level. Likewise, the chemical feed pumps will not activate until a normal level has been verified in the Overflow/Stripper Feed Tank indicating that a water level exists in the equipment.

An alternate arrangement using pressurized feed through static in-line mixers for chemical addition will also be acceptable if considered equally as effective as the series of tanks. In this case, the IPS may be elevated sufficiently such that the IPS

016596

overflow will have sufficient elevation to flow through the Sand filter and overflow to the Overflow/Stripper Feed Tank.

DESIGN PARAMETERS - IPS

	Design Criteria
Inlet solids, mg/l	1,000
Polymer dosage, gpm	1.0
Removal efficiency, %	95

The solids transfer pump located on the Inclined Plate Separator (IPS) vessel will transfer the sludge from the IPS to the Thickening tanks. The Sludge Thickening tanks, however, will be operated in a batch mode. The IPS vessel is pumped to one Sludge Thickening tank and then to the other. The Thickening tanks will be equipped with a level switch that will indicate to the controller it is ready to switch sludge addition from one thickening tank to the other thickening tank from the IPS vessel. The transfer of sludge to the thickening tanks will be continuous.

DESIGN PARAMETERS - Sludge Surge Tank

	Design Criteria
Filling rate, gpm	15
Residence time, hrs	8
Fill volume, gallons	7,200
Discharge rate, gpm	60
Transfer time, hrs	2
Total vessel volume, gal.	10,000

After the sludge has been held for approximately four(4) hours in the Thickener tank, the thickened sludge is pumped out of the Thickener to the Devolatilizer. Air sparging is used in the Devolatilizer to strip the VOCs from the sludge. The devolatilized solids are pumped to the Gravity Filter Drying Bed where further dewatering takes place. The aqueous effluents from the Sludge Thickener and Gravity Filter Drying Beds are recycled back to the Equalization tank.

016597

DESIGN PARAMETERS - Sludge Thickener Tank

	Design Criteria
Filling rate, gpm	60
Residence time, hrs	4
Fill volume, gallons	7,200
Discharge rate, gpm	60
Transfer time, hrs	2
Total vessel volume, gal.	10,000

DESIGN PARAMETERS - Sludge Devolatilizer Tank

	Design Criteria
Filling rate, gpm	60
Residence time, hrs	4
Fill volume, gallons	7,200
Total vessel volume, gal.	10,000
Air sparge rate, CFM	150
Discharge rate, gpm	60

If a malfunction occurs in the Pretreatment Unit equipment, such as the pH of the feed cannot be maintained at the proper setpoint, a mixer or pump fails, an alarm will appear on the operator's console in the control room. This alarm will give the operator a preset time to correct the alarm. During this time the Pretreatment Unit will continue to operate the mixers and chemical feed pumps, if not out of order, to maintain as much of the process as possible during that time. The transfer pump from the Overflow/Stripper Feed tank will also continue to operate feeding the Air Stripper Unit. If the operator is not available or cannot eliminate the condition creating the alarm during the preset time-out programmed, then the central PLC will turn off the Equalization tank discharge pump which discontinues the flow through the Pretreatment Unit. If the influent to the Overflow/Stripper Feed tank has been terminated due to a malfunction in the Pretreatment Unit, the Overflow/Stripper Feed tank will go to recycle from the

016598

Air Stripper, but turn off the Air Stripper Feed Pump when the level drops to 6%.

The gravity sand filter will operate under atmospheric pressure. The filtered water from the filter will be collected in the Overflow/Stripper Feed tank which is the feed water for the Air Stripper Unit. The continuous backwash reject will recycle back to the IPS feed. A pneumatic driven, double diaphragm pump will be required to pump the reject from the filter.

DESIGN PARAMETERS - FILTER

Gravity Sand Filter	Design Criteria
Inlet solids, mg/l	100
Expected particle diameter, μ	<100
Gas lift fluid	air
Removal efficiency, %	>75

The Thickener tanks will hold the solids for four(4) hours in order to increase the settled solids concentration. Polymer may be added if necessary to aid in the thickening process. The Thickener tanks will be equipped with several clear water manual discharge valves spaced approximately 12 inches apart. The valves will be piped to a common discharge line equipped with an automatic block valve that will discharge the water to the sump. The lowest clear water connection will be determined during initial start-up of the Thickener. Once the level has been determined the manual valve will be fixed **OPEN**. After the sludge has been held for the alloted time, the clear aqueous automatic discharge valve will **OPEN**, automatically dumping the separated water into the sump. This valve will operate on a timer so that when the valve is shut, the sludge transfer pump will **START** and the sludge will be transferred into the Devolatilization tank by a pneumatic driven, double diaphragm pump. The transfer will terminated by the Low Level Switch or a preset transfer time, either will turn off the air supply to the pump.

When the Thickener transfer pump reaches the Low Level Switch or times out, the air blower on the Devolatilizer tank will turn **ON**. The tank vapor discharge line is connected into the Catalytic Oxidizer Unit vapor feed line where the air contaminated with hydrocarbons transferred from the sludge will be destroyed. The Devolatilizer will operate on the same timed cycle as the Thickener. Therefore, as a charge of material from the IPS vessel is being transferred into the

Thickener tank, the Devolatilizer transfer pump will pump out the sludge to the Gravity Filter Drying Bed.

The Gravity Filter Drying Bed will be constructed with a dewatering collection system connected to a common sump which will collect water as the sludge continues to dewater. The sump will be level controlled using a sump level switch and a pneumatic driven, double diaphragm pump. High and Low level switches will turn the air supplying the pump **ON** and **OFF**. The water collected in the sump will be transferred back to the Equalization tank. When solids build sufficiently on the filter drying bed, they will be collected and stored in a roll-off boxes for proper disposal.

Specific Vessel Requirements

- Surge tank, Sludge thickening tank and Devolatilizer tank will be fabricated from carbon steel with 60° cone bottoms
- Devolatilization tank will be equipped with an internal air sparge ring

Specific Mechanical Requirements

- A roots type electric blower to produce 150 CFM air flow through the sparge ring of the Devolatilization tank

Specific Electrical Requirements

- None - see General Requirements

Specific Instrumentation Requirements

- None - see General Requirements

OPERATIONS

Operator Action

The operator functions are very similar to those activities described in the Well Field Operation. The operator must be sure the manual block valves are aligned for each of the unit operations that make up the Pretreatment Unit. He must place the **HAND-OFF-AUTO** switch in the **AUTO** position on the chemical feed pumps, mixers and forwarding pump. Power to the Pretreatment Unit will also be required from the MCC supplying the Unit control panel and the Unit control panel power switch must be turned **ON**.. Once the operator has determined the Unit is ready to place in service, he may request the Equalization tank feed pump be turned **ON** which is the influent supply to the Pretreatment Unit. When a malfunction occurs with the Pretreatment Unit, the operator will have an alarm in the central PLC.. The operator may acknowledge the existing alarms but they will not automatically reset until the condition has been eliminated.

016600

PLC Action

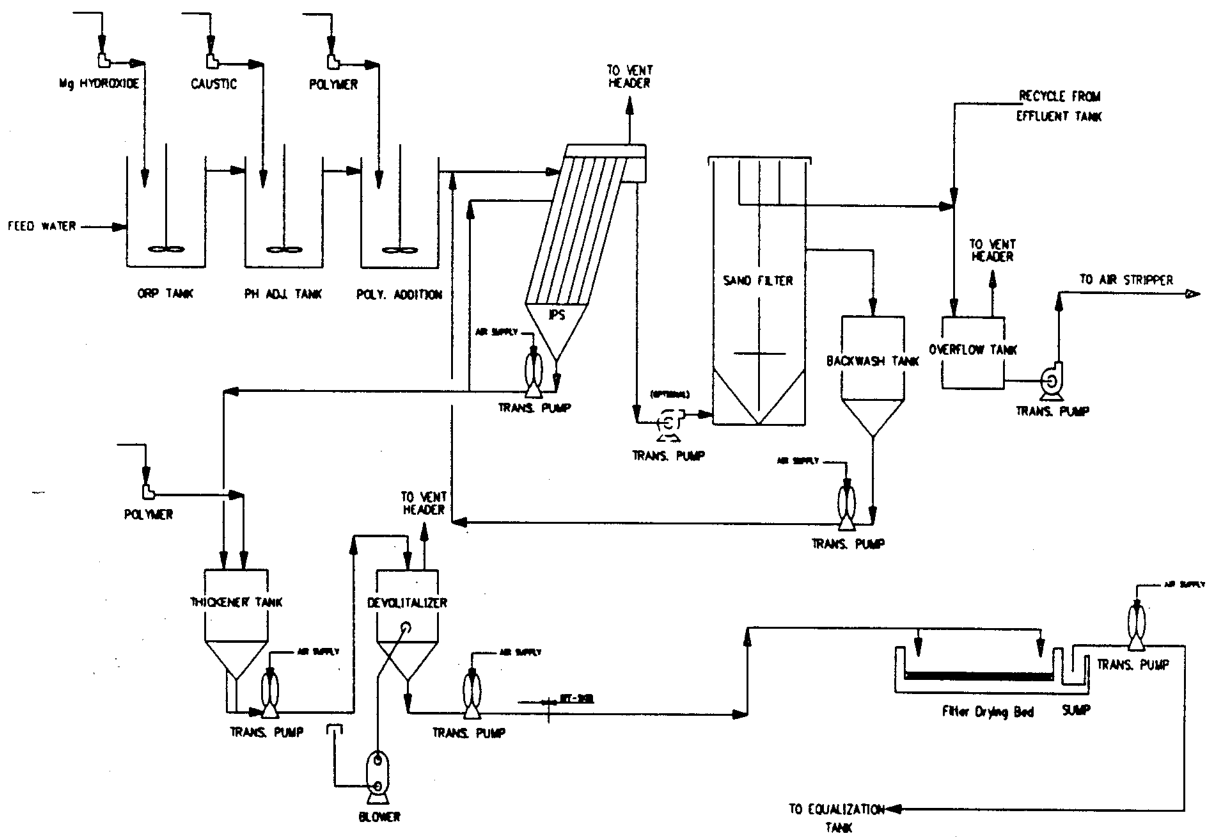
As stated previously, if no alarms from the Pretreatment Unit are detected by the central PLC when the operator request the Equalization discharge pump to turn **ON**, the pump will start and flow to the Pretreatment will begin. If the pump does not start upon entering a request to do so, then the operator will see an alarm indicating one or more reasons why the pump did not start:

- Equalization tank level low
- Equalization tank discharge pump switch not in position, no power to the pump or the pump is damaged
- Pretreatment Unit alarm

The central PLC monitors the status of the Equalization tank discharge pump, Pretreatment Unit and Overflow/Stripper Feed tank.. As long as no alarms from the Pretreatment Unit is detected by the central PLC and the Equalization tank levels are between the alarm range, the Pretreatment Unit and Air Stripper Unit operation will continue uninterrupted. If the Pretreatment Unit alarms, the central PLC will indicate an alarm, but will not proceed with any further action unless a preset alarm time out is reached, at which time the central PLC will turn **OFF** the Equalization tank discharge pump. Since the solids treatment process is locally controlled by level devices, no interaction from the central PLC is necessary. The central PLC will receive a High-high level alarm from the filter drying bed sump indicating a malfunction with the water transfer to the Equalization tank and alarm "Filter Drying Bed Sump Malfunction".

The Pretreatment flowsheet is provided to better visualize the various unit operations necessary to precipitate, flocculate, settle and clarify the aqueous stream and collect and manage the solids removed from the well water in pretreatment.

016601



PRETREATMENT UNIT MODULE DIAGRAM

Introduction

The air stripper utilizes a counter-current equilibrium process to extract the volatile contaminants remaining in the water by transferring them to the stripping air. The contaminated water line enters at the top of the tower containing an amount of "transfer packing" that provides the proper environment for the transfer to take place. The water flows from the top to the bottom of the stripping tower by gravity and collects in the reservoir provided at the bottom. The reservoir is equipped with a level measurement device that will maintain the level at a constant position by opening and closing the level discharge valve located on the discharge line after the discharge pump. In addition, an air supply line is installed below the tower packing bed support plate. This inlet is provided for the stripping air which flows upward through the tower. The air flow is furnished by a blower that supplies the pressure necessary to deliver the vent to the Catalytic Oxidizer Unit. The Air Stripper Unit status will be monitored by the central PLC.

Maximum flow rate to the Air Stripper Unit will be 315 GPM with 150 GPM considered its normal feed rate. Water delivered from the Pretreatment Unit will require additional chemical treatment to prevent scaling in the Air Stripper Unit. Hydrochloric acid, expected to be generated insitu, will be added to the Overflow/Stripper Feed tank on a continuous basis to convert the less soluble calcium carbonate, to calcium chloride, a more soluble salt. The process is equipped with an additional caustic metering pump, mixer and pH measurement to neutralize the acidic water before it goes in the Effluent tank. As the air removes the VOCs it will also remove CO_2 from the water, resulting in an increase in the pH of the effluent from the Air Stripper Unit. A recycle line from the Effluent tank discharge pump to the Overflow tank will be installed as a precaution. **TABLE 2** provides the basis for design of the tower packed height. The required discharge pressure from the stripper will be 1 inch of water positive pressure. An air flow rate to the Air Stripper Unit will be maintained by the blower at 4,500 ACFM at 80°F and sufficient pressure to exit the tower at a slight positive pressure.

016603

TABLE 2

Volatile Constituent	Planned Max. Influent Concentration (mg/l)	Design Max. Effluent Concentration (mg/l)
Methylene chloride	300	0.005
Trichloroethylene	40	0.005

The stripper tower reservoir is equipped with level switches that prevent the tower level from exceeding a maximum and minimum level, therefore, the Air Stripping Unit discharge pump will not operate if the reservoir is below the normal operating level. When the pump **HAND-OFF-AUTO** switch is in **AUTO**, the reservoir level will determine when the pump operates. In the case of a High-High level in the air stripper reservoir, the contact relay will drop out and the central PLC will turn **OFF** the Overflow/Stripper Feed tank discharge pump which feeds the Air Stripper Unit. The components that comprise the Air Stripper Unit are shown at the end of this section.

Specific Vessel Requirements

- The vessel will be free standing and supported entirely by anchoring in a concrete base. No guy wires will be allowed.
- The vessel will be fabricated from FRP with ultraviolet inhibitors
- The vessel sump will contain an inspection port and drain
- The vessel will contain random dumped polypropylene packing not to exceed 25 feet per packed section
- Packing will be supported using FRP support plate
- The water distribution system shall be constructed of PVC or FRP tray type. Redistributors will be required between packed sections
- Tower must be provided with manways for tower access to distributor and redistributors. Manways must also be provided to dump packing from each section.
- Tower will be hydrostatically tested by filling the tower full of water and inspecting for leaks after standing for 1 hour.
- Tower will require a platform at the top of the tower and at each access port. Ladders must be provided between platforms

Specific Mechanical Requirements

- Blower to be belt driven, with OSHA guard and appropriate inlet box and noise control to meet 85 dbl at 3'-0" from the unit

Specific Electrical Requirements

- See General Electrical Requirements, Page 2

Specific Instrumentation Requirements

- Tower differential pressure instrument
- Effluent water temperature gage
- Emergency shutdown controls

OPERATIONS

Operator Action

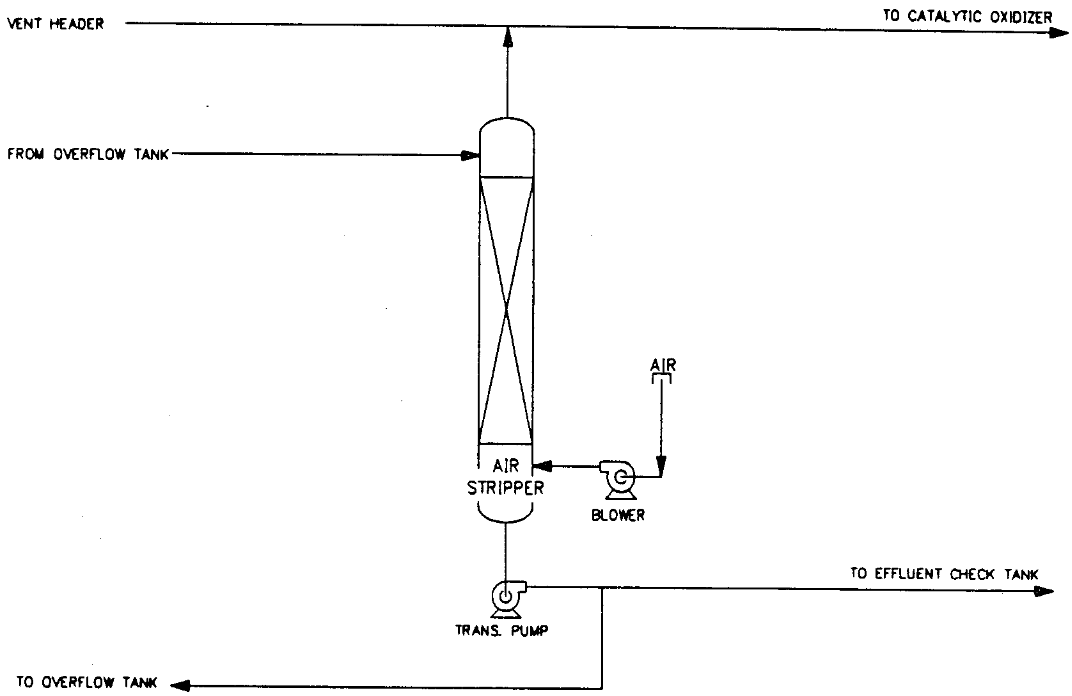
The operator will be required to properly align the block valves on the OverflowStripper Feed tank, Air Stripper Tower and Air Stripper Tower Discharge Pump. The Air Stripper Tower will start up in recycle to the Overflow/Stripper Feed tank. Once the water has been recycled for a preset time, field testing will determine time of recycle, the central PLC will reverse the control valve positions on the reservoir pump discharge line so that the recycle valve is **CLOSED** and the Effluent tank inlet valve is **OPEN**..

Power to the Air Stripper Unit must be available from the MCC breaker which supplies the necessary power to the local control panel of the Unit. The blower **HAND-OFF-AUTO** switch and the reservoir pump hand switch must be placed in the **AUTO** position. When the blower motor turns **ON**, the motor relay contact will be detected by the central PLC which will indicate the blower is operating. To prevent the addition of feed to the Air Stripper Unit prematurely, the Overflow/Stripper Feed tank feed pump will not be able to turn **ON** until the relay contact from the Catalytic Oxidation Unit has been detected. In fact, neither the blower nor the water feed pump to the Air Stripper Unit will be allowed to turn **ON** until the relay contact from the Catalytic Oxidizer Unit has been detected by the central PLC.

A loss of the motor relay contact of the blower or discharge pump by the central PLC will alarm and turn **OFF** the feed pump from the Overflow/Stripper Feed tank. If the Air Stripper Unit alarms, it will be necessary for the operator to determinel what caused the malfunction. The operator will be required to acknowledge the alarm condition but cannot reset the status until the cause of the alarm has been eliminated.

PLC Action

The central PLC will receive all inputs from the Air Stripper Unit and administer the control of all equipment, flows, levels, pH and alarms.



AIR STRIPPER UNIT DIAGRAM

016606

Introduction

The oxidizer is used to destroy the contaminants removed in the air stripper by the combustion process. It is also used to prevent the discharge of fugitive emissions from all of the operating vessel within the plant. All the vessels containing contaminated water in the entire facility will be vented through a common vent header to the Catalytic Oxidizer. The unit will require natural gas and air to produce sufficient heat for the effective removal of the contaminants over a catalyst. The use of catalyst greatly enhances the economics of operating the destructive device since the unit will operate at about one-half the temperature of conventional thermal oxidizers. Another added benefit to the catalytic oxidation process is the reduced quantities of NOx and carbon monoxide produced in the combustion process. The products of combustion are CO_2, H_2O and HCl. The HCl is dissolved in water during the quenching of the hot combustion gas. The result is an increase in the acidity of the quench water. To maintain the proper concentration of the quench water, a side stream is pumped from the scrubber reservoir to the Overflow/Stripper Feed tank and potable water is added into the Scrubber

The oxidizer/scrubber and catalyst will be purchased under two separate purchase orders and from different companies; however, assembly into the finished module will be done by the oxidizer supplier.

