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NIROP FRIDLEY
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REMEDIAL ACTION WORK PLAN NIROP FRIDLEY MN
3/1/2000
TETRA TECH

Remedial Action Work Plan

Naval Industrial Reserve Ordnance Plant

Fridley, Minnesota

Southern Division
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0057

March 2000

TETRA TECH NUS, INC.

7842-3.4.2

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PITT-03-0-028

March 8, 2000

Project Number 7842

Commanding Officer
Department of the Navy
SOUTHDIVFACENGCOM
Attn: Joel Sanders (Code 1868)
2155 Eagle Drive
North Charleston, South Carolina 29406

Reference: CLEAN Contract Number N62467-94-D-0888
Contract Task Order 0057

Subject: Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota
Remedial Action Work Plan

Dear Mr. Sanders:

Please find enclosed two copies of the recently revised Remedial Action Work Plan for NIROP Fridley. We anticipate updating this report with the necessary QAPP supplement now that a site contractor for O&M has been selected. The second copy is for Bay West Consultants. We can send additional copies as necessary.

The specific items addressed by the revision are detailed in our recent letters to MPCA (February 7, 2000) and USEPA (February 10, 2000). Additional informal Navy review comments have also been incorporated.

If you have any questions, feel free to call me at (412) 921-8216.

Sincerely,

Mark Sladic, P.E.
Task Order Manager

MS/kf

Enclosure

cc: Kerry Morrow, NAVSEA (1 copy)
David Douglas, MPCA (2 copies)
Tom Bloom, USEPA-Region V (1 copy)
Richard Harris, RAB Co-Chair (1 copy)
Keith Henn, TtNUS (1 copy)
Debra Wroblewski (cover letter only)
Mark Perry/File 7842 (1 unbound copy)

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REMEDIAL ACTION WORK PLAN

NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
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CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0057

MARCH 2000

PREPARED UNDER THE SUPERVISION OF:	APPROVED FOR SUBMITTAL BY:
MARK SLADIC, P.E.	DEBBIE WROBLEWSKI
TASK ORDER MANAGER	PROGRAM MANAGER
TETRA TECH NUS, INC.	TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA	PITTSBURGH, PENNSYLVANIA

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ACRONYMS AND ABBREVIATIONS

AER	Allowable Emission Rate
CTO	Contract Task Order
FS	Feasibility Study
FFA	Federal Facility Agreement
ft	feet or foot
in	inch or inches
MCES	Metropolitan Council Environmental Services
MCL	Maximum Contaminant Level
MGD	Million Gallons per Day
MPCA	Minnesota Pollution Control Agency
MSL	Mean Sea Level
MWCC	Metropolitan Waste Control Commission
NPDES	National Pollutant Discharge Elimination System
OU	Operable Unit
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
RAB	Restoration Advisory Board
RAMP	Remedial Action Monitoring Plan
RAWP	Remedial Action Work Plan
RI	Remedial Investigation
ROD	Record of Decision
SDS	State Disposal System
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
SOUTHNAVFACENGCOM	Southern Division, Naval Facilities Engineering Command
TCE	Trichloroethene
TRC	Technical Review Committee
TtNUS	TetraTech NUS, Inc.
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

1.1 BACKGROUND

This Remedial Action Monitoring Plan (RAMP) was prepared by Tetra Tech NUS, Inc. (TtNUS) for the Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) under Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0057. This RAMP addresses monitoring requirements associated with the groundwater extraction and treatment system at the Naval Industrial Reserve Ordnance Plant (NIROP) in Fridley, Minnesota. The groundwater extraction and treatment system includes Phases I and II of a remedial action plan for the groundwater (Operable Unit [OU] 1), as defined in the Record of Decision (ROD) for Groundwater Remediation (USEPA, 1990).

The ROD was signed in September 1990 by representatives of the Navy, the U.S. Environmental Protection Agency (USEPA) Region V, and the Minnesota Pollution Control Agency (MPCA). The remedial action specified in the ROD called for the hydraulic containment and recovery of all future migration of contaminated groundwater from the NIROP and the recovery, to the extent feasible, of contamination downgradient of the NIROP. The selected remedy included the installation and operation of groundwater containment and extraction wells, with a two-phased plan for disposal of groundwater from the well system. Contaminated groundwater located off site and downgradient of the NIROP in Anoka County Park is currently being allowed to naturally dissipate, but this condition is under review.

Under Phase I, the groundwater from the extraction system was discharged to an existing sanitary sewer system for treatment at a local wastewater treatment facility. Under Phase II, a groundwater treatment system was constructed and is operated to provide longer-term groundwater treatment. Treated groundwater from the onsite treatment facility is discharged to the Mississippi River through a National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permitted outfall (Outfall 020).

The groundwater extraction system and pretreatment facilities began operating in September 1992. Monitoring of these facilities and the monitoring wells has been performed since startup according to the procedures described in the Remedial Action Workplan for Groundwater Remediation (RMT, 1995a) that was approved by the USEPA and the MPCA. This document has been developed to update and replace the 1995 document.

As required by the ROD, an evaluation of the effectiveness of the groundwater extraction system in achieving hydraulic containment of contaminated groundwater from the site during the initial 90-day operating period was submitted to the USEPA and the MPCA in December 1992 (RMT, 1992). The evaluation concluded that additional groundwater extraction well(s) would be needed to achieve effective hydraulic containment. A workplan for upgrading the original extraction system was prepared (RMT, 1995b) and approved by the USEPA and the MPCA. Two additional extraction wells were installed and placed into operation in June 1995. The combined groundwater extraction system consisting of six wells is currently in operation.

The concentrations of trichloroethene (TCE) and other volatile organic compounds (VOCs) in the combined discharge from the extraction wells decreased significantly since startup in 1992. The concentrations decreased to levels where pretreatment of groundwater was no longer needed to comply with the MCES discharge limits. With the approval of the MCES, the pretreatment system was shut down in March 1995, and the combined discharge from the extraction wells was discharged directly to the sanitary sewer.

Construction of the Phase II onsite groundwater treatment facility began in September 1997 and was completed and in operation in December 1998. Treated groundwater from this facility is now discharged to the Mississippi River through Outfall 020 (NPDES/SDS Permit MN0000710). The discharge to the MCES sanitary sewer system has been stopped.

A five-year review of the selected remedy for groundwater outlined in the ROD was signed in September 1998 (USEPA, 1998). The five-year review recommended the continued operation, maintenance, and upgrade (if necessary) of the groundwater containment and recovery system, with eventual onsite treatment and discharge of treated groundwater in accordance with the NPDES/SDS permit. The five-year review also recommended that the following determinations be made:

- By September 1999, the Navy will confirm whether the present groundwater extraction well system has achieved substantial hydraulic containment of the contaminant plume. If a substantial amount of contaminated groundwater is flowing past the extraction well system, the extraction system will be enhanced so that groundwater from the property does not continue to flow into Anoka County Park.

- By September 1999, the Navy will fill data gaps in the existing groundwater and surface water monitoring network and revise the RAMP to document the additional monitoring.

- By September 1999, the Navy will determine if any potential sources of contamination exist in Anoka County Park that may impact residual groundwater contamination levels in the area where residual groundwater contamination is present.

- The MPCA will conduct another surface water assessment to incorporate new groundwater sampling information and groundwater modeling information to determine whether surface water standards and criteria are exceeded after the above actions are completed.

- By September 1999, the Navy will determine what can be done to significantly reduce residual groundwater contamination in Anoka County Park. The Navy will also determine if a response action will enhance the effectiveness of the selected remedy as it relates to residual groundwater in Anoka County Park. If warranted, the Navy will implement this response action by September 2000.

The Navy has initiated activity designed to fulfill the determinations, although for reasons not always within the Navy's control, issues have not been resolved.

1.2 PURPOSE AND SCOPE

The purpose of this RAMP is to fulfill the requirements of the Federal Facility Agreement for the NIROP dated March 1991 and signed by the USEPA Region V, the Navy, and the MPCA.

The scope of this RAMP addresses the monitoring requirements associated with the selected remedy in the ROD for groundwater remediation. These monitoring requirements include the following: evaluation of the overall groundwater extraction and treatment system, evaluation of the potential for contamination from upgradient sources, compliance with NPDES/SDS permit requirements, and evaluation of impacts to the Mississippi River from the indirect discharge of contaminated groundwater. The RAMP does not specifically address monitoring requirements related specifically to operation and maintenance of the groundwater treatment facilities. An Operations and Maintenance Manual for the groundwater treatment facility is available for that purpose. See the O&M Manual for information about sampling and analysis requirements for the sanitary sewer discharge and air emissions.

The following documents and data form the basis for the scope of the monitoring program approach and details presented in the RAMP:

- ROD for Groundwater Remediation, Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota (USEPA, 1990).

- Five Year Review Report (USEPA, 1998).

- Remedial Investigation Report for the Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota (RMT, 1987b).

- Addendum to the Remedial Investigation Report for the Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota (RMT, 1988a).

- Feasibility Study Report for the Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota (RMT, 1988b).

- Addendum to the Feasibility Study Report for the Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota (RMT, 1988b).

- NPDES/SDS Permit MN0000710 (MPCA, 1996).

- Annual Monitoring Report (submitted annually, TtNUS).

- Various correspondence and telephone discussions among the MPCA, USEPA, Navy, United Defense, and TtNUS.

This RAMP does not address monitoring requirements associated with the recommendations from the five-year review (except for surface water monitoring) that are to be completed in the future. When the recommendations from the five-year review have been completed, the RAMP will be updated to reflect any additional monitoring requirements.

1.3 QUALITY ASSURANCE

The USEPA requires that all environmental-monitoring and measurement efforts mandated or supported by the USEPA participate in a centrally managed quality assurance (QA) program. Any party generating data under this program has the responsibility to implement minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of its data are known and documented. To ensure that the responsibility is met uniformly, each party must adhere to a written QA project plan (QAPP) covering each project it is to perform.

A QAPP that presents the organization, objectives, functional activities, and specific QA and quality control (QC) activities associated with this RAMP is provided in Part 2 of the RAWP.

1.4 CONTENTS OF RAMP

The contents of this RAMP are as follows:

- Section 1.0 Introduction
- Section 2.0 Site Characteristics
- Section 3.0 Groundwater Extraction and Treatment Facilities
- Section 4.0 Groundwater Monitoring
- Section 5.0 NPDES/SDS Effluent Monitoring
- Appendix A NPDES/SDS Permit and MCES Industrial Discharge Permit
- Appendix B MPCA Risk Based Site Characterization and Sampling Guidance
- Appendix C Strategic Exit Plan
- Appendix D Field Forms

The information provided in Sections 4.0 and 5.0 and Appendix A address field sampling procedures.

1.5 UPDATES

The Navy intends to incorporate the proposed list of monitoring wells, the frequency of sampling, and the analyte list for the next year, in each year's Annual Monitoring Report (AMR). The MPCA and EPA will review the proposals, ad once agreement is reached, this RAMP is to be considered modified to support the modifications. The RAMP may be amended by letter report, until this becomes unmanageable. At which time a revised RAMP should be issued.

2.0 SITE CHARACTERISTICS

This section contains a brief description of general site characteristics. Additional descriptions can be found in the Annual Monitoring Reports and the Remedial Investigation (RI) and Feasibility Study (FS) Reports.

2.1 SITE LOCATION AND DESCRIPTION

The NIROP Fridley is located in the northern portion of the Minneapolis/St. Paul Metropolitan Area within the city limits of Fridley, Minnesota (Figure 2-1). Advanced naval weapons systems are designed and manufactured at the NIROP. The northern portion of the facility is government owned and operated by a private contractor (United Defense L.P. – Armament Systems Division), and the remainder of the facility is owned and operated independently by United Defense L.P. The site owner and occupants are likely to change in the future. The government-owned portion of the facility constitutes what is referred to as the NIROP Fridley site.

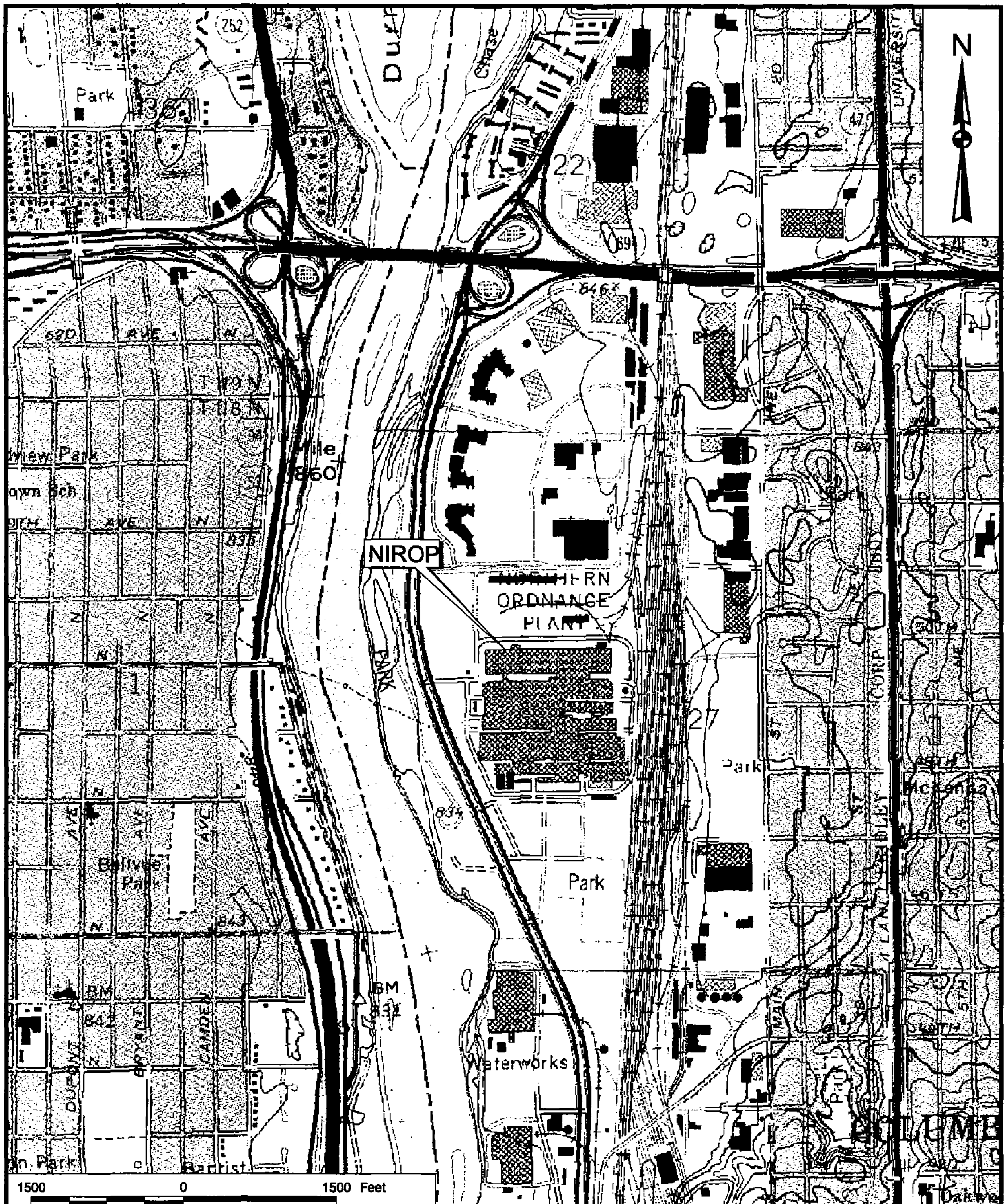
The site comprises approximately 82.6 acres, most of which is covered with buildings or pavement. The site is situated on a broad, flat glacial drift terrace that is approximately 30 feet above and 2000 feet east of the Mississippi River.

Adjacent land use is commercial and light industrial to the north, industrial to the south, recreational to the west, and railyards and commercial/light industrial to the east.

Natural resource use in the area consists of recreational activities in the Anoka County Riverfront Regional Park (Anoka County Park) that is directly across East River Road from the NIROP site and adjacent to the Mississippi River. Use of these resources does not result in access to the NIROP Fridley site, which is highly restricted by the Department of Defense. No federal or state freshwater wetlands are located within one mile of the site. No critical habitats of endangered species or national wildlife refuges have been identified near the site.

2.2 SITE HYDROGEOLOGY AND GROUNDWATER FLOW

The NIROP Fridley site is underlain by an unconsolidated sand and gravel aquifer that overlies a bedrock aquifer. The water table is 20 to 25 feet below the ground surface in the unconsolidated aquifer, which consists of approximately 100 feet of saturated thickness. A discontinuous clayey glacial till layer is present at various depths below the ground surface. The underlying bedrock consists of Prairie du Chien



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CHECKED BY	DATE	FACILITY MAP NIROP FRIDLEY, MINNESOTA	APPROVED BY	DATE
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Dolomite and Jordan Sandstone, which are referred to as the PCJ aquifer. The basal unit of the St. Peter Sandstone that overlies the PCJ aquifer across the northern portion of the site acts as a confining layer where it is present. Where it is absent, the unconsolidated aquifer is hydraulically connected to the PCJ aquifer. Groundwater flow in the unconsolidated aquifer is generally from the northeast to the southwest across the site toward the Mississippi River. The groundwater containment and extraction system has altered the groundwater flow characteristics.

The City of Fridley owns and operates a backup potable water supply well (Fridley Well No. 13) that draws water from the PCJ aquifer immediately north of the NIROP site. The total population served by groundwater within a 3-mile radius of the site is approximately 29,000 residents. Three onsite production wells that are completed in the PCJ aquifer are no longer in use. There are no groundwater supply wells or downgradient users between the facility and the Mississippi River.

The City of Minneapolis Water Treatment Plant intake, which draws water from the Mississippi River, is located less than one mile downstream from the NIROP site. Approximately 500,000 people are served by this treatment plant.

2.3 GROUNDWATER QUALITY

Groundwater in portions of the unconsolidated aquifer beneath the NIROP Fridley contains VOCs, including the following: 1,1-dichloroethane; 1,2-dichloroethene; ethylbenzene; tetrachloroethene; toluene; 1,1,1-trichloroethane; trichloroethene (TCE); and xylenes. The concentrations vary widely across the site; however, TCE has been detected more frequently and at higher concentrations than any other VOC. Results of laboratory analyses of samples collected from groundwater monitoring and extraction wells during each calendar year are presented and discussed in the Annual Monitoring Report (AMR) that is issued each year.

3.0 GROUNDWATER EXTRACTION AND TREATMENT FACILITIES

3.1 GROUNDWATER EXTRACTION

The groundwater containment and extraction system consists of six pumping wells and related piping and appurtenances. A site plan showing the locations of the extraction wells and associated facilities is shown in Figure 3-1.

The extraction wells are identified as well numbers AT-1A, AT-2, AT-3A, AT-4, AT-5A, and AT-5B. Wells AT-2, AT-3A, AT-5A, and AT-5B were constructed and located to contain contaminated groundwater along the southwestern portion (downgradient) of the NIROP site. Wells AT-1A and AT-4 were constructed and located to contain and extract contaminated groundwater on the eastern and northern sides of the plant, respectively.

A schematic diagram showing the components of the groundwater extraction and treatment facilities is shown on Figure 3-2. The discharge from each of the six extraction wells is routed via separate pipelines to a Control House that is located near the security fence on the western side of the plant. Instrumentation provided at the Control House includes a flow rate indicator and a flow volume totalizer for each extraction well discharge. The combined discharge from the six extraction wells flows via a single pipe to a Treatment Building located near the Control House. Sampling ports are located on the piping for each extraction well and the combined discharge to the Treatment Building.

3.2 GROUNDWATER TREATMENT SYSTEM

The construction of the treatment system involved the adaptation of the former pretreatment system and the installation of additional process equipment to ensure that NPDES discharge permit requirements are met.

The major components of the treatment system include a feed tank, air stripping units, and an effluent system. The feed system consists of an equalization tank to collect the groundwater pumped from the extraction well system and feed pumps to convey the groundwater from the equalization tank to the air strippers. Four low profile, tray-type air strippers are operated in parallel. The effluent water flows by gravity to the effluent sump, and the exhaust air is vented to the atmosphere. Effluent pumps convey the treated water from the effluent sump to an existing 72-inch diameter storm sewer. This storm sewer discharges to the Mississippi River through NPDES/SDS Outfall 020.

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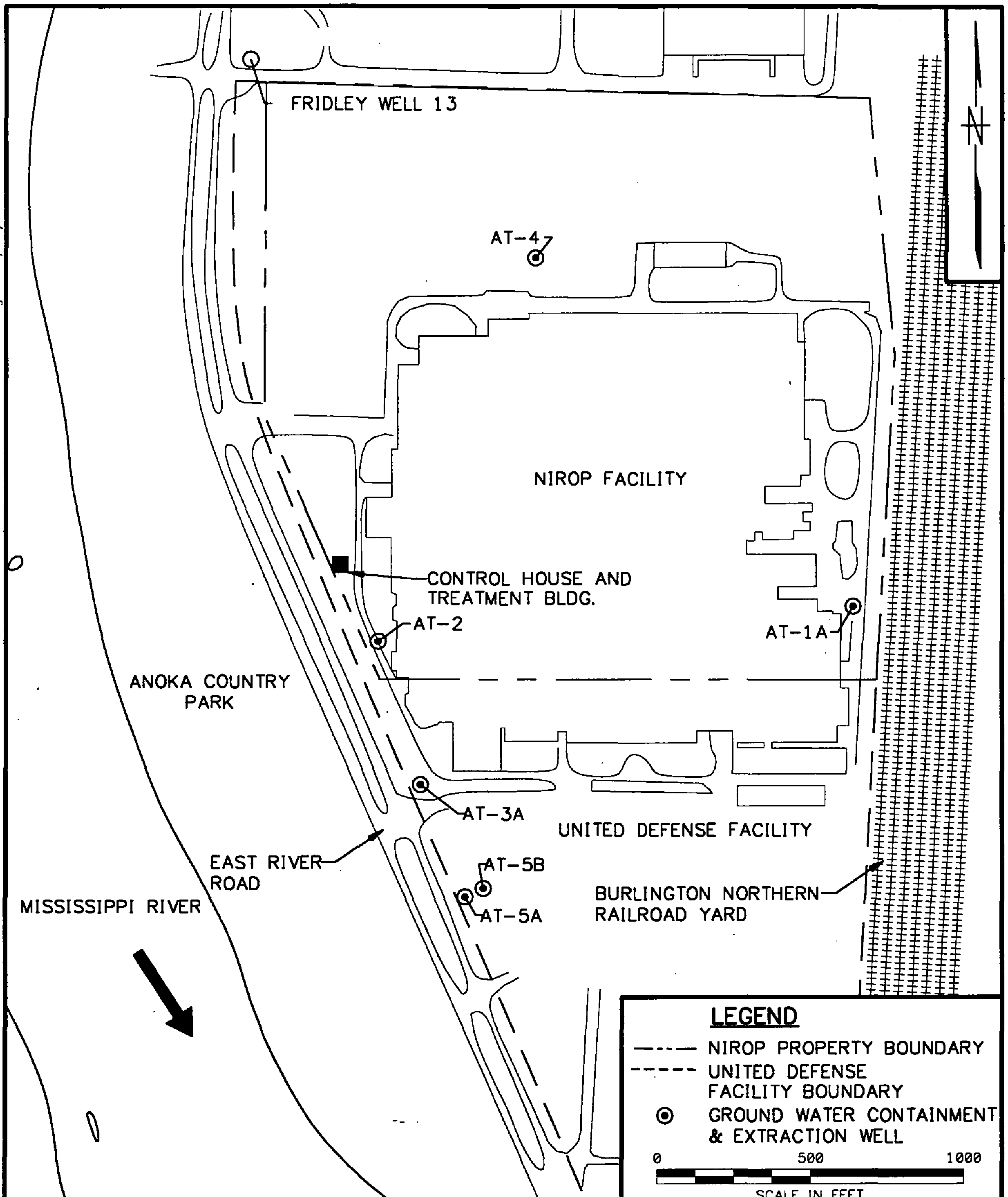

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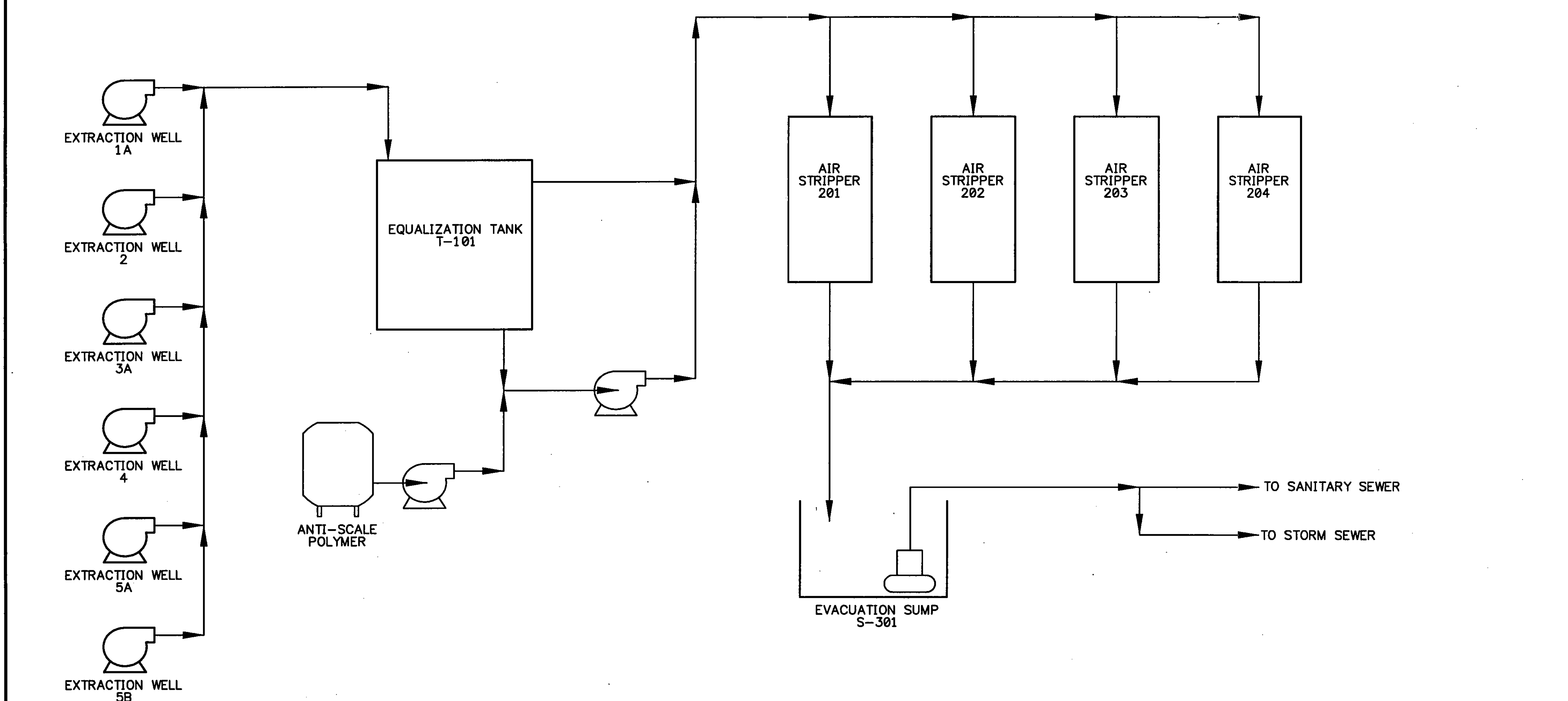

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GROUNDWATER EXTRACTION AND TREATMENT SYSTEM
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

CONTRACT NO. 7842
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There are no air emission controls for the air strippers. An analysis was conducted to establish site-specific allowable emission rates (AERs) for the groundwater treatment facility (Morrison Knudsen Corporation, 1998). Site-specific AERs are emission rate limits that ensure that maximum offsite ambient air impacts are below regulatory-defined allowable offsite concentrations (i.e., increased cancer risk to the public of 1E-05). Site-specific AERs were calculated for carcinogenic compounds that could potentially be emitted from operation of the groundwater treatment facility. The approach used involved using an atmospheric dispersion model to "back model" from the maximum allowable offsite impact to annual average site-specific AERs. The site-specific AERs and the maximum groundwater production rate were then used to calculate maximum allowable concentrations for groundwater entering the treatment facility. In this manner, groundwater concentrations can be used to predict air emissions so that measurement of air emissions is not required. The conservatively estimated allowable groundwater contaminant concentrations are all well above measured groundwater concentrations. Therefore, it is anticipated that no emission control measures will be required for operating the groundwater treatment facility. Samples of the air stripper influent and effluent were collected during start-up of the groundwater treatment facility to confirm that site-specific AERs were met. Additional samples of influent and effluent are to be collected to meet NPDES permit requirements. See Appendix A. To date, AERs have not been exceeded.