DESIGN PARAMETER - Catox Unit

Parameter	
Maximum air temperature, °F	68
Air Flow, CFM @ .5" w.c. press.	4,650*
Relative Humidity, %	100
Maximum RCl content, lbs/hr	51.15
Destruction Efficiency (Across Catox Unit) %	99.99
HCl Removal Efficiency (Across Scrubber) %	99.9

* Does not include burner combustion air

016607

VAPOR COMPOSITION**

Contaminant	Load (lbs/hr)
Methylene Chloride	44.86
Trichloroethylene	5.97
Balance Components	0.32*
Density, lbs/ft^3	0.0821

* Refer to Listing of Components below:

** **Increase** all contaminant loadings by **25%** for design of equipment and catalyst. Example: 44.86 lbs/hr x 1.25 = 56.075 lbs/hr

016608

Listing of Components

Contaminant	Load (lb/Hr)
Methylene Chloride	44.86
Trichloroethelene	5.9711
1,1 Dichloroethane	0.007
1,1 Dichloroethylene	0.0081
1,2 Dichloroethane	0.0052
Vinyl Chloride	0.0030
Acetone	0.1016
Chloroform	0.0023
Tetrachloroethelene	0.0002
1-ci2 Dichloroethylene	0.0696
1-tr2 Dichloroethylene	0.0555
Carbon Dioxide	0.0424
Hydrogen Chloride	0.0687
Chlorine (as Cl ion)	0.0022
Water	282.5664
Nitrogen	16,355.8929
Oxygen	4,966.2693
Total (gas density = 0.0821 lb/ft^3)	21,655.9236

016609

* CATALYST

Parameter	
Matrix	To be provided by Catalyst Vendor
Blocks size	23¼" W x 22¼"H x 4 3/8"D
Removable modules	yes
Module arrangement	To be provided by Catalyst Vendor
Module seal	Track mounted that seals front face against gas leakage

Specific Vessel/Module Requirements

- Module height not to exceed 12'-6"
- Scrubber tower and components to be constructed of FRP
- Tower to contain sufficient height of packing to capture required HCl removal efficiency

Specific Mechanical Requirements

- Combustion burners are to be of MAXON® Low NOx design or equal
- Contaminated gas stream never directly contacts the flame of the pre-heat burner
- Burner fuel to be natural gas
- The gas train shall be fabricated to FM/IRI specifications

Specific Electrical Requirements

- None

Specific Instrumentation Requirements

- Burner Management System to include: start-up, burner and flame safety supervision, temperature control of inlet and outlet and system shut-down control.
- Scrubber control and operation to be integrated with oxidizer operation

Other Specific Requirements

- A general plot plan shown in Plan and Elevation view are to be submitted with bid

016610

- Scrubber mass & energy balance is required as part of the bid

OPERATIONS

Operator Action

The operator must align all manual block valves around the quench drum and scrubber unit and any manual blocks on the oxidizer vapor lines to and from the Unit. The main fuel and pilot gas block valves must be opened to the oxidizer as well. Manual reset button may also be required, however, unless power has been turned **ON** the Unit, the switches will not activate. Any resets are usually done just prior to pushing the **START** button in the control panel. The local control panel will contain the usual operating lights for the blower and quench water pump. It will also contain the burner management PLC. The panel will contain a main panel breaker which must be **ON** and the quench pump hand switch and the blower **HAND-OFF-AUTO** switch must be placed in the **AUTO** position. The operation of the Catalytic Oxidizer Unit is independent of the rest of the Groundwater Treatment and may be started at any time prior to requesting the Equalization tank discharge pump to turn **ON**. Therefore, once the Equalization tank begins to obtain a level of water from the extraction wells, the operator will likely turn the Oxidizer **ON** by pushing the **START** or **ON** button in the control panel of the Unit.

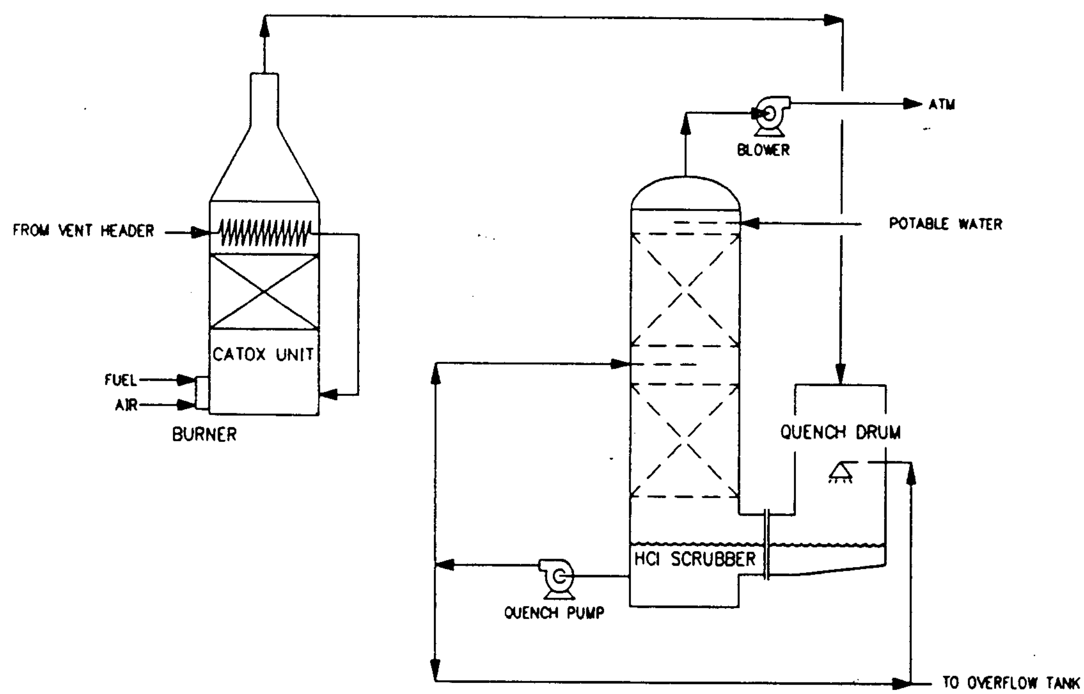
PLC Action

The Catalytic Oxidizer Unit PLC will **START** the quench water circulation pump from the scrubber reservoir and the combustion air blower to begin the purge time-out cycle through the combustion chamber and quench scrubber via the air makeup/purge valve located on the vapor inlet connection to the oxidizer. When the purge is complete and the quench recirculation water has been verified, the pilot ignition/prove cycle will begin and time out. When the pilot ignition cycle times out, the main fuel gas burner ignition/prove cycle will initiate and time out. If all cycles are proven by the burner management logic the fuel valve to the pilot will shut off and the main fuel valve will be controlled by the Unit PLC to bring the catalyst to the proper control temperature. At the same time, the fuel/air ratio will be controlled by modulating the purge air valve to maintain proper combustion. When the catalyst temperature has been reached for a set period of time, the relay contact supplied will close and the central PLC will detect the signal which indicates the Catalytic Oxidizer Unit to be operating. Once this relay has been detected by the central PLC, the Air Stripper Unit blower will receive the permissive to turn **ON**. At the same time the Blower turns **ON** to the Air Stripper Unit, the air purge valve on the Oxidizer inlet vapor line will begin to **CLOSE**. The air make up valve will modulate as required to maintain the

016611

catalyst temperature setpoint. If the oxidizer experiences a malfunction, the Unit PLC will respond to bring the equipment to a safe condition. If the Unit is affected in such a manner as to open the relay contact to the central PLC, the central PLC will immediately shutoff the power to the Overflow/Stripper Feed tank feed pump, the Air Stripper Unit blower, the reservoir discharge pump and the Effluent tank discharge pump. The central PLC will alarm "Catalytic Oxidizer Unit Malfunction".

The following diagram of the Catalytic Oxidizer Unit and vent scrubber shows the interconnections between the two unit operations.



CATALYTIC OXIDIZER & ACID SCRUBBER

016612

Introduction

The products of combustion from the oxidizer contain HCl which will dissolve in the water of the quench drum and the vent scrubber. A side stream of the quench water must be removed to maintain a fairly dilute concentration of hydrochloric acid, otherwise the scrubber would vent acid vapors. By maintaining a dilute concentration in the loop, the vapor pressure of HCl remains low enough to capture 99.9% of the HCl in the combustion products.

Since there is a net gain of water in the process, not all of the acid produced can be utilized in the process, therefore, before water is rejected from the Air Stripper Unit into the Effluent tank, it is neutralized with caustic An in-line static mixer is used to intimately mix the acidic water and caustic streams. The product of neutralization of the two streams is water and sodium chloride. If the quality of water does not meet with the discharge criteria, it can be rerun back through the stripper tower by transferring the water back to the Overflow/Stripper Feed tank from the Effluent tank discharge pump, which feeds the Air Stripper Unit. The Effluent tank will be equipped with level connections and a transmitter that will be monitored by the central PLC. Alarms will warn the operator if the level becomes greater than 80% or less than 15%. An independent Low-low switch will also be installed in the tank to turn **OFF** the Effluent tank discharge pump if the level reaches 5% in the tank. Under normal conditions, the central PLC will control the operation of the pump through the software control logic.

Since 30% caustic is used in the plant to adjust the pH of the water, a dependable source of supply is required. The plant will be supplied with a bulk storage tank and two metering pumps. One pump will be used for acid neutralization and the other for pretreatment pH adjustment. The vessel will be equipped with level connections and a transmitter that will be monitored by the central PLC. Alarms will warn the operator if the level becomes greater than 80% or less than 7%. The high level alarm will indicate the tank is being overfilled by the tank truck supplying the caustic and an automated block valve will be **CLOSED** by the central PLC monitoring the tank. On the other hand if the tank reaches its low level and nothing is done to replenish the level, the tank may continue to empty at which time the caustic feed will stop to the Pretreatment Unit and the Acid neutralization line and the pH of the water will move out of the operating range set by the control logic of the Pretreatment Unit or the central PLC operation of the neutralization. When that occurs, the Pretreatment Unit will go into an alarm state, the central PLC will detect the alarm and the Pretreament Unit will shut down or the central PLC will detect a low pH of the water from the neutralization mixer and alarm the condition.

016613

If the amount of acid generated by the Catalytic Oxidizer is not sufficient neutralize the feed water to the Air Sstripper, a supplemental acid tank and pump, TK-380 and P-380, will be used for this purpose.

Specific Vessel Requirements

- HCl tank to be, crosslinked polyethylene, 10,000 gallons capacity
- Effluent tank to be carbon steel, lined API type, 20,000 gallon capacity
- Static mixers to be PVC lined pipe with PVC elements and sparger
- Caustic tank to be crosslinked polyethylene, 12,000 gallon capacity

Specific Mechanical Requirements

- None - See General Specifications

Specific Electrical Requirements

- None - See General Specifications

Specific Instrumentation Requirements

- Level connections on HCl tank are to be sealed, capillary type
- Level connection on caustic tank are to be sealed, capillary type

OPERATIONS

Operator Action

The manual block valves around the three tanks and pumps must be in their proper position so that the process may receive and transfer the appropriate fluids stored in the vessels. Since these vessels are all equipped with pumps, the **HAND-OFF-AUTO** manual switch must be placed in the **AUTO** position. By doing so, the central PLC will be able to enable the power to the pumps when that vessel is required to be placed into service. The manual block valve of the neutralization mixer must be open for the caustic supply to enter the mixer.

PLC Action

The central PLC will monitor the three vessels. It will alarm high and low levels and in the case of the caustic tank, will automatically block the fill line to prevent the tank from overflowing. In the other tanks, the central PLC will STOP the appropriate pumps to prevent overfilling the vessel. It will also guard against operating a pump without liquid since the low level function of the central PLC will stop liquid transfer upon a low level alarm.

The central PLC will also operate the neutralization metering pump stroke adjustment using the pH probe installed in the mixer discharge line. The PLC will alarm if the pH varies outside the software control limits, either High or Low to warn the operator of a malfunction with the neutralization system.

Introduction

The Filter Drying Bed is used to dewater the thickened, devolatilized sludge that is precipitated and treated in the Pretreatment Unit. The slurry will be pumped by the Devolatilizer discharge pump to one of three (3) compartments that are roughly 20' x 40' or 800 square feet of surface area each. The transfer rate is 60 gpm as provided by a pneumatic, double diaphragm pump. Each compartment is supplied with a PVC pipe header running down each side of the compartment. Two discharge tees are provided along the header. The tee is equipped with a valve draining into the compartment. A 12" x 12" concrete splash pad is provided under each of the discharge valves. Each of the header laterals tee into a common header with block valves that connect back to the pump discharge.

When a compartment is selected, the lateral block valves are opened and when a transfer is made, the individual discharge valves are set to produce a balanced flow along the entire length of the filter bed. When a compartment has been filled, approximately 18"-24" above the polyurethane filter panels, the bed is taken out of service and allowed to dry. Another compartment is placed in service during this time.

A drain hub is installed through the bottom of the basin on 50 square feet centers. The compartment collection is discharged to a common header pipe that dumps the water to the sump.

When the sludge dries sufficiently to be transported, the compartment is cleaned using a small front-end loader ("Bobcat"). The basin is constructed in such a way that the loader has access into each basin at one end.

To facilitate drying the entire area is covered to prevent as much infiltration of rainwater as is practical. Covering the sump also eliminates the added capacity of water to be treated.

Specific Vessel Requirements

- Sludge support media to be high-density polyurethane panels
- The entire filter bed system will be underlayed with a high density polyethylene liner

Specific Mechanical Requirements

- Sump pump to be Wilden, pneumatic, double diaphragm for 60 gpm flow

Specific Electrical Requirements

- None - See General Requirements

016616

Specific Instrumentation Requirements

- None - See General Requirements

OPERATIONS

Operator Action

The operator aligns the main header valves for the compartment that is desired and makes sure the pump discharge valve is open. In most cases, once the first transfer of sludge occurs, no adjustments are required on the individual discharge valves located on the basin headers. The operator places the sump pump **HAND-OFF-AUTO** manual switch in the **AUTO** position.

When a compartment has been used, the main header valves are changed to place another compartment in service.

PLC Action

The central PLC has no functions to perform on the Filter Drying Bed.

016617

Summary

Each of the plant operations will contain sufficient instrumentation to operate within the necessary limits for the removal of all contaminants of concern. To manage these different unit operations as a groundwater treatment plant, a central PLC will be used to give the operating personnel a means of communicating with the well field and monitor the critical parameters of the modules to prevent environmental abuse.

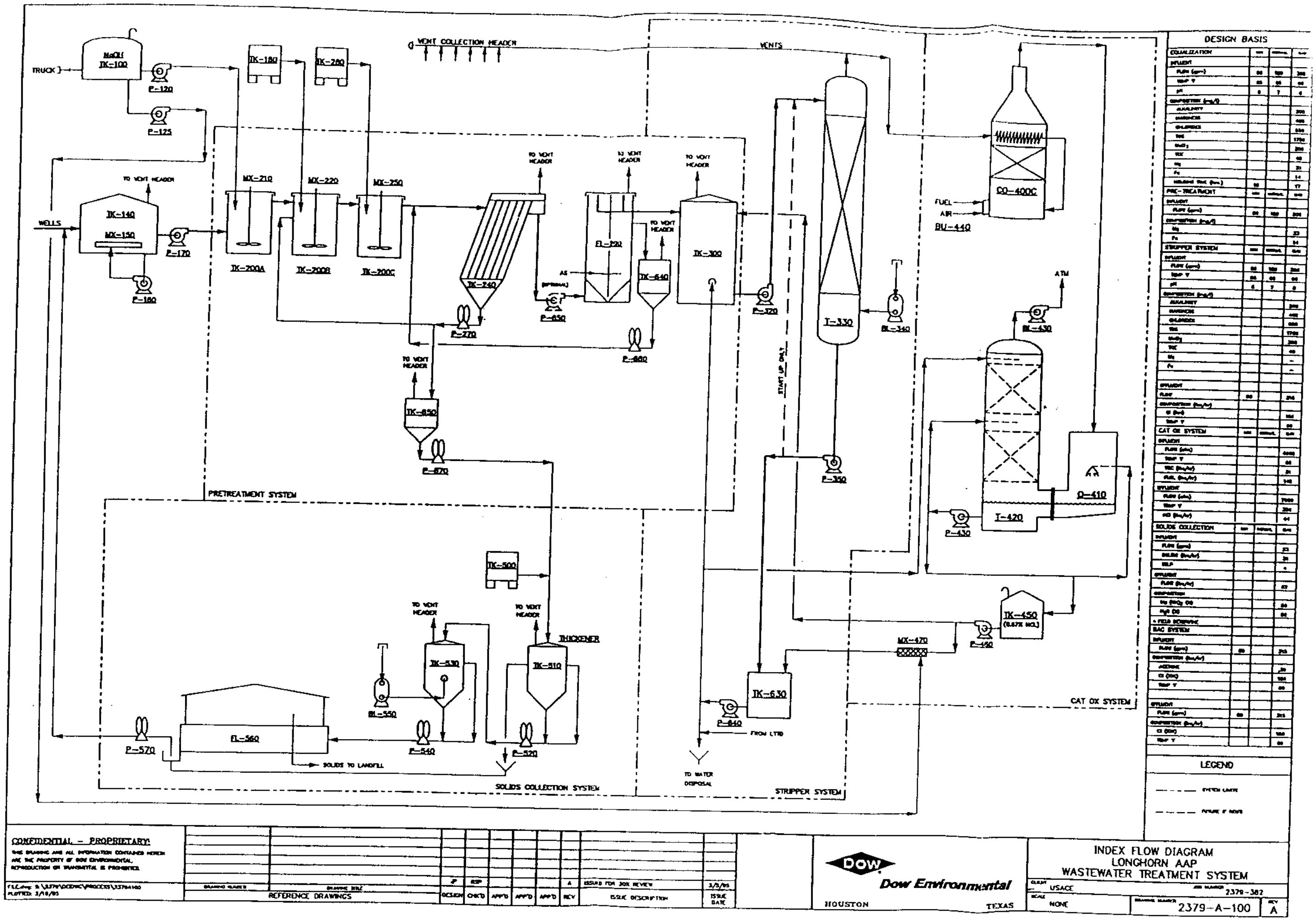
For example, the central PLC will use alarms or relay contacts from each of the four (4) modules to determine whether the module is available to operate or is operating. The loss of the relay contact or an alarm input will indicate that a malfunction has occurred and the central PLC will take the appropriate action to prevent discharge of contaminated water from the facility or over flow liquids from the equipment by terminating the flow of water to a module. This interface will allow the central PLC to interlock operations out until the proper sequence of operations has been brought on-line and proper contaminant removal is assured. For example, the Air Stripper Unit feed pump from the Overflow/Stripper Feed tank cannot operate if the Catalytic Oxidizer and Vent Scrubber is not operating.

The central PLC will allow the well field management to operate independently of the rest of the facility, with the exception of the Equalization tank high level condition. It will also offer an interface for individual pieces of equipment or unit operations not practical to be provided as one of the vendor supplied modules, i.e., air compressor/dryers, Effluent tank level, discharge pump, caustic tank level, etc. to be monitored and integrated into the plant operation.

The operator will be notified of a module malfunction or any condition that falls outside the constraints programmed into the PLC. For module problems, the operator will have to visually inspect the specific control panel of each module to determine the cause of the malfunction but a minimum requirement of the control panel is to contain sufficient alarm indications to be able to troubleshoot the cause of a malfunction. The module control panel will also have, as a minimum requirement, an acknowledge and reset button or switch. The acknowledge by the operator will cause any blinking indicators to quit blinking and any audio alarm to stop sounding. When the condition creating the alarm has been removed, the module control system will not automatically clear but will require a manual 'reset' from the operator indicating the module is capable of restarting before interlocks are removed and the indicator light turned off.

016618

INDEX FLOW DIAGRAM



VENT COLLECTION HEADER
VENTS
NaOH TK-100
TRUCK
P-120
P-125
TK-180
TK-280
TK-140
MX-150
WELLS
P-170
P-180
MX-210
MX-220
MX-250
TK-200A
TK-200B
TK-200C
TK-240
P-270
P-650
FL-290
TK-640
TK-300
P-660
P-320
T-330
BL-340
P-350
TK-650
P-670
START UP ONLY
CO-400C
FUEL
AIR
BU-440
ATM
BL-430
T-420
D-410
P-430
TK-450
P-460
MX-470
TK-630
P-640
FROM LTID
TO WATER DISPOSAL
TK-500
THICKENER
TK-530
TK-510
BL-550
FL-560
P-570
P-540
P-520
SOLIDS TO LANDFILL
PRETREATMENT SYSTEM
SOLIDS COLLECTION SYSTEM
STRIPPER SYSTEM
CAT OX SYSTEM
TO VENT HEADER
DESIGN BASIS
LEGEND
CONFIDENTIAL - PROPRIETARY
REFERENCE DRAWINGS
ISSUED FOR 30% REVIEW
DOW
Dow Environmental
HOUSTON
TEXAS
INDEX FLOW DIAGRAM
LONGHORN AAP
WASTEWATER TREATMENT SYSTEM
USACE
NONE
2379-382
2379-A-100
A

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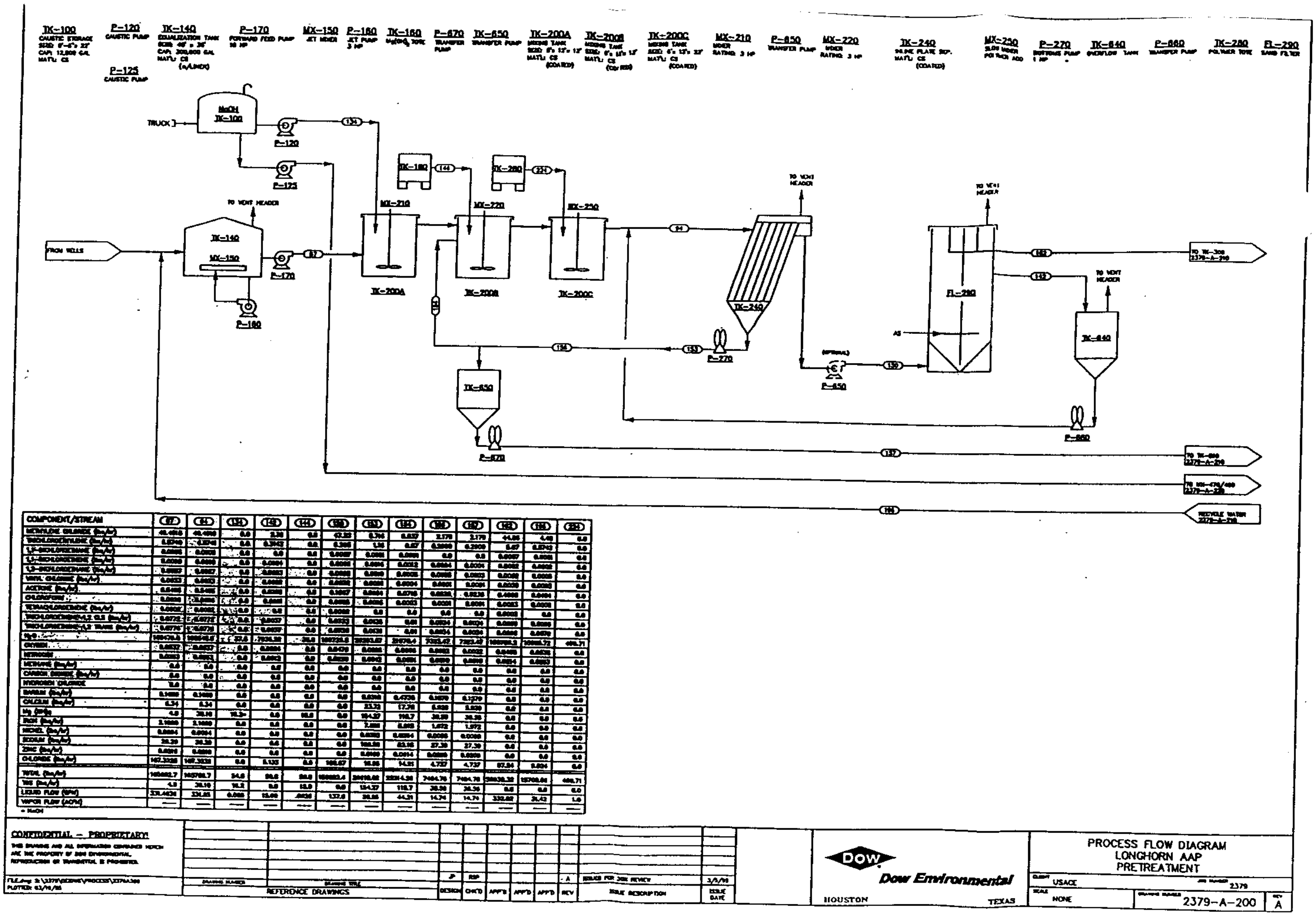
016620

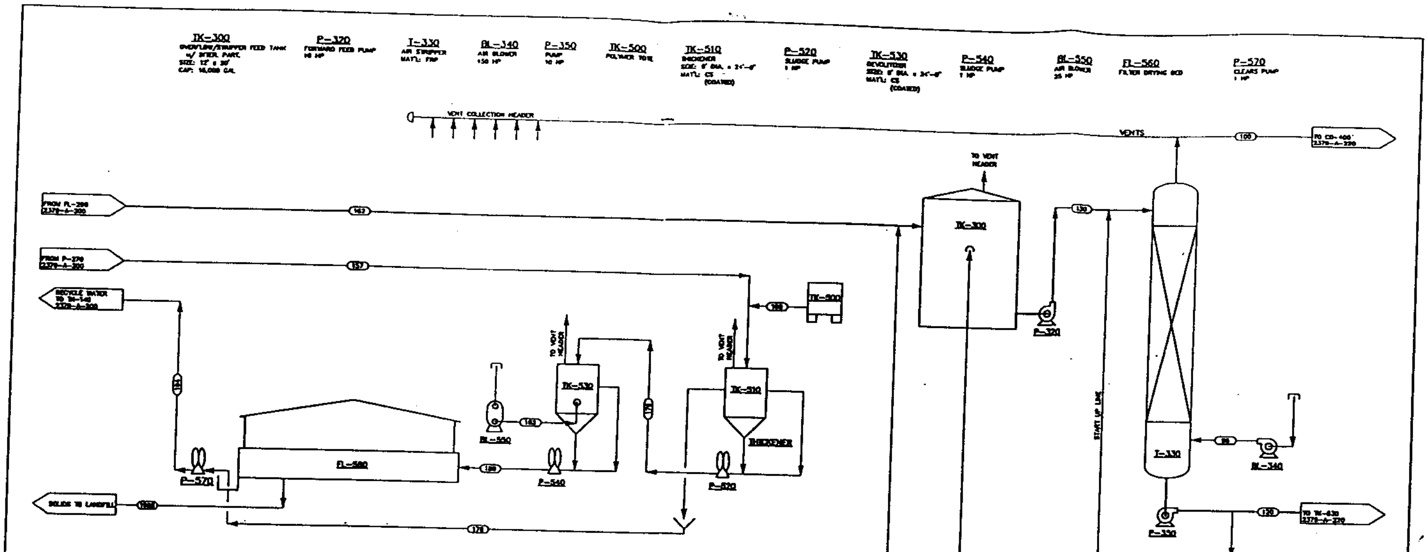
PROCESS FLOW DIAGRAM



TK-100
P-120
TK-140
P-170
MX-150
P-180
TK-160
P-670
TK-650
TK-200A
TK-200B
TK-200C
MX-210
P-650
MX-220
TK-240
MX-250
P-270
TK-640
P-660
TK-280
FL-290
P-125
TRUCK
FROM WELLS
TO VENT HEADER
RECYCLE WATER
2379-A-210
COMPONENT/STREAM
TOTAL
CONFIDENTIAL — PROPRIETARY
REFERENCE DRAWINGS
DESIGN
ISSUE DESCRIPTION
ISSUE DATE
Dow Environmental
HOUSTON
TEXAS
PROCESS FLOW DIAGRAM
LONGHORN AAP
PRETREATMENT
USACE
2379
NONE
2379-A-200
A

016621

016622



COMPONENT/STREAM	90	100	117	120	130	150	160	163	168	170	175	180	190	192	199
METHYLENE CHLORIDE (lbs/hr)	0.0	44.8	.0004	0.0	44.8	3.2	2.4	44.06	0.0	1.044	3.5	0.0	0.0116	0.0026	0.0100
TRICHLOROETHYLENE (lbs/hr)	0.0	5.0	0.0	0.0	5.0	0.38	0.3146	5.57	0.0	0.139	0.47	0.0	0.0734	0.0711	0.0003
1,1-DICHLOROETHANE (lbs/hr)	0.0	.0487	0.0	0.0	.0487	0.0	0.0	0.0007	0.0	0.0	0.0001	0.0	0.0	0.0	0.0
1,1-DICHLOROETHENE (lbs/hr)	0.0	0.4081	0.0	.0001	0.0082	0.0004	0.0004	0.0082	0.0	0.0002	0.0006	0.0	.0001	0.0001	0.0
1,2-DICHLOROETHANE (lbs/hr)	0.0	0.0053	0.0	0.0	0.0002	0.0003	0.0003	0.0053	0.0	0.0001	0.0004	0.0	0.0005	0.0001	0.0
VINYL CHLORIDE (lbs/hr)	0.0	0.0039	0.0	0.0	.0039	0.0001	0.0002	0.0030	0.0	0.0001	0.0002	0.0	0.0	0.0	0.0
ACETONE (lbs/hr)	0.0	0.1614	0.0081	0.3883	0.4806	0.0236	0.0236	0.4068	0.0	0.0114	0.0382	0.0	0.0076	0.0073	0.0002
CHLOROFORM	0.0	0.0023	0.0	0.0	0.0023	0.0001	0.0001	0.0023	0.0	0.0001	0.0002	0.0	0.0	0.0	0.0
TETRACHLOROETHENE (lbs/hr)	0.0	0.0002	0.0	0.0	0.0002	0.0	0.0	0.0002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRICHLOROETHENE-1,2 CIS (lbs/hr)	0.0	0.0886	0.0	0.0	0.0886	0.0034	0.0037	0.0886	0.0	0.0016	0.0054	0.0	0.0008	0.0009	0.0
TRICHLOROETHENE-1,2 TRANS (lbs/hr)	0.0	0.0885	0.0	0.0146	0.0880	0.0034	0.0037	0.0886	0.0	0.0014	0.0054	0.0	0.0001	0.0008	0.0
H_2O	274.43	382.87	3433	1672710.0	1672710.7	7202.47	7026.38	1807780.2	800.0	3624.06	12134.00	0.0	2201.90	2207.00	73.00
OXYGEN	4886.16	4886.27	0.0433	1.000	0.0000	0.0022	0.0034	0.0406	0.0	0.0011	0.0035	1.10	0.0284	0.0320	0.0000
NITROGEN	16386.06	16328.0	0.0073	1.230	0.000	0.0010	0.0012	0.0214	0.0	0.0006	0.0017	3.63	0.0000	0.0134	0.0004
METHANE (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CARBON DIOXIDE (lbs/hr)	0.0	0.0434	0.0434	0.0	0.0434	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HYDROGEN CHLORIDE	0.0	0.0067	33	0.0	43.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARIUM (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.1870	0.2	0.0	0.0	0.1579	0.0	0.0	0.1570	0.0	0.1570
CALCIUM (lbs/hr)	0.0	0.0	0.0	0.0	0.0	5.0296	0.0	0.0	0.0	5.83	0.0	0.0	5.83	0.0	5.83
Hg (lbs/hr)	0.0	0.0	0.0	0.0	0.0	38.0462	0.0	0.0	0.0	38.56	0.0	0.0	38.06	0.0	38.064
IRON (lbs/hr)	0.0	0.0	0.0	0.0	0.0	1.0716	0.0	0.0	0.0	1.07	0.0	0.0	1.07	0.0	1.07
NICKEL (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0086	0.0	0.0	0.0	0.0086	0.0	0.0	0.0086	0.0	0.0086
SODIUM (lbs/hr)	0.0	0.0	0.0	0.0	0.0	27.3947	0.0	0.0	0.0	27.39	0.0	0.0	27.3947	0.0	27.39
ZINC (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0206	0.0	0.0	0.0	0.0206	0.0	0.0	0.0206	0.0	0.0206
CHLORIDE (lbs/hr)	0.0	0.0022	1.73	167.62	167.62	4.74	5.13	97.54	0.0	2.2703	7.6	0.0	1.4002	1.46	0.0463
TOTAL (lbs/hr)	21300.06	21450.0	3468	1674?1.8	167530	7404.75	7944.12	150838.3	300.0	3702.34	12144.5	4.73	2408.25	2336.15	148.1
TDS (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.0	38.56	0.0	0.0	38.56	0.0	38.564
LIQUID FLOW (GPM)	40.76	40.67	7.0	315.04	315.13	14.74	15.0	302.07	1.0	7.33	24.31	0.0108	4.80	4.84	0.0
VAPOR FLOW (ACFM)	—	4396.38	—	—	—	—	—	—	—	—	—	—	—	—	—

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FILE: S:\2379\DESIGN\PROCESS\2379210A
PLOTTED: 3/10/95

DRAWING NUMBER	DRAWING TITLE
	REFERENCE DRAWINGS

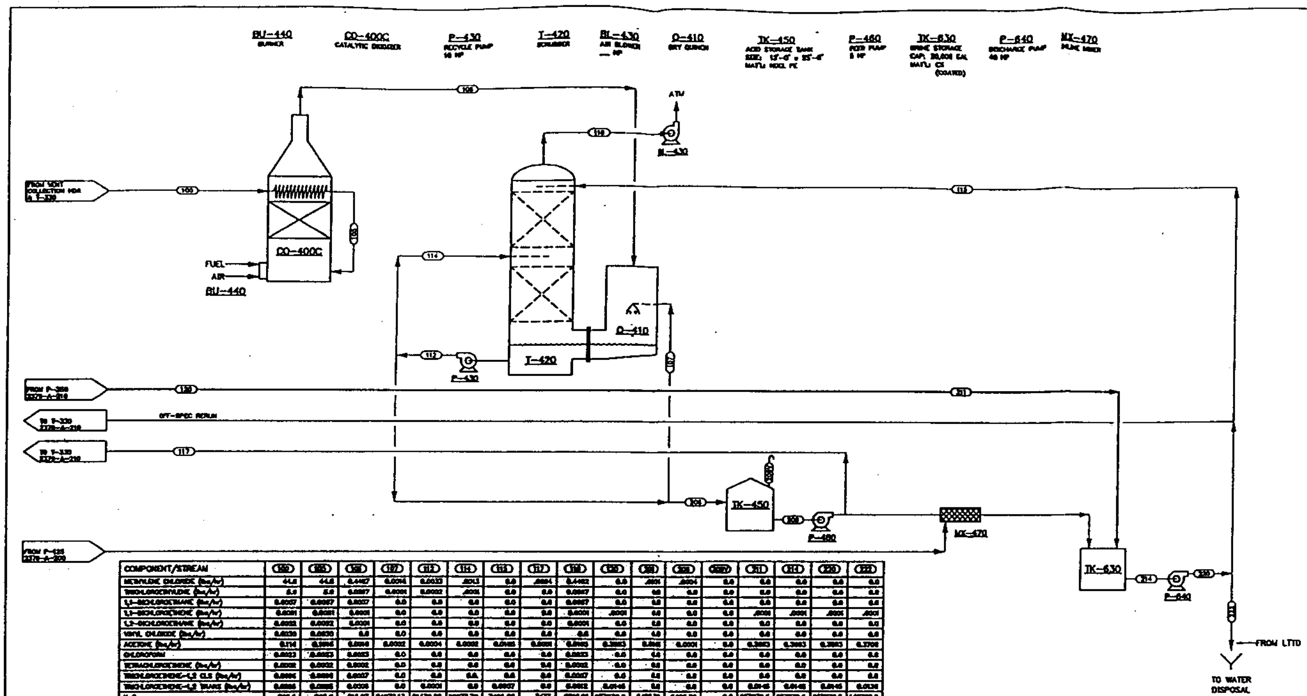
DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
JP	RSP				A	ISSUED FOR 30% REVIEW	3/3/95

Dow Environmental

HOUSTON TEXAS

PROCESS FLOW DIAGRAM
LONGHORN AAP
STRIPPING/SOLIDS HANDLING

CLIENT USACE JOB NUMBER 2379
SCALE NONE DRAWING NUMBER 2379-A-210 REV A



COMPONENT/STREAM	100	105	106	107	112	114	115	117	118	120	201	203	[illegible]	211	214	220	222
METHYLENE CHLORIDE (lbs/hr)	44.8	44.8	0.4467	0.0016	0.0033	.0013	0.0	.0004	0.4462	0.0	.0001	.0004	0.0	0.0	0.0	0.0	0.0
TRICHLOROETHYLENE (lbs/hr)	5.0	5.0	0.0087	0.0001	0.0002	.0001	0.0	0.0	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-DICHLOROETHANE (lbs/hr)	0.0007	0.0007	0.0007	0.0	0.0	0.0	0.0	0.0	0.0007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-DICHLOROETHENE (lbs/hr)	0.0001	0.0001	0.0001	0.0	0.0	0.0	0.0	0.0	0.0001	.0001	0.0	0.0	0.0	.0001	.0001	.0001	.0001
1,2-DICHLOROETHANE (lbs/hr)	0.0002	0.0002	0.0001	0.0	0.0	0.0	0.0	0.0	0.0001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VINYL CHLORIDE (lbs/hr)	0.0030	0.0030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACETONE (lbs/hr)	0.114	0.1896	0.0016	0.0032	0.0004	0.0002	0.0165	0.0051	0.0165	0.3883	0.0165	0.0001	0.0	0.3883	0.3883	0.3883	0.3708
CHLOROFORM	0.0023	0.0023	0.0023	0.0	0.0	0.0	0.0	0.0	0.0023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TETRACHLOROETHENE (lbs/hr)	0.0002	0.0002	0.0002	0.0	0.0	0.0	0.0	0.0	0.0002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRICHLOROETHENE-1,2 CIS (lbs/hr)	0.0006	0.0006	0.0007	0.0	0.0	0.0	0.0	0.0	0.0007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRICHLOROETHENE-1,2 TRANS (lbs/hr)	0.0006	0.0006	0.0006	0.0	0.0001	0.0	0.0007	0.0	0.0012	0.0146	0.0	0.0	0.0	0.0146	0.0146	0.0146	0.0136
H_2O	2012.6	2012.6	813.67	2407213	81430.22	16872.78	7404.62	2433	4846.81	1672270.8	6488.39	6488.38	0.0	1672270.6	1672270.6	1672270.6	1487782.8
OXYGEN	4061.37	4061.37	4063.67	0.1065	0.3420	0.1332	0.0023	0.0433	4068.42	1.006	0.0433	0.0433	0.0	1.006	1.0300	1.0306	1.0463
NITROGEN	14386.0	14386.0	17660.34	0.1617	0.2743	0.1454	0.0486	0.0472	17660.35	1.0230	0.0472	0.0472	0.0	1.1230	0.0565	0.0065	0.0120
METHANE (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CARBON DIOXIDE (lbs/hr)	0.0434	0.0434	288.3081	0.1433	0.3364	0.1307	0.0	0.0434	288.27	0.0	0.0434	0.0434	0.0	0.0	0.0	0.0	0.0
HYDROGEN CHLORIDE	0.0087	0.0087	43.3286	166	342	133	0.0	33	0.0	0.0	43.1	43.2	0.0	0.0	0.0	0.0	0.0
BARIUM (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CALCIUM (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
$Mg(OH)_2$	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IRON (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NICKEL (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SODIUM (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZINC (lbs/hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHLORIDE (lbs/hr)	0.0022	0.0022	–	12.5046	23.0473	10.0775	7.5047	1.73	0.0	157.42	3.273	3.273	0.0	157.42	157.42	157.42	180.1
TOTAL (lbs/hr)	21036.83	21035.82	–	22136	31687.6	20421	7405.06	3496	24424.06	1674325.76	6530	6530	0.0	157428.5	157431.5	157431.5	149633.5
TDS (lbs/hr)	0.0	0.0	–	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUID FLOW (GPM)	40.0	40.0	–	60.00	142.00	40.0	16.0	7.0	66.32	316.04	12.00	12.00	0.0	315.04	315.04	315.04	308.04
VAPOR FLOW (ACFM)	4306.35	7546.71	–	—	—	—	—	—	—	—	—	—	0.0	—	—	—	—