It is likely that the extraction well system will be modified in the future. Any system modifications are subject to permit approval, and can result in permit modifications. These permit modifications could result in modified AERs.

4.0 GROUNDWATER MONITORING

4.1 OBJECTIVES

The objectives of groundwater monitoring are as follows:

- Evaluate the ability of the groundwater extraction system to effectively contain downgradient migration of contaminants and provide water quality improvement;
- Assess the potential for contamination from onsite sources and upgradient (offsite) sources;
- Evaluate air stripper emissions to the atmosphere;
- Evaluate whether or not the remedies comply with the Record of Decision (ROD);
- Evaluate whether or not the remedies are protective of human health and the environment;
- Evaluate the progress of the remedies in achieving the goals specified in the ROD;
- Evaluate whether or not project permits are met; and
- Evaluate the relative contaminant concentrations along the flow path in relation to the following: upgradient groundwater conditions, known and potential source areas, capture and non-capture of the groundwater contaminant plume, residual contamination beyond the effectiveness of the capture of the remedial system and discharge to the river, and vertical head relationships and the potential flow of contaminants from one aquifer interval to another.

The objective of groundwater remediation is to ultimately restore groundwater quality to Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs). The constituents to be monitored and their respective MCLs are provided in Table 4-1.

RMT, Inc. previously conducted and air quality analysis of the Groundwater Treatment Facility at NIROP Fridley. The analysis involved modeling three emission scenarios with a configuration of four 55-foot high emission stacks.

TABLE 4-1

**GROUNDWATER CHEMICALS AND TARGET CLEANUP LEVELS
NIROP FRIDLEY
FRIDLEY, MINNESOTA**

Parameter	Maximum Contaminant Level (μg/L)
Acetone	700
Benzene	5
Bromodichloromethane	80
Bromoform	80
Bromomethane	--
2-Butanone	--
Carbon disulfide	--
Carbon tetrachloride	5
Chlorobenzene	100
Chloroethane	--
Chloroform	80
Chloromethane	--
Dibromochloromethane	80
1,1-Dichloroethane	--
1,1-Dichloroethene	7
1,2-Dichloroethane	5
1,2-Dichloroethene (total)	70 (cis-)
1,2-Dichloropropane	5
1,3-Dichloropropene (cis-)	--
1,3-Dichloropropene (trans-)	--
Ethylbenzene	700
2-Hexanone	--
Methylene chloride	5
4-Methyl-2-pentanone	--
Styrene	100
1,1,2,2-Tetrachloroethane	--
Tetrachloroethene	5
Toluene	1,000
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
Trichloroethene	5
Vinyl chloride	2
Xylenes (total)	10,000

Maximum contaminant levels (MCLs) per 40 CFR 141.

The analysis was conducted to establish site-specific allowable emission rates (AERs) for the Groundwater Treatment Facility. Site-specific AERs are emission rate limits that ensure that maximum off-site ambient air impacts are below regulatory-defined allowable off-site concentrations. Allowable off-site air concentrations are based on an increased cancer risk to the public of 10^{-5} (10-in-one million). Site-specific AERs were calculated for carcinogenic compounds that were previously identified as potentially emitted contaminants from the operation of the Groundwater Treatment Facility.

The approach used in this analysis involved using the EPA-approved Industrial Source Complex Short-Term, Version 3 (ISCST3) (Rev 2), atmospheric dispersion model to "back model" from the maximum allowable off-site impact to annual average site-specific AERs. The site-specific AERs and the maximum groundwater production rate were then used to calculate maximum allowable concentrations for groundwater entering the facility. Table 4-2 presents the allowable air concentrations based on 10^{-5} risk, AERs, and allowable groundwater concentrations.

The allowable groundwater concentration is the level that will not cause the allowable air concentration to be exceeded, based on modeling.

4.2 MONITORING LOCATIONS AND FREQUENCIES

The selection of groundwater monitoring locations has been designed to meet the objectives listed in Section 4.1. Figure 4-1 shows the locations of all monitoring and extraction wells at the site. Fifty wells have historically been used to evaluate the effects of the groundwater extraction system. These include 44 monitoring wells and the 6 extraction wells. Table 4-3 lists the monitoring wells for monitoring groundwater chemical characteristics, and Table 4-4 lists data quality objectives and the intended data uses. Some of the wells specified in the previous RAMP have since been renumbered. The water level monitoring network includes all of the existing onsite and offsite wells (e.g., Anoka County Park) at the site (Figure 4-1; see Section4.3.2.1). The 42 newly installed monitoring wells included on Figure 4-1 and Table 4-3 were also sampled as part of the Anoka County Park investigation. These wells are currently being evaluated as to whether or not they will be included into the annual monitoring well network.

One additional well is included in the RAMP to address issues not directly related to containment. Fridley Well No. 13, which is currently not in use, is sampled to confirm that the potable water supply from this well will remain unaffected by groundwater contamination from the site.

The monitoring and extraction wells are sampled on a semi-annual basis, in April and October. Fridley Well No. 13 is sampled on an annual basis, in April.

TABLE 4-2

SITE-SPECIFIC ALLOWABLE AIR EMISSION RATES AND GROUNDWATER CONCENTRATIONS NIROP FRIDLEY FRIDLEY, MINNESOTA

Parameter	Allowable Air Concentrations (µg/m³)	Allowable Emission Rate (µg/sec)	Allowable Groundwater Concentration (µg/L)
1,1-Dichloroethane	500	1.35E+8	2,100,000
1,1-Dichloroethene	0.2	5.4E+4	850
Methylene chloride	20	5.4E+6	85,000
Tetrachloroethene	17.2	4.6E+6	73,000
Trichloroethene	5.9	1.6E+6	25,000

Source: Morrison Knudson Corporation, 1998.

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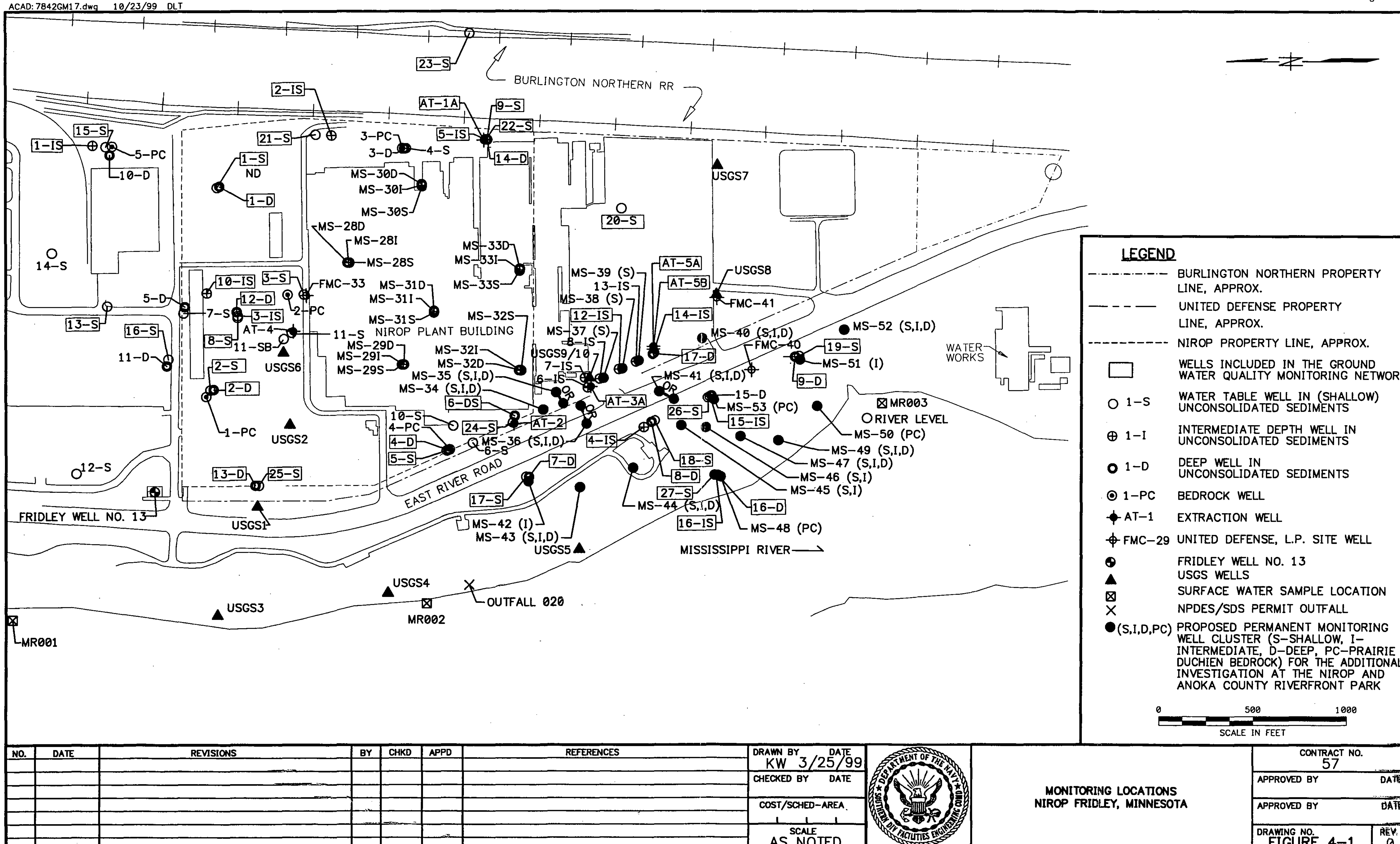

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TABLE 4-3

MONITORING WELLS FOR MONITORING GROUNDWATER CHEMICAL CHARACTERISTICS
NIROP FRIDLEY, MINNESOTA
PAGE 1 OF 2

Unconfined Aquifer		Upper Confined Aquifer	Prairie du Chien Aquifer
Shallow Wells	Intermediate Wells		
1-S	1-IS	1-D	1-PC
2-S	2-IS	2-D	2-PC
3-S	3-IS	4-D	3-PC
5-S	4-IS	6-D	4-PC
7-S	5-IS	7-D	5-PC
8-S	10-IS	8-D	MS-48PC[1]
9-S	12-IS	9-D	MS-50PC[1]
13-S	14-IS	12-D	MS-53PC[1]
15-S	15-IS	13-D	
16-S	16-IS	14-D	
17-S	MS-34I[1]	15-D	
18-S	MS-35I[1]	16-D	
19-S	MS-36I[1]	17-D	
20-S	MS-40I[1]	MS-34D[1]	
21-S	MS-41I[1]	MS-35D[1]	
23-S	MS-42I[1]	MS-36D[1]	
24-S	MS-43I[1]	MS-40D[1]	
25-S	MS-44I[1]	MS-41D[1]	
26-S	MS-45I[1]	MS-43D[1]	
27-S	MS-46I[1]	MS-44D[1]	
MS-34S[1]	MS-47I[1]	MS-47D[1]	
MS-35S[1]	MS-49I[1]	MS-49D[1]	
MS-36S[1]	MS-51I[1]	MS-52D[1]	
MS-37S[1]	MS-52I[1]		
MS-38S[1]			
MS-39S[1]			
MS-40S[1]			
MS-41S[1]			
MS-43S[1]			
MS-44S[1]			
MS-45S[1]			
MS-46S[1]			
MS-47S[1]			
MS-49S[1]			
MS-52S[1]			

TABLE 4-3

MONITORING WELLS FOR MONITORING GROUNDWATER CHEMICAL CHARACTERISTICS NIROP FRIDLEY, MINNESOTA PAGE 2 OF 2

Unconfined Aquifer		Upper Confined Aquifer	Prairie du Chien Aquifer
Shallow Wells	Intermediate Wells		
MS-28S	MS-28I	MS-28D	
MS-29S	MS-29I	MS-29D	
MS-30S	MS-30I	MS-30D	
MS-31S	MS-31I	MS-31D	
MS-32S	MS-32I	MS-32D	
MS-33S	MS-33I	MS-33D	

NOTE: The wells with the prefix MS are permanent wells that were recently installed for the additional investigation at the NIROP and Anoka County Riverfront Park.

1 Wells are currently being installed (September-November 1999). These wells will be sampled once (November 1999) during the same investigation. Samples from these wells will be used in making decisions regarding understanding of site hydrogeology, potential OU1 remedial improvements, evaluating the Anoka County Park remedies, and the discharge of site groundwater to the Mississippi River. These wells may also be used for the monitoring of potential migration of contaminants from off-site sources. Upon receipt of the analytical, the Navy will evaluate the need to include them into the monitoring well network.

TABLE 4-4

DATA QUALITY OBJECTIVES FOR GROUNDWATER CHEMICAL ANALYSIS
NIROP FRIDLEY
FRIDLEY, MINNESOTA
PAGE 1 OF 3

Well Group/Location	Well Identification Number	Intended Data Use
Northeast, off site, upgradient (background wells)	15-S, 1-IS	Assess quality of background groundwater.
North, off site, sidegradient	13-S, 16-S	Assess quality of background groundwater.
North, on site	2-S, 2-D	Assist in defining shallow and deep groundwater quality at northern boundary of site and near perimeter of contaminated groundwater zone. Assist in evaluating rate of groundwater quality improvement over time at boundary of site.
	7-S, 10-IS	Assist in evaluating rate of improvement of shallow and intermediate depth groundwater quality over time.
	1-S, 1-D	Assist in confirming continued minimal groundwater impacts in northeast area of site.
North 40	8-S, 3-IS, 12-D, 3-S, 2-PC	Assist in evaluating rate of groundwater quality improvement over time in vicinity of former waste disposal areas.
Northwest, on site	25-S, 13-D	Assist in confirming continued absence of groundwater impacts in northwest corner of site near perimeter of contaminated groundwater zone. Define groundwater chemistry to support conclusions regarding capture zone effectiveness based on groundwater flow model and particle tracking simulation.
East, on site	21-S, 2-IS	Assist in evaluating rate of groundwater quality improvement over time at site boundary.
	9-S, 5-IS, 14-D	Assist in defining shallow, intermediate, and deep groundwater quality at eastern boundary of site at an extraction well location. Assist in evaluating rate of groundwater quality improvement over time.
East, off site	23-S	Assist in defining contaminant concentrations due to offsite, upgradient source.
West, on site	5-S, 4-D	Assist in confirming continued minimal groundwater impacts on west side of site near perimeter of contaminated groundwater zone. Define groundwater chemistry to support conclusions regarding capture effectiveness based on groundwater flow model and particle tracking simulation.
	24-S, 6-D	Assist in evaluating continued improvement in shallow and deep groundwater quality over time at an extraction well location.
West, off site	17-S, 7-D	Assist in defining shallow and deep groundwater quality to west of site in Anoka County Park. Assist in evaluating rate of groundwater quality improvement over time.

TABLE 4-4

DATA QUALITY OBJECTIVES FOR GROUNDWATER CHEMICAL ANALYSIS
NIROP FRIDLEY
FRIDLEY, MINNESOTA
PAGE 2 OF 3

Well Group/Location	Well Identification Number	Intended Data Use
South, off site	20-S	Assist in confirming continued minimal groundwater impacts to south of site at perimeter of contaminated groundwater zone. Define groundwater chemistry to support conclusions regarding capture zone effectiveness based on groundwater flow model and particle tracking simulation.
Southwest, off site	12-IS, 14-IS, 17-D	Assist in evaluating rate of groundwater quality improvement over time and effects of startup of two additional extraction wells (AT-5A and AT-5B).
	18-S, 4-IS, 8-D, 26-S, 15-IS, 15-D	Assist in defining shallow, intermediate, and deep groundwater quality to southwest of site in Anoka County Park. Define groundwater chemistry to support conclusions regarding ability of extraction well system to capture contaminated groundwater downgradient of site in Anoka County Park, based on groundwater flow model and particle tracking simulation. Assist in evaluating rate of groundwater quality improvement over time as VOCs are flushed out of aquifer.
	27-S, 16-IS, 16-D	Assist in defining shallow, intermediate, and deep groundwater quality at riverbank downgradient of site where groundwater discharges into river. Assist in evaluating rate of groundwater quality improvement over time. .
	19-S, 9-D	Assist in evaluating rate of groundwater quality improvement over time at farthest location of impacted groundwater downgradient of site near perimeter of contaminated groundwater zone.
	MS-34(S, I, D), MS-35(S, I, D), MS-37(S), MS-38(S), MS-39(S), MS-40 (S, I, D)	Assist in verifying capture zone effectiveness of the extraction system.(1)
Groundwater extraction wells	AT-1A, AT-2, AT-3A, AT-4, AT-5A, AT-5B	Assist in defining groundwater quality at point of removal to evaluate effects of each extraction well on combined system. Provide data to assist in selecting optimum groundwater pumping rates to maximize overall capture effectiveness. Assist in evaluating rate of groundwater quality improvement over time. Provide data to track cumulative quantity of VOCs removed by the remedial action.
Water supply well	Fridley Well No. 13	Confirm continued absence of groundwater impacts to city water supply.

TABLE 4-4

DATA QUALITY OBJECTIVES FOR GROUNDWATER CHEMICAL ANALYSIS
NIROP FRIDLEY
FRIDLEY, MINNESOTA
PAGE 3 OF 3

Well Group/Location	Well Identification Number	Intended Data Use
Anoka County Riverfront Park Area	MS-42(I), MS-52(S, I, D), MS-47(S, I, D)	Assist in defining the extent of the plume in the shallow, intermediate, and deep intervals of the unconsolidated aquifers.(1)
	MS-44(S, I, D)	Assist in better defining the lateral extent of the Anoka Park anomaly and to evaluate the potential impact from the Former Vehicle Maintenance Building.(1)
	MS-45(S, I), MS-46(S, I)	Assist in better defining the lateral extent of the Anoka Park anomaly and to evaluate the highest concentrations.(1)
	MS-51(I)	Assist in better defining the lateral extent of groundwater contamination in the intermediate zone.(1)
	MS-43(S, I, D)	Assist in verifying capture zone effectiveness of the extraction system and to evaluate the Anoka Park anomaly as well as monitor groundwater at compliance point.(1)
	MS-50(PC)	Assist in verifying capture zone effectiveness of the extraction system and to monitor groundwater at compliance point in the PC aquifer.(1)
	MS-53(PC)	Assist in verifying capture zone effectiveness of the extraction system and to monitor groundwater in the PC aquifer.(1)
	MS-48(PC)	Assist in verifying capture zone effectiveness of the extraction system and to evaluate compliance point in the PC aquifer.(1)
	MS-49(S, I, D)	Assist in verifying capture zone effectiveness of the extraction system. This monitoring well will also assist in defining the extent of the plume in the shallow, intermediate, and deep aquifers.(1)
East River Road Area	MS-36 (S, I, D), MS-41 (S, I, D)	Assist in verifying capture zone effectiveness of the extraction system.(1)
OU3 Monitoring Wells Sampled as part of the RI/FS	MS-28 (S, I, D) MS-29 (S, I, D) MS-30 (S, I, D) MS-31 (S, I, D) MS-32 (S, I, D) MS-33 (S, I, D)	Data from these wells will provide hydrologic and chemical information for plant building area and is needed for making interpretations of the site hydrogeology and making remedial decisions.(2)

Notes: 1 See Tetra Tech NUS, July 1999 for additional details.
2 See Tetra Tech NUS, August 1999 for additional details.

4.3 SAMPLING PROTOCOL

4.3.1 Preparation

4.3.1.1 Analyses, Bottleware, and Preservation Requirements

All groundwater samples will be analyzed at a laboratory for VOCs and analyzed in the field for pH, electrical conductivity, and temperature. The specific VOCs and associated practical quantitation limits (PQLs) are provided in Table 4-5. Laboratory-supplied sample containers and preservatives are to be used for all groundwater samples. Table 4-6 provides a summary of the sample analyses, sample containers, preservation methods, holding times, and analytical methods.

Additional information on sample containers and preservation is provided in Appendix B.

It is anticipated that Table 4-6 is in agreement with MPCA guidance in Appendix B. If contradicting information is present, always defer to MPCA guidance in Appendix B.

4.3.1.2 Purging and Sampling Equipment

The sampling techniques for all groundwater monitoring associated with the groundwater extraction and treatment system evaluation at the NIROP will be consistent.

The groundwater monitoring wells will be purged until stabilized and sampled using a submersible pump. This is discussed in greater detail in Sections 4.3.2.2 and 4.3.3.1.

The extraction wells are continuously pumped; therefore, additional purging or stabilization tests will not be required. Groundwater extraction wells are sampled from taps in the Control House.

Fridley Well No. 13 will be purged until stabilized by City of Fridley Employees. This well is sampled from a sampling tap in the building housing Fridley Well No. 13.

A groundwater sampling technique which may be used in place of traditional purge-and-sample methodology for the RAWP may be low-cost passive diffusion samplers. Recent studies have shown that passive water-filled diffusion samplers can be used to rapidly and inexpensively obtain ground-water samples for volatile organic compounds (VOCs) in observation wells (Vroblesky and Hyde, 1997). When used appropriately, representative samples for volatile organic compounds (VOCs) can be obtained without purging.

TABLE 4-5

PRACTICAL QUANTITATION LIMITS (PQLs) – GROUNDWATER PARAMETERS
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Analyte	Analytical Method (SW-846)	PQL (µg/L)
Acetone	8260B	10
Benzene	8260B	5
Bromodichloromethane	8260B	5
Bromoform	8260B	5
Bromomethane	8260B	5
2-Butanone	8260B	10
Carbon disulfide	8260B	5
Carbon tetrachloride	8260B	5
Chlorobenzene	8260B	5
Chloroethane	8260B	5
Chloroform	8260B	5
Chloromethane	8260B	5
Dibromochloromethane	8260B	5
1,1-Dichloroethane	8260B	5
1,1-Dichloroethene	8260B	5
1,2-Dichloroethane	8260B	5
1,2-Dichloroethene (total)	8260B	5
1,2-Dichloropropane	8260B	5
1,3-Dichloropropene (cis-)	8260B	5
1,3-Dichloropropene (trans-)	8260B	5
Ethylbenzene	8260B	5
2-Hexanone	8260B	10
Methylene chloride	8260B	5
4-Methyl-2-pentanone	8260B	10
Styrene	8260B	5
1,1,2,2-Tetrachloroethane	8260B	5
Tetrachloroethene	8260B	5
Toluene	8260B	5
1,1,1-Trichloroethane	8260B	5
1,1,2-Trichloroethane	8260B	5
Trichloroethene	8260B	5
Vinyl chloride	8260B	5
Xylenes (total)	8260B	5

TABLE 4-6

BOTTLEWARE, PRESERVATION, AND HOLDING TIME REQUIREMENTS
GROUNDWATER SAMPLES
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Sample Type	Analytical Parameters	Analytical Method	Number of Containers	Type of Container	Preservation Requirements	Holding Time
Monitoring Wells	VOCs	SW-846 8260B	2	40 mL glass vial	HCl to pH < 2; Cool to 4°C	14 days
	Field parameters	Field	NA	NA	NA	Analyze immediately
Extraction Wells	VOCs	SW-846 8260B	2	40 mL glass vial	HCl to pH < 2; Cool to 4°C	14 days
	Field parameters	Field	NA	NA	NA	Analyze immediately
Fridley Well No. 13	VOCs	SW-846 8260B	2	40 mL glass vial	HCl to pH < 2; Cool to 4°C	14 days
	Field parameters	Field	NA	NA	NA	Analyze immediately

Notes:
VOCs -- volatile organic compounds (see Table 4-1).
Field parameters -- pH, temperature, and electrical conductivity.
NA -- not applicable
mL -- milliliter
HCl – hydrochloric acid

The materials needed for using diffusion samplers includes a low-density polyethylene (LDPE) tube or "bag" heat-sealed at both ends which contains deionized water which is lowered into the well with a weighted line. On the outside of the sampler, a low-density polyethylene-mesh covering the LDPE tube or "bag" provides protection against abrasion inside the well. The sampler is positioned at the target horizon via a weighted line, which is secured at the surface. Once the sampler is installed it equilibrates with the groundwater over a specified period of time. The sampler is then removed and the water is then containerized and analyzed using traditional procedures.

Currently, a technical evaluation is being conducted to (1) examine the utility of using diffusion samplers for long-term monitoring of VOCs in ground-water wells at the NIROP in Fridley, Minnesota, and (2) test the feasibility of using diffusion samplers to monitor natural attenuation parameters. Once the results of this investigation are complete a decision to use diffusion samplers instead of traditional methods will be made. At that time this document will be modified accordingly.

4.3.1.3 Quality Assurance for Field Procedures

Particular care will be exercised to avoid the following common ways in which cross contamination or background contamination may compromise groundwater samples:

- Improper storage or transportation of equipment.
- Contaminating the equipment or sample bottles on site by setting them on or near potential contamination sources such as uncovered ground, a contaminated vehicle, or vehicle exhaust.
- Handling bottles or equipment with dirty hands or gloves.
- Inadequate cleaning of well purging or sampling devices.
- Placing equipment directly onto the ground surface.

Special care will be exercised to prevent cross contamination of sampling equipment, sampling bottles, or anything else that could potentially compromise the integrity of samples. Field quality assurance procedures to evaluate potential cross contamination are described in Section 4.3.3.

4.3.1.4 Decontamination and Storage and Transport of Equipment

It is important not to contaminate or alter the sample during collection. The sampling devices must be clean and constructed of material that is compatible with the well construction material and the laboratory testing program. Clean outer garments will be accessible to field personnel in an area free from potential contamination. Water, soap, and paper towels will also be kept in a clean location for both regular clean-up and emergency use.

- Field personnel will wash and dry their hands and all exposed surfaces before leaving the contamination reduction zone. Used paper towels will be placed in the disposal bag.

- Sample bottles will be pre-cleaned by the manufacturer.

It is anticipated that Table 4-7 is in agreement with MPCA guidance n Appendix B. If contradicting information is present, always defer to MPCA guidance in Appendix B.

Decontamination of sampling equipment is essential to prevent cross-contamination of samples with the sampling device. Decontamination procedures are shown in Table 4-7.

Small-diameter (e.g., 2-inch or 3-inch) submersible pumps will be used to purge and sample water from the monitoring wells. Pumps will be decontaminated by using the following procedure:

- Prior to pump use, connect all hoses and ready the pump for use.

- A pre-constructed decontamination station, consisting of four sections of appropriate length and diameter of PVC pipe, will be stood on end. Fill the first section of tube with Alconox/Clean Water Solution. Fill the remaining three tubes with commercially purchased distilled water.

- Submerge the pump in the first station, with the open hose end also in the same tube to recirculate the solution.

- Stand by with additional solution and turn on the pump. Immediately refill the tube to the top to replace solution that enters the tubing. Allow pump to run for approximately 1 minute.

- Move pump successively through the remaining three stations at 1-minute intervals. The pump must be turned off during each move.

TABLE 4-7

SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Equipment	Laboratory-Grade Soap and Water Wash	Alconox/Clean-Water Solution*	Triple Rinsed with Distilled Water
Water Level Indicator	X		X
Pumps		X	X
pH meter, conductivity meter, thermometer			X

Note: Tap water will not be from the NIROP Fridley water supply system. City of Minneapolis drinking water will be used. Distilled water may be substituted.

* The following procedure will be used for the decontamination of pumps used for purging and sampling.

1 Clean pumps inside and out with an Alconox/clean-water solution – applied with a scrub brush made of inert materials.
2 Rinse with clean "control" water.
3 Inspect for remaining particles or surface film and repeat cleaning and rinse procedures if necessary.

- Pumps should not be allowed to run for more than approximately 1 minute at each station or overheating may occur and result in pump damage.

- External hose surfaces will be cleaned by rinsing once with distilled water. The hoses will be placed in clean, large plastic garbage bags.

Because the pump is used to both purge and sample the monitoring well, it must be decontaminated after use at each well. Purging and sampling of monitoring wells will begin with the least contaminated wells and proceed to increasingly contaminated wells. For each set of equipment, for example a pump and tubing, both the purging and sampling will be completed for the first well without removing the pump or tubing before beginning purging at subsequent wells. New, clean, plastic drop cloths will be used at each well location to protect equipment from contact with soil around the well.

Water level measuring equipment that contacts the groundwater must also be decontaminated after use at each well.

4.3.2 Preliminary Field Work

4.3.2.1 Water Level Measurements

Groundwater level measurements will be taken in conjunction with the semi-annual groundwater sampling rounds in April and October. During each sampling round a synoptic round of water-level measurements will be taken from all monitoring wells and river stage measurements at the facility. Table 4-8 summarizes all of the wells, at a minimum, that are to be measured. This list includes the monitoring wells and extraction wells that are sampled for groundwater as well as other wells at the facility. If possible, these synoptic water level measurements should be performed during the same period as any synoptic water level measurements planned at the adjacent UDLP site. All measurements shall be taken within a 24-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. The sequence of measuring water levels will be determined in the field by the site technician. Water level measurements shall be recorded on the appropriate field forms in Appendix D.

Monitoring Wells

All groundwater level measurements will be made using a reference point established on the well casing. The reference point consists of either an indelible mark or a notch on the highest point on the northern edge of the well casing. A battery-operated water level indicator will be the primary device for water level

TABLE 4-8

**LOCATIONS WHERE WATER LEVEL MEASUREMENTS ARE TO BE TAKEN
NIROP FRIDLEY
FRIDLEY, MINNESOTA**

Shallow Wells	Intermediate Wells	Deep Wells	Bedrock Wells	Mississippi River Staff Gauge
1-S	1-IS	1-D	1-PC	River Level (1)
2-S	2-IS	2-D	2-PC	
3-S	3-IS	3-D	3-PC	
4-S	4-IS	4-D	4-PC	
5-S	5-IS	5-D	5-PC	
6-S	6-IS	6-D	MS-48PC	
7-S	7-IS	7-D	MS-50PC	
8-S	8-IS	8-D	MS-53PC	
9-S	10-IS	9-D	FMC-31 (2)	
10-S	12-IS	10-D		
11-S	13-IS	11-D		
11-SB	14-IS	12-D		
12-S	15-IS	13-D		
13-S	16-IS	14-D		
14-S	AT-1A	15-D		
15-S	AT-5A	16-D		
16-S	MS-28I	17-D		
17-S	MS-29I	AT-3A		
18-S	MS-30I	AT-5B		
19-S	MS-31I	MS-28D		
20-S	MS-32I	MS-29D		
21-S	MS-33I	MS-30D		
22-S	MS-34I	MS-31D		
23-S	MS-35I	MS-32D		
24-S	MS-36I	MS-33D		
25-S	MS-40I	MS-34D		
26-S	MS-41I	MS-35D		
27-S	MS-42I	MS-35DPZ		
AT-2	MS-43I	MS-36D		
AT-4	MS-44I	MS-40D		
MS-28S	MS-45I	MS-41D		
MS-29S	MS-46I	MS-43D		
MS-30S	MS-47I	MS-44D		
MS-31S	MS-49I	MS-47D		
MS-32S	MS-51I	MS-49D		
MS-33S	MS-52I	MS-52D		
MS-34S		USGS 10		
MS-35S				
MS-36S				
MS-37S				
MS-38S				
MS-39S				
MS-40S				
MS-41S				
MS-43S				
MS-44S				
MS-45S				
MS-46S				
MS-47S				
MS-49S				
MS-52S				
USGS 1				
USGS 2				
USGS 3				
USGS 4				
USGS 5				
USGS 6				
USGS 7				
USGS 8				
USGS 9				

Notes:
1 - River level adjacent to south storm sewer outfall on southern end of Anoka County Park.
2 - Permission will be required from United Defense LP to access well FMC-31.

measurements. The indicator will be a self-contained, transistorized instrument equipped with a cable and sensor that activates a buzzer and a light when it comes in contact with the water. The depth to water is read from permanent 0.01-foot increment markings on the cable.

Additional information on water level measurements is provided in Appendix B.

Extraction Wells

Water level readings for the groundwater extraction wells will be made by reading the water level indication gauges installed at each well head. If necessary, the protective covers over the pitless adapters will be removed and water level measurements will be taken using the same battery-operated water level indicator used for measurements at the monitoring wells.

Fridley Well No. 13

Water level measurements from Fridley Well No. 13 will be used to calculate the volume of water to be purged during the well stabilization test. A stabilization test (see Section 4.3.2.2) may be necessary since Fridley Well No. 13 is not routinely used. During November 1990, the static water level was 33 feet below ground surface and the pumping level was 41 feet. Using these values, the total well volume was calculated as 6,670 gallons. This value will be used for well purging. Additional water level data from the City of Fridley will not be required.

Mississippi River

Water level data for the Mississippi River immediately west of the NIROP Fridley will be collected during each round of water level measurements. Water level measurements will be made by measuring down to the river surface from an appropriate existing structure along the riverbank near the NIROP. A paint mark has been established on the structure to serve as a reference elevation. The reference elevation has been surveyed relative to the benchmark used to establish the reference elevations for the monitoring well network.

4.3.2.2 Purging, Stabilization, and Field Tests

The following section discusses well purging, stabilization and field test procedures. For additional information please see Appendix B, Section 3.4, Field Water Quality Measurements, and Section 3.5, Purging and Stabilization.

Monitoring Wells

Well purging will be performed to remove stagnant water from the well casing prior to collecting a sample, because the stagnant water is not representative of actual groundwater chemistry. The purging will draw in groundwater from the area surrounding a well to obtain a sample more representative of the water quality.

Prior to purging, the intake of the sampling pump (i.e., submersible pump intake) shall be placed at the approximate midpoint of the well screen or at least three feet above the bottom of the well. Purging shall begin by pumping at a rate near to the well's recovery rate. A maximum or 2 feet of drawdown (from the static water level) should occur in the well as a result of pumping. If this value is exceeded, then the pumping rate should be decreased, as needed, to a minimum of 0.25 gpm (0.95 liters/min). The maximum pumping rate during purging should be 0.4 gpm (1.5 liters/min).

Purging will be accomplished by removing water from the monitoring well until three consecutive well volumes yield stable pH, conductivity, and temperature readings. If the field tests are within the following ranges, the well has been stabilized:

- pH ± 0.1 pH units
- conductivity ± 5 percent
- temperature ± 0.1°C
- Turbidity ≤10 NTU

If the requirements for stable conditions are not met after a total of five well volumes have been removed, appropriate notations should be made in the field log and sampling should begin. Additional information concerning whether or not a well has stabilized can be found in the MPCA Sampling Protocol in Appendix B. See Appendix B section 3.5 Purge and Stabilization.

The field technician shall record all information (e.g., field parameter measurement results taken after every well volume extracted, field observations, etc.) on the groundwater sample log sheets and field logbook as described in Section 4.3.5. Examples of field log sheets are in Appendix D.

Purging will be accomplished using submersible pumps (i.e., Grundfos pump). A calibrated bucket or other container is used to measure the volumes of water removed. Purged water will be placed in drums, and disposed of via the GWTF, pending permit restrictions and operator consent.

Well volumes will be calculated by subtracting the depth to water from the total depth of the well and multiplying the difference by the cross-sectional area of the inside diameter of the well casing. Monitoring well construction data are shown in Table 4-9. The data in this table will be supplemented with information on newly constructed wells, as it becomes available. In the field, personnel will use pre-calculated conversion formulas to determine the number of gallons that must be removed to perform purging. The calculation for a well volume is depth to bottom minus depth to water times the pre-calculated gallons per linear foot of casing. These values are as follows:

- 2-inch diameter well - 0.163 gallon per linear foot
- 3-inch diameter well - 0.367 gallon per linear foot
- 4-inch diameter well - 0.653 gallon per linear foot

Additional information on well purging and field tests is provided in Appendix B.

Extraction Wells

The groundwater extraction wells will be continuously pumping. Therefore, well stabilization tests or additional purging will not be performed.

Fridley Well No. 13

Well purging will be conducted by City of Fridley employees. Well stabilization as previously described for monitoring wells will be performed. A flow volume totalizer at the pump house will be used to record the water volume pumped for purging. The anticipated pumping rate is approximately 1,000 gallons per minute.

4.3.3 Sample Collection

The sampling techniques for all groundwater monitoring associated with the groundwater extraction and treatment system evaluation at the NIROP will be consistent. The sampling techniques are discussed in greater detail in Sections 4.3.1.2 and 4.3.2.2. Tables 4-3 and 4-4 provide a summary of the monitoring program for groundwater.

TABLE 4-9

MONITORING AND EXTRACTION WELL CONSTRUCTION DATA
NIROP FRIDLEY
FRIDLEY, MINNESOTA
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Well Number	Top of Casing Elevation (ft msl)	Well Depth (ft)[(1)]	Nominal Well Diameter (in)
1-S	836.93	34.98	2
1-IS	835.12	78.3	2
1-D	836.55	115.54	2
1-PC	836.93	208.66	4
2-S	835.91	34.65	2
2-IS	837.89	77.5	2
2-D	835.89	112.3	2
2-PC	837.91	178.28	4
3-S	836.62	34.75	2
3-IS	837.21	77.4	2
3-D	837.35	80.87	2
3-PC	838.53	159.4	4
4-S	837.33	34.85	2
4-IS	833.34	76.9	2
4-D	834.65	120.93	2
4-PC	834.63	182.33	4
5-S	834.92	34.71	2
5-IS	837.86	62.8	2
5-D	835.83	117.1	2
5-PC	834.33	192.8	4 and 3[(2)]
6-S	835.60	34.65	2
6-IS	836.53	78.00	2
6-D	835.54	129.95	2
7-S	835.80	29.94	2
7-IS	837.02	80.00	2
7-D	835.61	118.0	4
8-S	835.59	29.9	2
8-IS	836.65	73.00	2
8-D	833.92	128.0	4
9-S	836.53	29.3	2
9-D	834.22	124.6	4
10-S	835.73	31.3	2
10-IS	836.87	75.1	2
10-D	834.61	103.7	3
11-S	835.75	31.3	2
11-D	837.37	132.9	3
12-S	838.38	35.9	2
12-IS	834.94	75	2

TABLE 4-9

MONITORING AND EXTRACTION WELL CONSTRUCTION DATA
NIROP FRIDLEY
FRIDLEY, MINNESOTA
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Well Number	Top of Casing Elevation (ft msl)	Well Depth (ft)(1)	Nominal Well Diameter (in)
12-D	837.37	132.9	3
13-S	834.40	33.9	2
13-IS	834.96	75	2
13-D	835.59	102.5	3
14-S	835.82	34.4	2
14-IS	835.21	75	2
14-D	837.75	99.6	3
15-S	834.68	34.5	2
15-IS	833.67	75.5	2
15-D	834.01	132.5	2
16-S	837.12	35.8	2
16-IS	832.77	80	2
16-D	833.08	115	2
17-S	835.48	39.0	2
17-D	835.24	105.5	2
18-S	833.86	40.75	2
19-S	834.18	45.0	2
20-S	837.51	35.6	2
21-S	837.50	37.1	2
22-S	837.60	36.3	2
23-S	846.96	45.5	2
24-S	836.19	36.7	2
25-S	835.14	37.0	2
26-S	834.06	40.5	2
27-S	832.74	40	2
FMC-33	837.07	73.0	4
AT-1A	838.53	67.2	6-1/8
AT-2	836.45	88.0	10
AT-3A	836.39	90.00	8
AT-4	836.44	47.2	8
AT-5A	835.57	66.0	8
AT-5B	835.62	136.0	8
River Level	808.82 (3)	NA	NA

1 From top of casing as installed.
2 4-inch-diameter black iron casing to 163 feet below grade and 3-inch-diameter open hole in bedrock from 163 feet to 190.5 feet below grade.
3 Elevation of reference point for manual measurement of river water surface elevation.

4.3.3.1 Monitoring Wells

To ensure that the water sample being collected is representative of in-situ water, the samples should be collected immediately after the well has been purged. The same pump used for purging will be used for sample collection. The pump should be placed within two feet of the water column. The flow rate from the pump will be the same as was used during purging. The purging methods and pumping rates are discussed in greater detail in Section 4.3.2.2. Procedures for sampling monitoring wells are as follows:

- Verify that sufficient vials are available for each sampling location and that each is properly labeled in accordance with Section 4.3.4.

- Immediately fill the sample vial by allowing the water stream from the pump tubing to strike the inner wall of the vial to minimize formation of air bubbles. Do not rinse the sample vial. The sample should be collected to prevent excessive amounts of agitation and aeration. Fill the sample vial with a minimum of splashing. Fill each vial until the water forms a positive meniscus at the brim. Allow the vial to overflow slightly before capping. After capping, invert each vial and visually inspect for air bubbles. If air bubbles are present, discard the vial, and repeat this step using a new vial. If no bubbles are present, place samples on ice in cooler immediately and record the appropriate field information on the field logsheets shown in Appendix D. Containers, preservatives, and holding times used for sample collection are shown in Table 4-6. Additional information on groundwater sample collection is provided in Appendix B.

4.3.3.2 Extraction Wells

Sampling procedures for the groundwater extraction wells are the same as those described in Section 4.3.3.1 for monitoring wells, with the exception that the samples will be collected from a sampling port rather than from the pump discharge tubing. The first portion (5 to 10 seconds) of water from the tap will not be sampled and will be collected in a bucket that will be emptied into a drum and disposed of as investigation-derived waste. The flow rate from the sampling port should be adjusted to as low as possible for sample collection.

4.3.3.3 Fridley Well No. 13

Sampling procedures will be the same as those described in Section 4.3.3.2 for groundwater extraction wells.

4.3.3.4 Field QA/QC Samples

Field QA/QC samples include blank, duplicate, and matrix spike samples. See Table 4-10.

Field blank and field duplicate samples will be collected and analyzed to assess the quality of the data resulting from the field sampling program. All QA/QC samples will be collected in the same type of container and with the same preservation requirements as the primary groundwater samples. QA/QC samples will be collected at sampling points suspected to have relatively higher levels of contamination to provide meaningful information for blank or duplicate sample evaluation. They will be analyzed for the same parameters (i.e., VOCs) as the groundwater samples. Field QA/QC samples are not analyzed for field parameters. All blank and duplicate samples will be assigned identification aliases on the sample bottle label and on the chain-of-custody sheet to avoid alerting laboratories that the sample is a blank or replicate sample. The identity of the blank and duplicate samples will be recorded in the field sampling log.

Trip blanks are used to assess the potential for VOC cross-contamination of samples caused by contaminant migration during sample shipment and storage. Trip blanks will be filled and sealed by the laboratory with laboratory-controlled, analyte-free water. The blank sample vials will travel with the actual sample vials to and from the field in the cooler, to the well head, etc., so that the blanks are exposed to precisely the same conditions as the actual samples. The trip blanks are never opened in the field. One set of trip blanks is returned to the laboratory with each cooler containing samples for VOC analysis.

Equipment rinsate (or field) blanks are obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after decontamination and prior to use. Collection of rinsate blanks should be conducted to simulate actual field sampling methods in a manner that would detect the presence of background or cross-contamination of samples from the ambient environment, preservatives, or sampling equipment. An effort should be made to have the blank sample water contact all equipment surfaces that the sample water will contact. Equipment rinsate blanks will be collected at a frequency of one rinsate blank per day.

Field duplicate samples will be collected to evaluate variability on sampling and analytical methods. Field duplicate samples are two samples collected independently at a sampling location. The field duplicate should be collected immediately after the primary groundwater sample is collected. Field duplicate samples will be collected at a frequency of one duplicate per 10 groundwater samples.

TABLE 4-10

SUMMARY OF GROUNDWATER MONITORING PROGRAM
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Sample Type	Analytical Parameters(1)	Analytical Method	No. of Samples	No. of Field Duplicates	No. of Rinsate Blanks(2)	No. of Trip Blanks(3)	No. of MS/MSD Samples	Frequency
Monitoring Well	VOCs	SW-846 8260B	44	5	4	4	3	Twice a year
	Field parameters	Field measurement	44	0	0	NA	NA	Twice a year
Extraction Well	VOCs	SW-846 8260B	6	1	1	1(4)	1	Twice a year
	Field parameters	Field measurement	6	0	0	NA	NA	Twice a year
Fridley Well No. 13	VOCs	SW-846 8260B	1	1	0	1(4)	1	Once a year
	Field parameters	Field measurement	1	0	0	NA	NA	Once a year

Notes:

1 VOCs – volatile organic compounds (see Table 4-1); Field parameters - pH, temperature, and electrical conductivity.
2 Equipment rinsate blanks will be collected once daily during monitoring well sampling. Rinsate blanks will not be collected during sampling of Fridley Well No. 13 as this well has a dedicated pump in place.
3 The number of trip blanks is estimated. One cooler containing VOC samples per day is anticipated.
4 Trip blank shown for groundwater extraction well and Fridley Well No. 13 is intended for sampling rounds if only these wells are sampling. When more than one type of well is sampled (monitoring well, extraction well, Fridley well), additional trip blanks are not required, as long as the rate of one trip blank per cooler is met.

In addition to field blanks and field duplicates, matrix spike samples will be collected. Matrix spikes provide information about the effect of the sample matrix on the extraction and measurement methodology. Matrix spikes are performed in duplicate and are referred to as MS/MSD samples. These analysis are performed as internal (i.e., laboratory) QC checks. To accommodate these laboratory QC samples, the field crew must provide extra aliquots of sample, as required. These extra sample aliquots are identified with the same sample location information as the selected groundwater sample(s). MS/MSD samples are provided to the laboratory with a frequency of one set per 20 groundwater samples.

4.3.4 Investigative Derived Waste (IDW) Handling

It is anticipated that the field investigation will generate three types of IDW; personal protective equipment (PPE), sampling equipment decontamination fluids, and purge water. Based on the activities and types of contaminants present, none of the residues are expected to represent a significant risk to human health or the environment if properly managed. All PPE will be double-bagged and disposed of appropriately. Unless written permission is received, the O&M contractor shall not deposit these materials in dumpsters owned by the Navy or other site entities. All purge water will be disposed by pumping into a Ground Water Treatment Facility pump-house located on Navy property.

4.3.5 Documentation

4.3.5.1 Sample Identification

Groundwater sample identification numbers will be unique and will correspond with individual well identifiers. Well identifiers will be preceded with the letters "MS," except well FMC-33, the six groundwater extraction wells (AT-1A, AT-2, etc.), and Fridley Well No. 13, to facilitate the computer database management system. Sample designations for the exceptions are as follows:

- FMC-33 FMC33
- Fridley Well No. 13 FW13
- AT-1A AT01A
- AT-2 AT02
- AT-3A AT03A
- AT-4 AT04
- AT-5A AT05A
- AT-5B AT05B

Chain-of-custody entries and the database management system will not use the dash (-) in the well identification. Quality control samples will be labeled as "QC" samples, followed by a letter that designates the type of sample and a sequential number beginning with 01. QC samples are "blind" samples that will be used as a quality control check on field and laboratory procedures.

Field duplicate samples will be labeled with "D" following the QC prefix and numbered sequentially (QCD01, QCD02, etc.). The locations of duplicate samples will be recorded in field notebooks, on the chain-of-custody (COC) forms not submitted to the laboratory, and groundwater sample logsheets (Appendix D).

Trip blanks will be labeled with "T" following the QC prefix and numbered sequentially (QCT01, QCT02, etc.).

Equipment rinsate (field) blanks will be labeled with "R" following the QC prefix and numbered sequentially (QCR01, QCR02, etc.).

Sequential numbering of duplicates and blanks will be re-initiated at "01" during each sampling round since sample dates will be used to separate computer data files.

Samples that have extra aliquots for MS/MSD analysis will be noted on the chain-of-custody form.

Sample labels are to be completed for each sample using waterproof ink, unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample label because the ballpoint pen would not function in freezing weather.