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DRAWING NUMBER	DRAWING TITLE
	REFERENCE DRAWINGS

DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
JP	RSP				A	ISSUED FOR ... REVIEW	3/?/95

Dow Environmental
HOUSTON TEXAS

PROCESS FLOW DIAGRAM
LONGHORN AAP
CATOX/STRIPPER BOTTOMS TREATMENT

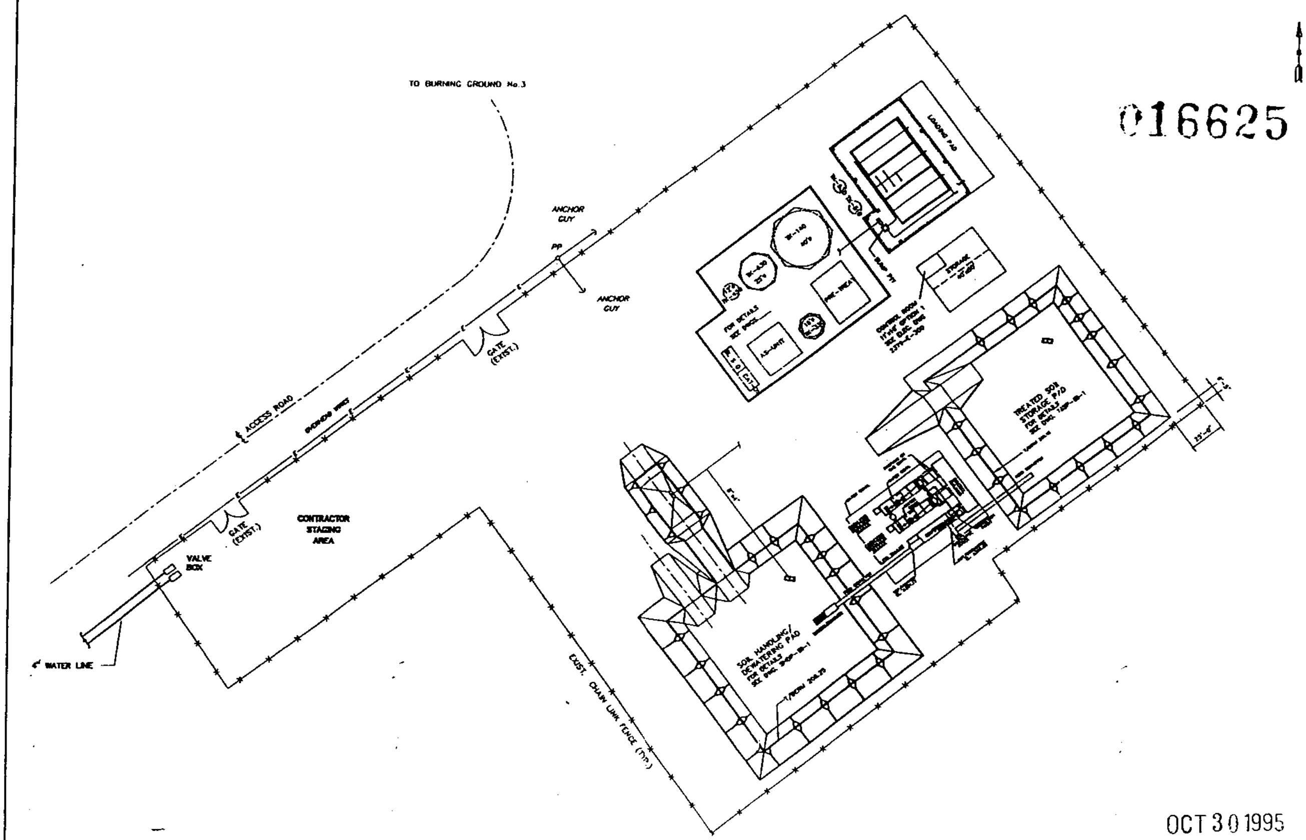
CLIENT | JOB NUMBER 2379
SCALE NONE | DRAWING NUMBER 2379-A-220 | REV A

016623

016624

CONCEPTUAL PLOT PLAN, SECTIONS, AND DETAILS

016625



OCT 30 1995

US Army Corps of Engineers Tulsa District

TSSP-III-1	TREATED SOIL STORAGE PAD	DBC	RP				A	ISSUED FOR APPROVAL	10/05/95
DRAWING NUMBER	DRAWING TITLE	DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
REFERENCE DRAWINGS									

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PLOTTED 10/05/95 1:00PM

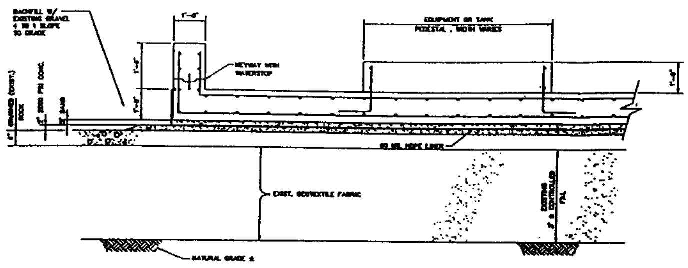
DOW Dow Environmental

STAGING AREA-GWTP, TSSP & SHDP

BURNING GROUND No. 3
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PROJECT: LHAAP 18 & 24 III, IRA — PROJECT No. 2379

SCALE: 1"=30' — DRAWING NUMBER: 2379-G-200 — REV: A



TYPICAL SECTION @ CONTAINMENT SLAB

016626

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Drawing Number	Drawing Title	Design	Chk'd	App'd	App'd	App'd	Rev	Issue Description	Issue Date
C-100	INITIAL PLOT PLAN						A	ISSUED FOR COMMENTS	

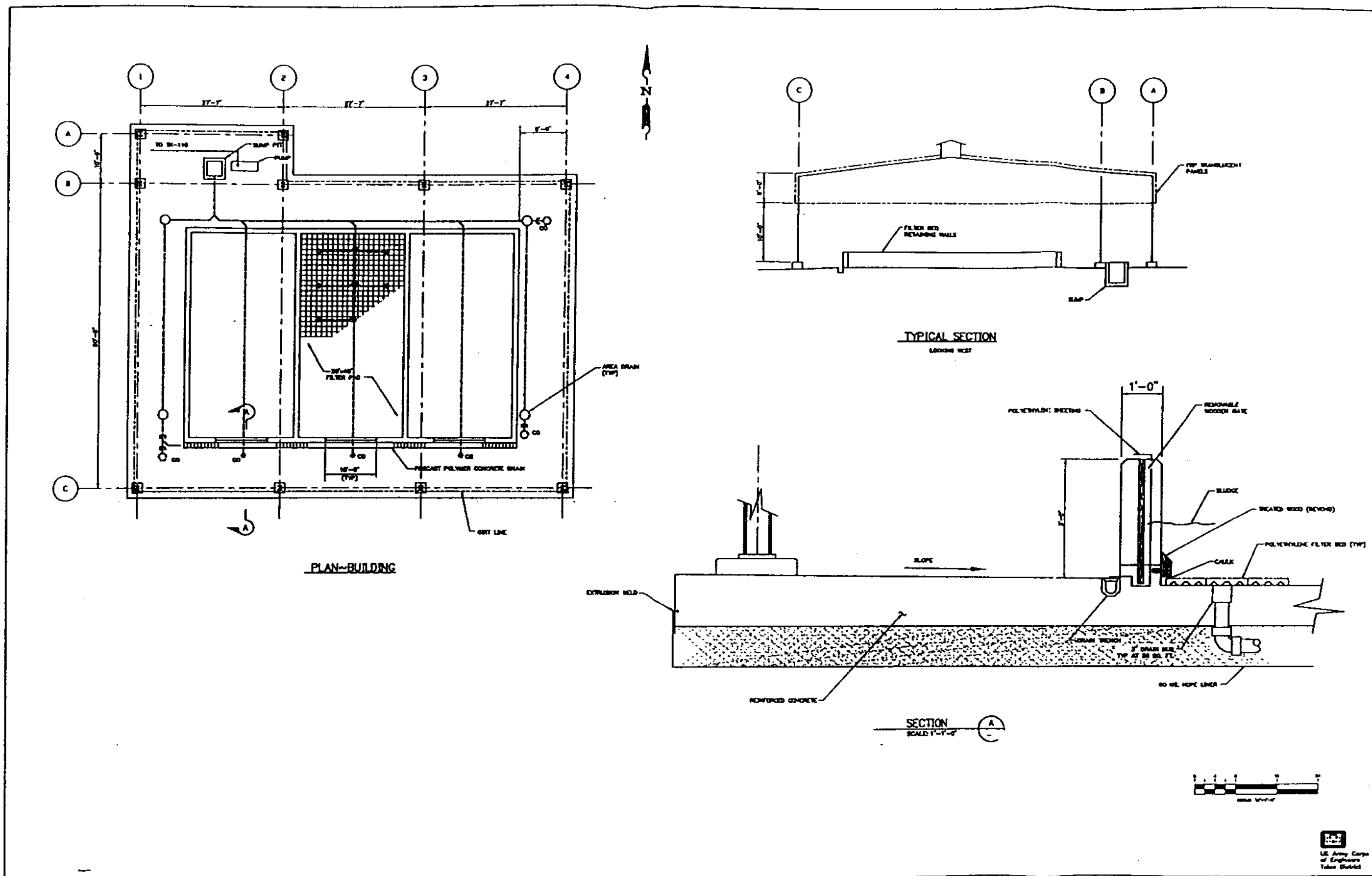
REFERENCE DRAWINGS

Dow Environmental

SECTION @ CONTAINMENT AND DISCHARGE

LHAAP 18 & 24 PHASE III, IRA — Project No. 2379

Scale: 3/4"=1'-0" — Drawing Number: 2379-G-101 — Rev: A



CONFIDENTIAL – PROPRIETARY!

Drawing Number	Drawing Title	Design	Chk'd	App'd	App'd	App'd	Rev	Issue Description	Issue Date
G-100	INITIAL PLOT PLAN	CWB	CKW	RSP			A	ISSUED FOR COMMENTS	05/14/93

REFERENCE DRAWINGS

Dow Environmental

FILTER DRYING BED
PLAN, SECTIONS AND DETAILS
BURNING GROUND No. 3
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Project: LHAAP 18 & 24 PHASE III, IRA — Project No. 2379

Scale: 1/4"=1'-0" — Drawing Number: 2379-B-100 — Rev: A

016627

Groundwater Treatment Plant
Longhorn Army Ammunition Plant

016628

Influent Tank and Caustic Storage -Equipment List

ITEM	*DESCRIPTION*
Tk-100	Caustic Storage
P-120	Caustic Feed Pump
P-125	Caustic Feed Pump
Tk-140	Influent Tank
MX-150	Mixer
P-160	Recycle Pump
P-170	Forward Feed Pump

Groundwater Treatment Plant
Longhorn Army Ammunition Plant

016629

Pretreatment System -Equipment List

ITEM	DESCRIPTION
Tk-160	$Mg(OH)_2$ Tote
Tk-280	Polymer Tote
MX-210	Mixer
MX-220	Mixer
MX-250	Slow Speed Mixer
TK-200A	Mixing Tank
TK-200B	Mixing Tank
TK-200C	Mixing Tank
TK-650	Sludge Surge Tank
P-670	Transfer Pump
P-270	Transfer Pump
TK-240	Incline Plate Separator
P-650	Forward Feed (optional)
FL-290	Sand Filter
TK-640	Backwash Tank
P-660	Transfer Pump
TK-300	Overflow Tank

Groundwater Treatment Plant
Longhorn Army Ammunition Plant

016630

Solids Collection System -Equipment List

ITEM	*DESCRIPTION*
P-570	Transfer Pump
FL-560	Filter Drying Bed
BL-550	Blower
P-540	Transfer Pump
TK-530	Devolitizer Tank
TK-500	Polymer Tote
TK-510	Thickener Tank
P-520	Transfer Pump

Groundwater Treatment Plant
Longhorn Army Ammunition Plant

016631

Air Stripper System -Equipment List

ITEM	*DESCRIPTION*
P-320	Transfer Pump
T-330	Air Stripper Tower
P-350	Transfer Pump
BL-340	Blower
P-640	Recycle Pump
TK-630	Effluent Tank

Groundwater Treatment Plant
Longhorn Army Ammunition Plant

016632

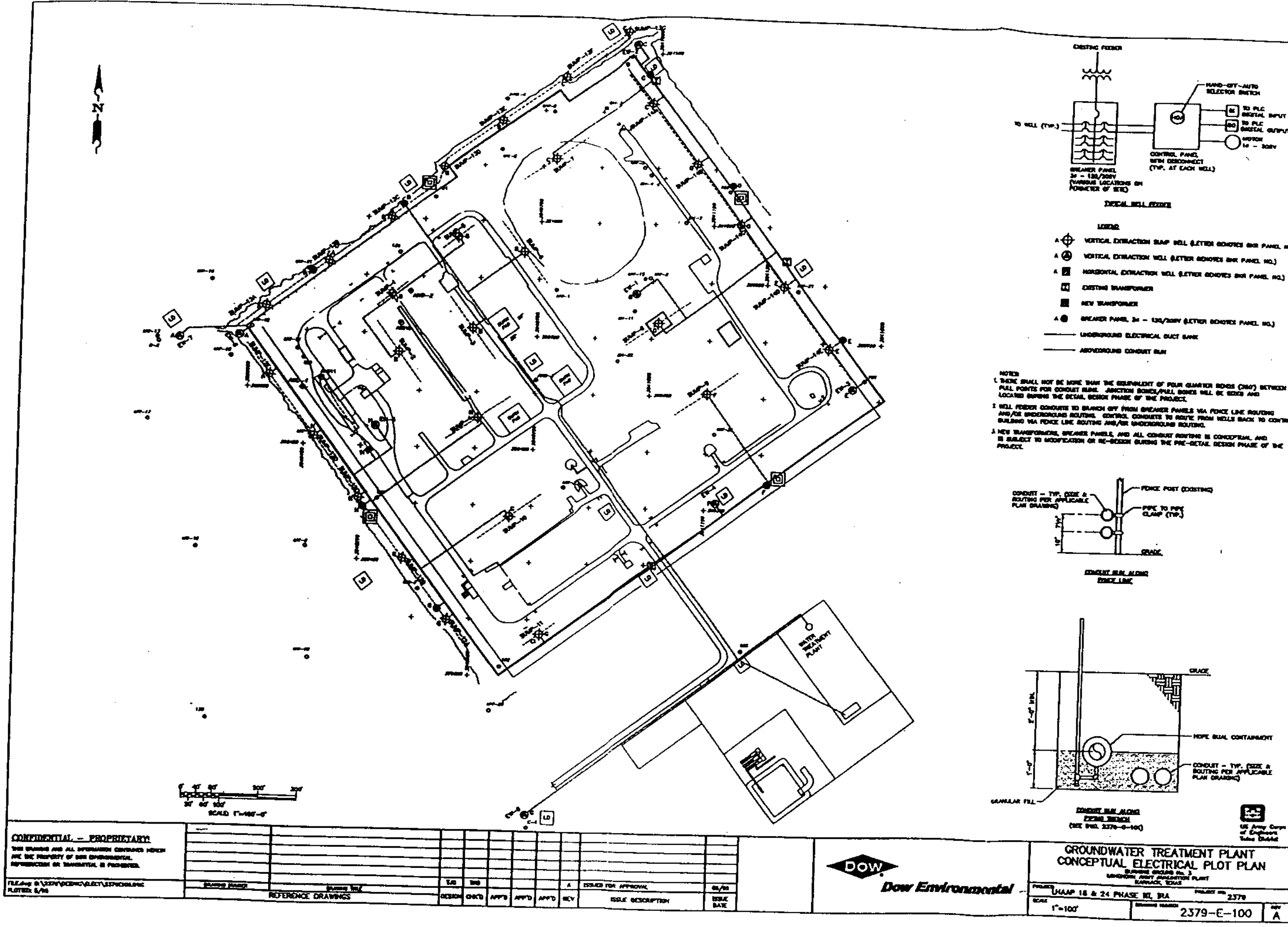
Cat Ox System -Equipment List

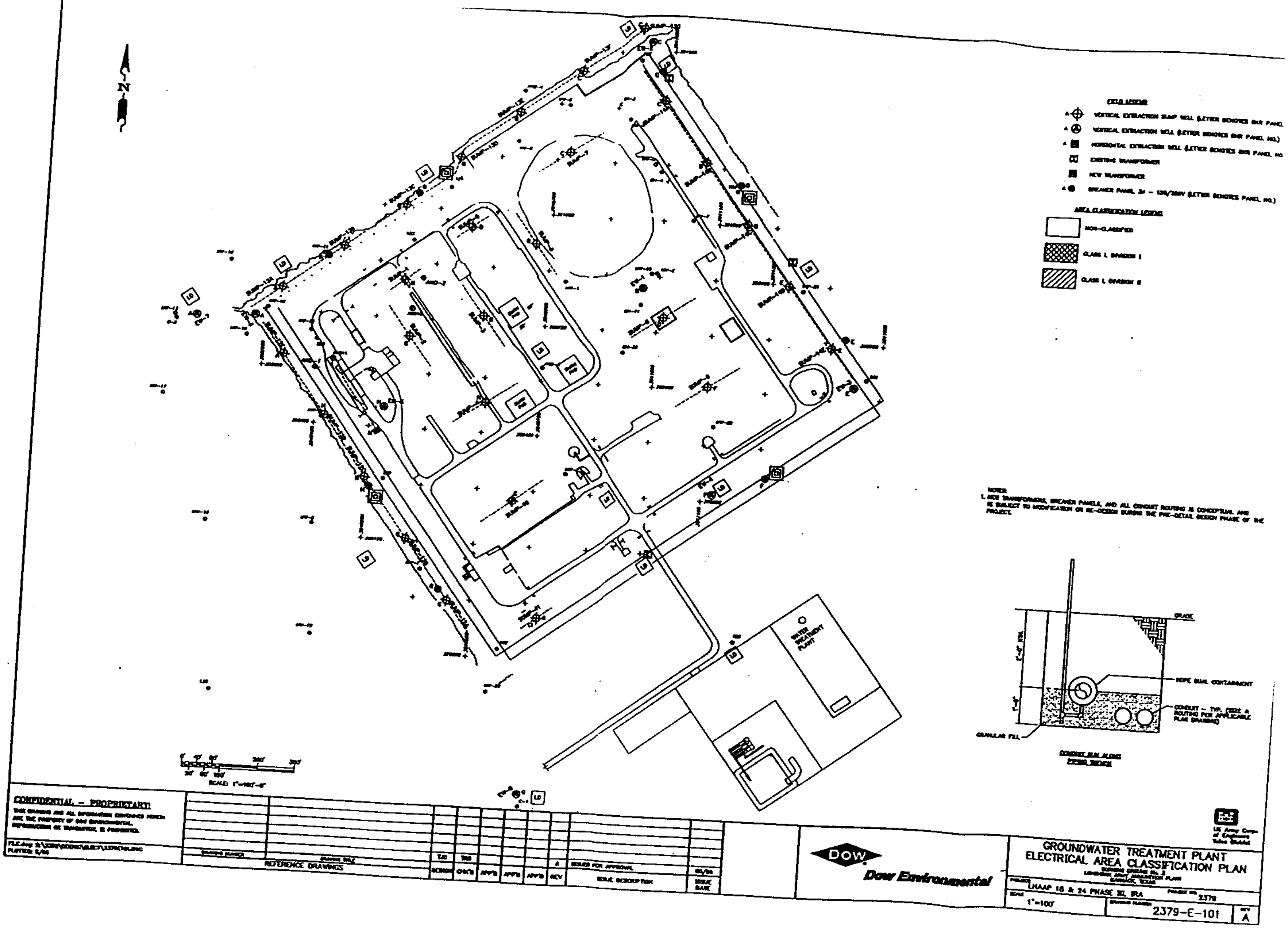
ITEM	*DESCRIPTION*
CO-400C	Catalytic Oxidizer
BU-440	Burner
BL-430	Blower
Q-410	Quench
T-420	HCl Scrubber
P-430	Quench Transfer Pump
TK-450	Acid Storage Tank
P-460	Transfer Pump
MX-470	Mixer

016633

CONCEPTUAL ELECTRICAL PLOT PLAN, DETAILS,

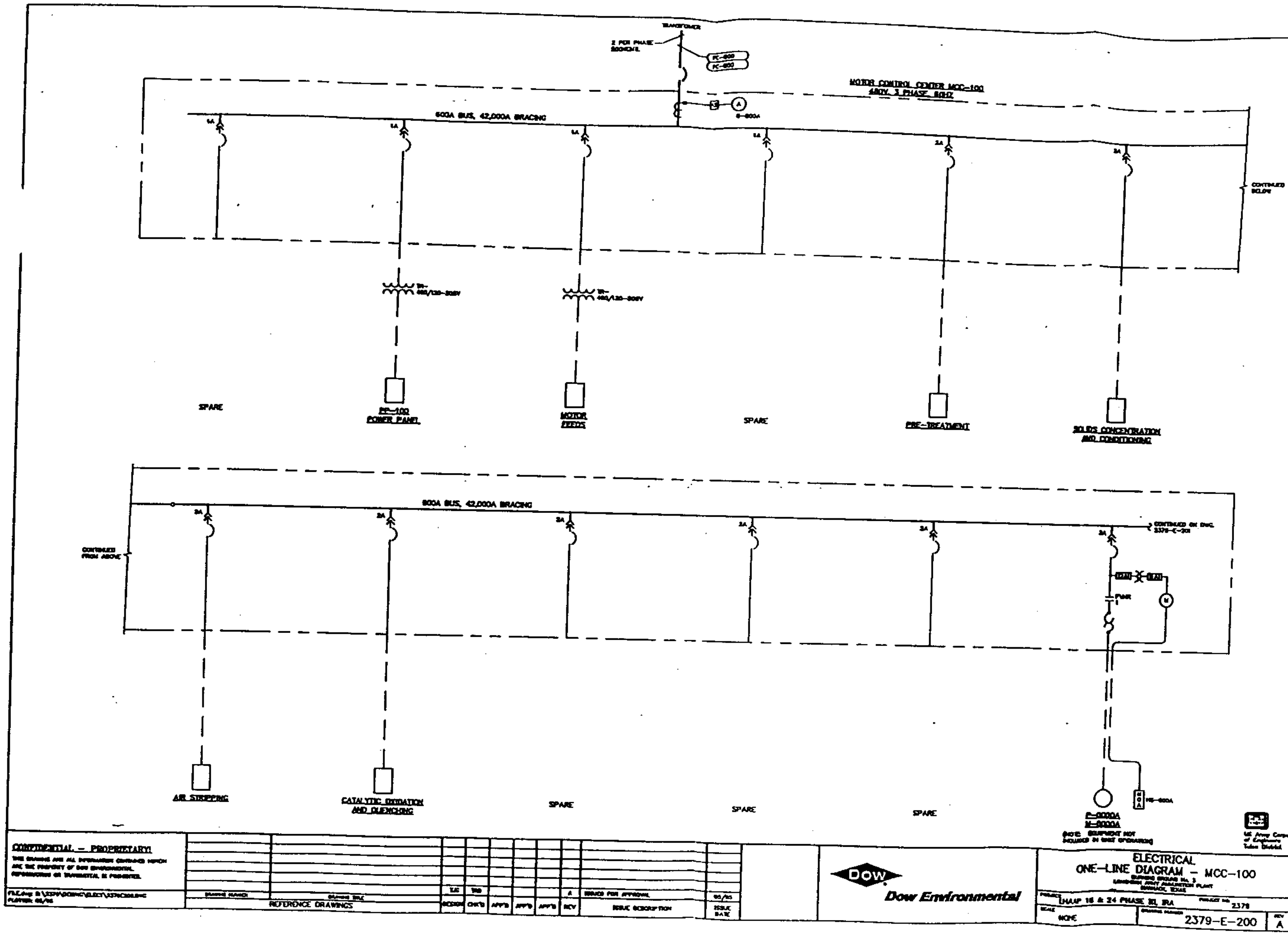
LOAD LIST, AND AREA CLASSIFICATION PLAN


CONFIDENTIAL — PROPRIETARY
SCALE: 1"=100'-0"
REFERENCE DRAWINGS
DESIGN
CHK'D
APP'D
APP'D
APP'D
REV
A
ISSUED FOR APPROVAL
ISSUE DESCRIPTION
ISSUE DATE
DOW
Dow Environmental
GROUNDWATER TREATMENT PLANT
CONCEPTUAL ELECTRICAL PLOT PLAN
KARNACK, TEXAS
LHAAP 18 & 24 PHASE III, IRA
2379
1"=100'
2379-E-100
A
HDPE DUAL CONTAINMENT
GRANULAR FILL
US Army Corps of Engineers Tulsa District
WATER TREATMENT PLANT
TYPICAL WELL FEEDER
LEGEND
NOTES
FENCE POST (EXISTING)
GRADE



N
NON-CLASSIFIED
CLASS I, DIVISION I
CLASS I, DIVISION II
WATER TREATMENT PLANT
GRADE
HDPE DUAL CONTAINMENT
GRANULAR FILL
SCALE 1"=100'-0"
CONFIDENTIAL - PROPRIETARY!
REFERENCE DRAWINGS
Dow Environmental
GROUNDWATER TREATMENT PLANT
ELECTRICAL AREA CLASSIFICATION PLAN
LHAAP 18 & 24 PHASE III, IRA
2379
1"=100'
2379-E-101
A

016635


MOTOR CONTROL CENTER MCC-100
480V, 3 PHASE, 60HZ
600A BUS, 42,000A BRACING
SPARE
PP-100
POWER PANEL
MOTOR
FEEDS
SPARE
PRE-TREATMENT
SOLIDS CONCENTRATION
AND CONDITIONING
600A BUS, 42,000A BRACING
AIR STRIPPING
CATALYTIC OXIDATION
AND QUENCHING
SPARE
SPARE
SPARE
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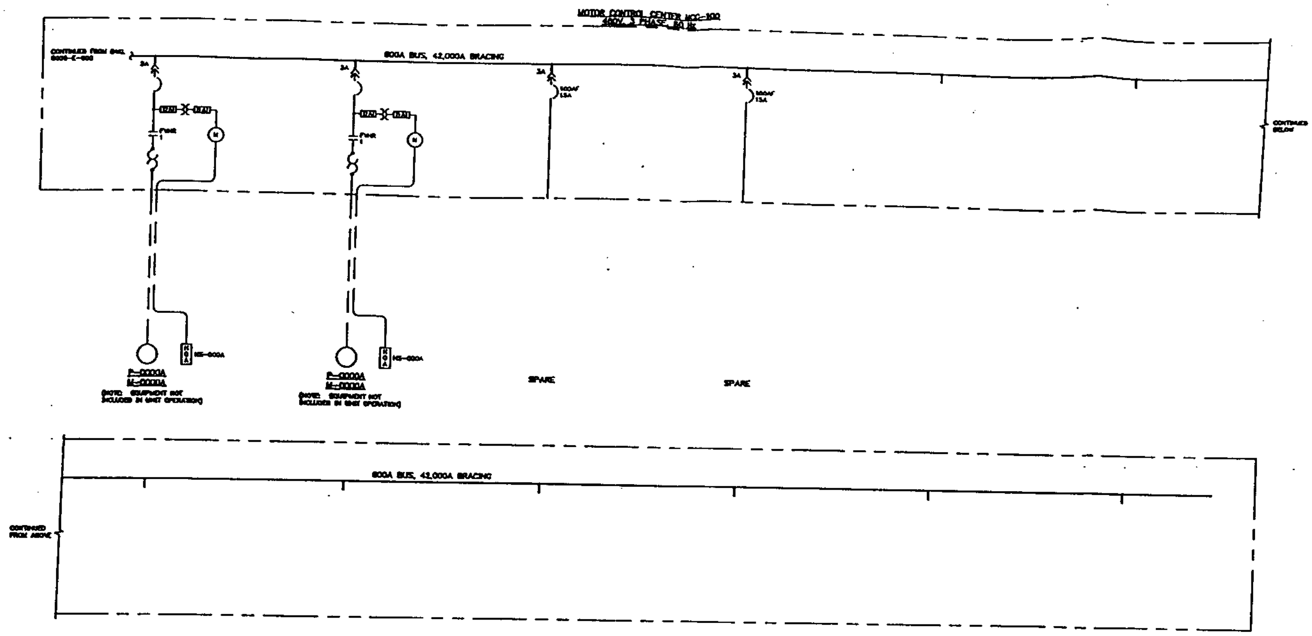
REFERENCE DRAWINGS
ISSUED FOR APPROVAL
ISSUE DESCRIPTION
Dow Environmental
ELECTRICAL
ONE-LINE DIAGRAM - MCC-100
2379-E-200
A

016636



REFERENCE DRAWINGS

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DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE

Dow Environmental

ELECTRICAL
ONE-LINE DIAGRAM - MCC-100

LHAAP 16 & 24 PHASE III, IRA

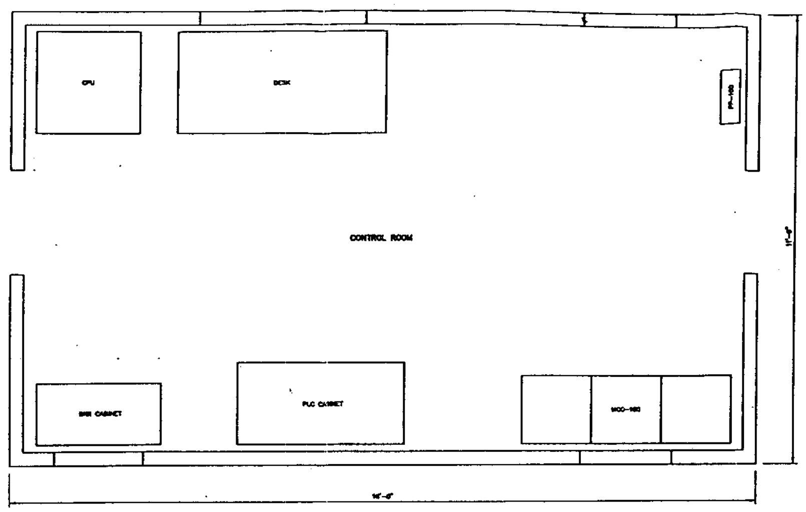
2379

NONE

2379-E-201

A

016637



CONTROL BUILDING
OPTION 1

NOTES:

1. CONTROL BUILDING TO BE SHOP FABRICATED AS A "TURN-KEY" PRODUCT. THIS INCLUDES A COMPLETE OUTER SHELL, PROVIDING/INSTALLING ALL ELECTRICAL EQUIPMENT, INSTALLING ALL APPLICABLE CONDUIT RUNS AND INTERCONNECT WIRING, AND PROVIDING EXTERIOR RACEWAY ENTRY OPENINGS AS REQUIRED.
2. ALL ELECTRICAL WORK SHALL CONFORM TO THE LATEST NATIONAL ELECTRICAL CODE AND ALL LOCAL CODES APPLICABLE TO THE INSTALLATION OF THE CONTROL BUILDING.
3. THE CONTROL BUILDING INTERIOR IS TO BE A NON-CLASSIFIED INSTALLATION.
4. FOR INFORMATION NOT SHOWN, REFER TO THE APPLICABLE DISCIPLINE SPECIFICATIONS.

US Army Corps of Engineers Tulsa District

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DRAWING NUMBER	DRAWING TITLE	DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE
		TJC	[illegible]				A	ISSUED FOR APPROVAL	05/96

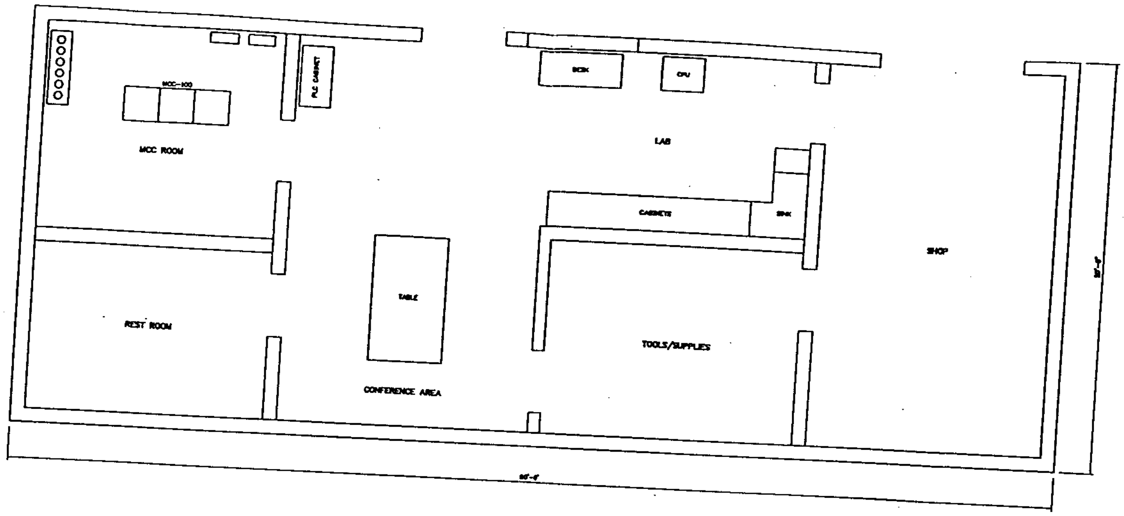
REFERENCE DRAWINGS

Dow Environmental

GROUNDWATER TREATMENT PLANT
SHOP FABRICATED CONTROL ROOM

PROJECT: LHAAP 18 & 24 PHASE III, IRA
PROJECT NO.: 2379
SCALE: 1"=1'
DRAWING NUMBER: 2379-E-300
REV: A

016638



CONTROL BUILDING
OPTION 2

NOTES:
1. BUILDING CONSTRUCTION TO BE REINFORCED CONCRETE MASONARY UNIT WALLS, SLAB FOUNDATION WITH WITH FLEXICORE ROOF PANELS, MEMBRANE ROOF AND HOLLOW CORE METAL DOORS, ETC.

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PLOTTED: 05/95

DRAWING NUMBER	DRAWING TITLE								
		TJG	TRB				A	ISSUED FOR APPROVAL	05/95
REFERENCE DRAWINGS		DESIGN	CHK'D	APP'D	APP'D	APP'D	REV	ISSUE DESCRIPTION	ISSUE DATE

Dow Environmental

US Army Corps of Engineers Tulsa District

GROUNDWATER TREATMENT PLANT
ELECTRICAL CONTROL ROOM
BURNING GROUND No. 3
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PROJECT: LHAAP 18 & 24 PHASE III, IRA
PROJECT No.: 2379
SCALE: 1/2"=1'
DRAWING NUMBER: 2379-E-301
REV: A

016639

DOW

Dow Environmental

Date: 5/19/95
Revision: A
Author: T. Bauer

ELECTRICAL EQUIPMENT LIST

PIN: 2379

CLIENT: LONGHORN

Assoc Equip Tag	Elect Equip Tag	Description	Plant Area	Status	HP	BHP	Volt	RPM	NAME PLATE FLA	NEC FLA	FDR NO.	MCC No.	NOTE	Plan Dwg. No.	One-Line Dia. No.	RFQ No.	P. O. No.	Sched Compl
	MCC-100	Motor Control Center	Groundwater Treatment Plant	New			460											
		Pre-Treatment Skid	Groundwater Treatment Plant	New			460					MCC-410						
		Solids Conc. and Conditioning skid	Groundwater Treatment Plant	New			460					MCC-410						
		Air Stripping Skid	Groundwater Treatment Plant	New			460					MCC-410						
		Catalytic Oxidation Skid	Groundwater Treatment Plant	New			460					MCC-410						
		Sump Pump	Groundwater Treatment Plant	New			460					MCC-410						
		Air Handling Unit	Groundwater Treatment Plant	New			460					MCC-410						
		Power Panel	Groundwater Treatment Plant	New			460					MCC-410						
		208v Motor Feeds	Groundwater Treatment Plant	New			460					MCC-410						
		Motor Not in Unit Ops.	Groundwater Treatment Plant	New			460					MCC-410						
SUMP-12A		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-12B		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-12C		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-12D		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-12E		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-13A		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-13B		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-13C		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-13D		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-13E		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-13F		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-13G		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-14A		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-14B		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-14C		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						

016640

Assoc Equip Tag	Elect Equip Tag	Description	Plant Area	Status	HP	BHP	Volt	RPM	NAME PLATE FLA	NEC FLA	FDR NO.	MCC No.	NOTE	Plan Dwg. No.	One-Line Dia. No.	RFQ No.	P. O. No.	Sched Compl
SUMP-14D		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-14E		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-1		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-2		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-3		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-4		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-5		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-6		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-7		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-8		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-9		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-10		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
SUMP-11		Vertical Extraction Sump Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-1		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-2		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-3		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-4		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-5		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-6		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-7		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
EW-8		Vertical Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						
HEW		Horizontal Extraction Well	Burning Ground No. 3	New	1		208			6.7		Local Panel						

016641

016642

PROJECT PLANNING AND

SPECIFICATION BASIS

016643

LABOR AND MATERIAL

SPECIFICATIONS

TABLE OF CONTENTS

016644

SECTION 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle Size Analysis of Soils
ASTM D 1556	(1990) Density of Soil in Place by the Sand Cone Method
ASTM D 698	(1978; R 1990) Moisture Density Relations of Soils and Soil Aggregate Mixtures Using a 5.5 lb (2.49 kg) Rammer and 12 in. (305 mm) Drop (Standard Compaction Test)
ASTM D 2167	(1984; R 1990) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
ASTM D 2922	(1981; R 1990) Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

1.3.1 Degree of Compaction - Degree of compaction shall be expressed as a percentage of the maximum density obtained by standard compaction test procedures.

1.3.2 Excavation - Excavation is all material excavated, whether earth or rock, in performance of work.

1.3.3 Fill Material - Fill material is job excavated material or material obtained from an approved off-site source used to backfill trenches, as specified herein.

1.3.4 Waste Material - Waste material is the portion of the materials excavated in performance of the work, whether from permanent construction sites, foundation excavation, or temporary access roads that can not be made or processed to meet the specification requirements for fill material, this material shall be disposed of off-site at an approved licensed disposal facility.

1.4 QUALITY CONTROL

1.4.1 General - All work covered here under "Quality Control" will be provided by the Subcontractor as a subsidiary obligation of the Subcontract. SECTION 01440 - QUALITY CONTROL, provides requirements for establishing and implementing the Subcontractor's Quality Control Program.

1.4.2 Testing Laboratory - All tests to ensure that fill and backfill materials and their placement comply with specified requirements shall be made by an independent testing laboratory.

1.4.3 Test Procedures - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The latest version/revision of each publication shall be apply.

ASTM C 33	Quality and Soundness
ASTM D 422	Particle-Size Analysis of Soils
ASTM D 423	Test for Liquid Limit of Soils
ASTM D 424	Test for Plastic Limit and Plasticity Index of Soils
ASTM D 1556	Density of Soil In-Place by the Sand-Cone Method
ASTM D 698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 5.5 lb (2.49 kg) Rammer and 12 in. (305 mm) Drop
ASTM D 2049	Relative Density of Cohesionless Soil
ASTM D 2167	Density and Unit Weight of Soil In-Place by the Rubber Balloon Method
ASTM D 2216	Laboratory Determination of Moisture Content of Soil
ASTM D 2487	Classification of Soils for Engineering Purposes

ASTM D 2922	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

1.5 SUBMITTALS - Submittals shall be in accordance with SECTION 01300 - SUBMITTALS.

1. Submit certified laboratory test results on all aggregates, borrow materials, and topsoil obtained from off-site sources to be incorporated into the work, as specified herein, before production or delivery materials.