4.3.5.2 Chain-of-Custody

The possession of samples must be traceable from the time of collection using chain-of-custody procedures. Specific chain-of-custody forms must accompany all sample shipping containers to document the transfer of the shipping containers and samples from the field to the laboratory receiving the samples for analysis. The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

An example chain-of-custody form is provided in Appendix D. The actual form may differ slightly according to the laboratory used. When filling out the chain-of-custody form, it is important to use only black ink and to write legibly. Errors are to be corrected by drawing a single line through the incorrect information and entering the correct information. All corrections are to be initialed and dated by the person making the corrections. This procedure also applies to words or figures inserted or added to a previously recorded statement. A checklist of information that must be included on the chain-of-custody form is provided in Appendix B.

4.3.5.3 Field Activity Documentation and Logbooks.

The field logbook and field logsheets will provide the means of recording the data collection activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without relying on their memory. Field logbooks are discussed below and examples of field data logsheets are in Appendix D.

Field logbooks will be bound field survey books or notebooks. Three-ring binders may be used to store field information and field forms, if the pages are numbered sequentially and dated. Each logbook will be identified by the project-specific number. The title page of each logbook will contain the following:

- Name of the person(s) to whom the logbook is assigned.
- Logbook number.
- Project name.
- Project start date.
- Project completion date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather conditions, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigative team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Whenever a sample is collected or a measurement is made, a detailed description of the station, including compass and distance measurements, shall be recorded. All entries will be made in indelible black ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, dated, and initialed by the person making the correction. The number of photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration. The identification of equipment should include make, model, and serial number of all pumps and field meters and the type of any electrodes used.

The following sampling information will also be recorded: make and model of pump; the time of sampling; a sample description; the volume of sample removed from the well; and the number, type, and size of containers, including the type of preservative in the container. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under the sample description.

Additional information on field documentation is provided in Appendix B, Section 5.0.

4.3.6 Sample Preservation, Handling, and Transport

This section describes procedures that will be followed between the time samples are collected and the time they are either shipped or delivered to an analytical laboratory.

Samples will be preserved as shown in Table 4-6. All samples will be thermally preserved in the field immediately after sample collection by placing samples in an insulated cooler containing "blue ice." Regular ice may be used if blue ice is not available. Particular care will be taken to assure that paper work and sample labels are not damaged by water. The regular ice will be placed inside uncontaminated leak-proof plastic containers, and the chain-of-custody record and other paper work will be placed inside a Ziplock™ bag.

All ice chests will be accompanied by a chain-of-custody form and will contain a complete address and return address both inside and outside the chest. The samples will be maintained at approximately 4°C during transport to the laboratory. Before transporting sample, field personnel will perform the following tasks:

- Verify that laboratory personnel will be present to receive samples when they arrive.
- Verify that laboratory personnel understand chain-of-custody and sample storage and preservation requirements.
- Check labeling and documentation to ensure sample identify will be clear to laboratory personnel.

- Hand deliver or ship samples in a manner that ensures samples will remain cool (approximately 4°C) until received by laboratory personnel.

- Maintain chain-of-custody according to procedures described in Section 4.3.5.

Procedures to be implemented for sample shipment and transfer of custody are as follows:

- Prepare sample containers with pre-applied labels.

- Properly identify and label each sample in the field with indelible, waterproof black ink.

- Complete chain-of-custody forms in the field. Indicate sample identification, containers filled, sampling date, sampling time, sample collector's name, and sample preservation. This information will also be noted in the field notebooks maintained for the site.

- Repack shipping containers with samples, chain-of-custody forms, and ice packs. Each set of samples to be shipped together in a single shipping container is assigned a chain-of-custody form that travels with the shipping container.

- Place the chain-of-custody form in a plastic bag, seal the bag, and tape it to the inside cover of the cooler.

- Seal and ship containers to the appropriate laboratory. Common carriers or intermediate individuals shall be identified on the chain-of-custody form. Copies of all bills-of-lading will be retained.

- Ship by overnight delivery service to the approved laboratory. The correct laboratory shipping address is to be confirmed with the laboratory prior to shipment.

The laboratory will receive and check the shipping containers for broken seals or damaged sample containers. If no problems are noted, samples are logged into the laboratory. The chain-of-custody form is completed when laboratory personnel sign the form. The laboratory will include a copy of the completed chain-of-custody form with the analytical data report.

Additional information on sample handling is provided in Appendix B.

4.4 DATA REDUCTION AND VALIDATION AND STATISTICAL EVALUATIONS

4.4.1 Data Reduction and Validation

4.4.1.1 Field Measurements and Activities

Raw data from field measurements and sample collection activities will be appropriately recorded in the field logbook. Data will include water level measurements and readings, flow rate readings, pH, electrical conductivity, and temperature. Reduction of field data will consist of transferring data from the field notebooks for use in Annual Monitoring Reports and other documents. Validation will consist of cross-checking log versus report entries.

4.4.1.2 Laboratory Data

Data validation consists of a stringent review of the chemical analytical data packages generated by the laboratory. Sample handling and receipt, observance of maximum holding time allowances, performance of the analytical method employed, accuracy of data reporting, and completeness of the deliverables generated are evaluated. Data validation also considers the impact of field-related QC checks. The overall purposes of data validation are to access the validity of the data generated with respect to pre-established criteria and to generate a report detailing noncompliance that warns potential users of limitations in data utility.

Data generated by the laboratory will be validated by qualified chemists in accordance with the most recent edition of the EPA National Functional Guidelines for Evaluating Organic Analysis, method-specific QC criteria, and the QC limits established by the laboratory QA plan. Professional judgement will also be used. Data validation reports summarizing non-compliant items will be generated, and qualifier flags will be applied to data to alert users of limitations in utility.

Laboratory data generated for the NIROP Fridley remedial action will be computerized in a format organized to facility data review and evaluation. The computerized data set will include the data qualifier flags from data validation and additional comments of the data reviewers.

4.4.2 Statistical Evaluation

The achievable concentration of any constituent in groundwater from a pumping program cannot be predicted with certainty. At this site, there is uncertainty that target cleanup levels can be achieved within a reasonable time frame. Despite extensive recovery efforts, the concentration of TCE and other VOCs may decline and asymptotically approach a limiting low level above the target cleanup levels. To attempt further reduction below this limiting level may not be achievable in a reasonable time (duration of pumping) or at a reasonable cost. This phenomenon has been observed and documented at other groundwater remediation sites. USEPA guidance also defines approaches and detailed procedures for addressing this type of remediation response on evaluating the attainment of cleanup standards (USEPA, 1988a and USEPA, 1988b).

The determination of whether a limiting level has been reached and when it has been reached will be made on an annual basis, when such evaluation is determined to be appropriate, using statistical procedures. In addition, progress made toward remediation of contaminated soil at the NIROP Fridley will be considered in the interpretation of improvement of groundwater quality over time, including the interpretation of a limiting low level of TCE and other VOCs that may be achieved.

The specific statistical method used to determine whether the cleanup targets have been achieved will be based on USEPA guidelines. The data from the monitoring well network will be evaluated as follows:

- Determine which wells will be used for the application of remedial action goals.

- TCE concentrations will be plotted against time for the selected wells.

- The TCE plots from each well will be visually examined for discontinuities indicative of the transportation lag of masses of water high in TCE concentration as they are transported to the extraction wells.

- If the resulting plot is linear or may be fitted to a linear model in time and shows no discontinuities, then a least-squares regression will be performed, and the slope of the fitted curve will be calculated. In this case, the linear model will be used more or less as a "french curve" to estimate the slope.

- If the resulting plot is nonlinear and shows no discontinuities, then an appropriate curve will be fitted to the data by nonlinear least-squares regression. The slope will be the first derivative of the curve calculated at a value of time of the last data point.

- The resulting residuals from the linear or nonlinear model will be examined for outliers, seasonal differences, and serial correlations. The residual sum of squares will be used to estimate error variance after accounting for outliers, seasonal differences, and serial correlation. This error variance will be used to make the interval estimates in the model parameters and forecasts. Type I (α) and Type II (β) error rates of 0.05 will be used.

- A limiting or asymptotic concentration of TCE will be considered to be achieved if the slope estimated from the last data point using the least-squares estimates of the parameters for the linear or nonlinear model lies between zero and negative 25 µg/l TCE/year and the interval estimate of the slope at the 95-percent confidence interval includes zero.

When an evaluation indicates that the concentration of TCE and other VOCs has declined to a limiting low level, a confirmatory risk assessment will be performed to determine whether the concentration is protective of public health under the exposure conditions existing at that time. If risks are acceptable, groundwater extraction will be terminated. If the groundwater quality is determined to be not protective, the Navy will evaluate alternative remedial actions and/or institutional controls.

If the groundwater TCE concentration has not reached a limiting low level, a risk assessment may be performed. If the groundwater quality at that time is protective of public health under exposure conditions existing at that time, the Navy may request approval to terminate groundwater extraction operations and to continue a groundwater monitoring program. If the groundwater quality is determined to be not protective, the Navy will either continue operation of the extraction wells, evaluate alternative remedial actions, or both.

TCE and other constituents have also been detected in monitoring wells upgradient of known and potential contaminant sources at the NIROP Fridley, on property not owned by the Navy. Since there may be upgradient sources that contribute TCE to the groundwater, monitoring data from onsite wells will be compared to upgradient "background" wells. If it is shown, based on the facts at the time, that upgradient sources are contributing TCE to the groundwater, the Navy will request approval of an alternate cleanup target level or approval to terminate groundwater recovery operations.

4.5 REPORTING AND RECORD KEEPING

The following requirements are based on the Federal Facility Agreement (FFA), the previous RAMP, and past Annual Monitoring Reports.

4.5.1 Periodic Monitoring Reports and Progress Reports

The Navy shall submit the analytical and water level results to the USEPA and the MPCA during the period following the sampling for all analyses completed during the previous period. This information may be presented and recorded during the regularly scheduled Restoration Advisory Board (RAB) meetings. The RAB was formerly known as the Technical Review Committee (TRC).

Per the FFA, the Navy will submit to the USEPA and the MPCA quarterly written progress reports (which may take the form of RAB meeting minutes) that describe the actions the Navy has taken during the previous three months to implement the requirements of the FFA. Progress reports shall also describe the activities scheduled to be taken during the upcoming quarter. The progress reports shall include a detailed statement of the manner and extent to which the requirements of the FFA are being met. In addition, the Progress Reports shall identify any anticipated delays in meeting deadlines or target dates, the reason(s) for the delay(s), and actions taken to prevent or mitigate the delay(s) and any need for additional work.

4.5.2 Annual Monitoring Report

The Navy will submit an Annual Monitoring Report to the USEPA and MPCA during each year after startup of the groundwater extraction system, as required by the Federal Facility Agreement. The Annual Monitoring Reports will include the following items related to groundwater remediation:

- A description of the current groundwater remediation facilities and any planned modifications.
- Results of all groundwater and river water elevations for the previous year.
- Hydraulic head maps of water table elevations and piezometric surface elevations for the lower sand unit (deep monitoring wells) and bedrock.
- Evaluation of hydraulic containment effectiveness of the extraction well system based on hydraulic head information, capture zone modeling, and chemical trends.
- A map showing the location of each monitoring well and extraction well.

- Isoconcentration maps and cross-sections (with a cross section locator map) for TCE developed from the results of the last groundwater sampling round performed each year for all monitoring wells in the approved monitoring network.

- Graphs illustrating TCE concentrations over time using data from each sampling event. The graphs will be cumulative showing groundwater quality for all previous years during extraction system operations as well as the reporting year.

- Laboratory results from chemical analyses of all groundwater samples.

- Evaluation of statistical significance of groundwater quality data, if applicable (see Section 4.4.2).

- QA/QC summary of chemical water quality data, including precision, accuracy, and completeness.

- Evaluation of suitability of monitoring well network, including the need for addition or deletion of monitoring wells.

- Summary of extraction system operation and maintenance.

- Summary of treatment system operation and maintenance.

- A monitoring plan for the next year with an assessment of the monitoring parameters and sampling frequencies.

- Quarterly Progress Reports.

The suitability of individual monitoring wells to assess groundwater quality will be evaluated in each Annual Monitoring Report. Hydraulic and chemistry monitoring data for each well will be used for the evaluation. The evaluation will assess whether continued use of each well is necessary and appropriate for the overall objectives of the monitoring program. The evaluation will also assess whether additional existing wells are needed in the monitoring network. If revisions to the monitoring well network are determined to be appropriate, the recommended changes will be included in the Annual Monitoring Report. Review and approval of any recommended revisions will be obtained from the USEPA and MPCA prior to implementing any changes to the monitoring well network.

Hydraulic containment will be reached when it can be demonstrated that groundwater gradients are effectively directed toward an extraction well in areas within the contaminated groundwater zone (horizontally and vertically). Evaluation of the effectiveness of hydraulic containment will be re-evaluated annually. Groundwater chemistry data will be used to support the evaluation of containment effectiveness, as appropriate. Maps, tables, and/or graphs that depict water table and piezometric head contours will be compared to historical data to estimate the extent of the radius of influence of the groundwater extraction system. Demonstration of containment by measured hydraulic heads can be complemented by use of a 3-dimensional groundwater flow model that has been calibrated to actual site conditions. The model will be used to evaluate whether hydraulic containment has been, or will be, achieved.

4.5.3 Retention of Records

All documents contained in the Administrative Record, the Public Information Repository, and all final primary and secondary documents (as defined in the FFA), shall be preserved by the Navy (and other agencies) for a minimum of 10 years after termination of the FFA. The RAWP is defined as a primary document, and sampling and data results are defined as secondary documents. Therefore, the Navy will retain all groundwater monitoring results for at least 10 years after the FFA is terminated. The FFA can be terminated when the Navy, with USEPA and MPCA concurrence, determines that any final remedial action has been completed with the requirements of the FFA.

5.0 NPDES/SDS EFFLUENT MONITORING

5.1 OBJECTIVES

The objective of effluent monitoring is to confirm compliance with discharge limitations in NPDES/SDS Permit MN0000710 issued to United Defense L.P. The permit is for all direct discharges from the NIROP Fridley to the Mississippi River. This permit was issued on October 31, 1996. The permit expires on September 30, 2000. This section only discusses monitoring at Outfall 020 where the effluent from the groundwater treatment facility is discharged to the river. The parameters to be monitored, the discharge limits, and the frequency of monitoring for Outfall 020 are discussed in Section 5.2.

All samples collected to determine compliance with the permit shall be analyzed by a laboratory certified by the Minnesota Department of Health as provided by Minnesota Rules Part 4740.2040, Certified Test Categories.

5.2 MONITORING LOCATIONS AND FREQUENCIES

The monitoring location (Outfall 020) is based on the NPDES/SDS permit and is shown on Figure 4-1. If the outfall is flooded because of a high water level in the Mississippi River, samples shall be collected from the nearest upgradient manhole (or other appropriate accessible location) that is not flooded. The permit states that samples taken in compliance with the monitoring requirements shall be at a point representative of the discharge to the river.

The discharge limitations and monitoring requirements for Outfall 020 are provided in Table 5-1. The flow rate is to be measured continuously. Temperature is to be measured monthly. Iron and manganese are to be measured quarterly. Selected VOCs are to be measured twice a month. Full VOC analysis is to be conducted twice a year.

The permit states that twice monthly monitoring for VOCs is required for the first year of the discharge, after which the permittee may request a monitoring reduction. The request must be in writing and must receive written approval of the MPCA. The permit states that monitoring reductions will only be granted if contaminant levels are consistently well below discharge limits. In addition, monitoring for iron and manganese may be eliminated after one year with written approval of the MPCA.

TABLE 5-1

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS
OUTFALL 020
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Parameter	Daily Maximum	Measurement Frequency(1)	Sample Type
Flow (MGD)	--	Continuous Monitoring(2)	--
Temperature	26.5°C(80°F)	Monthly	Grab
Iron	--	Quarterly	Grab
Manganese	--	Quarterly	Grab
Carbon disulfide	700 µg/L	Twice monthly	Grab
1,1-Dichloroethane	70 µg/L	Twice monthly	Grab
1,1-Dichloroethene	6.0 µg/L	Twice monthly	Grab
1,2-Dichloroethene (cis-)	70 µg/L	Twice monthly	Grab
1,2-Dichloroethene (trans-)	100 µg/L	Twice monthly	Grab
Methylene chloride	5.0 µg/L	Twice monthly	Grab
Tetrachloroethene	3.8 µg/L	Twice monthly	Grab
1,1,1-Trichloroethane	200 µg/L	Twice monthly	Grab
Trichloroethene	5.0 µg/L	Twice monthly	Grab

Notes:

1 Twice monthly monitoring for VOCs is required for the first year after startup of the discharge from the groundwater remediation system after which the permittee may request a monitoring reduction. Monitoring for iron and manganese may be eliminated after one year's worth of monitoring with written approval of the MPCA.

2 For brief periods of flow meter maintenance and other down time (e.g., 1 to 3 day a couple of times per year) alternative methods of flow measurements may be used as long as such methods provide representative flow measurements.

Other Requirements:

Complete VOC monitoring shall be conducted on the effluent twice annually. EPA Methods 601 and 602 shall be used for all analyses.

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored by grab samples analyzed immediately. These upper and lower limits are not subject to averaging and shall be met at all times.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

The discharge shall not contain oil or other substances in amounts sufficient to create a visible color film on the surface of the receiving water.

The discharge shall not contain significant color in amounts sufficient to create a visible discoloration of the receiving water at the point of discharge.

5.3 SAMPLING PROTOCOL

5.3.1 Preparation

5.3.1.1 Analysis, Bottleware, and Preservation Requirements

The effluent samples will be analyzed in the laboratory for VOCs, iron, and manganese and analyzed in the field for pH and temperature. The specific VOCs and metals and the associated PQLs are provided in Table 5-2. Laboratory-supplied sample containers and preservatives are to be used for all effluent samples. Table 5-3 provides a summary of the sample analyses, sample containers, preservation methods, holding times, and analytical methods.

Additional information on sample containers and preservation is provided in Appendix B.

5.3.1.2 Sampling Equipment

Effluent samples will be collected using a pre-cleaned stainless steel or glass beaker or similar device and then transferred to the sample bottle(s). If the flow rate is low enough and pre-preserved sample bottles are not used, it may be possible to fill the sample bottle directly.

5.3.1.3 Quality Assurance for Field Procedures

Particular care will be exercised to avoid the following common ways in which cross contamination or background contamination may compromise effluent samples:

- Improper storage or transportation of equipment.
- Contaminating the equipment or sample bottles on site by setting them on or near potential contamination sources such as uncovered ground, a contaminated vehicle, or vehicle exhaust.
- Handling bottles or equipment with dirty hands or gloves.
- Inadequate cleaning of sampling devices.
- Placing equipment directly onto the ground surface.

Special care will be exercised to prevent cross contamination of sampling equipment, sampling bottles, or anything else that could potentially compromise the integrity of samples. Field quality assurance procedures to evaluate potential cross contamination are described in Section 5.3.2.

TABLE 5-2

PRACTICAL QUANTITATION LIMITS (PQLs) – EFFLUENT PARAMETERS
NIROP FRIDLEY
FRIDLEY, MINNESOTA
PAGE 1 OF 2

Analyte	Analytical Method	PQL (µg/L)
METALS		
Iron	SW-846 6010B	50(1)
Manganese	SW-846 6010B	3(1)
VOCs		
Benzene	EPA 602	1
Bromodichloromethane	EPA 601	1
Bromoform	EPA 601	1
Bromomethane	EPA 601	1
Carbon disulfide(2)(3)	EPA 601	1
Carbon tetrachloride	EPA 601	1
Chlorobenzene	EPA 601	1
Chloroethane	EPA 601	1
2-Chloroethylvinyl ether	EPA 601	5
Chloroform	EPA 601	1
Chloromethane	EPA 601	1
Dibromochloromethane	EPA 601	1
1,2-Dichlorobenzene	EPA 601	1
1,3-Dichlorobenzene	EPA 601	1
1,4-Dichlorobenzene	EPA 601	1
Dichlorodifluoromethane	EPA 601	1
1,1-Dichloroethane(3)	EPA 601	1
1,2-Dichloroethane	EPA 601	1
1,1-Dichloroethene(3)	EPA 601	1
1,2-Dichloroethene (cis-)(2)(3)	EPA 601	1
1,2-Dichloroethene (trans-)(3)	EPA 601	1
1,2-Dichloropropane	EPA 601	1
1,3-Dichloropropene (cis-)	EPA 601	1
1,3-Dichloropropene (trans-)	EPA 601	1
Ethylbenzene	EPA 602	1
Methylene chloride(3)	EPA 601	5
1,1,2,2-Tetrachloroethane	EPA 601	1
Tetrachloroethene(3)	EPA 601	1
Toluene	EPA 602	1
1,1,1-Trichloroethane(3)	EPA 601	1
1,1,2-Trichloroethane	EPA 601	1
Trichloroethene(3)	EPA 601	1

TABLE 5-2

PRACTICAL QUANTITATION LIMITS (PQLs) – EFFLUENT PARAMETERS
NIROP FRIDLEY
FRIDLEY, MINNESOTA
PAGE 2 OF 2

Analyte	Analytical Method	PQL (μg/L)
Trichlorofluoromethane	EPA 601	1
Vinyl chloride	EPA 601	1

Notes:

1 Typical Instrument Detection Limit.
2 Compound is not on the EPA Method 601 or 602 target list; however, the permit mandates that EPA Methods 601 and 602 be used for all VOC analysis.
3 These compounds are monitored twice a month. All VOCs are monitored twice a year.

TABLE 5-3

BOTTLEWARE, PRESERVATION, AND HOLDING TIME REQUIREMENTS
EFFLUENT SAMPLES
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Analytical Parameter	Analytical Method	Number of Containers	Type of Container	Preservation Requirements	Holding Time
Permit specified VOCs[(1)]	EPA 601	2	40 mL glass vial	HCl to pH < 2; Cool to 4°C	14 days
Full VOCs[(2)]	EPA 601 and 602	2	40 mL glass vial	HCl to pH < 2; Cool to 4°C	14 days
Iron and Manganese	SW-846 6010B	1	250 mL HDPE	HNO3 to pH < 2	6 months
pH and Temperature	Field measurement	NA	NA	NA	analyze immediately

Notes:

1 Includes carbon disulfide; 1,1-dichloroethane; 1,1-dichloroethene; 1,2-dichloroethene (cis- and trans-); methylene chloride; tetrachloroethene; 1,1,1-trichloroethane; and trichloroethene.
2 See Table 5-2 for full EPA 601/602 monitoring list.

VOCs – volatile organic compounds
mL – milliliter
HDPE – high density polyethylene
HCl – hydrochloric acid
HNO3 – nitric acid
NA – not applicable

5.3.1.4 Decontamination and Storage and Transport of Equipment

It is important not to contaminate or alter the sample during collection. The sampling devices must be clean. Clean outer garments will be accessible to field personnel in an area free from potential contamination. Water, soap, and paper towels will also be kept in a clean location for both regular clean-up and emergency use. Personnel decontamination procedures are as follows:

- Protective disposable outer garments will be removed and placed in disposable plastic bags at the perimeter of the exclusion zone (vicinity of the outfall) before each departure from the exclusion zone.

- If disposable outer boots are worn, they will be removed first, and then the gloves will be removed. If reusable rubber or neoprene boots are worn, they will be washed and rinsed before leaving the contamination reduction zone.

- Field personnel will wash and dry their hands and all exposed surfaces before leaving the contamination reduction zone. Used paper towels will be placed in the disposal bag.

- The plastic bags containing waste materials will be disposed daily. Unless written permission is received, the O&M contractor shall not deposit these materials in dumpsters owned by the Navy or other site entities.

- Sample bottles will be pre-cleaned by the manufacturer.

Decontamination of sampling equipment is not needed. This equipment will be pre-cleaned or dedicated and will only be used to collect samples at one location. The pH meter probe and thermometer will be triple rinsed with distilled water before and after each use.

5.3.2 <u>Sample Collection and Field Tests</u>

Table 5-4 provides a summary of the monitoring program for effluent.

5.3.2.1 Effluent Samples

Methods for determining, pH and temperature are described in Appendix B.

Procedures for sampling the discharge from Outfall 020 are as follows:

TABLE 5-4

SUMMARY OF EFFLUENT MONITORING PROGRAM
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Analytical Parameters[1]	Analytical Method	No. of Samples	No. of Field Duplicates	Number of Rinsate Blanks[2]	Number of Trip Blanks[3]	N0. of Matrix Spike/Matrix Spike Duplicates	Monitoring Frequency
Permit-specified VOCs[4]	EPA 601	1	1	0	1	1	Twice a month
Full VOCs[5]	EPA 601 and 602	1	1	0	1	1	Twice a year
Iron and Manganese	SW-846 6010B	1	1	0	NA	1	Quarterly
Temperature and pH	Field measurement	1	0	0	NA	NA	Monthly

Notes:

1 VOC – volatile organic compounds
2 Rinsate blanks will not be collected because only one location is sampled, and disposable or pre-cleaned sampling equipment will be used.
3 Assumes only effluent samples are being collected. If groundwater and/or surface water samples are being collected during the sampling event, additional trip blanks may not be required, as long as the rate of one trip blank per cooler is met.
4 Permit-specified VOCs: carbon disulfide; 1,1-dichlroethand; 1,1-dichloroethene; 1,2-dichloroethene (cis- and trans-); methylene chloride; tetrachloroethene; 1,1,1-trichloroethane; and trichloroethene.
5 See Table 5-2 for full EPA 601/602 monitoring list.

- Verify that sufficient sample bottles are available and that each is properly labeled.

- Fill the sample bottles for metals analysis (if a quarterly sampling event).