2. Submit quality control field and laboratory data in accordance with SECTION 01440 - QUALITY CONTROL.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials - Satisfactory materials shall consist of any material classified by ASTM D 2487 as GW, GP, SW, SP, SM, CL, and ML, or as approved by the Contractor.

2.1.2 Unsatisfactory Materials - Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 2 inches, and materials classified in ASTM D 2487, as PT, OH, and OL. Unsatisfactory materials also include manmade fills, refuse, or backfills from previous construction.

2.1.3 Cohesionless and Cohesive Materials - Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.4 Unyielding Material - Unyielding material shall consist of rock and gravelly soils with stones greater than 4 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.5 Unstable Material - Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.6 Select Granular Material - Select granular material shall consist of wellgraded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1 inch sieve. The maximum allowable aggregate size shall be 1 inch, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.7 Initial Backfill Material - Initial backfill shall consist of select granular material or satisfactory materials free from rocks 1 inch or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than ½ inch in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Plastic Marking Tape - Plastic marking tape shall be acid and alkali-resistant polyethylene film, six inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities and shall identify the utility being protected. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Should marking tape from existing utilities be damaged during excavation the contractor shall repair or replace to ensure continuity of the marking tape. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

Table 1 - Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 - EXECUTION

3.1 EXCAVATION - After topsoil removal has been completed, excavation of every description, regardless of material encountered, within the grading limits of the project shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site shall be disposed of by the Subcontractor. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Contractor.

3.1.1 Trench Excavation - The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such minimum width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 5 feet high shall be shored or suitable shielding installed. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Subcontractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Subcontractor without any additional cost to the Contractor.

3.1.1.1 Bottom Preparation - The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material - Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material - Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Subcontractor in the performance of the work, the resulting material shall be excavated and replaced by the Subcontractor without additional cost to the Contractor.

3.1.1.4 Excavation for Appurtenances - Excavation for manholes, catchbasins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling - Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contractor's On-site Representative, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections. The Subcontractor shall jack under the roadways, and railways as indicated on the drawings. These borings shall be sleeved for a minimum of five feet on either side of the roadway or railway. Railway sleeves shall have a minimum of 4 feet of cover and roadway sleeves shall have a minimum of 3 feet of cover.

3.1.1.6 Stockpiles - Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Subcontractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Contractor. Locations of stockpiles of satisfactory materials shall be as shown subject to prior approval of the Contractor's On-site Representative.

3.2 BACKFILLING AND COMPACTION - Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill - Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 12 inches above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test. The trench shall not be backfilled until all specified tests are performed.

3.2.1.1 Replacement of Unyielding Material - Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material - Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Bedding and Initial Backfill - Bedding shall be of the type and thickness recommended by the pipe manufacturer. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill - The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways and Railroads: Pipe under roadways and railways shall be jacked under the roads and shall be blocked in the sleeves and shall have sand floated into the sleeve up to the springline of the pipe.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Water flooding or jetting methods of compaction will be permitted for granular noncohesive backfill material. Water jetting shall not be allowed to penetrate the initial backfill. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances - After the manhole, catch-basin, inlet, thrust block, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS - Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Water Lines - Trenches shall be of a depth to provide a minimum cover of 24 inches from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For railroad crossings an additional 24 inches of cover is required and for a road crossing and additional 12 inches of cover is required.

3.3.5 Plastic Marking Tape - Warning tapes shall be installed directly above the pipe, at a depth of 12 inches below finished grade unless otherwise shown. Warning tapes shall be terminated above grade and shall be tightly adhered to the piping a minimum of 6 inches above grade.

3.4 TESTING - Testing shall be the responsibility of the Subcontractor and shall be performed at no additional cost to the Contractor.

3.4.1 Testing Facilities - Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Subcontractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contractor's On-site Representative. The first inspection shall be at the expense of the Contractor. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Subcontractor.

3.4.2 Testing of Backfill Materials - Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture density relations of soils ASTM D 698. A minimum of one particle size analysis and one moisture density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests - Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 1000 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used and a minimum of 1 for each type of backfill material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contractor's On-site Representative. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contractor. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Contractor.

END OF SECTION

SECTION 02660

WATERLINES

PART 1 - GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI B1.20.1	(1983) Pipe Threads, General Purpose (Inch)
ANSI B16.1	(1975) Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B16.3	(1985) Malleable-Iron Threaded Fittings, Classes 150 and 300

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA-03	(1988) Manual for Railway Engineering (Fixed Properties): Chapter 1, Roadway and Ballast

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1988 Rev. a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM D 1599	(1988) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1981) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D 2241	(1988) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1988) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1988) Pocket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1988) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D 2855	(1983) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM F 477	(1976; R 1985) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1987) Hypochlorites
AWWA B301	(1987) Liquid Chlorine
AWWA C104	(1985) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1982) Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	(1987) Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids
AWWA C111	(1985) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

AWWA C115	(1983) Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	(1986) Ductile-Iron Pipe, Centrifugally Cast and in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153	(1988) Ductile-Iron Compact Fitting, 3 In. through 6 In. for Water and Other Liquids
AWWA C203	(1986) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape-Hot-Applied
AWWA C205	(1985) Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger--Shop Applied
AWWA C207	(1986) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In.
AWWA C208	(1983) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C500	(1986) Gate Valves for Water and Sewage Systems
AWWA C502	(1985) Dry-Barrel Fire Hydrants
AWWA C503	(1982) Wet-Barrel Fire Hydrants
AWWA C509	(1987) Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems
AWWA C600	(1987) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1986) Disinfecting Water Mains
AWWA C700	(1977) Cold Water Meters--Displacement Type

AWWA C701	(1978) Cold Water Meters--Turbine Type for Customer Service
AWWA C800	(1984) Underground Service Line Valves and Fittings
AWWA C900	(1981; Errata) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In. for Water
AWWA M23	(1980) PVC Pipe – Design and Installation

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-01	(1986, 2nd Ed.) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1975) Hazardous Chemicals Data
NFPA 325M	(1984) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1985) Identification of the Fire Hazards of Materials

NATIONAL SANITATION FOUNDATION (NSF)

NSF Std 14	(Oct. 1965, Rev. thru Oct. 1987) Plastic Piping System Components and Related Materials

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-Paint 21	(1982) White or Colored Silicone Alkyd Paint

SSPC-Paint 25 (1982) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.3 GENERAL - This section covers water supply distribution service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required.

1.3.1 Piping for Water Service Lines - Piping for water service lines less than three inches in diameter shall be galvanized steel, Polyvinyl Chloride (PVC) plastic, polyethylene, polybutylene, or copper tubing, unless otherwise shown or specified. Piping for water service lines for sizes 3 inches and larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic through 12-inch nominal diameter, filament-wound reinforced or centrifugally cast reinforced, thermosetting resin, thermosetting reinforced plastic mortar pressure pipe, or steel, unless otherwise shown or specified.

1.3.2 Piping for Water Distribution Lines Three Inches or Larger - Piping for water distribution lines three inches or larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic through 12-inch nominal diameter, filament-wound reinforced or centrifugally cast reinforced, thermosetting resin, thermosetting reinforced plastic mortar pressure pipe, or reinforced concrete, unless otherwise shown or specified.

1.3.3 Piping for Water Supply Lines Three Inches or Larger - Piping for water supply lines 3 inches or larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic through 12-inch nominal diameter, filament-wound reinforced or centrifugally cast reinforced, thermosetting resin, thermosetting reinforced plastic mortar pressure pipe, steel, or reinforced concrete, unless otherwise shown or specified.

1.3.4 Plastic Pipe - All thermoplastic piping system components (PVC, polyethylene and polybutylene) intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

1.3.5 Excavation, Trenching, and Backfilling for Water Lines - Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02222, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.4 SUBMITTALS

1.4.1 Installation Instructions - Submit the manufacturer's recommendations for each material or procedure to be utilized. The Subcontractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless otherwise directed by the Contractor. Submittals shall be in accordance with SECTION 01300 - SUBMITTALS.

1.4.2 Materials and Equipment - Submit manufacturer's descriptive data and technical literature for pipe, fittings, valves, valve boxes, gaskets, prefabricated concrete vaults, backflow preventer, jointing materials and other appurtenances. Submittals shall be in accordance with SECTION 01300 - SUBMITTALS.

1.4.3 Records - Deficiency Items - The Subcontractor will maintain a chronological record throughout the course of the subcontract of all uncorrected deficiency items.

1.4.4 Road and Railroad Jacking Procedures - The Subcontractor shall provide a written description of the procedures that will be used to jack and sleeve the pipe runs under roads and railroads. Specify the type of equipment that will be used.

1.4.5 Hangers and Bridge Crossing Procedures - The Subcontractor shall provide a written description of the procedures that will be used to jack and sleeve the pipe runs under roads and railroads. Specify the type of equipment that will be used.

1.4.6 Hydrostatic Testing and Flushing and Testing - The Subcontractor shall submit descriptions and results of all test procedures and the flushing and decontamination procedures used with all results.

1.5 HANDLING - Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Contractor.

Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place. Polyvinyl Chloride, pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49- and NFPA 325M.

1.5.1 Coated and Wrapped Steel Pipe - Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

PART 2 - MATERIALS

2.1 Materials - All pipe and related products shall conform to ANSI/NSF Standard 61. Materials shall conform to the respective specifications and other requirements specified below.

2.1.1 Pipe

2.1.1.1 Ductile-Iron Pipe - Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be encased with 6 mil thick polyethylene in accordance with AWWA C105. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Pipe - All pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4-Inch Diameter:

(1) Screw-Joint - Pipe to dimensional requirements of ASTM D 1785 Schedule 80, with joints and appurtenance meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, must be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint - Pipe shall be to dimensional requirements of ASTM D 1785, Schedule 40 with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure	Minimum Hydrostatic Pressure
26	100	133
21	120	160
17	150	200
13.5	200	266

In addition to the above requirements, the pipe, couplings and fittings must be hydrostatically tested as required by AWWA C900, and must be to iron pipe (I.P.S.) or cast iron outside diameter (CIOD) size dimensions.

(3) Solvent Cement Joint - Pipe to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

b. Pipe 4-Inch through 12-Inch Diameter - Pipe, couplings and fittings 4-inch through 12-inch diameter shall conform to the requirements of AWWA C900, Class 150, SDR 26, CIOD pipe dimensions only, elastomeric-gasket joint only, unless otherwise shown or specified.

2.1.1.3 Galvanized-Steel Pipe, Less Than Three Inches - ASTM A 53, standard weight.

2.1.1.4 Protective Materials for Steel Pipe - Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of one of the following the following for the indicated pipe material and size:

a. Steel pipe and fittings less than three inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203; threaded ends of pipe and fittings shall be adequately protected prior to coating.

b. Steel Pipe Three Inches or Larger, Not Galvanized:

(1) Cement-mortar coating and lining shall conform to and shall be applied in conformity with AWWA C205. Cement-mortar coating and lining shall not be used for pipe less than 4 inches in diameter.

(2) Coal-tar enamel lining, coating and wrapping shall conform to AWWA C203 for materials, method of application, tests and handling. Pipe shall be coated with coal-tar primer followed by a hot coat of coal-tar enamel, and a wrapper of kraft paper or a coat of water-resistant whitewash.

(3) Cement-mortar lining, in lieu of coal-tar enamel lining, may be used with coal-tar enamel coating and wrapping. Cement-mortar lining shall conform to and shall be applied in conformity with AWWA C205.

2.1.2 Joints

2.1.2.1 Ductile-Iron Pipe

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricant shall conform to the applicable requirements of AWWA C111.

2.1.2.2 Polyvinyl Chloride Pipe - Joints, fittings, and couplings shall be as specified for PVC pipe and comply with AWWA M23, AWWA C900. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contractor.

2.1.2.3 Insulating Joints - Insulating joints shall be installed between non-threaded ferrous and nonferrous metallic pipe, fittings and valves. Insulating joints shall consist of a sandwich-type flange insulating gasket of the dielectric type, insulating washers, and insulating sleeves for flange bolts. Insulating gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt insulating sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.1.2.4 Connections - Connections between fittings, valves or hydrants shall be made with jointing materials conforming to AWWA C603.

2.1.3 Fittings and Specials

2.1.3.1 Ductile-Iron Pipe - Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard thickness. Ductile-iron compact fittings shall be accordance with AWWA C153.

2.1.3.2 Polyvinyl Chloride (PVC) Pipe

a. For pipe less than 4-inch diameter, fittings for threaded pipe shall conform to the requirements of ASTM D 2464, threaded to conform to the requirements of ANSI B1.20.1 for use with Schedule 80 pipe and fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467 fittings for elastomeric-gasket joint pipe shall be ductile iron conforming to AWWA C110 or AWWA C111.

b. For pipe 4-inch through 12-inch diameter, fittings and specials shall be cast iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with the requirements of AWWA C900. Cast-iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

2.1.3.3 Dielectric Fittings - Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.1.4 Couplings

2.1.4.1 Mechanical Couplings - Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.1.5 Valves

2.1.5.1 Check Valves - Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to -MSS SP-80-, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the 125-pound type conforming to ANSI B16.1.

2.1.5.2 Gate Valves - Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than three inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves three inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient Seated Gate Valves - For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

2.1.5.3 Pressure Reducing Valves - Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for 150 psi operating pressure on the inlet side, with outlet pressure set for 70 psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.1.5.4 Vacuum and Air Relief Valves - Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float. Vacuum and Relief valves shall be installed at high and low spots in the line as recommended by the valve manufacturer.

2.1.5.5 Shut-off Valves - Shut-off valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than three inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves three inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

2.1.5.6 Indicator Post for Valves - Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by wrench. One wrench shall be provided for valve operation.

2.1.6 Valve Boxes - Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location.

2.1.7 Valve Pits - Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with the requirements of the American Concrete Institute.

2.1.8 Back Flow Preventers - Back flow preventers shall be installed at locations as shown on the plans. Preventer assembly shall be of brass containing two check valves, ball valves, full-port, and test cocks. It shall provide cross connection control subject to back pressure and shall be capable of operating under maximum pressure of 175 psi and maximum temperature of 140°F. Back flow preventer type valves shall conform to the performance requirements of AWWA C504.

2.1.9 Miscellaneous Items

2.1.9.1 Service Clamps - Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.1.9.2 Corporation Stops - Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.1.9.3 Goosenecks - Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections be in accordance with standard practice.

2.1.9.4 Service Stops - Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.1.9.5 Tapping Sleeves - Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable-iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound. Tapping sleeves shall of a type capable of performing a wet tap in the size and type of pipe indicated on the drawings.

2.1.9.6 Service Boxes - Service boxes shall be cast iron or concrete. Extension service boxes of the required length and having either screw or slide-type adjustment shall be installed at all service box locations. The boxes shall have housings of sufficient size to completely cover the service stop and shall be complete with identifying covers.

2.1.9.7 Disinfection - Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301

Hypochlorite, Calcium and Sodium: AWWA B300

2.1.9.8 Meters - Meters shall be of the displacement type conforming to AWWA C700 or turbine type conforming to AWWA C701. Registers may be round or straight reading type. Connection to the water line shall be as required for the particular installation. All meters used for the same system shall be of one type and manufacturer.

2.1.9.9Meter Boxes - Meter boxes shall be of cast iron or concrete of sufficient size to completely enclose the meter and shut-off valve or service stop. Box height shall extend from invert of the meter to final grade at the meter location. Cover shall be cast iron with the word "WATER" cast in it.

2.1.9.10 Pipe Insulation and Cover - The section of pipe suspended from the bridge to make river and bayou crossing shall be insulated against freezing with 1 inch heavy density pre-formed fiberglass insulation with an aluminum jacket approved for exterior service. The jacket shall be a heavy weight jacket with minimum thickness of 0.016 inch with 3/16 inch corrugations and shall equipped with a moisture barrier.

2.1.9.11 Freeze-proof Yard Hydrant - Freeze-proof yard hydrants shall be installed at locations shown on the plans, with adequate concrete support. The hydrant shall be designed to extend two feet above grade and will be fitted with appropriate hose assemblies. Signs shall be placed adjacent to the hydrants advising that the water is dispensed by the hydrant is "Non-potable Water". Sign lettering shall be a minimum of 3 inches high. Hydrants shall be installed on water line with 3/4" FPT and 1" MPT inlets. Hydrants will have a lever for flow control, shut-off valve, 3/4" brass garden hose thread outlets, and pipe column. The hydrant shall be installed so that the partial pipe column and the shut-off are below the frost line for maintaining water flow during the winter. Freeze-proof yard hydrant shall be McMaster-Carr Model Number 4728K22 or approved equal.

2.1.9.12 Expansion Control Joints- The aboveground lengths of ductile iron pipe traversing bridges and other structures shall be equipped with flexible expansion/contraction joints. One expansion joints shall be installed on each straight run of pipe to minimize the potential for pipe damage due to expansion and contraction. Expansion joint shall be a minimum of 150 lb. and shall have ASA companion flanged connectors, or an approved equivalent. Slip on expansion joints shall not be allowed, without prior approval. The expansion joints shall be supported with pipe hangers on both sides of the joint.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe - Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contractor, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable and all pipe shall be cut square, reamed to full diameter and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines - Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 9 feet in all directions from a sewer line except where the bottom of the water pipe will be at least 24 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 4 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 9 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 4 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than two feet above the sewer main. Joints in the sewer main, closer horizontally than 4 feet to the crossing, shall be encased in concrete.

3.1.2.2Water Lines - Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3Nonferrous Metallic Pipe - Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches must be maintained between pipes.

3.1.2.4Roads & Railroads - Water pipe shall be encased in a sleeve of rigid conduit extending a minimum of 5 feet on either side of the road or railroad. Sleeves under railroads shall be in accordance with the railroad company requirements the criteria contained in AREA-03, Part 5 and shall have a minimum cover of 4 feet. Where sleeves are required, in all other cases, the pipe sleeve shall be of rigid construction and shall have a minimum of 3 feet of cover. The sleeves under A minimum clearance of at least two inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with corrosion protection as required for the conditions encountered at the site of installation.

3.1.2.5Bridges - Pipe runs traversing bridges shall be suspended from the structure using non-binding roller (Harvard) type support system or an approved equivalent. Above grade piping shall be ductile iron or an approved equivalent. Should different piping material be used for below grade work the transitions shall be made a minimum of one full pipe length before rising above grade and one full pipe length after returning to subsurface elevation. The aboveground section shall be insulated and jacketed with aluminum and shall be protected at the hanger by a minimum of 12 inches of formed steel hanger protector. Hanger spacing shall as a minimum will comply with the requirements of the BOCA Plumbing Code and the pipe manufacturers recommendations.

3.1.2.6Structures - Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required for roads, railroads, and airfields. Care shall be exercised and proper precautions taken during installation of the water pipe and sleeve to assure that there will be no damage to the structures and no settlement or movement of foundations or footings. Any damage occurring as a result of the Subcontractor's operation shall be corrected and all costs connected therewith shall be borne by the Subcontractor.

3.1.3 Joint Deflection

3.1.3.1 Ductile-Iron Pipe - The maximum allowable deflection will be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.3.2 Flexible Plastic Pipe. Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contractor, but in no case shall it exceed 5°.

3.1.3.3 Steel Pipe - For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be 5° unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified hereinbefore.

3.1.4 Placing and Laying - Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contractor, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joining is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Subcontractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Connections - Connections between new work and existing mains shall be made by using fittings and procedures suitable to the actual conditions and material of construction identified in the field. Standard methods shall be used for making connections to various types of pipe, either under pressure (wet tap) or in dewatered condition (dry tap). Where made under pressure, these connections shall be installed as approved by the Contractor. Where possible connections shall be made without discontinuing service in existing lines.