- Fill the glass VOC sample vial. Do not rinse the sample vial. The sample should be collected to prevent excessive amounts of agitation and aeration. Fill the sample vial with a minimum of splashing. Fill each vial until the water forms a positive meniscus at the brim. Allow the vial to overflow slightly before capping. After capping, invert each vial and visually inspect for air bubbles. If air bubbles are present, discard the vial, and repeat this step using a new vial.

- Place sample on ice in cooler immediately.

Containers, preservatives, and holding times used for sample collection are shown in Table 5-3.

Additional information on effluent sample collection is provided in Appendix B.

5.3.2.2 Field QA/QC Samples

Field QA/QC samples are the same as described in Section 4.3.3.4 for groundwater samples, except that equipment rinsate blanks will not be required because there is only one sample location and pre-cleaned or dedicated sampling devices will be used.

5.3.3 Documentation

5.3.3.1 Sample Identification

The sample number for NPDES/SDS Outfall 020 is OUT020.

Quality control samples will be identified in the same manner described for groundwater monitoring (Section 4.3.4.1), except that equipment rinsate blanks will not be needed.

5.3.3.2 Chain-of Custody

Chain-of-custody procedures are the same as described for groundwater monitoring (Section 4.3.4.2).

5.3.3.3 Field Activity Documentation and Logbooks

The procedures described in Section 4.3.4.3 for groundwater monitoring also apply to effluent monitoring.

5.3.4 Sample Preservation, Handling, and Transport

Samples will be preserved as shown in Table 5-3. The other aspects of sample handling and transport are the same as described in Section 4.3.5 for groundwater monitoring.

5.4 DATA REDUCTION AND VALIDATION

Data reduction and validation procedures described for groundwater monitoring in Section 4.4.1 also apply to effluent monitoring. In addition, laboratory data for metals (i.e., iron and manganese) will be validated in accordance with the most recent edition of the EPA National Functional Guidelines for Evaluating Inorganic Analysis.

5.5 REPORTING AND RECORD KEEPING

The following requirements are based on the FFA, the previous RAMP, and the NPDES permit.

5.5.1 Period Monitoring Reports and Progress Reports

The requirements for these reports are the same as described in Section 4.5.1.

5.5.2 Annual Monitoring Report

In addition to the information required in Section 4.5.2, NPDES/SDS monitoring results will be included in the Annual Monitoring Report. This includes an evaluation of compliance with NPDES/SDS permit conditions and Discharge Monitoring Reports (see Section 5.5.3). The O&M contractor will not be preparing this comprehensive report, but will be required to make information available to other Navy contractors in a timely fashion to support production of this report.

5.5.3 Monthly Reports

All monitoring results obtained following the provisions of the NPDES/SDS permit shall be summarized on a monthly basis and reported on the designated Discharge Monitoring Report Forms provided by the MPCA. Reports shall be submitted monthly and received or postmarked no later than the 21st day of the month following the month during which monitoring was completed. Reports shall be signed by an authorized representative of the permittee.

Signed copies of these reports shall be submitted to the MPCA at the following address (the Navy may request distribution of additional copies to various parties):

Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155-4194
Attn: W.Q. Point Source Compliance

The results of the monitoring shall be reported in the units specified in the permit (same as presented in Tables 5-1 and 5-2). The reports or written statements shall be submitted even if no discharge occurred during the reporting period.

The report shall include the following:

- A description of any modifications to the wastewater collection, treatment, or disposal facilities;
- Any substantial changes in operational procedures;
- Any other significant activities that alter the nature or frequency of the discharge; and
- Any other material factors affecting compliance with the conditions of the permit.

For each measurement taken or sample collected, the following information shall be recorded:

- The exact place, date, and time of sampling;
- The dates the analysis were performed;
- The person who performed the analysis;
- The analytical techniques, procedures, and methods used; and
- The results of such analyses.

5.5.4 Special Discharge Reports

Special discharge reports must be submitted to the MCES on a quarterly basis, even when no discharge has been made. The requirements are substantially similar to the NPDES reports described in Section 5.5.3.

5.5.5 Performance Curves

The O&M contractor will tabulate site data to prepare the following performance curves for the Navy on a monthly basis.

- Plot cost-per-gallons-treated versus time (months)
- Plot cost-per-pound-of-contaminant-mass-removed versus time (months)
- Plot cumulative-contaminant-mass-removed versus cumulative cost
- Plot influent-contaminants-concentration versus time (months)

5.5.6 Records Retention

According to the NPDES/SDS permit, all records and documents that relate to the permit shall be retained for a minimum of three years. However, the records retention requirements (i.e., 10 years) provided in Section 4.5.3 supercede this permit requirement.

REFERENCES

Brown & Root Environmental, 1998. 1997 Annual Monitoring Report, Naval Industrial Reserve Ordnance Plant (NIROP), Fridley, Minnesota. Pittsburgh, PA.

Morrison Knudsen Corporation, 1998. Calculation of Site-Specific Allowable Emission Rates, Groundwater Treatment Facility, NIROP, Fridley, Minnesota. North Charleston, SC.

MPCA, 1996. Authorization to Discharge and to Construct, Install, and Operate a Wastewater Disposal System under the National Pollutant Discharge Elimination System and State Disposal System Permit Program. October 31, 1996. St. Paul, MN.

RMT, Inc., 1987a. Interim Report for Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota. Madison, WI.

RMT, Inc., 1987b. Remedial Investigation Report for the Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota. Madison, WI.

RMT, Inc., 1988a. Addendum to the Remedial Investigation Report for the Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota. Madison, WI.

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RMT, Inc., 1988c. Addendum to the Feasibility Study Report for the Remedial Investigation/Feasibility Study at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota. Madison, WI.

RMT, Inc., 1992. Determination of Groundwater Contaminant System Effectiveness for the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota. Revision 0, December 1992. Madison, WI.

RMT, Inc., 1995a. Remedial Action Workplan for Groundwater Remediation at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota. Revision 3, Final. Madison, WI.

RMT, Inc., 1995b. Workplan for Improvement of Groundwater Containment System Effectiveness for the Naval Industrial Reserve Ordnance Plant (NIROP), Fridley, Minnesota. Final, January 1995. Madison, WI.

Tetra Tech NUS, Inc., July 1999. Additional Investigation at the NIROP and Anoka County River Front Park, NIROP, Fridley, Minnesota.

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USEPA, 1988a. Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites. EPA/540/G-88-003, OSWER Directive 9283, Office of Emergency and Remedial Response, Washington, DC.

USEPA, 1988b. Statistical Methods for Evaluating the Attainment of Superfund Cleanup Standards; Volume 2: Groundwater, Draft 2.0.

USEPA, 1990. Record of Decision for Groundwater Remediation at the Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota. Region 5. Chicago, IL.

USEPA, 1998. Five Year Review Report, Naval Industrial Reserve Ordnance Plant Site, Fridley, Minnesota, Pursuant to CERCLA. Region 5. Chicago, IL.

APPENDIX A

NPDES/SDS PERMIT AND
MCES INDUSTRIAL DISCHARGE PERMIT

Minnesota Pollution Control Agency

October 31, 1996

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Doug Hildre, P.E.
Environmental Control Manager
United Defense L.P.
4800 East River Rd.
Minneapolis, MN 55421-1498

RE: FINAL ISSUANCE NPDES/SDS PERMIT MN0000710
Naval Industrial Reserve Ordnance Plant
Minneapolis, Minnesota

Dear Mr. Hildre:

We are enclosing the final issued National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) water quality permit for your facility. This reissued/modified permit supersedes the previous NPDES/SDS permit that was issued on January 2, 1996. Please note the changes on page 5 of the modified permit, which includes quarterly monitoring for copper from outfalls 010 and 030.

Discharge Monitoring Report (DMR) forms to be used in reporting the required monitoring and analyses will be sent to you within forty-five days of permit issuance. Please contact us if you have not received these report forms at least one week before your first required report submittal date.

Compliance with the terms and conditions of this permit is required as of the date of issuance.

If you have any questions concerning the final permit or related materials, please contact Caroline Voelkers at 612/296-7716.

Sincerely,

Douglas A. Hall, Supervisor
Permits/Technical Review Unit
Point Source Compliance Section
Water Quality Division

DAH:ls

Enclosure: Final Issued Permit

cc: U.S. Environmental Protection Agency, Chicago (w/ final permit)
C.O. David Cabeniss, U.S. Navy

AUTHORIZATION TO DISCHARGE AND TO CONSTRUCT, INSTALL AND

OPERATE A

WASTEWATER DISPOSAL SYSTEM

UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

AND STATE DISPOSAL SYSTEM PERMIT PROGRAM

In compliance with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et seq; hereinafter the "Act"), Minn. Stat. chs. 115 and 116, as amended, and Minn. Rules ch. 7001

U.S. NAVY - NAVAL SEA SYSTEMS COMMAND AND ARMAMENT SYSTEMS DIVISION, UNITED DEFENSE LIMITED PARTNERSHIP

(hereinafter the Permittee) is authorized by the Minnesota Pollution Control Agency (MPCA) to construct, install and operate a wastewater disposal system at and to discharge from 4800 E. River Road, Fridley, Minnesota to receiving water named Mississippi River, in accordance with effluent limitations, monitoring requirements and other conditions set forth herein.

This permit is a reissuance of an existing permit which has an expiration date of midnight, October 31, 1994. This reissued permit shall become effective on the date of issuance by the Commissioner and shall supersede the existing permit upon issuance.

This permit and its authorization shall expire at midnight, September 30, 2000. The Permittee is not authorized to discharge nor to operate the disposal system after the above date of expiration. In order to receive such authorization beyond the above date of expiration, the Permittee shall submit such information and forms as are required by the MPCA no later than 180 days prior to the above date of expiration pursuant to Minn. Rules pt. 7001.0040.

Date: October 31, 1996

Marvin E. Hora, Manager
Point Source Compliance Section
Water Quality Division

For Peder A. Larson
Acting Commissioner
Minnesota Pollution Control Agency

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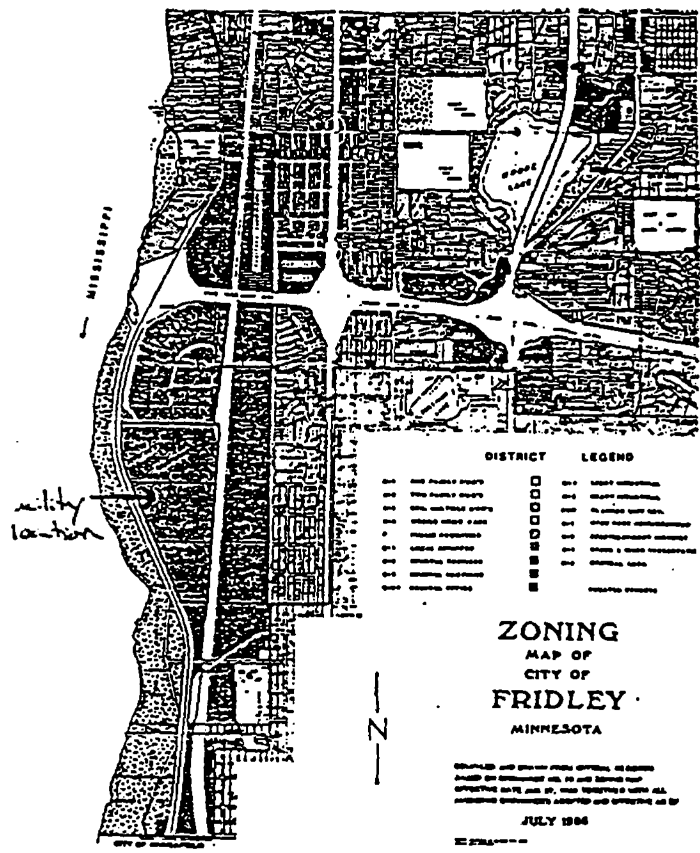
A. DESCRIPTION

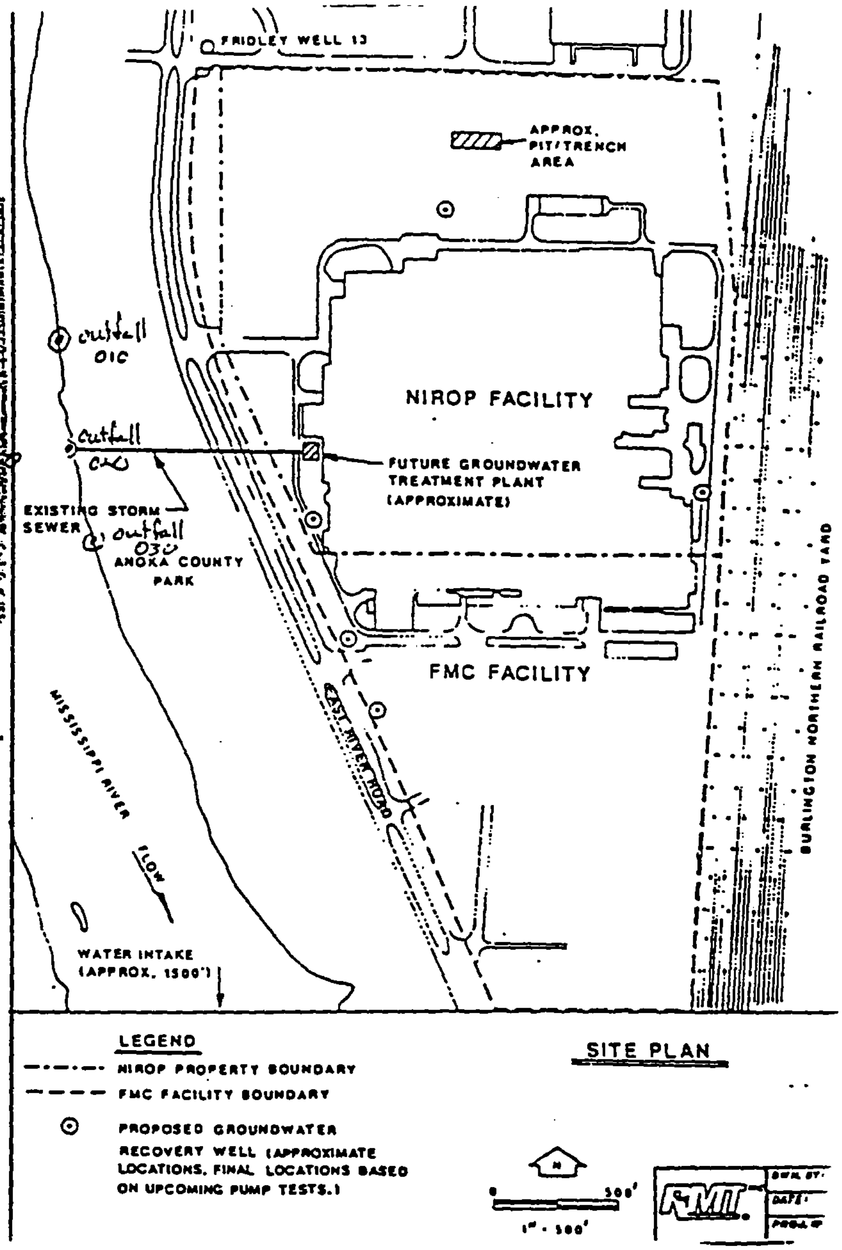
The Principal activity at this facility is the development, design, engineering, testing, and manufacturing of advanced ordnance weapons systems.

The discharge consists of once-through non-contact cooling water, storm water runoff, and discharge from a ground water remediation/treatment system. The average and maximum rates during non-runoff conditions are 585,000 and 1,200,000 gallons per day respectively for the cooling water, and 936,000 and 1,400,000 gallons per day average and maximum for the ground water remediation system discharge. Outfall 010 discharges storm water runoff only, outfall 030 discharges cooling water and storm water, and outfall 020 discharges cooling water, storm water and all of the water from the ground water remediation system. All of the outfalls discharge to the Mississippi River via private storm sewers.

At the time of this permit issuance, the ground water treatment system is still in the design phase, but will consist of some type of air stripping followed by carbon filtration if necessary to meet permit limits. Backwash from the treatment system will be discharged to the sanitary sewer. Discharge to the river is not anticipated to start until some time in 1996-1997. The permittee is required to submit plans and specifications for the treatment system for the Commissioner's approval prior to construction of the system. The monitoring requirements for VOC's listed on page 6 will not go into effect until discharge from the ground water treatment system begins.

Location of discharge:





B. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting until September 30, 2000 the Permittee is authorized to discharge from outfall serial numbers 010 and 030.

Such discharges shall be limited and monitored by the Permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Other Units (specify)			
	Monthly Average	Daily Max	Measurement Frequency	Sample Type
Flow (MGD)	--	--	Continuous Monitoring	--
Temperature*	--	26.5°C(80°F)	Monthly	Grab
Copper*	monitoring only		Quarterly	Grab

For the purpose of this permit, the above discharge shall be limited solely to non-contact cooling water and storm water free from process and other wastewater discharges.

The pH shall not be less than 6.0 nor greater than 9.0. These upper and lower limitations are not subject to averaging and shall be met at all times.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

The discharge shall not contain oil or other substances in amounts sufficient to create a visible color film on the surface of the receiving waters.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: at a point representative of the discharge to the river from outfalls 010 and 030.

* The daily maximum temperature limitation and copper monitoring apply only to outfall serial number 030.

B.2. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting until September 30, 2000 the Permittee is authorized to discharge from outfall serial number 020.

Such discharges shall be limited and monitored by the Permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	kg/day (lbs/day)	Other Units (specify)		
	Monthly Average	Daily Max	Measurement Frequency*	Sample Type
Flow (MGD)			Continuous Monitoring**	
Temperature		26.5°C(80°F)	Monthly	Grab
Iron		--	Quarterly	Grab
Manganee		--	Quarterly	Grab
Methylene chloride		5.0 ug/l	Twice monthly	Grab
Carbon disulfide		700 ug/l	Twice Monthly	Grab
1,1 dichloroethene		6.0 ug/l	Twice Monthly	Grab
1,1 dichloroethane		70 ug/l	Twice monthly	Grab
1,2 dichloroethene (cis)		70 ug/l	Twice monthly	Grab
1,2 dichloroethene (trans)		100 ug/l	Twice monthly	Grab
1,1,1 Trichloroethane		200 ug/l	Twice Monthly	Grab
Trichloroethene		5.0 ug/l	Twice Monthly	Grab
Tetrachloroethene		3.8 ug/l	Twice Monthly	Grab

* Twice monthly monitoring for VOC's is required for the first year, after startup of the discharge from the ground water remediation system after which the permittee may request a monitoring reduction. The permittee must request a reduction in writing and must receive written approval from the Commissioner prior to reducing monitoring. Monitoring reductions will only be granted if contaminant levels are consistently well below the discharge limits. Monitoring for iron and manganese may be eliminated after one year's worth of monitoring with written approval of the Commissioner.

**See Part D.1.a.

Complete VOC monitoring shall be conducted on the effluent twice annually after startup of the treatment system. EPA methods 601 & 602 shall be used for all analyses.

Monitoring for VOC's, iron and manganese, is not required until discharge from the treatment system to the river begins. Reporting for this outfall is required as of the date of permit issuance. Until such time as discharge from the ground water treatment system begins, it should be noted on the discharge monitoring reports (DMR's), in the space provided for reporting of VOC's, iron and manganese, that no discharge occurred from the treatment system.

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored monthly by grab samples analyzed immediately. These upper and lower limitations are not subject to averaging and shall be met at all times.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

The discharge shall not contain oil or other substances in amounts sufficient to create a visible color film on the surface of the receiving waters.

The discharge shall not contain significant color in amounts sufficient to create a visible discoloration of the receiving water at the point of discharge.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: at a point representative of the discharge to the river from outfall 020.

C. SPECIAL REQUIREMENTS

1. Pretreatment Requirements

No pollutant shall be discharged from this facility to a publicly owned treatment works except in accordance with pretreatment standards established in accordance with the Act or Minnesota Statutes or any such local standards or requirements. No pollutant shall be discharged into any publicly owned disposal system which interferes with, passes through inadequately treated or otherwise is incompatible with such disposal system. The Permittee shall not make modifications to divert any discharge of pollutants authorized by this permit to a publicly owned treatment works without having first notified and received the approval of the Commissioner.

2. Water Treatment and Chemical Additives

The Permittee shall not use nor increase the use of water treatment or chemical additives at this facility other than those additives and in the amounts reported prior to issuance of this permit and approved by the Commissioner, without the prior approval of the Commissioner. The Permittee shall request approval from the Commissioner in writing at least 30 days in advance of the proposed new use or increase in use of a water treatment or chemical additive at this facility. This written request shall include at least the following information for the proposed additive:

a. Material Safety Data Sheets, and the complete product use and instruction labels;
b. The commercial and chemical names;
c. Aquatic toxicity and human health or mammalian toxicity data;
d. Environmental fate information (including, but not limited to, persistence, half-life, intermediate breakdown products, and bioaccumulation data);
e. Whether the chemical is a suspected carcinogen, mutagen or teratogen; and
f. The proposed methods, concentrations, and average and maximum rates and frequencies of chemical addition.

This permit may be modified to restrict the use or discharge of a water treatment or chemical additive, or to require additional monitoring.

3. Reopening Clause

This permit shall be modified, or, alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under sections 301 (b)(2)(C), and (D), 304 (b)(2), and 307 (a)(2) of the Act, if the effluent standard or limitation so issued or approved:

(1) Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
(2) Controls any pollutant not limited in the permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

4. Ground Water Treatment System. The permittee shall submit, for the commissioners review and approval, plans and specifications for the ground water treatment system not less than three months prior to the anticipated date of treatment system installation. The permittee must receive written approval of the plans and specifications prior to construction/installation of the treatment system. The Permittee shall include in the treatment system design, some type of alarm system or automatic shut-off to assure that the discharge is stopped immediately in the event of a failure of the treatment system.

D. MONITORING AND REPORTING

1. Monitoring

a. Representative Sampling
Samples and measurements taken for the purposes of monitoring shall be representative of the volume and nature of the monitored activity. For brief periods of flow meter maintenance and other down time (i.e. 1-3 days a couple of times per year), alternative methods of flow measurements may be used as long as such methods provide representative flow measurements.

b. Certified Laboratory
In order to insure the quality and validity of analytical data, all samples collected to determine compliance with this permit shall be analyzed by a laboratory certified by the Minnesota Department of Health as provided by Minn. Rules pt. 4740.2040, Certified Test Categories.

c. Test Procedures
Test procedures for the analysis of parameters shall conform to regulations promulgated pursuant to Section 304 (h) of the Act, and Minn. Stat. § 115.03, subd. 1 (e) (7) as amended, and 40 Code of Federal Regulations Part 136.

The Permittee shall calibrate all field instruments in the field prior to sample collection. The Permittee also shall periodically calibrate and perform maintenance on all other monitoring and analytical instrumentation used to monitor parameters under this permit, at intervals to insure accuracy of measurements. The Permittee shall maintain written records of all such calibrations and maintenance.

d. Recording of Results
For each measurement taken or sample collected pursuant to the requirements of this Permit, the Permittee shall record the following information:

1) The exact place, date, and time of sampling;
2) The dates the analyses were performed;
3) The person who performed the analyses;
4) The analytical techniques, procedures and methods used; and
5) The results of such analyses.

e. Additional Monitoring by Permittee

If the Permittee monitors any parameter designated herein more frequently than required by this permit, or as otherwise directed by the MPCA or Commissioner, the results of such monitoring shall be included in the calculation and reporting of values submitted on the Discharge Monitoring Report Form. Any increased monitoring frequency shall also be indicated on such designated form.

f. Recording and Records Retention

The Permittee shall retain for a minimum of three years all records and documents in its possession or the possession of its divisions, employees, agents, accountants, contractors or attorneys that relate to this permit, including original recordings from any continuous monitoring instrumentation, and any calibration and maintenance records. These retention periods shall be automatically extended during the course of any legal or administrative proceedings or when so requested by the Regional Administrator, the MPCA, or the Commissioner.

2. Reporting

a. Submittal of Quarterly/Monthly Report

All monitoring results obtained pursuant to the provisions of this permit shall be summarized on a monthly basis and reported on the designated "Discharge Monitoring Report Form." Reports shall be submitted monthly and received or postmarked no later than the 21st day of the month following the month during which the monitoring was completed. The first report is due on the reporting date following the first month where monitoring is required beginning on the date of issuance of this permit. Reports shall be signed by the Permittee or the duly authorized representative of the Permittee.

Signed copies of these, and all other reports required herein, shall be submitted to the Commissioner at the following address:

Minnesota Pollution Control Agency
Water Quality Division
Industrial Section
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

b. Contents of Monthly Report

The Permittee shall report the results of the monitoring in the units specified in this permit. The reports or written statements shall be submitted even if no discharge occurred during the reporting period.

The report shall include:

(1) A description of any modifications in the wastewater collection, treatment, and disposal facilities;

(2) Any substantial changes in operational procedures;

(3) Any other significant activities which alter the nature or frequency of the discharge; and

(4) Any other material factors affecting compliance with the conditions of this permit and such information as the MPCA or Commissioner may reasonably require of the Permittee pursuant to Minn. Stat. chs. 115 and 116 as amended, and Minn. Rules ch. 7001.

c. Availability of Data

Except for data determined to be confidential under Section 308 of the Act, and Minn. Stat. § 116.075, subd. 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the MPCA. Procedures for submitting such confidential material shall be pursuant to Minn. Rules pt. 7000.1300. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report, confidential or otherwise, is subject to the imposition of criminal penalties as provided for in Section 309 of the Act and Minn. Stat. §§ 115.071 and 609.671.