3.1.4.2 Penetrations - Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic or caulk and shall be watertight.

3.1.4.3 Flanged Pipe - Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 Ductile-Iron Pipe - Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits. Aboveground ductile iron pipe shall be equipped with restrained joints.

3.1.5.2 Polyvinyl Chloride (PVC) Plastic Pipe

a. Pipe Less Than 4-Inch Diameter - Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. Care shall be exercised to assure the gasket and ring groove in the bell or coupling match. The manufacturer of the pipe or fitting must also supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall utilize sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4-Inch through 12-Inch Diameter - Joints shall be elastomeric-gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4-inch diameter with configuration utilizing elastomeric ring gasket.

3.1.5.3 Steel Pipe, Not Galvanized

a. Mechanical Couplings - Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.

b. Rubber Gaskets - Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the recommendations of the pipe manufacturer.

3.1.5.4 Galvanized-Steel Pipe - Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

3.1.5.6 Bonded Joints - Bonded joints shall be installed in accordance with details specified for joints under paragraph "MATERIALS."

3.1.5.7 Insulating Joints Dielectric Fittings - Insulating joints Dielectric fittings shall be installed in accordance with details specified for joints under paragraph "MATERIALS." Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8-inch thickness of coal tar over all fitting surfaces.

3.1.5.7 Connections - Connections between different types of pipe`and accessories shall be made with transition fittings approved by the Contractor.

3.1.6 Service Lines - Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately five feet outside the building where such building service exists. Where building services are not installed, the Subcontractor shall terminate the service lines approximately five feet from the site of the proposed building at a point designated by the Contractor. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with extension service boxes of the lengths required. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 2 Inches and Smaller - Service lines two inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in Table I. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

a. Connections to Mains - Heavy couplings may be utilized for connecting service lines smaller than two inches to new water mains. Couplings shall have factory threaded outlets. Threads may be either iron-pipe thread or AWWA type. A corporation stop and a gooseneck shall be provided with the connection. Maximum sizes for outlets shall be as follows:

Pipe Size Inches	Outlet Sizes Inches
3 and 4	3/4, 1, 1-1/4
6 and larger	3/4, 1, 1-1/4, 1-1/2

(1) Service lines 1-1/2 inches and smaller shall have a service stop.

(2) Service lines 2 inches in size shall have a gate valve.

(3) Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Three-inch and larger lines may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.7 Field Coating and Lining of Pipe

3.1.7.1 Steel Pipe 3 Inches and Larger, Not Galvanized

a. Cement-Mortar Coating and Lining - Field jointing shall conform to Appendix, AWWA C205. Any defective area found in the coating and/or lining of pipe and joints shall be removed to the pipe wall, and the area shall be repaired in a manner such that the repaired areas will be at least equal in thickness to the minimum coating and/or lining required for the pipe. Steel reinforcement in the coating shall be repaired or replaced as necessary to assure a complete and soundly reinforced coating.

b. Coal-Tar Enamel Coating, Lining and Wrapping - Field jointing shall conform to AWWA C203. The applied materials shall be tested by means of a spark-type electrical inspection device in accordance with the requirements of AWWA C203. Any flaws or holidays found in the coating and/or lining of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating and/or lining required for the pipe.

3.1.7.2 Galvanized-Steel Pipe - Field joints shall be given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203. The tests of the coating shall conform to -AWWA C203-, and any flaws or holidays found in the coating of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating required for the pipe.

3.1.8 Setting of Valves and Valve Boxes

3.1.8.1 Valves and Valve Boxes - Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8.3 Valves - Valves after delivery shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the hydrant or valve shall be fully opened and fully closed to insure that all parts are in working condition.

3.1.8.4 Service Boxes - Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.8.5 Valves - Check valves, Pressure reducing valves, Vacuum and air relief valves shall be installed in valve pits as shown.

3.1.9 Tapped Tees and Crosses - Tapped tees and crosses for future connections shall be installed where shown.

3.1.10 Thrust Restraint plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, shall be provided with thrust blocking, or metal tie rods and clamps or lugs, as directed. Valves shall be securely anchored or shall be provided with thrust blocking to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks - Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid undisturbed earth and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps shall be protected by galvanizing or by coating with bituminous paint.

3.1.10.2 Restrained Joints - For ductile-iron pipe, restrained joints shall be designed by the Subcontractor or the pipe manufacturer in accordance with DIPRA-01.

3.2 HYDROSTATIC TESTS - Where any section of a water line is provided with concrete thrust blocking for fitting or hydrants, the hydrostatic tests shall not be made until at least five days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test - After the pipe is laid, the joints completed, hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contractor when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the contract.

d. An unforeseeable cause which would result in excess cost.

The Subcontractor may request the waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02222 - EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test - Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to 200 psi pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

L = 0.0001351ND(P raised to 1/2 power) for pipe materials

In which L equals the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the foregoing table, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Contractor.

3.2.3 Time for Making Test - Except for joint material setting or where concrete reaction backing necessitates a 3-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

3.2.4 Concurrent Hydrostatic Tests - The Subcontractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Subcontractor at no additional cost to the Contractor.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be re-accomplished.

3.3 DISINFECTION - Before acceptance of potable water operation, each unit of completed water-line shall be disinfected as prescribed by AWWA C651 as specified herein. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite; or sodium hypochlorite, conforming to paragraph "MATERIALS." The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner.

Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case will the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each valve on the line shall be opened and closed several times. From several points in the unit, the Subcontractor shall take the indicated number of samples of water in proper sterilized containers for bacterial examination. Water samples will be collected and submitted to a laboratory approved by the State of Texas Department of Health. A minimum of 1 sample per 1,000 linear feet of installed pipe shall be collected and submitted for bacteriological analysis. The system will not be placed into service until the samples indicate that the facility is free from microbial contamination. The disinfection shall be repeated until tests indicate the absence of pollution for at least two full days. The facility will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP - Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

END OF SECTION

SECTION 02680
HDPE PIPE

016676

High Density Polyethylene (HDPE)/High Density Polyethylene (HDPE) Double Containment Piping System

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to install HDPE, PE 3408 (Primary/HDPE, PE 3408 (Secondary Containment) double containment piping, valves and appurtenances for complete systems as shown on the drawings and as specified herein, SDR rating as specified.

1.02 SUBMITTALS

Shop drawings shall be submitted to the engineer, and shall include details of pipe fabrications (Including supporting devices, method of attachment, spacing, etc), pre-fabricated double containment fitting dimensions, starting and terminating connections, high point vent and low point drain details for the secondary containment, valves and accessories. Submit joint details, methods and location of supports, and all other pertinent technical data for all piping to be furnished.

1.03 QUALIFICATIONS

The double containment piping system shall be a pre-fabricated system as manufactured by Guardian Systems, Div. of NIBCO Inc or approved equal. The system shall be designed, fabricated, installed and tested in accordance with manufacturer's recommendations and as specified herein and shall be suitable for the intended service. Manufacturer shall have a minimum of five (5) years experience. Contractor shall not design and or fabricate the piping system.

PART 2: PRODUCTS

2.01 GENERAL

Each contained piping system shall consist of HDPE primary piping system supported within a HDPE secondary containment housing. Each system shall be provided with suitable drains and vents and be designed to provide complete drainage of both the primary and secondary containment piping. Interstitial supporting devices shall be made from Polypropylene and shall be provided within the secondary containment pipe, they shall be designed to allow continuous drainage in the annular space to the low point drains. Drain fittings shall be designed to allow a valve attachment to be made so that the secondary containment compartment may be readily drained and manually checked for leaks.

2.02 MATERIALS

2.02.1 The primary pipe and fittings shall be manufactured from HDPE materials as listed by PE 3408.

2.02. The secondary containment pipe and fittings shall be manufactured from HDPE materials, as listed by PE 3408.

2.02.3 All listed primary and containment pipe shall be HDPE materials, and shall have SDR series wall thickness as specified. All listed pressure fittings shall be SDR rated as specified and manufactured according to ANSI. All other unlisted components that are intended for use as pressure retaining components shall have sufficient thickness and reinforcement so as to be able to maintain the same pressure ratings as specified.

2.02.4 Interstitial supporting devices, used to center and support the primary piping within the secondary containment piping, shall be manufactured from Polypropylene according to ASTM and ANSI.

2.02.5 All listed secondary containment pipe and components shall be PE 3408 HDPE materials, and shall have SDR series wall thickness as specified. All other unlisted components that are intended for use as pressure retaining components shall have sufficient thickness and reinforcement so as to be able to maintain the same pressure ratings as specified.

2.02.6 All fittings shall be pre-assembled and pre-tested by the manufacturer.

PART 3: EXECUTION

3.01 INSTALLATION

3.01.1 All installation procedures shall be according to the manufacturer's specific recommendations. [The manufacturer shall furnish the services of a competent representative to supervise the contractor's personnel during the start of installation.]

3.01.2 All primary and secondary piping welds shall be made using simultaneous thermal butt fusion techniques according to ASME B 31.3 standard. All fusion welding shall be performed in accordance to manufacturers recommendations and shall be subject to 100% visual inspection prior to testing.

3.01.3 The splitting and re-welding of fitting shall not be permitted. The use of hot gas welding for pressure retaining joints shall be kept to those locations where it is deemed necessary by manufacturer, and in any event shall not be permitted on pressure retaining joints of the primary piping system. Flanges, unions, couplings or other methods of disassembly shall be provided at connections to equipment, dissimilar piping, and at other locations suitable for inspection or dismantling of a system.

3.01.4 All contractor personnel that will prepare butt fusion field welds shall be qualified to do so according to the requirements of the ASME B 31.1, by sufficient experience, or by some other agreed to method, as determined suitable by manufacturer.

3.02 CLEANING AND TESTING

3.02.1 Upon completion of installation, the primary piping system shall be pressure tested at 150% of the system design pressure for a period of one hour. Additionally, the system may be tested during the installation at intervals to be determined by the manufacturer. Both the preliminary and final tests shall be done in strict accordance with the recommendations of the manufacturer, including the sequence and duration of such tests.

3.02.2 Upon completion of the installation, the secondary containment piping system shall be pneumatically tested at a minimum duration of 2-1/2 hours. The external joints should be soaped and visually inspected for leaks. It is imperative that a working pressure regulator be used during the pneumatic test to insure that overpressurization of the system, beyond 10 PSI cannot occur. Also, all precautions should be taken to protect against the hazards of a possible brittle fracture of pipe under compressed gas. Both the preliminary and final tests shall be done in strict accordance with the recommendations of the manufacturer, including the sequence and duration of such test.

3.02.3 Following installation of the systems, the primary piping system shall be flushed clean. The contractor shall check the operation of all valves, leak detection devices and appurtenances.

3.02.4 The annular space shall be purged of moisture containing air by replacing the volume of air with clean, dry nitrogen.

 ?16679

STRUCTURAL CONCRETE FORMWORK

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 347R	(1988) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1982; R 1988) Basic Hardboard

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1983) Construction and Industrial Plywood

1.3 SUBMITTALS - Contractor approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL

DESCRIPTIONS:

SD-04 Drawings

Concrete Formwork; FIO.

Drawings showing details of formwork including, dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

1.4 DESIGN - Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

2.1.3 Forms For Class D Finish - Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.7 Form Releasing Agents - Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork - Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION and conforming to construction tolerance given in TABLE 1. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING - Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING - Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS - Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. In no case will supporting forms or shores be removed before the concrete strength has reached 70 percent of design strengths as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1
TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:

   a. In the lines and surfaces of columns, piers, walls and in arises

   b. For exposed corner columns, control-joint grooves, and other conspicuous lines

2. Variation from the level or from the grades indicated on the drawings:

   a. In slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores

   b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines

3. Variation of the linear building lines from established position in plan

4. Variation of distance between walls, columns, partitions

5. Variation in the sizes and locations of sleeves, floor openings, and wall opening

6. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls

In any 10 feet of length —— 1/4 inch

Maximum for entire length —— 1 inch

In any 20 feet of length —— 1/4 inch
Maximum for entire length —— 1/2 inch

In any 10 feet of length ____ 1/4 inch
In any bay or in any 20 feet of length
——————————3/8 inch
Maximum for entire length——3/4 inch

In any bay or in any 20 feet of length
————————1/4 inch
Maximum for entire length—— 1/2 inch

In any 20 feet ———— 1/2 inch
Maximum ————— 1 inch

1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total variation
Minus ————————— 1/4 inch
Plus ————————— 1/2 inch

Minus ————————— 1/4 inch
Plus ————————— 1/2 inch

7. Footings:

a. Variations of dimensions in plan

b. Misplacement of electricity

c. Reduction in thickness

8. Variation in steps:

a. In a flight of stairs

b. In consecutive steps

AWD03100

Minus ——————— 1/2 inch
Plus ——————— 2 inches
when formed or plus 3 inches when placed against unformed excavation

two percent of the footing width in the direction of misplacement but not more than ——————— 2 inches

Minus ——————— 5 percent of specified thickness

Riser ——————— 1/8 inch
Tread ——————— 1/4 inch
Riser ——————— 1/16 inch
Tread ——————— 1/8 inch

END OF SECTION

016684

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(1989; 318R-89) Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1989a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 82	(1988) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184	(1988) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1988) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	(1989) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 499	(1981; R 1988) Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A 615	(1989) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675	(1988) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706	(1989) Low-Alloy Steel Deformed Bars for Concrete Reinforcement

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1979) Structural Welding Code-Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI DA4 (1990; 25th Ed) Manual of Standard Practice

1.3 SUBMITTALS - Indicate submittal classification in the blank space using "GA" when the submittal requires Contractor approval or "FIO" when the submittal is for information only.

SD-04 Drawings

Concrete Reinforcement System; FIO.

Detail drawings showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

1.5 DELIVERY AND STORAGE - Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 REINFORCING STEEL - Reinforcing steel shall be deformed bars conforming to ASTM A 615 or ASTM A 706, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82.

2.2 WELDED WIRE FABRIC - Welded wire fabric shall conform to ASTM A 185 or ASTM A 497.

2.3 WIRE TIES - Wire ties shall be 16-gauge or heavier black annealed steel wire.

2.4 SUPPORTS - Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI DA4 and shall be steel or precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT - Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.

3.1.1 Placement - Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing - Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by a mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC - Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

END OF SECTION

SECTION 03250

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS 11/88

PART 1 GENERAL

1.1 SUMMARY - (Not Applicable)

1.2 REFERENCES - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1982; R 1988) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 17511983	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752 (1984)	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2628 (1981)	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835 (1989)	Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

CORPS OF ENGINEERS (COE)

COE CRD-C 513	(1974) Rubber Waterstops
COE CRD-C 572 (1974)	Polyvinylchloride Waterstops

FEDERAL SPECIFICATIONS (FS)

FS SS-S-200	(Rev E; Am 1) Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

FS SS-S-1401 (Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

FS SS-S-1614 (Rev A; Notice 1) Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements

1.3 SUBMITTALS - Contractor approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 1300 SUBMITTAL DESCRIPTIONS:

SD-01 Data Materials; _____.

Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

SD-13 Certificates Materials; _____.

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.4 DELIVERY AND STORAGE - Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION-JOINT STRIPS - Contraction-joint strips shall be 1/8-inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 EXPANSION-JOINT FILLER - Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8-inch thick and of a width applicable for the joint formed.

2.3 JOINT SEALANT - Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Joint Seals - ASTM D 2628

2.3.2 Lubricant for Installation of Preformed Compression Seals - ASTM D 2835

2.3.3 Hot-Poured Type - FS SS-S-1401

2.3.4 Cold-Applied Jet-Fuel Resistant Type - FS SS-S-200, Type M

2.3.5 Hot-Applied Jet-Fuel Resistant Type - FS SS-S-1614

2.4 WATERSTOPS. Waterstops shall conform to COE CRD-C 513 or COE CRD-C572.

PART 3 EXECUTION

3.1 JOINTS - Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

3.1.1.1 Joint Strips - Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC strips shall be discarded and the insert left in place. Means shall be provided to insure true alignment of the strips is maintained during insertion.

3.1.1.2 Sawed Joints - Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete-sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC insert strips into the plastic concrete or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8-inch wide and shall extend into the slab approximately one-fourth the slab thickness but not less than 1 inch.

3.1.2 Expansion Joints - Premolded expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.

3.1.3 Joint Sealant - Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Types and locations of sealants shall be as indicated. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant. Joints sealed with field molded sealant shall be completely filled with sealant.

3.2 WATERSTOPS - Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Splices shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.

END OF SECTION

016691

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL - This section includes specifications for cast-in-place concrete work as shown on the Subcontract Drawings.

1.2 ITEMS - The principle items of work are as follows:

1.2.1 General - Providing normal weight cast-in-place concrete, including reinforcement and appurtenant materials, to the sizes and shapes and at the locations indicated, in accordance with ACI 301, as modified and supplemented herein, and in accordance with the Subcontract Documents.

1.3 QUALITY CONTROL

1.3.1 General - All work covered here under "Quality Control" will be provided by the Subcontractor as a subsidiary obligation of the Contract. SECTION 01400 - QUALITY CONTROL provides requirements for establishing and implementing the Subcontractor's Quality Control Program.

1.4 TESTING LABORATORY - All required laboratory tests to ensure that cast-in-place concrete and their placement comply with the specification shall be made by an independent testing laboratory.

1.5 TEST PROCEDURES - Tests for slump shall be made on concrete sampled from each truck load delivered to the site. Slump shall be determined using ASTM C 143.

1.6 SUBMITTALS

1. Submit certified concrete mix designs including proposed admixtures.

2. Submit certified test reports before delivery of materials as specified in SECTION 01300 - SUBMITTALS for each item listed below:

   - Admixtures
   - Aggregate
   - Cement
   - Reinforcing and accessories
   - Materials for curing concrete
   - Joint sealing materials

- Expansion joint materials

3. Submit reinforcing placement drawings and reinforcement steel schedules for all cast-in-place concrete work.

PART 2 - MATERIALS

2.1 REINFORCEMENT - Reinforcing bars shall comply with the requirements of ASTM A 615, minimum yield strength of 60,000 psi unless otherwise indicated. Reinforcing accessories shall conform to the requirements of CRSI Manual of Standard Practice.

2.2 ADMIXTURES

1. Concrete shall be 3000 psi (28-day) and higher and shall be air entrained unless otherwise indicated.

2. Water reducing and retarding admixtures may be used with the permission of the Engineer. The Subcontractor is responsible for the compatibility of admixtures.

3. The use of calcium chloride will not be permitted without approval.

2.3 APPURTENANT MATERIALS

2.3.1 Vapor Barrier - Polyethylene film shall be Product Standard PS17, 6 mil, or equal.

2.3.2 CURING MATERIALS

1. Curing paper shall conform to requirements of ASTM C 171, waterproof, clear or white polyethylene sheeting, or polyethylene-coated burlap. Use only non-staining material over all surfaces to remain permanently exposed.

2. Curing compound shall conform to requirements of ASTM C 309, white-pigmented, Type 2, free of paraffin or petroleum.

2.4 JOINT SEALER

1. Sealer hot applied shall conform to requirements of ASTM D 1190.

2. Sealer cold applied shall conform to requirements of ASTM D 1850.

2.5 MIX DESIGN

1. Concrete shall have a minimum 7-day compressive strength of 2500 psi and a minimum 28-day compressive strength of 3000 psi.

2. Cement shall be ASTM C 150 Type I.

3. Slump shall be between 1 and 3 inches in accordance with ASTM C 143.

4. Provide ASTM C 33 aggregate Size No. 57 or 67.

5. Air entrainment between 4 to 6 percent.

6. Maintain a maximum water cement ration of 0.45.

2.6 WATER - Water shall be potable.

PART 3 - EXECUTION

3.1 FORMS - Set forms true to line and grade and make mortar tight. Chamfer above grade exposed joints, edges, and external corners of concrete 3/4 inch, unless otherwise indicated. Before concrete placement, coat the contact surfaces of forms with a nonstaining form coating compound. Prevent concrete damage during form removal. Maintain forms for slabs in place until the concrete has attained 25 percent of the concrete's 28-day design strength, as approved by the Contractor.

3.2 REINFORCEMENTS -

1. Reinforcements shall be accurately formed and shall be free from loose rust, scale, and contaminates which reduce bond. Unless otherwise indicated on the Subcontract Drawings or specified herein, the details of fabrication shall conform to ACI 315 and 318.

2. Reinforcements shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips.

3. Splices shall conform to the requirements indicated on the Subcontract Drawings. Welding or tack welding of reinforcement is prohibited unless specified herein. Reinforcement upon which improper or unauthorized welding has been done shall be removed and replaced.

4. For slabs, a vapor barrier shall be placed above the compacted aggregate base material.

3.3 EMBEDMENTS

1. Anchor bolts, castings, steel shapes, conduit, sleeves, masonry anchorage, and other materials that are to be embedded in the concrete shall be accurately positioned in the forms and securely anchored.

2. Unless installed in pipe sleeves, anchor bolts shall have sufficient threads to permit a nut to be installed on the concrete side of the form or template. A second nut shall be installed on the other side of the form or template, and the two nuts shall be adjusted so that the bolt will be held rigidly in proper position.

3. Embedments shall be clean when installed. After concrete placement, surfaces not in contact with concrete shall be cleaned of concrete splatter and other foreign substances.

3.4 BATCHING AND MIXING

1. Concrete shall be furnished by an acceptable ready-mix concrete supplier and shall conform to ASTM C 94.

2. The consistency of the concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

3. A delivery ticket shall be prepared for each load of ready-mix concrete. A copy of each ticket shall be handed to the Subcontractor by the truck operator at the time of delivery. Tickets shall show the mix identification, quantity delivered, the amount of each material in the batch, the time at which the cement was added, the numerical sequence of the delivery, maximum amount of mixing water which can be added at job site to obtain specified water/cement ratio. Copies of all delivery tickets shall be submitted to the Contractor after completion of the pour.

3.5 CONCRETE PLACEMENT

1. Notify the Contractor before placing concrete. The limits of the concrete pour shall be predetermined by the Subcontractor and shall be acceptable to the Contractor. All concrete within such limits shall be placed in one continuous operation.

2. Wet down formwork and reinforcement before placing concrete so as to prevent leaching of water from concrete, but do not allow free water standing in the forms.

3. Before concrete is placed, forms, reinforcements, water stops, anchor bolts, and embedments shall be rigidly secured in proper position; all dirt, mud, water, and debris shall be removed from the space to be occupied by concrete; all surfaces encrusted with dried concrete from previous placement operations shall be cleaned; and the entire installation shall be acceptable to the Contractor.

4. Place concrete within 90 minutes after cement has been mixed with aggregate and within 45 minutes after addition of water and admixtures. Concrete which has not been placed within these time limits shall not be incorporated into the Work and shall be discarded off-site at no cost to the Contractor.

5. Concrete shall be conveyed to the point of final deposit by methods which will prevent separation or loss of ingredients. Concrete shall be placed in final position without being moved laterally in the forms more than 5 feet.

6. Concrete shall be thoroughly settled when top finished. All laitance, debris, and surplus water shall be removed from concrete surfaces at tops of forms by screeding, scraping, or other effective means. For all concrete pours, the forms shall be overfilled and after the concrete has settled, the excess shall be screeded off.

7. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcements and embedments and into the corners of the forms. Mechanical vibrators shall be used which maintain at least 9,000 cycles per minute when immersed in the concrete.

8. Cold weather concreting shall comply with ACI 306. Hot weather concreting shall comply with ACI 305.

3.6 FINISHING UNFORMED SURFACES

1. Buried concrete and encasement will require no finishing except that necessary to obtain the required surface elevations or contours. The unformed surfaces of all other concrete shall be screeded and given an initial float finish followed by additional floating, and troweling where required.

2. Unless specified to be beveled, exposed edges of floated or troweled surfaces shall be edged with a tool having 3/4 inch corner radius.

3. Exterior slabs shall be broom finished unless indicated. Provide a float finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3. CURING - Concrete shall be protected from loss of moisture for at least 7 days after placement. Curing shall be performed by one of the following methods:

3.8.1 Moist Curing - Continually wet the concrete throughout the curing period by ponding, immersion, fog spraying or sprinkling, or by use of wetted mats.

3.8.2 Impervious - Sheeting Curing - Wet the entire exposed surface thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting.

3.9 PROTECTION OF FINISHED SURFACES - Prohibit foot and vehicular traffic and other sources of abrasion during the curing period.

3.10 REPAIR AND/OR REMOVAL OF DEFECTIVE CONCRETE

1. Defects in formed concrete surfaces shall be repaired within 24 hours, to the satisfaction of the Contractor.

2. Concrete not repaired to the satisfaction of the Contractor or not meeting the requirements specified herein shall be removed, disposed of and replaced by the Subcontractor at no cost to the Contractor.

END OF SECTION

SECTION 05140
PREFAB METAL BUILDINGS

016697

1.0 DESIGN AND CONSTRUCTION

1.1 Buildings shall be designed according to the Metal Building Manufacturer's Association (MBMA), 1981, "Design Practice Manual", except as noted herein.

1.2 The basic design criteria, rationally applied to the structure and its components specified herein, shall conform to the applicable sections relating to design requirements and allowable stresses of the following publications.

1.2.1 American Institute of Steel Construction "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and "Code of Standard Practice for Steel Buildings and Bridges".

1.2.2 American Iron and Steel Institute - "Specification for the Design of Cold-Formed Steel Structural Members".

1.2.3 American Iron and Steel Institute - "Design of Light Gage Steel Diaphragms".

1.2.4 American Welding Society - "Structural Welding Code".

1.2.5 Aluminum Association - "Specification for Aluminum Structures".

1.2.6 Aluminum Association - "Aluminum Formed Sheet Building Sheathing Design Guide".

1.3 Building design shall be the manufacturer's standard size and type as specified on the purchase order with modifications as required to meet these specifications. Exceptions or deviations from these specifications must accompany the manufacturer's proposal.

1.4 The design shall meet the following load conditions.

1.4.1 Wind Loads: Fastest mile wind velocity shall be 70 miles per hour Exposure C Importance factor for wind loads shall be 1.00.

1.4.2 Roof Live Load: 20 pounds per square foot on horizontal projection.

1.4.2.1 Snow Loads: none

1.4.3 Superimposed loads as shown on the drawings.

1.4.4 Seismic Load: Zone 1 per UBC.

1.5 Structural framing members for openings shall be adequate for the specified design loads.

2.0 MATERIALS

2.1 Structural steel shall be in accordance with ASTM A-36.

2.2 Hot rolled steel sheet, plate and strip used in the fabrication of welded assemblies shall conform to the requirements of ASTM A529, A570 Grade E, or A572 Grade 42, minimum yield strength 42,000 psi.

2.3 Light gage cold-formed steel structural members shall be in accordance with the specifications of the American Iron and Steel Institute.

2.4 Hot rolled sheet and strip used in the fabrication of cold-formed members shall conform to the requirements of ASTM A570 Grade E, minimum yield strength 50,000 psi.

2.5 Main building frames and wind columns shall have 3/16 inch minimum web thickness and 1/4 inch minimum flange thickness.

2.6 Corrugated fiberglass siding and roof panels shall be acrylic modified polyester resin complying with the requirements of commercial sandard. CS-214-57 for general purpose, Type 1 and 2 materials.

2.6.1 Standard corrugation pattern shall be 7 in. x 1 1/2 in. Standard panel weights shall be nominal 8.0 oz. per sq. ft. for siding applications and nominal 12.0 oz. per sq. ft. for roofing applications. Panels shall have pebbled surface.

2.6.1.1 Acceptable siding will be:

Resolite Fire Snuf 25A
Lascolite Fireblock 25, with LasCoat coating Tuff-Span Series FR, with Acrylic Polymer coating

2.6.1.2 Color for translucent panels shall be:

Lascolite - 452 White (Approximately 50% Light Transmission)
Resolite - 31 White (Approximately 40% Light Transmission)
Tuff-Span - -- White (Approximately 50% Light Transmission)

Lascolite - #416 White Approximately 80% Light Transmission
Resolite - # 11 Clear Approximately 84% Light Transmission
Tuff-Span - -- Clear Approximately 80% Light Transmission)

2.6.1.3 Color for opaque panels shall be:

Lascolite - 638 Dawn Gray
Resolite - 33 Stone White
Tuff-Span - --White

3.0 <u>FASTENERS</u>

3.1 High strength bolts shall be used throughout, and shall conform to ASTM A325. Bolt usage shall conform to "Specifications for Structural Joints Using ASTM A325 or A490 Bolts", approved by "The Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation".

3.2 Connections using high strength bolts shall be designed as bearing type connections considering threads in a plane of contact surface.

3.3 Hardened flat washers are not required for A325 bolts.

3.4 Bolts shall be installed by the turn-of-the-nut method. Alternative methods may be submitted for approval by DEI.

3.5 Bolts shall have a minimum diameter of 3/4 inch except as otherwise shown or specified or where the size of a beam flange limits the size to a smaller bolt.

4.0 FABRICATION

4.1 Bolted connections shall not be less than two bolt connections.

4.2 Bolt holes in structural members shall be drilled or punched. Burning of holes will not be permitted.

4.3 Framing members shall be shop fabricated for bolted field assembly. Field cutting or drilling when required shall be clearly noted on the shop drawings.

4.4 All field connections shall be bolted.

4.5 Shop connections shall be welded in accordance with AWS D1.1.

5.0 PAINTING

5.1 Structural steel components shall be factory cleaned to remove loose dirt, grease and mill scale, and then painted with one coat of zinc chromate alkyd, formulated to equal or exceed the performance requirements of federal specification TT-P-636C.

5.2 Secondary structural framing such as purlins, girts, eave struts, door and window framing, etc. shall be primed finished in accordance with the requirements specified for the primary members.

5.3 Finish paint all structural component to match building using an acrylic based enamel.

5.4 Surfaces damaged during shipping or erection shall be repaired the same day.

5.4.1 Where damage to paint reveals the substrate metal, spot blast or power tool clean.

5.4.2 Where coating is damaged, remove dust, dirt and contamination and recoat per sections 5.1 & 5.2.

6.0 ERECTION

016700

6.1 Structures that are to be erected on concrete foundations shall be set to the grade shown on the drawings, using metal shims as required. The amount of shims required will be indicated on the drawings by the allowance for grout.

6.2 Framing members shall be set to the elevations and dimensions shown on the drawings.

6.3 The frame shall be carried up true and plumb, within the limits defined in Section 7 of the AISC Code of Standard Practice, and temporary bracing shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including equipment and the operation of same. Such bracing shall be left in place as long as may be required for safety.

6.4 As erection progresses, the work shall be securely bolted, or welded to take care of all dead load, wind and erection stresses.

6.5 No permanent bolting or welding shall be done until as much of the structure as will be stiffened thereby has been properly aligned.

6.6 The completed installation shall be plumb and square.

7.0 <u>SIDING AND ROOFING - PANELS</u>

7.1 Siding and roofing shall be 26 gage galvanized steel ribbed panels conforming to ASTM A44, Grade C (40,000 psi yield). The sheet steel shall be galvanized by the hot-dip process with a minimum of 1.25 ounces of zinc according to ASTM A525.

7.2 Interior panels shall be of 24 gage steel, with interlocking ribs at the side joints. The panels shall extend 10 foot 6 inches above the bottom of steel. The panels shall present a flush interior surface.

7.3 Panels fabricated from zinc-coated steel shall be thoroughly cleaned and phosphate treated, then coated on one face with a thermosetting acrylic plastic-base enamel. The enamel shall be oven baked resulting in a coating of a minimum of 1 mil. (.001 inch) thick. The color shall be determined by the DEI representative from manufacturer's standard colors.

7.4 Roof panels shall be designed to resist a live load of 20 pounds per square foot, and siding panels a wind load of 20 pounds per square foot.

8.0 <u>SIDING AND ROOFING - FASTENERS</u>

8.1 Siding and roofing fasteners shall be designed to resist an internal wind pressure of 20 pounds per square foot.

8.2 Side lap bolts are to be furnished with a neoprene washer for both the top and bottom sides.

8.3 No "S" clips shall be used.

8.4 Exposed fasteners and washers shall be color coated to match wall and/or roof panels.

8.5 Cadmium plated or galvanized 1/4-inch bolts or self tapping screws shall be used to attach sheets to steel structures. The bolts or screws shall have armored weather sealing neoprene washers, or engineer approved equal.

9.0 SIDING AND ROOFING - MATERIAL PROTECTION

9.1 Materials shall be handled carefully to prevent damage after delivery to the job site. Sheets shall be piled on firm, level supports which extend the full width of the sheets and are spaced approximately 12 inches on centers. Piles shall not exceed two feet in height. Corrugated panels shall be carefully nested.

9.2 The sheets shall not be piled on the roof during erection. The sheets shall not be subjected to abuse, overloading, or shock. Planks or chicken ladders shall be used by the erectors during erection and at any time that access to the roof is required.

10.0 SIDING AND ROOFING - ERECTION

10.1 Roofing and siding shall be applied by the stagger-joint method. Sheets shall be nested properly and applied in proper alignment. Vertical joints shall be plumb and at right angles to the horizontal lap lines.

10.2 Siding shall be applied with one corrugation side lap. Roofing shall be applied with two corrugation side laps.

10.3 End laps shall be a minimum of 6 inches, and shall occur over a purlin or girt.

10.4 Sheets shall be lapped away from the direction of the prevailing wind.

10.5 Before securing, endlaps and sidelaps of roofing panels shall be sealed with a continuous ribbon of tape sealer.

10.6 Closure strips shall be installed, where required, to insure a weather-tight structure. Closure strips shall be fabricated from synthetic rubber, expanded polyethylene, or polyvinyl chloride, matching configuration

10.7 Ridge rolls shall be installed with closure strips and sealed to make a watertight application.

10.8 Corner rolls shall be installed and sealed.

10.9 Closure strips shall be fabricated from synthetic rubber, expanded polyethylene or polyvinyl chlorine in proper matching configurations.

10.10 One side lap or "stitch" bolt shall be placed in the side lap midway between purlins and girts where the purlin or girt spacing exceeds 30 inches, and 2 (evenly spaced) when the span exceeds 48 inches.

10.11 No fasteners shall be placed in the center of the sheet at intermediate purlins where an end lap does not occur.

10.12 Panels shall be fastened to all purlins, girts, and supports.

10.13 Sidelap of panels shall be stitched through the rib with sheet metal screws at a maximum spacing of 20 inches.

10.14 Fastener shall be as recommended by panel manufacturer.

11.0 DOORS WINDOWS AND FRAMES

Doors, windows and frames shall be provided in accordance with DEI Spec. No. 6500, Architectural.

12.0 INSULATION

12.1 Insulated shall be .6 pound density glass fiber blanket, with reinforced foil-scrim-kraft (white textured) facing and flame spread rating of 25 or less. Unless otherwise noted, minimum insulation thickness shall be 4 inches on roof and 3 inches on side wall. Insulation blankets shall be provided with 2 inch edge tabs for the rolling and stapling required to secure the sidelaps.

12.2 Thermal spacers shall be 6 inches wide by 1 inch thick with a minimum density of 2 pcf., and a flame spread rating of 25 or less.

13.0 ACCESSORIES

13.1 Adjustable louver frame shall be fabricated from 16 gage galvanized steel and blades from 24 gage galvanized steel. Component pieces shall be coated per paragraph 7.3. Louver assembly shall be self-flashing and weather stripped with 1/16 inch by 1/2 inch pressure sensitive tape. Blades shall be equipped with nylon bushings at each end and designed to operate with tension spring and chain. Louver shall be furnished with interior mounted bird screen.

13.2 Roof curb bases shall be fabricated from 18 gage galvanized steel and coated per paragraph 7.3. Base height shall be 10 inches above the weather plane. Base of curb shall be formed to match roofing configuration, using a rubber closure strip for weather tight seal.

13.3 Gutters shall be fabricated from galvanized steel. Gutters shall have a factory finish paint application and shall be supported by painted galvanized steel hangers from roof panels. Assembly shall include preformed rubber weather seals at roof corrugations and preformed steel eave flashing. Downspouts shall be a minimum of 4"x 4" square, 26 gage factory colored steel.

13.4 Flashings and trim shall be provided at the rake, corners, eaves, framed openings and where necessary in accordance with the drawing detail and manufacturer's recommendation to ensure weather tightness and a finished appearance.

13.5 Gravity ridge ventilators shall be manufactured from 26 gage galvanized steel and painted to match building. Ventilator shall be furnished with bird screen, riveted end caps and chain operated damper. Throat opening to be 9". Skirt shall match the roof slope and shall be properly sealed to prevent entrance of rain.

14.0 FINISHING

14.1 Galvanized steel for flashings, metal closures, trim and other miscellaneous uses shall conform to ASTM A361, class G90 and be coated per paragraph 7.3.

14.2 Panels, gutters, downspouts and flashing shall be galvanized steel with 1.25 oz. zinc coating. After galvanizing , add two coats of vendor paint on both sides.

15.0 SHOP DRAWINGS

15.1 Proposal drawings shall be provided showing the proposed combination of structural systems, together with catalog information defining wall and roof panels, insulation values and accessory items to be furnished. Sufficient information is required for evaluation of bidding.

15.2 After the contract is awarded, applicable erection drawings and instructions shall be provided for approval prior to shipment of material.

16.0 WARRANTIES AND CERTIFICATION

16.1 All checked design notes and drawings shall bear the seal of a registered professional engineer, licensed to operate in the state of which the building is to be erected. If design is run on computer, send explanation along with output for interpretation.

16.2 The building manufacturer shall furnish column reactions and other forces that must be included in the foundation design, within 2 weeks after receipt of order.

16.3 The manufacturer shall accompany the proposal with complete specifications for the building, including the standard warranty coverage for workmanship and materials.

APPENDIX D

PUMPING WELL AND OBSERVATION WELL DATA SHEETS

016705

AWD Technologies, Inc
15204 Omega Drive
Rockville, Maryland 20850

Pumped Well No.________
Page 1 of _____

PUMP TEST WELL DATA SHEET

Site Address____

Project Number____________________ Well Ground Level Elevation____________________

Well Depth from Ground Level____________ Height of Measuring Point Above Ground Level__________

Well Inside Diameter__________ Screen: Length__________ Diameter__________ Depth to Top__________

Drilling Contractor____________________ Water Temperature__________°F/°C

SupervisingEngineer____________________ Weather____________________ Date____________

Time	Elapsed Time (min)	Depth to Water from M.P. (ft/m)	Nominal Drawdown or Recovery (ft/m)	Corrected Drawdown or Recovery (ft/m)	Pumping Rate (GPM)	Remarks

AWD Technologies, Inc

Date_______________

016706

Pumped Well No.________

Page ________ of ________

PUMP TEST WELL DATA SHEET

Time	Elapsed Time (min)	Depth to Water from M.P. (ft/m)	Nominal Drawdown or Recovery (ft/m)	Corrected Drawdown or Recovery (ft/m)	Pumping Rate (GPM)	Remarks

AWD Technologies, Inc
15204 Omega Drive
Rockville, Maryland 20850

Observation Well No. 016707
Page 1 of ______
For Pumped Well No. ______

PUMP TEST OBSERVATION WELL DATA SHEET

Site Address ______________________________

Project Number ______________ Well Ground Level Elevation ______________

Well Depth from Ground Level ______________ Height of Measuring Point Above Ground Level ______________

Well Inside Diameter ________ Screen: Length ________ Diameter ________ Depth to Top ________

Distance From Pumped Well ______________ Static Water Level ______________

Drilling Contractor ______________ Water Temperature ________ °F/°C

SupervisingEngineer ______________ Weather ______________ Date ______________

Time	Elapsed Time (min)	Depth to Water from M.P. (ft/m)	Nominal Drawdown or Recovery (ft/m)	Corrected Drawdown or Recovery (ft/m)	Pumping Rate (GPM)	Remarks

AWD Technologies, Inc

Date________________

Observation Well No.________

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For Pumped Well No.________

PUMP TEST OBSERVATION WELL DATA SHEET

016708

Time	Elapsed Time (min)	Depth to Water from M.P. (ft/m)	Nominal Drawdown or Recovery (ft/m)	Corrected Drawdown or Recovery (ft/m)	Pumping Rate (GPM)	Remarks