E. DEFINITIONS

1. The "Act" means the Clean Water Act, as amended 33 U.S.C. 1251, et seq.

2. The "MPCA" means the Minnesota Pollution Control Agency, as constituted pursuant to Minn. Stat. § 116.02, subd. 1.

3. "Best Available Technology" means the application to a treatment facility of the best available technology economically achievable as required by Section 301 (b)(2) of the Clean Water Act, United States Code, Title 33, Section 1311 (b)(2).

4. "Best Management Practices" means practices to prevent or reduce the pollution of the waters of the state, including schedules of activities, prohibitions of practices, and other management practice, and also includes treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge, or waste disposal or drainage from raw material storage.

5. The "Commissioner" means the Commissioner, or other MPCA staff as authorized by the Commissioner, of the Minnesota Pollution Control Agency as described in Minn. Stat. § 116.03 as amended.

6. "Daily Maximum" concentration means the greatest daily determination of concentration for any calendar day.

7. "Grab" sample is an individual sample collected at one point in time.

8. "Monthly Average" concentration is defined as the arithmetic mean (weighted by flow value) of all the daily determinations of concentration made during the calendar month. Daily determinations of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily determination of concentration shall be the arithmetic mean (weighted by flow value) of all the samples collected during the calendar day. The arithmetic mean (weighted by flow value) is the summation of each concentration times its respective flow divided by the summation of the respective flows.

9. "Pollutants, Toxic Pollutants, Other Wastes, Point Source, Disposal System, Waters of the State," and other terms for the purpose of this permit are defined in Section 502 of the Act and Minn. Stat. § 115.01 as amended and Minn. Rules ch. 7001.

10. The "Regional Administrator" means the Environmental Protection Agency (EPA) Region Administrator for the region in which Minnesota is located (now Region 5).

PART II

A. MANAGEMENT REQUIREMENTS

1. Permit Limit Exceedances. If, for any reason, the Permittee exceeds any effluent limitation specified in the Permit, the Permittee shall report with the next Discharge Monitoring Report, the following information:

   a. A description of the discharge, approximate volume, and the cause of the noncompliance.
   b. The period of noncompliance including exact dates and times, the anticipated time of noncompliance if it is still continuing, and the steps taken to correct, reduce, eliminate, and prevent recurrence of the noncomplying discharge.

2. Adverse Impact

   The Permittee shall take all reasonable steps to minimize any adverse impact to waters of the State resulting from:

   a. All unauthorized discharges accidental or otherwise, of oil, toxic pollutants or other hazardous substances consistent with Minn. Stat. § 115.061 and 40 CFR PART 110 and 116;

   b. Effluent limitation violations.

   The Permittee shall immediately notify the Commissioner in writing of any occurrences as described in a. or b. above.

3. Change in Discharge

   a. All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit. Such a violation may result in the imposition of civil or criminal penalties as provided for in Section 309 of the Act, Minn. Stat. §§ 115.071 and 609.671.

   b. Facility modifications, additions, and/or expansions that increase the plant capacity shall be reported to the Commissioner (Attn: Point Source Compliance Section, Water Quality Division) and this permit may then be modified or reissued to reflect such changes.

   c. Any anticipated change in the facility discharge, including any facility expansions, production increases, process modifications, new or modified industrial discharges, or change in the quality of existing industrial discharges to the treatment system that may result in a new or increased discharge of pollutants shall be reported to the Commissioner (Attn: Point Source

Compliance Section, Water Quality Division). Modification to the permit may then be made to reflect any necessary change in permit conditions, including any necessary effluent limitations for any pollutant not identified and limited herein.

d. In no case are any new connections, increased flows, or significant changes in influent quality permitted that will cause violation of the limitations and conditions specified herein.

4. Facilities Operation and Quality Control

All waste collection, control, treatment, and disposal facilities shall be operated in a manner consistent with the following:

a. Maintenance of the treatment facility that results in impairment of treatment efficiency of the disposal system and/or degradation of water quality shall be scheduled as much as possible during non-critical water quality periods and shall be carried out in a manner approved by the Commissioner.
b. The Commissioner may require the Permittee to submit a maintenance plan to eliminate water quality degradation. The Permittee shall operate the disposal system in accordance with this plan as approved by the Commissioner.
c. The Permittee shall provide an adequate operating staff which is duly qualified under Minn. Rules ch. 9400 and, if applicable, as determined by the Commissioner pursuant to Minn. Rules pt. 7001.0150, to carry out the operation, maintenance and testing functions required to insure compliance with the conditions of this permit.
d. The Permittee shall at all times maintain in good working order and operate as efficiently as possible all facilities or systems of control installed or used to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.
e. Necessary in-plant control tests shall be conducted at a frequency adequate to ensure continuous efficient operation of the treatment facility.

5. Removed Substances

The Permittee shall dispose of solids, sludges, filter backwash, or other pollutants removed from or resulting from treatment or control of wastewaters in such manner as to prevent any pollutant from such materials from entering waters of the state. In disposing of such materials, the Permittee shall comply with all applicable water, air, solid waste and hazardous waste statutes and regulations. When requested, the Permittee shall submit a plan for such disposal for approval by the Commissioner.

6. System Reliability

The Permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastes at all times. The Permittee is responsible for insuring system reliability by means of alternate power sources, back-up systems, storage of inadequately treated effluent, or other appropriate methods of maintaining system reliability.

7. Construction

This permit only authorizes the construction of treatment works to attain compliance with the limitations and conditions of this permit, after plans and specifications for treatment facilities have been submitted to and approved in writing by the Commissioner prior to the start of any construction.

8. Need to Halt or Reduce not a Defense

It shall not be a defense for the 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 this permit.

9. Bypass prohibited

There shall be no bypass of the ground water treatment system. In the event of a system failure, routine maintenance or if, for any other reason, the treatment system needs to be shut down, the discharge will be stopped until the treatment system is operational.

B. RESPONSIBILITIES

1. Transfer of Ownership or Control

No permit may be assigned or transferred by the holder without the approval of the MPCA. In the event of any changes in control or ownership of the facilities, a Request for Permit Transfer, signed by both parties shall be sent to the MPCA (Attn: Industrial Section, Water Quality Division). Any succeeding owner or controller also shall comply with the terms and conditions of this permit.

2. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;
b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;
c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge; or
d. Minn. Rules pts. 7001.0170 and 7001.0180.

3. Toxic Pollutants

Notwithstanding PART II, B.2 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307 (a) of the Act or Minn. Stat. chs. 115 and 116 as amended, for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitations for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and in accordance with applicable laws and regulations.

4. Right of Entry

The Permittee shall, pursuant to Section 308 of the Act and Minn. Stat. § 115.04, allow the Commissioner of the MPCA, the Regional Administrator, and their authorized representatives upon presentation of credentials:

a. To enter upon the Permittee's premises where a disposal system or other point source or portion thereof is located for the purpose of obtaining information, examination of records, conducting surveys or investigations;
b. To bring such equipment upon the Permittee's premises as is necessary to conduct such surveys and investigations;

c. To examine and copy any books, papers, records, or memoranda pertaining to the installation, maintenance, or operation of the discharge, including but not limited to, monitoring data of the disposal system or point source or records required to be kept under the terms and conditions of this permit;
d. To inspect any monitoring equipment or monitoring procedures required in this permit; and
e. To sample and monitor any substances or parameters at any location.

5. Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for non-compliance with the terms and conditions provided herein.

6. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject to under Section 311 of the Act and Minn. Stat. chs. 115 and 116 as amended.

7. Liability Exemption

This permit authorizes the permittee to perform the activities described herein under the conditions set forth. In issuing this permit, the state/agency assumes no responsibility for any damage to persons, property or the environment caused by the activities of the permittee in the conduct of its actions, including those activities authorized, directed or undertaken pursuant to this permit. To the extent the state/agency may have any liability for the activities of its employees, that liability is explicitly limited to that provided in the Torts Claim Act, Minn. Stat. § 3.736.

8. Minnesota Laws

Nothing in this permit shall be construed to preclude the institution of any legal or administrative proceedings or relieve the Permittee from any responsibilities, liabilities, or penalties for violation of effluent and water quality limitations not included in this permit.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

10. Severability

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

11. NPDES/SDS Rules

The Permittee shall comply with the provisions of Minn. Rules pts. 7001.0150, subp. 3 and 7001.1090, subp. 1.

12. Other Statutes, Rules and Ordinances

The MPCA's issuance of a permit does not release the Permittee from any liability, penalty or duty imposed by Minnesota or federal statutes or local ordinances, except the obligation to obtain the permit.

13. More Stringent Rules

The MPCA's issuance of a permit does not prevent the future adoption by the MPCA of pollution control rules, standards, or orders more stringent than those now in existence and does not prevent the enforcement of these rules, standards or orders against the Permittee.

14. MPCA Obligation

The MPCA's issuance of a permit does not obligate the MPCA to enforce local laws, rules or plans beyond that authorized by Minnesota Statutes.

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090
Code 18610
21 Apr 98

Mr. Michael V. Flaherty
Metropolitan Council Environmental Services
Industrial Waste Section
230 East Fifth Street
St. Paul, MN 55101-1633

Subj: INDUSTRIAL DISCHARGE PERMIT RENEWAL FOR NIROP FRIDLEY – SPECIAL DISCHARGE NO. 2154

Dear Mr. Flaherty:

Please find the attached Permit renewal form for subject Industrial Discharge Permit.

Should you have any questions or comments, please contact me at (843) 820-5587.

Sincerely,

SCOTT A. GLASS, P.E.
Remedial Project Manager
Installation Restoration II Division

Encl:
(1) Permit Renewal

Copy to:
United Defense L.P. (Mr. Douglas L. Hildre)
Tetra Tech NUS (Mr. Mark Sladic, P.E.)

Metropolitan Council
Environmental Services

Permit No.: 2154
Expiration Date: 7/98

METROPOLITAN COUNCIL ENVIRONMENTAL SERVICES

INDUSTRIAL DISCHARGE PERMIT - SPECIAL DISCHARGES RENEWAL APPLICATION

1. Company Name: U.S. NAVY

2. Mailing Address: COMMANDING OFFICER, ATTN: SCOTT A GLASS, CODE 18610
SOUTHNAVFACENGCOM
P O BOX 190010, NORTH CHARLESTON, SC 29419-9010

3. Facility Name: NIROP FRIDLEY

4. Facility Address: 5001 EAST RIVER ROAD
MINNEAPOLIS, MN 55421-1406

5. Responsible Person: SCOTT A. GLASS, P.E.
Title: ENVIRONMENTAL ENGINEER
Phone Number: (843) 820-5587

6. Consultant: TETRA TECH NUS, INC., ATTN: MARK SLADIC, P.E.
Phone Number: (412) 921-8216

7. Consultant Address: FOSTER PLAZA VII, 661 ANDERSON DRIVE
PITTSBURGH, PA 15220-2745

8. Please list names and phone numbers of current contact persons involved in regulating this project (Minnesota Pollution Control Agency, Minnesota Department of Natural Resources, county and community).

THOMAS R. BLOOM, U.S. EPA REGION V, (312) 886-1967

DAVID N. DOUGLAS, MPCA, (612) 296-7818

EVAN DRIVAS, MDNR, (612) 297-4604

9. Discharge volume: Rate: 600 GPM gallons/minute.

Annual Volume:* 190MM/70MM gallons/year

* Approximately 190 million gal/yr for first year of permit term and approximately 70 million gal/yr for second and third years of permit term.

10. Means of disposal into the Metropolitan Disposal System:

96" Sanitary interceptor sewer line at NIROP Fridley

11. Is the discharge continuous or intermittent? (Explain) Continuous from beginning of permit term to approximately October 1998 and intermittent thereafter. Discharge is from a groundwater extraction and treatment system.

12. Estimated duration of the project: 20 years

13. Please attach a description and diagram of the current treatment system. Are there any plans to modify or expand this system in the next three years? The groundwater treatment system is currently being modified to discharge treated groundwater directly to the Mississippi.

14. Has application been made for an NPDES permit for this site? Yes. Permit No. 0000710 was issued 31 October 1996

15. Contaminants detected in this discharge: Trichloroethene
1, 2 Dichloroethene

I hereby certify that the information supplied in this application is true and accurate to the best of my knowledge.

Name (Print): Scott A. Glass, P.E.

Title: Environmental Engineer

Signature: Scott A Glass

Date: 4/21/98

This application must be signed by the Responsible Party. If you wish to designate a representative for the purpose of signing and submitting reports and for billing purposes, please complete the attached form. If no representative is designated for billing purposes, all invoices will be sent to the responsible party at the company mailing address.

V:\M9\EVERYONE\

gwren496.doc

DESIGNATION OF AUTHORIZED REPRESENTATIVE FOR SUBMITTING REPORTS AND BILLING

In many cases, a responsible party may wish to designate a representative for the purpose of signing and submitting routine self-monitoring reports required by the Industrial Discharge Permit (Special Discharges). In addition, some permittees prefer to have billing for permit fees, add-on service charges and strength charges submitted to their consultant or agent. If you wish to designate a representative for either of these purposes, please complete this form and submit it with your permit application. If no representative is designated for billing purposes, all invoices will be sent to the responsible party at the permit mailing address.

Site: NIROP Fridley
5001 East River Road
Minneapolis, MN 55421-1406

I Scott A. Glass hereby designate Douglas L. Hildre (United Defense L.P.) as my authorized representative for the purpose of signing and submitting MCES Special Discharge Reports for the above referenced site. I understand that this designation does not release me from responsibility or liability for any violations that may occur at this site.

Invoices for permit fees, strength charge or add-on service fees shall be sent to:

Contact: Scott A. Glass, P.E.

Billing Party: Commanding Officer, ATTN: Scott A. Glass, Code 18610

Billing Party Address: SOUTHNAVFACENGCOM
P. O. BOX 190010
North Charleston, SC 29419-9010

Scott A. Glass
Name (Responsible Party)

[signature]
Signature

U.S. NAVY
Company

4/21/98
Date

gw496.sam

Permit No.: 2154
Expiration Date: 7/98

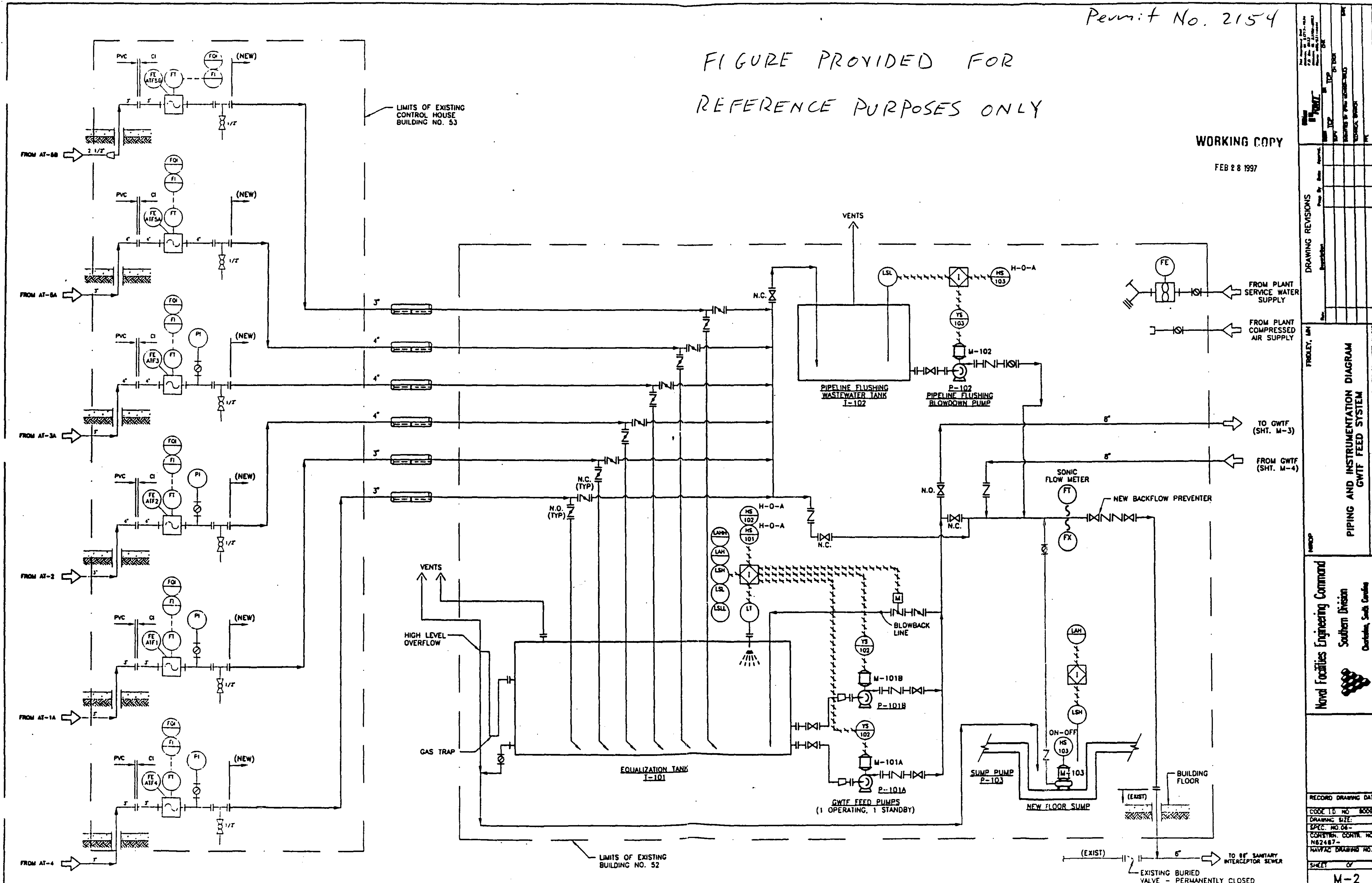
Continuation for Item 13 of Permit Renewal for NIROP Fridley

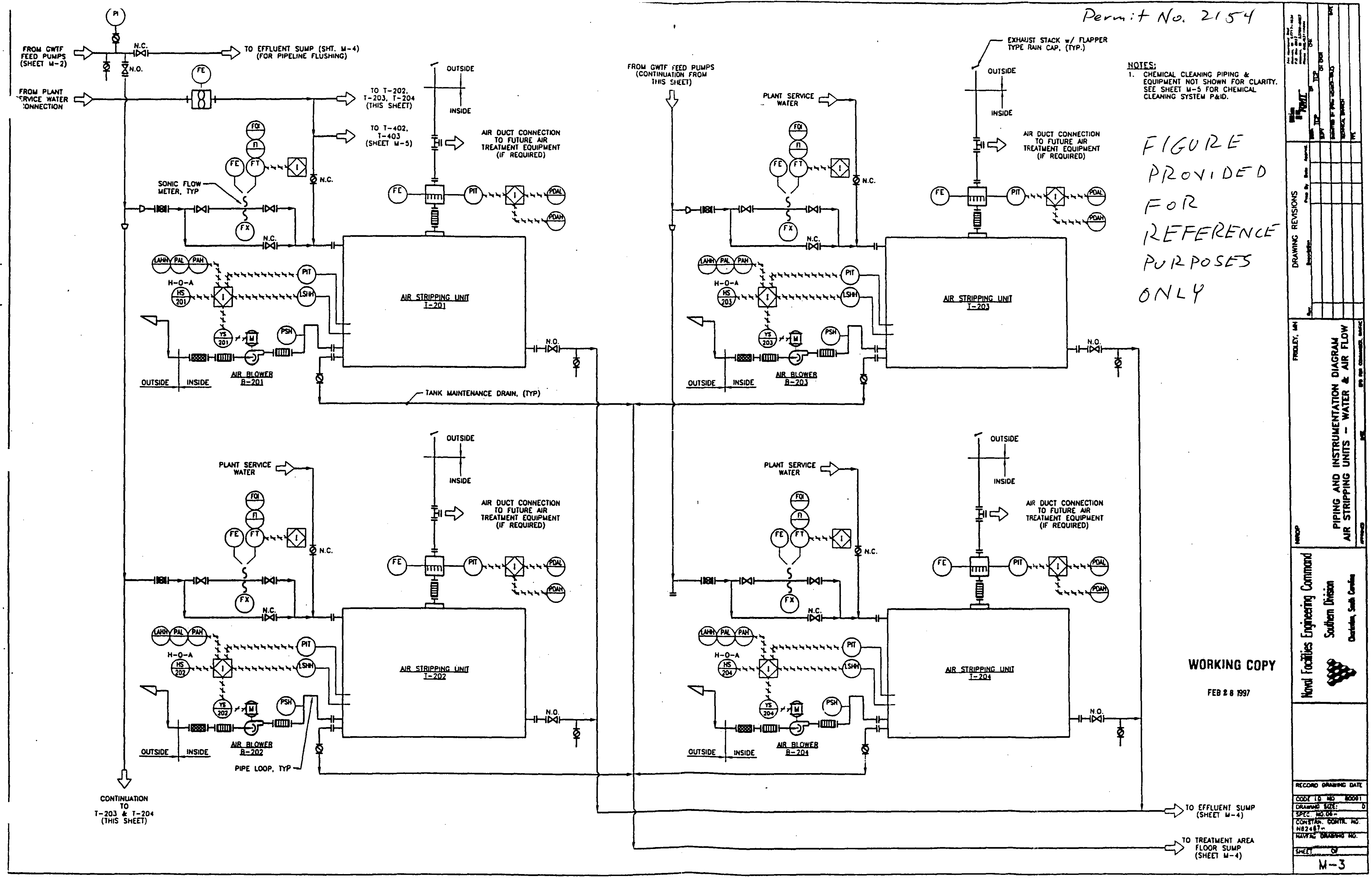
The original groundwater extraction and treatment system began operating in September 1992 and consisted of four extraction wells (AT-1A, AT-2A, AT-3A, and AT-4A) and a pretreatment system that reduce the VOC concentration in the extracted groundwater to meet sanitary sewer discharge requirements. Two additional extraction wells (AT-5A and AT-5B) were constructed and placed into operation in June 1995. The combined discharge concentration of VOCs from the six extraction wells has decreased to below levels where pretreatment is necessary for discharge to the sanitary sewer. With the approval of the MCES, the pretreatment system was shut down in March 1995. The combined discharge from the six extraction wells has been discharged directly to the sanitary sewer without pretreatment since March 1995.

Upgrades to the groundwater treatment facility began in September 1997. The upgraded groundwater treatment system is expected to be operational in October 1998. Refer to Figures M-2, M-3, M-4 and M-5 for a general configuration of the new treatment system. The original piping and pretreatment system was dismantled. Piping modifications have been made and the treatment components of the new system are currently under construction. The extraction system was shut down for approximately two months, from November 1997 to January 1998, to support system modifications. The system continues to discharge directly to the sanitary sewer. When the upgraded groundwater treatment facility is operational, treated groundwater will be diverted from the sanitary sewer to the storm sewer and discharged directly to the Mississippi River via a National Pollutant Discharge Elimination System (NPDES) permitted discharge point, at Outfall 020 from the NIROP facility.

For a period of approximately two months, during system start-up and check-out, from September 1998 to November 1998, frequent discharges to the sanitary sewer are expected. When the Navy has confidence that the NPDES discharge requirements can be maintained, the treated groundwater will be discharged to the storm sewer. Occasional discharges to the sanitary sewer will continue to be required for the disposal of system cleaning and flushing wastewater and if the treatment system has to be taken off-line for maintenance.

The new groundwater extraction and treatment system will route groundwater from the six existing extraction wells to an equalization tank where the extracted groundwater will be routed to air stripping units (ASUs) via feed pumps. Food grade polymers will be added to the groundwater at the suction side of the feed pumps. The polymers are used to minimize scaling of the ASUs in order to maintain stripping efficiencies and to reduce the frequency of chemical cleaning. Four low-profile tray type ASUs will operate in parallel. Each ASU has a 250 gpm capacity, therefor, only three ASUs will be required to operate at a time to handle the current flow. The fourth is a standby unit that will be utilized during ASU maintenance and cleaning operations. Air will be blown through the ASUs, counter to the flow of groundwater, to strip VOCs from the groundwater. The air exiting the ASUs will be exhausted to the atmosphere via an exhaust stack. The treated groundwater will flow from the ASUs to the effluent sump, where the groundwater will be pumped to the storm sewer, and discharged to the Mississippi River.

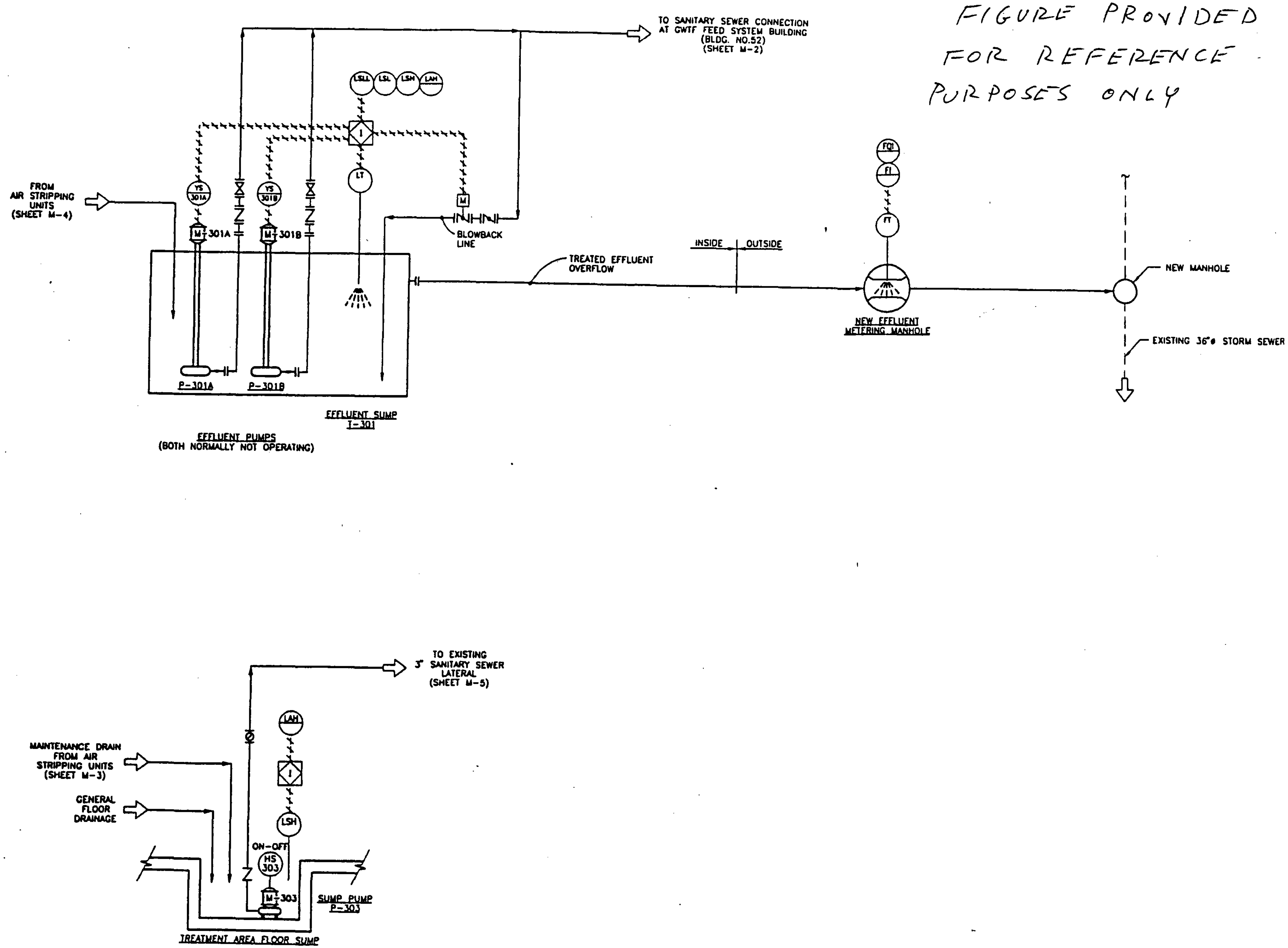

Permit No. 2154
FIGURE PROVIDED FOR
REFERENCE PURPOSES ONLY
WORKING COPY
FEB 28 1997
LIMITS OF EXISTING CONTROL HOUSE BUILDING NO. 53
FROM AT-6B
FROM AT-6A
FROM AT-3A
FROM AT-2
FROM AT-1A
FROM AT-4
PVC
CI
(NEW)
FQI
FI
FT
FE ATF5B
FE ATF5A
FE ATF3
FE ATF2
FE ATF1
FE ATF4
PI
VENTS
LSL
HS 103
H-O-A
YS 103
M-102
PIPELINE FLUSHING WASTEWATER TANK T-102
P-102 PIPELINE FLUSHING BLOWDOWN PUMP
N.C.
N.O.
N.C. (TYP)
N.O. (TYP)
FE
FROM PLANT SERVICE WATER SUPPLY
FROM PLANT COMPRESSED AIR SUPPLY
TO GWTF (SHT. M-3)
FROM GWTF (SHT. M-4)
SONIC FLOW METER
FX
NEW BACKFLOW PREVENTER
HS 102
HS 101
LAHH
LAH
LSH
LSL
LSLL
LT
BLOWBACK LINE
YS 102
M-101B
P-101B
M-101A
P-101A
GWTF FEED PUMPS (1 OPERATING, 1 STANDBY)
HIGH LEVEL OVERFLOW
GAS TRAP
EQUALIZATION TANK T-101
ON-OFF
SUMP PUMP P-103
NEW FLOOR SUMP
BUILDING FLOOR
(EXIST)
LIMITS OF EXISTING BUILDING NO. 52
EXISTING BURIED VALVE - PERMANENTLY CLOSED
TO 8" SANITARY INTERCEPTOR SEWER
DRAWING REVISIONS
PIPING AND INSTRUMENTATION DIAGRAM
GWTF FEED SYSTEM
Naval Facilities Engineering Command
Southern Division
Charleston, South Carolina
RECORD DRAWING DATE
CODE I.D. NO. 80091
DRAWING SIZE: D
SPEC. NO. 04-
CONSTRN. CONTR. NO. N62467-
NAVFAC DRAWING NO.
SHEET OF
M-2



Permit No. 2154
FROM GWTF FEED PUMPS (SHEET M-2)
TO EFFLUENT SUMP (SHT. M-4) (FOR PIPELINE FLUSHING)
FROM PLANT SERVICE WATER CONNECTION
TO T-202, T-203, T-204 (THIS SHEET)
TO T-402, T-403 (SHEET M-5)
SONIC FLOW METER, TYP
OUTSIDE
INSIDE
AIR DUCT CONNECTION TO FUTURE AIR TREATMENT EQUIPMENT (IF REQUIRED)
EXHAUST STACK w/ FLAPPER TYPE RAIN CAP, (TYP.)
FROM GWTF FEED PUMPS (CONTINUATION FROM THIS SHEET)
PLANT SERVICE WATER
AIR STRIPPING UNIT T-201
AIR STRIPPING UNIT T-202
AIR STRIPPING UNIT T-203
AIR STRIPPING UNIT T-204
AIR BLOWER B-201
AIR BLOWER B-202
AIR BLOWER B-203
AIR BLOWER B-204
TANK MAINTENANCE DRAIN, (TYP)
PIPE LOOP, TYP
CONTINUATION TO T-203 & T-204 (THIS SHEET)
TO EFFLUENT SUMP (SHEET M-4)
TO TREATMENT AREA FLOOR SUMP (SHEET M-4)
NOTES:
1. CHEMICAL CLEANING PIPING & EQUIPMENT NOT SHOWN FOR CLARITY. SEE SHEET M-5 FOR CHEMICAL CLEANING SYSTEM P&ID.
FIGURE PROVIDED FOR REFERENCE PURPOSES ONLY
WORKING COPY
FEB 28 1997
DRAWING REVISIONS
PIPING AND INSTRUMENTATION DIAGRAM AIR STRIPPING UNITS - WATER & AIR FLOW
Naval Facilities Engineering Command
Southern Division
Charleston, South Carolina
RECORD DRAWING DATE
SHEET M-3

Permit No. 2154

FIGURE PROVIDED FOR REFERENCE PURPOSES ONLY



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FEB 28 1997

DRAWING REVISIONS

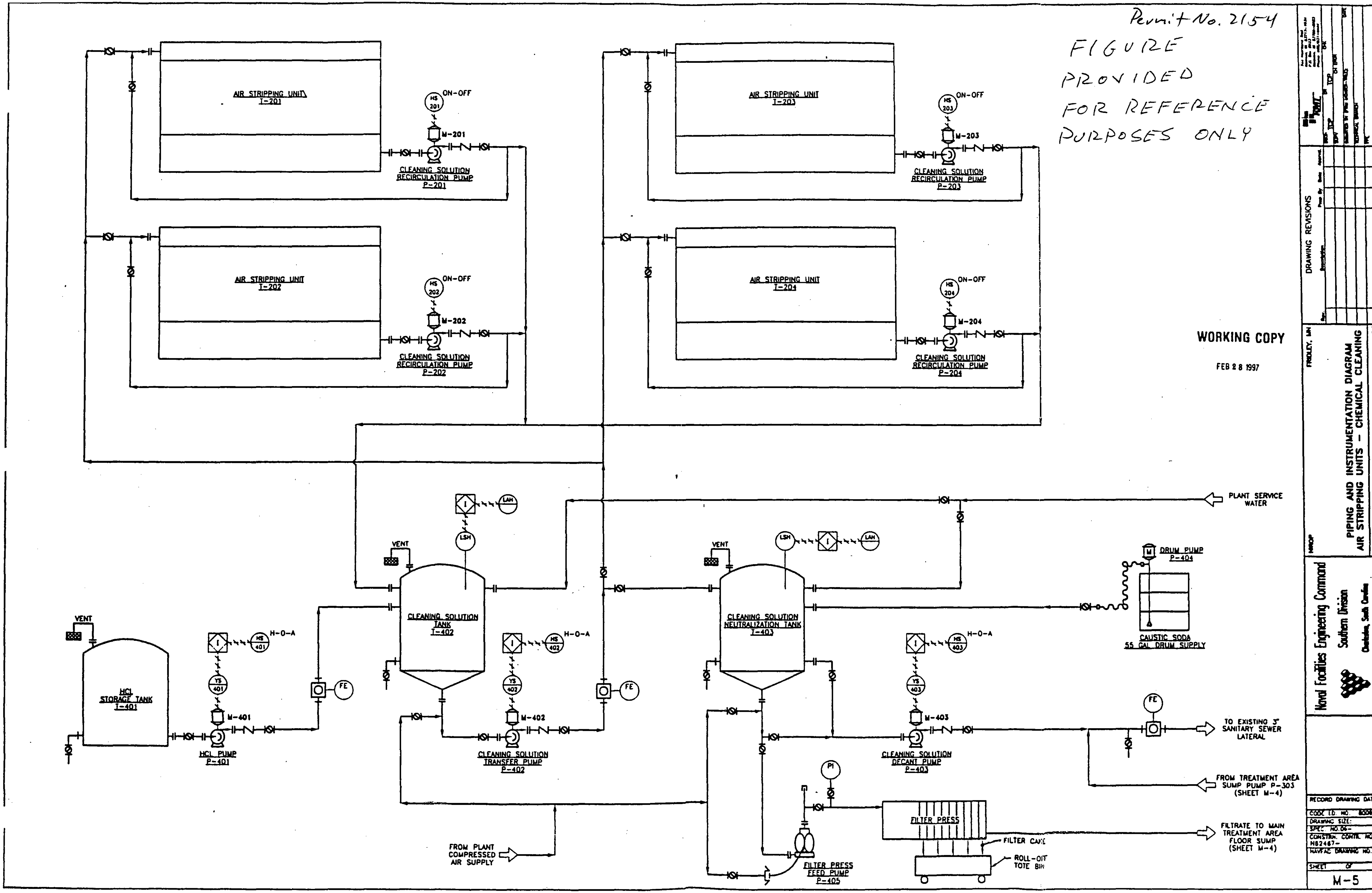
FRIDLEY, MN

NIROP

PIPING AND INSTRUMENTATION DIAGRAM
EFFLUENT DISCHARGE & TREAT. AREA SUMP

Naval Facilities Engineering Command
Southern Division
Charleston, South Carolina

RECORD DRAWING DATE
CODE I.D. NO. 80091
DRAWING SIZE: D
SPEC. NO.06-
CONSTRN. CONTR. NO. N62467-
NAVFAC DRAWING NO.
SHEET OF
M-4



Permit No. 2154
FIGURE PROVIDED FOR REFERENCE PURPOSES ONLY
AIR STRIPPING UNIT T-201
AIR STRIPPING UNIT T-202
AIR STRIPPING UNIT T-203
AIR STRIPPING UNIT T-204
HS 201 ON-OFF
HS 202 ON-OFF
HS 203 ON-OFF
HS 204 ON-OFF
M-201
M-202
M-203
M-204
CLEANING SOLUTION RECIRCULATION PUMP P-201
CLEANING SOLUTION RECIRCULATION PUMP P-202
CLEANING SOLUTION RECIRCULATION PUMP P-203
CLEANING SOLUTION RECIRCULATION PUMP P-204
WORKING COPY
FEB 28 1997
PLANT SERVICE WATER
VENT
LSH
LAH
I
CLEANING SOLUTION TANK T-402
CLEANING SOLUTION NEUTRALIZATION TANK T-403
DRUM PUMP P-404
CAUSTIC SODA 55 GAL DRUM SUPPLY
HCL STORAGE TANK T-401
HS 401 H-O-A
HS 402 H-O-A
HS 403 H-O-A
YS 401
YS 402
YS 403
M-401
M-402
M-403
FE
PI
HCL PUMP P-401
CLEANING SOLUTION TRANSFER PUMP P-402
CLEANING SOLUTION DECANT PUMP P-403
TO EXISTING 3" SANITARY SEWER LATERAL
FROM TREATMENT AREA SUMP PUMP P-303 (SHEET M-4)
FILTER PRESS
FILTRATE TO MAIN TREATMENT AREA FLOOR SUMP (SHEET M-4)
FILTER CAKE
ROLL-OFF TOTE BIN
FILTER PRESS FEED PUMP P-405
FROM PLANT COMPRESSED AIR SUPPLY
DRAWING REVISIONS
FRIDLEY, MN
PIPING AND INSTRUMENTATION DIAGRAM
AIR STRIPPING UNITS – CHEMICAL CLEANING
Naval Facilities Engineering Command
Southern Division
Charleston, South Carolina
RECORD DRAWING DATE
CODE I.D. NO. 80091
DRAWING SIZE: D
SPEC. NO. 06-
CONSTR. CONTR. NO. N62467-
NAVFAC DRAWING NO.
SHEET OF
M-5

APPENDIX B

MPCA RISK BASED SITE CHARACTERIZATION AND SAMPLING GUIDANCE

APPENDIX 2: SAMPLING PROTOCOL TEMPLATE FOR MONITORING WELLS

Superfund and Voluntary Investigation and Cleanup Programs Minnesota Pollution Control Agency

Sampling Protocol Template For Monitoring Wells

FOREWORD

When to Use a Sampling Protocol

A sampling protocol is a description of the equipment and methodologies used in the collection of samples at a given site for a defined long term project. The goals of a protocol are to help maintain a high level of consistency in sampling methods for the duration of the project or operable unit. Protocols are not required at all sites. They are most useful at sites where:

- multiple sampling events take place over a long period of time (years);
- multiple consulting firms may be used during the duration of the project; and
- samples are used for monitoring changes in concentrations close to project action levels.

An example of such a site would be a project involving long term monitoring of monitoring wells located between drinking water wells and a release source where the concentrations in the monitoring wells are close to levels set for a response action (activation of a ground water containment system, initiate alternative water supply, etc.). The goal of the protocol would be to ensure that the sampling methods would produce a higher level of data consistency if the consultants or MPCA staff change during the project. Having a sampling protocol for a site does not limit the sampling options, but does require an informed decision be made when changing the sampling methods due to advances in technology or to reflect changes in the data.

Protocols do not take the place of sampling plans. For a site with a sampling protocol in force, sampling plans detail the schedule, specific parameters and changes in equipment or methodologies for a sampling event or short term series of sampling events. Sampling plans may reference the site sampling protocol for economy of preparation and review time of the plans.

USE OF TEMPLATE

The purpose of this sampling protocol template is to provide an example of the level of detail generally required by MPCA staff and to expedite preparation of a sampling protocol. Use of the template is recommended, but not required.

This Sampling Protocol Template has been designed to be used as a component of, and in concert with, the complete "MPCA Ground Water Sampling Guidance Document, Development of Sampling Plans, Protocols and Reports, 1995" (Guidance Document). This Sampling Protocol Template is a flexible template and requires modification to become suitable for application to a site. Refer to Chapter 3 of the Guidance Document and the "Instructions" that follow. Your site-specific *data quality objectives (DQOs)* should play a major role in determining how you modify the Sampling Protocol Template. DQOs are defined in the Guidance Document. *See Chapter 2, Table 1 from the Guidance Document for DQO criteria*. Topics in Chapters Four and Five of the Guidance Document are presented parallel to the structure of the Sampling Protocol Template The parallel structure is intended to assist the user in cross-referencing technical background information while customizing the Sampling Protocol Template.

TEMPLATE COPIES

This Sampling Protocol Template will be available for copying on diskette in the MPCA library to facilitate modification with word processing software. It is also available on diskette for site-specific application. Forward the request to MPCA, support staff by calling (651) 296-7291. The requester shall provide a formatted disk with a return self-addressed, stamped disk envelope for duplication of the protocol. Until further notice, there will be no charge for copying the protocol to the diskette. Initially, a copy will be available in Microsoft® Word for Windows version 6.0. In the future, copies may be available in other formats or available for electronic transfer via modem.

This Sampling Protocol Template must be edited before it can be applied to an actual site. This section provides instructions on how to customize the Sampling Protocol Template for site-specific needs. More general, but important guidance on using this Sampling Protocol Template can be found in Chapter Three of the main body of the Guidance Document.

This Sampling Protocol Template was designed to assist user's with the creation of scenario-specific protocols. Private organizations and individuals can use this template to create a site and/or event specific protocol.

HOW TO EDIT THE SAMPLING PROTOCOL TEMPLATE

Obtain a electronic copy of this Sampling Protocol Template from the sources listed previously. The Sampling Protocol Template is designed to be easily edited and customized into a scenario-specific protocol. Square brackets "[ ]" are used to indicate where scenario-specific choices must be made, while braces "{ }" are used to indicate editorial comments. Simply fill in the information requested or choose from the options listed within the brackets.

Refer to the technical guidance presented in Chapters Four and Five of the Guidance Document for assistance in evaluating proposed modifications.

[?]: When brackets appear around a question mark, enter the necessary site- or event-specific information, or enter additional detail if appropriate.

1. Begin editing the Sampling Protocol Template. The editing should reflect the sampling objectives stated in the Sampling Plan. Do not delete the Table of Contents; it should be retained in the final protocol. Do not delete the editorial comments in advance; they should be read as you are editing each section. It is normally best to begin by customizing only the tables and appendices that include the lists of analytes (parameters) to be analyzed. Then proceed to the main body of the protocol.

IMPORTANT: Changing text in one part of the document, even when it is associated with brackets "[ ]", may require additional changes in related text located in other parts of the document. To avoid overusing the brackets, (subsequent) related text is often unmarked. When any text is changed, use the Table of Contents or use the "search" (or "find") function of your word processor to locate other occurrences of key words for modification or deletion. For example, when changing the word "pump" to "bailer", use "search" to locate other places where obvious changes are required.

2. When you have finished customizing your program- or site-specific sampling protocol, use a word processing "search" function to look for all "{ }"s and "[ ]"s to ensure that all of them were found.

All brackets "[ ]", braces "{ }" and editorial comments must be removed from the actual (final) protocol before use in the field. Specific choices must be selected from the alternatives located within or adjacent to the "[ ]"s.

3. Next delete the "Foreword" and the "Instructions" (if included on the diskette).

4. Finish editing any of the appendices, tables and text that were not customized earlier.

REVIEW/APPROVAL

NOTE: MPCA Section staff may request that significant, proposed changes to protocols be marked to facilitate review and approval. Consider highlighting or otherwise marking all proposed changes or deletions for reviewers/approvers. Word-processing software can make this entire process very easy. Software such as Microsoft® Word includes "revision" features that can automatically mark all proposed deletions and additions to an original document. "Annotations" can also be imbedded within the text to provide explanations for the proposed changes.

Two types of alterations can be made that are not considered changes:

deleting an editorial comment along with the braces that enclose it after final approval

deleting alternate text within brackets.

Sampling Protocol Template For Monitoring Wells

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For Monitoring Wells

1.0 INTRODUCTION

This document outlines procedures to be used for ground water quality measurements and for collecting and handling ground water samples obtained from monitoring wells at **[fill in site name]** during the time period **[specify sampling dates]**. Deviations from these procedures may be required by unforeseen circumstances that develop during the sampling event(s). Such deviations will be approved by the lead technical staff or the field crew leader as described below. When regulatory or lead technical staff approvals cannot be obtained in advance, deviations from the established procedures will be evaluated as soon as possible after sampling and the need for re-sampling will be evaluated. Deviations from the specified procedures will be clearly noted on the **[sampling information form (SIF) or field logbook]** used for the sampling of each well and will be included in the Sampling and Analysis Report.

2.0 ADVANCE PREPARATION FOR SAMPLING

{For technical guidance, refer to page 37 of the MPCA Ground Water Sampling Guidance Document (Guidance Document): Chapter Four, Section 4.2: "ADVANCE PREPARATION FOR SAMPLING"}

Selection of analytical parameters, laboratory arrangements, the order of sampling wells, field measurement and sampling techniques, equipment selection and other quality assurance measures are based on the sampling objectives presented in the main body of the Sampling and Analysis Plan.

2.1 Selection Of Analytical Parameters

Samples will be collected for analysis of the parameters shown in Appendix [1] to fulfill requirements of the MPCA Superfund and/or Voluntary Investigation and Cleanup (VIC) programs. *{In order to create this appendix, edit (customize) Appendix B from the main body of the Guidance Document or insert a table of parameters required by the Superfund or VIC Programs. . Indicate what analytical method and reporting limit will apply for each parameter.}* Samples will be collected and analyzed for the parameters from the wells listed in Table 3.

Analytical techniques for trace metals and organic compounds were selected primarily on the basis of ability to [detect potential contaminants at low levels; positively identify contaminants detected as opposed to achieving the lowest detection levels].

2.2 Detection Limits

Practical quantitation limits are listed in the project specific QAPP and in Appendix A.

2.3 Quality Assurance For Field Procedures

Particular care will be exercised to avoid the following common ways in which cross contamination or background contamination may compromise ground water samples:

- improper storage or transportation of equipment
- contaminating the equipment or sample bottles on site by setting them on or near or downwind of potential contamination sources such as uncovered ground, a contaminated vehicle, or vehicle or generator exhaust
- handling bottles or equipment with dirty hands or gloves
- inadequate cleaning of well purging or sampling devices

Field methods quality assurance verification procedures are described below in Section 4.4, "Field Blanks, Replicates and Split Samples". Field personnel should work under the assumption that contamination exists in land surface, soil and vegetation near sampling points, wash water, etc. Therefore, exposure to these media will be minimized by taking at least the following precautions:

- minimizing the amount of rinse water left on washed materials
- minimizing the time sampling containers are exposed to airborne dust or volatile contaminants in ambient air
- placing equipment on clean, ground-covering materials instead of on the land surface

Clean gloves made of appropriately inert material will be worn by all field crew. Gloves will be kept clean while handling sampling-related materials. The gloves will be replaced by a new pair between each sampling site.

2.4 Sampling Containers And Preservatives

[Laboratory-supplied or contractor purchased] sampling containers and preservatives to be used for samples from all wells are shown in Table 2. The Laboratory Quality Assurance Project Plan (Lab-QAPjP) includes specific procedures for the following: sample container cleaning, testing, labeling and storage; preparation and addition of preservatives. Preservatives for volatile organic samples are added to the sample container in the field. Chemical preservatives for all other parameters are added in the **[laboratory, field]** before samples are collected.

2.5 Purging And Sampling Equipment

Well purging and sampling equipment includes the following:

- [list the equipment used including the pump name and model, if applicable]]
- pump discharge lines, if applicable: [new or decontaminated tubing type]
- regulators and compressed nitrogen [air] tanks
- [{list other equipment such as}rope, other pumps, generators, air compressors (with air/oil filter), etc.]

2.6 Decontamination, Storage And Transport Of Equipment

{When practical, the following alternatives can substantially reduce the time spent on field decontamination and may result in considerably less opportunity for cross-contamination: 1) permanently installing sampling pumps and tubing, 2) discarding bailer and bailer line or dedicating bailer and bailer line to individual wells, 3) discarding pump tubing or dedicating tubing to individual wells (place in labeled plastic bag for next sampling event), 4) for bladder pumps: discarding bladder or dedicating bladder to individual wells, 5)discarding other sampling related equipment such as filtration devices, personal protection gear and materials coming in contact with actual sampling equipment or personnel. If one of these approaches is to be used, specify such here. Delete field decontamination steps that have become unnecessary due to the change in approach. Replace these field decontamination steps by specifying "laboratory" or manufacturer's decontamination procedures used to prepare equipment for the field. For convenience, the "laboratory" or manufacturer's procedures may be specified by reference to an appendix attached to this protocol.}

[(New or decontaminated) pump tubing will be used each time each well is sampled; Tubing will be dedicated to a single well for subsequent sampling events. Between sampling events, the tubing will be stored in a sealed, chemically inert plastic bag. The bag will be labeled with the well name and stored in a secure, clean location.] Pump bladders will be **[discarded after use at each well; dedicated, labeled, and stored in the same manner as tubing; decontaminated by circulating decontamination fluids through the pump as described below].**

All sampling-related equipment including filtration devices, personal protection gear and materials coming into contact with actual sampling equipment or with sampling personnel will be decontaminated. *{If using bailers or sampling pumps and tubing that are permanently installed or dedicated to individual wells, state that they are exempt from field decontamination.}* Decontamination will be performed [**before, between or after**] working at each sampling point, *{Here specify where decontamination will be performed for all equipment:}* **[....in a lab or controlled "clean" room, at a decontamination station in the field; at each individual sampling point in the field**.] All equipment will be handled in a manner that will minimize cross-contamination between wells and avoid introducing surface contamination or ambient air contamination into a well.

Before mobilizing for field work or performing any decontamination, a source of "control" water and organic-free deionized water for decontamination will be selected and evaluated. The evaluation process will include sufficient laboratory analysis to assess the suitability of the proposed water. The proposed decontamination water will only be used for decontamination if analyses indicate it is appropriate for the complete set of target parameters. In the event that use of a desorbing agent is necessary, the desorbing agent will be ***[list type of desorbing agent*** made from reagent grade components and deionized water. Examples of organic desorbing agents are **isopropanol acetone methanol**. Examples of inorganic desorbing agents are a 10% nitric or hydrochloric acid solution made with reagent grade acid and deionized water. Equipment will be decontaminated in the following manner:

[Modify decontamination procedure listed below to suit site specific needs] {Additional examples of decontamination procedures can be found in Chapter Four, Section 4.2 Pages 57-59 of the Guidance Document.}

Equipment that does not contact sample water or the inside of the well
clean (inside and out where possible) with a hot water pressure washer filled with clean water
[clean (inside and out) with an Alconox/clean-water solution - applied with a scrub brush where practical]
rinse with clean control water

inspect for remaining particles or surface film and repeat cleaning and rinse procedures if necessary

Equipment that contacts sample water or the inside of the well
clean (inside and out where possible) with an Alconox/clean-water solution - applied with a scrub brush made of inert materials
rinse with clean "control" water
inspect for remaining particles or surface film and repeat cleaning and rinse procedures if necessary ***{If the sampling objective is only to obtain a gross, qualitative evaluation of contamination, the above procedures may be sufficient. If parameter-specific evaluation at trace level concentrations is necessary, addition of procedures #6 and #7 are suggested to meet high DQOs.}***

{The following procedure may be necessary when gross levels of contamination exist:} [rinse with an inorganic desorbing agent] *{delete if samples will **not** be analyzed for inorganic chemicals.}* [organic desorbing agent] *{delete if samples will **not** be analyzed for organic chemicals}* *{Note: use of desorbing agents requires pre-approval by MPCA Site Remediation staff.}*

rinse with clean "control" water
rinse thoroughly with laboratory controlled deionized water
shake off remaining water [and allow to air dry]

The <u>internal surfaces</u> of pumps {*here specify any other equipment that should be decontaminated internally*} and tubing that cannot be adequately cleaned by the above methods alone <u>will also be cleaned by circulating decontamination fluids through them</u>. The fluids will be circulated through this equipment in the order shown above under "B".

Wastewater from well purging and equipment cleaning will be [containerized on-site until analytical results are obtained to determine proper disposal][sewered on-site after sampling][disposed of on-site on the ground surface within the zone of contamination after sampling]. Disposable personal protective and sampling equipment will be containerized on-site [for disposal at a sanitary landfill].

When transporting or storing equipment after cleaning, the equipment will be protected in a manner that minimizes the potential for contamination. {Specify here how equipment will be protected.} The tubing will be placed in a clean, inert plastic bag. {<u>Here specify other equipment to be wrapped in inert plastic or aluminum foil</u>}.

2.7 Selection Of Sample Collection Techniques

Sample collection techniques outlined in this document have been tailored to the goals of this sampling event and the individual characteristics of this site. A summary of the sampling goals and the pertinent site, well and contaminant characteristics is given in the Sampling and Analysis Plan.

2.8 Order of Sampling

The ground water monitoring wells will be purged and sampled in the following order:

[list the purging and sampling order here as well as on Table 2]

{Refer to the Chapter Four, Section 4.3, Page 60 and Appendix A, Table A-2 of Guidance for a discussion of how to select a sampling sequence.}

3.0 PRELIMINARY FIELD WORK

{For technical guidance, refer to page 61 of the MPCA Ground Water Sampling Guidance Document: Chapter Four, Section 4.3: "PRELIMINARY FIELD WORK."}

[List any necessary preliminary field work here]

3.1 Field Inspections And Field Decisions

Before purging or sampling, all wells should be inspected to verify that:

- all sampling points are safely accessible;
- all wells are in satisfactory condition;
- current water levels indicate a gradient consistent with the preliminary order of well sampling;
- the existing health and safety plan procedures are appropriate for actual site conditions.

Any unusual conditions including the presence of wind-blown dust or odor in the ambient air should be recorded **[on a SIF or field log]**.

- well depth and that the annular seal is intact at the surface.

3.2 Detection Of Immiscible Layers

Air inside a well suspected of significant contamination will be tested immediately with an organic vapor detecting device **[list type of device here]**. The measurement will be recorded on the **[SIF or field log book]**. If immiscible layers of contaminants (free product "floaters" or "sinkers") are suspected or if odors or an oil sheen are observed, procedures will be followed to characterize the distribution of contaminants in the water-yielding zone adjacent to the well screen. Because free product can accumulate anywhere from the top to the bottom of the water column, the normal sequence of purging and sampling will be preceded by a free-product evaluation step to allow for the best characterization of contamination. An attempt to measure the thickness of any free product will be made using the following equipment: **[list equipment here, e.g., an interface probe]**. General procedures for detection and sample collection of immiscible layers will be in accordance with guidance provided in U.S. EPA RCRA Ground-Water Monitoring: Draft Technical Guidance, November 1992, Section 7.2.3; specific detailed procedures actually used in response to site/well conditions will be recorded on the **[SIF or field logbook]** and included in the Sampling and Analysis Report. The presence of and characteristics of any detected immiscible layers will be noted on the **[SIF and field logbook]**.

A bailer will be used to collect any pre-purging samples from the water table surface and a thief sampler will be used to collect any pre-purging discrete-interval samples from below the top of the water column. In addition to any discrete-interval samples collected, an additional sample will be collected from near the middle of the water column after normal purging. Analytical needs for these three samples will be reviewed with the **[Superfund or**

Voluntary Investigation and Cleanup Program technical representative] to determine which analyses are required for each sample. Visual screening or sequential analysis of samples may eliminate the need to analyze all samples collected in some circumstances.

3.3 Water-Level Measurements

Prior to any well evacuation or sampling, initial static water levels will be measured and recorded for all wells. This is done to facilitate selection of the proper pump intake depths for purging and sampling and calculation of the ground water flow direction.

During initial static water level measurement, a minimum of two water level measurements will be made at each well. The two water level measurements will be made in rapid succession. If there is poor agreement between the first and second static water level measurements (i.e., a difference of more than 0.01 feet), data will be re-evaluated for measurement errors, unsuspected pumping that may be causing transient changes in gradient, etc. If the discrepancy cannot be rectified, a third static water level measurement will be made at each questionable sampling point to assess the true water level, verify non-steady state conditions, etc.

The sampling crew will make water-level measurements at all appropriate monitoring wells and piezometers within the shortest time interval practical to provide comparable numbers by which to calculate the ground water gradient. A time limit exceeding **[list amount of time in hours]** will be considered a reportable protocol exception for this sampling event. An additional water level measurement will be taken immediately after sampling to evaluate potential cascading problems. These water levels will be entered on the [**SIF or field logbook**].

Water levels will be measured with a(n) [electronic water-level sensor probe; steel tape].

The depth-to-water should be referenced to the measuring point marked at the top of the innermost well casing. Where a measuring point has not been marked at the top of the casing, the measuring point will be assumed to be at the top of the innermost casing on the north side of the casing. When reporting absolute water level elevation, this measurement will be converted to water level elevation (MSL) from the surveyed elevation of the top of well casing. Water level measurement data will be recorded on the [**SIF or field logbook**

{Further information regarding water level measurements can be found in the Guidance, Chapter 4, Section 4.3, Page 62.}

3.4 Field Water-Quality Measurements

[Specific conductance, pH, temperature, turbidity, or dissolved oxygen (redox potential)] will be measured in the field immediately before sample collection. All measurements will be recorded on **[the SIF or fieldbook]**. Purging and stabilization information will also be noted on the [**SIF or logbook**].

{Editorial note: Without use of a properly designed flow cell, procedures required to obtain meaningful field water quality data are much more complex. Acquisition of reliable data requires a thorough understanding of factors affecting field readings, extensive training, and a lot of care and patience. A limited amount of background information to facilitate the design of such procedures is provided in Chapter Four, Sec 4.3, page 64, "Measurements Without a Flow Cell". ***If a flow cell is not used for any field water quality measurement, then the procedures outlined in Chapter. 4.3 must be detailed in this section.}***

All measurements except for turbidity will be taken within a [**closed flow cell, other device**] designed to allow measurement of these parameters while minimizing changes in temperature, pressure, and dissolved gases from the in-situ aquifer environment. The flow cell has the following characteristics:

- Air tight fittings for installation of all probes.
- Intake is connected directly to the pump discharge line.
- Resides in a water bath kept at a temperature close to the in-situ ground water temperature.
- A discharge line at least 3 feet long that is connected to the flow cell with an air tight connection.
- A maximum volume of no greater than five times the per minute volumetric rate of inflow to the cell to maintain measurement sensitivity to temporal changes in water quality.
- A minimum volume of 500 ml to provide enough thermal mass to minimize external temperature effects.
- The flow cell will be shielded from strong winds and on hot days it will be shielded from direct sunlight.

The operation of the probes will be as follows:

1. The flow of extracted ground water through the flow cell will be maintained as continuous and steady as practical throughout the measurement period.
2. Discharge velocities through the flow cell are kept low enough to prevent streaming potential problems with probes.
3. All probes will be fully immersed without touching the sides of the air tight, non-metallic flow cell.
4. All probes will be allowed to equilibrate with fresh well water for five minutes before recording measurements.

Specific procedural details for measurement of individual field water quality parameters are outlined in the manufacturer's instruction/owner's manual. General care, maintenance, calibration procedures, and operation of each measurement device will also follow manufacturer's specifications as detailed in the instruction/owner's manual for each device.

3.5 Purging And Stabilization

Before a well is sampled for the dissolved phase, it will be evacuated to ensure that samples contain fresh formation water. While the well is being purged, water quality parameters described above in Section 3.4, "Field Water-Quality Measurements", and the quantity of water evacuated will be recorded on the [**SIF or field logbook**].

A purging rate that will minimize drawdown while still allowing the well to be purged in a reasonable length of time will be used and recorded on [**SIF** or logbook]. Care will be taken to avoid any significant amount of cascading or turbulence in the well.

<u>Wells with extremely slow recharge rates due to tight formation materials</u>, will require alternate purging and sampling methods. If normal purging is clearly impractical, the well will be pumped to near dryness and allowed to partially recover [insert estimate of time required] Sampling will then commence as soon as possible after evacuation. {*The maximum reasonable time limit is one hour; however, data for sensitive parameters may be considered questionable unless sampling occurs even sooner after purging.*}

Wells that do not have extremely slow recharge rates will be purged and sampled as described below. Purging will be conducted in a manner that, to the extent practical, removes all the "old" water in the well so it is replaced by fresh ground water from outside the well installation.

1. The well will be purged by withdrawing water from within **[list number of feet]** feet of the top of the water column.
2. Repeated vertical adjustment of the purging equipment intake may be necessary as the water level drops.
3. **[List type of equipment which will be used for purging and sampling].**
4. Sampling will immediately follow purging and stabilization .

Field water quality parameters will be measured for stabilization [**every 3 or 5 minutes**; after each water-column volume is purged]. The following target criteria for three consecutive measurements (every 3-5 minutes or one water-column volume apart) will be used to demonstrate stabilization:

- pH +/- 0.1 units
- temperature +/- 0.1 degrees Celsius
- specific conductance (temperature corrected EC) +/- 5%
- dissolved oxygen +/-0.5 mg/L [redox potential +/-20 mv]
- turbidity: less than or equal to 5 NTU {10 NTU may be acceptable when not sampling for sensitive parameters such as trace metals or trace organics.}

Samples for laboratory analysis will be collected only after a minimum of **[# of water column volumes]** water-column volumes have been purged and stabilization of field water-quality parameters has been demonstrated by meeting the target criteria defined in the preceding paragraph. If field parameters do not stabilize after approximately five water-column volumes, then field staff will check operator procedures, equipment functioning and well construction information for potential problems. In particular, field staff will re-evaluate whether or not water is being withdrawn from the appropriate depth to effectively evacuate the well.

If all the checks produce no new insight, a decision might be made to collect samples after five or more water-column volumes have been purged even if field measurements have not stabilized. Before authorizing the laboratory to analyze samples, the meaningfulness and value of completing laboratory analysis of the sampling suite will be evaluated by reviewing the results of field measurements, well construction data, site hydrogeology, etc. Where such data is presented, it will be clearly documented that stabilization was not achieved; at a minimum, this fact will be reported on the **[SIF or field logbook]** and in the Sampling and Analysis Report.

As with water from well development, purge water will be properly stored, tested, and disposed of in accordance with all applicable rules including Minnesota Rule 7060. Fifty-five gallon drums will be located at each of the wells to collect water removed from the wells during development or evacuation. No significant amount of well water will be emptied or discharged onto the ground surface unless analytical data are available and indicate that the water is not contaminated. After water analyses become available, and appropriate disposal alternatives are evaluated, the water will be disposed of in an environmentally safe manner that does not conflict with any applicable rules.

4.0 SAMPLE COLLECTION

{For technical guidance, refer to page 75 of the MPCA Ground Water Sampling Guidance Document (Guidance Document): Chapter Four, Section 4.4: "SAMPLE COLLECTION"}

This section describes procedures for setting the sampling pump and collecting ground water samples. Field data for these items will be recorded on the SIF for each sampling point.

4.1 Pump Setting

A **[insert actual sampling device to be used]** will be used as the default device for sample collection. If well recovery is so slow that a satisfactory water column height (for normal pump operation) is not reached in a reasonable amount of time, **[a zero submergence bladder pump or Teflon® bailer]** will be used for sample collection. The **[SIF or field logbook]** will show what type of device was used to sample each well. If any device other than the one described above is used, it should be reported as a protocol exception.

[In very slowly recharging wells, the pump intake will be set approximately two feet from the bottom of the well to minimize aeration problems] *{Note for alternate scenario where static water level is sufficiently above the top of the screen: the sampling pump intake should be set at approximately two feet above the top of the screen and at least two feet below the top of the water column.* }

The same pump should be used for sampling as was used for purging. Pumping will be continuous and sampling will immediately follow purging. If pumping is not continuous it will be noted on the **[SIF or logbook]**. The sample collection pumping rate will be less than or equal to the purging rate. The sampling rate will be based on the purging and sampling rate test, and will not cause cascading or turbulence. The rate will be less than or equal to **[list rate here]**.

4.2 Sample Filtration

Table 2 identifies which sample containers will be filled with sample water that has been filtered in the field. Sample filtration will be completed as follows:

1. The filter will be connected directly to the well sampling pump discharge line using positive pressure to force the sample through the filter.
2. From the filter, the flow will be routed directly into the sample collection container.
3. A **[insert pore size]** micron pore size filter will be used.
4. The flow rate will not exceed a rate that causes cascading or turbulence to occur.
5. Agitation and aeration of the sample will be minimized.
6. **[insert tubing type]** tubing will be used for the pump and filter discharge lines.

4.3 Filling Sample Containers

{For technical guidance, refer to page 84 of the MPCA Ground Water Sampling Guidance Document: Chapter Four, Section 4.4 "Sample Collection"}

Table 2 summarizes the sample container type, filling method, preservation method and holding time for each analytical parameter set. Individually prepared bottles will not be opened until they are to be filled with water samples.

1.

2. A clean and dry sheet of relatively inert plastic shall be placed on the ground surface in the wellhead area. If materials used in the sampling process must be put down, they will be placed on a clean portion of the plastic sheet instead of the ground surface.

3. A clean pair of [ ] *{specify glove type: appropriate gloves should be specified in the Health and Safety plan but should be made of material that will not contribute contaminants to sample containers}* gloves will be put on at the onset of sampling activities at each new sampling point.

4. Sampling personnel will keep their hands as clean as practical and replace gloves if they become soiled while performing sampling activities.

5.

Bottles will be labeled and chain-of-custody sections will be filled out by the field personnel according to procedures described below in Section 5: "Documentation of Sampling Event". To prevent a mix up with sample bottle identification, no sampling-point specific information such as "well name" will be filled out in advance of sampling. Chain of custody information will be completed before leaving the sampling point. Laboratory-prepared bottles will be used to assure quality control.

The order of filling bottles with water to be analyzed will be as follows:

1. major and minor ions
2. nitrates
3. cyanide
4. trace metals
5. chromium VI
6. "miscellaneous" parameters
7. volatile organics
8. non-volatile organics
9. dioxin and dibenzo furans
10. coliform bacteria
11. total organic carbon
12. total phosphorus

13. sulfide

14. radium, gross alpha, and gross beta

[This order will be reversed in very slowly recharging wells and will be noted on the SIF or field logbook.] Replicate samples will be collected sequentially as described in Section 4.4: "Field Blanks, Replicates and Split Samples". Methods for filling sample containers for individual analyses are described in Table 2.

The sample water discharge point at the end of the tube will be held as close as possible to the sample container without allowing the sample tubing to contact the container. **[The exception to this rule is for dissolved oxygen and chemical oxygen demand samples where the container is filled from the bottom up by inserting the tube into the bottom of the container.]** At a minimum, sampling personnel will use their body to shield the sampling container from wind and airborne dust while filling. When strong winds, heavy rain, or dusty conditions are present, additional measures will be implemented to guard against background interference.

4.4 Field Blanks and Replicates

Sample blanks will be collected to detect background or method contamination. Replicate samples will be collected to evaluate variability in analytical methods. QA/QC samples will be collected at sampling points suspected to have relatively higher levels of contamination to provide meaningful information for blank or duplicate sample evaluation. Field duplicate samples will be assigned identification aliases on the sample bottle label and on the chain of custody sheet to avoid alerting laboratories that the sample is a replicate sample. The true identity of the field duplicate samples will be recorded in the field sampling log.

The collection schedule for QA/QC samples will be as follows:

1. one trip blank (composed of three replicate vials) for each cooler of VOC samples
2. one field methods (equipment) blank each day by each field sampling crew (or one field blank for every tenth primary sample if it results in more blanks collected)
3. at least one replicate set for every **[# of samples]**samples collected
4. one field ambient air blank each day by each field sampling crew (or one field blank for every tenth primary sample if it results in more blanks collected) *{Ambient air filled blanks are appropriate on a site specific basis. Examples of appropriate situations are: where an automobile engine continues to run during the sampling event; where wind is mobilizing particulates; or when VOCs are being emitted from an operating facility during sampling.}*

For each type of QA/QC sample, containers will be prepared and submitted for the following analyses:

1. trip blank: **[purgeable halocarbons, purgeable aromatics]**
2. field methods (equipment) blank: **[purgeable halocarbons, purgeable aromatics, trace metals, non-volatile organics, dioxins and furans, and total coliform bacteria.]**
3. replicates: all analytical parameters
4. field ambient air blank: **[purgeable halocarbons, purgeable aromatics, trace metals]**

Field Blank Samples

Methods that will be used for preparing field blank samples are described below.

Trip blanks for VOCs consist of a set of three pre-filled 40 ml purge and trap vials that will be filled and sealed by **[the primary VOC analytical laboratory or specify another source]** with laboratory-controlled, **[HPLC-grade]**, organic-free water. The 40 ml, purge and trap, blank sample vials will travel with the actual sample vials to and from the field in the cooler, to the well head, etc., so that the blanks are exposed to precisely the same conditions as the actual samples. The bottle blanks will not be opened until they are analyzed in the laboratory along with the actual VOC samples they have accompanied.

Field equipment/methods blanks will be collected in the field for target parameters . Sample containers used for each blank will be the same as for the actual analysis of sample water for these parameter groups. All containers shall be pre-cleaned within the laboratory's QA/QC program in the same manner as primary sample bottles. The sample blank containers will be filled in the field. Laboratory-controlled, **[HPLC-grade]**, organic-free water will be used to fill all organic blank samples. Trace metals blanks will be filled with laboratory-prepared, triply distilled water. The same preservatives will be added to both the methods blank and the primary samples.

{Collection of field equipment/methods blank samples should be conducted to simulate actual field sampling methods in a manner that would detect the presence of background or cross-contamination of samples from the ambient environment, preservatives or sampling equipment. An effort should be made to have the blank sample water contact all the interfaces and preservatives (where applicable) that the sample water will contact. These may include the sampling mechanism, ambient air, sample container and, when applicable, tubing, filtration membranes and preservatives.}

Laboratory-supplied blank water will be pumped out of a short section of (mock up) well casing by the sampling pump fitted with the same tubing used in the previously sampled well **[assuming there is not a permanent sampling pump installation]** and into the sample blank containers. Blanks for filtered samples will be collected by passing the blank sample water through the filtration device and the same type of filters used for collecting the primary samples.

Ambient air field blanks will be filled in the field. VOC vials will be filled with laboratory-controlled, **[HPLC-grade]**, organic-free water, while trace metal containers will be filled with laboratory-prepared **[triply distilled]** water. Empty vials will be opened and placed or held as closely as practical to the point (vertical positioning will be respected) at which actual sample containers are opened and filled. The sample blank containers will be filled with the laboratory-supplied water by the same personnel and at approximately the same time as the primary (actual) samples are being collected. The sample blank water in each container will be exposed to the air on site for an amount of time equivalent to that for filling and closing a primary sample container. A**[n ambient air field blank and a]** field equipment/methods blank sample will be collected sometime during the first day of each sampling event (round of sampling) and at every tenth sampling point. **[Sample documentation should indicate that the ambient air field blank samples need only be analyzed when the corresponding field equipment/methods blank detects contamination provided that no holding times would be exceeded.]**

Field Replicate Samples

Field replicate samples of actual ground water will be collected for the following parameters: **[?]** The **[state number of replicates to be collected]** replicate samples will be collected by sequentially filling all **[# of]** containers as close together in time as practical with a sampling stream that is as steady and continuous as practical. The sequence number (first, second, etc.) and time of sample filling will be listed in the field notebook. The time that each individual container was filled will be listed on the container and on the Sample Identification - field chain of Custody Record (SI-FCCR) in the same manner as primary samples. **[Here state which laboratory will receive which sequence numbers of each parameter type.]** One field replicate sample set will be collected for every ten primary sampling sets.

Field Split Samples

[Field split samples of actual ground water will be collected for the following parameters: [list parameters here] The **[state number (#) of split samples to be collected]** split samples will be collected by filling the **[# of]** subsample containers from a single homogeneous sample water **[stream (divided just before discharge into sample containers)][container]** at the same time. **[Here state which laboratory will receive which split samples.] [One field split sample will be collected for every ten primary sampling sets]**

{*Editorial note: Do not split VOC samples.*}]

5.0 DOCUMENTATION OF SAMPLING EVENT

{For technical guidance, refer to page 92 of the MPCA Ground Water Sampling Guidance Document (Guidance Document) Chapter Four, Section 45: "DOCUMENTATION OF SAMPLING EVENT"}

This sampling protocol template includes the use of forms shown in Appendix B; they are designed for documentation of field activities and collection of field data. They also provide a means to verify whether or not this protocol was followed during a number of key steps in the ground water sampling event. The forms include the following:

1. Sampling Information Form
2. Purging and Stabilization Form
3. Identification - Field Chain of Custody Record (SI-FCCR)

5.1 Sample Identification

The Sample Identification - Field Chain of Custody Record (SI-FCCR) in Appendix B will be completed as described above in Section 5.0, "Documentation of Sampling Event".

The SI-FCCR will be at least a two-part (carbonless copy) form.

Each sample container will be labeled with the following information:

- unique container ID #

- sample collection Date and Time
- initials of person collecting sample
- analyses required
- preservation method

Container information will be entered at the sampling point at the time of sample collection. However, for containers receiving preservatives in advance, "analyses required" and "preservation method" will be entered onto labels by laboratory staff. For containers receiving preservatives in the field, "preservation method" will be entered at the time individual containers are filled.

5.2 Chain Of Custody

A chain-of-custody record (SI-FCCR) will be initiated in the field at the time of sampling; a copy will accompany each set of samples (cooler) shipped to any laboratory.

Each time responsibility for custody of the samples changes, the new and previous custodians will sign the record and denote the date and time. A copy of the signed record will be made by the receiving laboratory. The final signed SI-FCCR will be submitted with analytical results in the Sampling and Analysis Report.

Field Chain of Custody Documentation

All signatures related to sample custody will be made in indelible ink on the SI-FCCR in a timely fashion. One or more signatures will be entered to identify the person or persons who are collecting the samples. Each time the custody of a sample or group of samples is transferred, a signature, date and time will be entered to document the transfer. The signatures, date and time will be entered at the time of transfer. A sample will be considered to be in custody if it is in any one of the following states:

1. in actual physical possession
2. in view, after being in physical possession
3. in physical possession and locked up so that no one can tamper with it
4. in a secured area, restricted to authorized personnel

A secured area such as a locked storage shed or locked vehicle specified in the "comments" column, may be used for temporary storage. When using such an area, the time, date, and location of the secured area will be recorded in the "relinquished by" space. The time at which an individual regains custody will then be recorded in the "received by" space.

Chain of Custody During Shipping and Transfer of Samples

When samples are shipped, the person sealing the shipping container will enter the time, date and their signature on the SI-FCCR. The laboratory part of the SI-FCCR will be enclosed in the container; the top page (first part) will be retained for the project manager's file. A post office receipt, bill of lading, or similar document from the shipper will be retained as part of the permanent chain-of-custody documentation.

One or more custody seals will be affixed over the opening of the shipping container in a manner that precludes opening the container without breaking the seal(s). The container seal(s) will be inscribed with the signature of the person sealing the container and the date and time sealed.

The receiving laboratory will be notified in advance of chain-of-custody procedures that must be followed for a group of samples. The laboratory will be instructed to note whether or not the container seal(s) are intact and sign in the appropriate blank on the SI-FCCR at the time of receipt. They will also be instructed to keep a copy and return the original form to their client's quality assurance officer.

5.3 Field Sampling Log

A daily field log of sampling activities will be kept by the leader of the field sampling crew. At a minimum, the log will contain a record of the following items:

- list of field personnel present
- field conditions(see Section 5.5)
- description of exceptions to this protocol including specification of which samples may have been impacted by exception(s)
- For each well sampled:
  1) Well Name and unique SI-FCCR # used to identify samples,
  2) equipment used for evacuation and stabilization,
  3) date and time that purging and sampling began and ended,
  4) a list of all samples sent to each laboratory

{For field duplicates, include an alias cross reference list for QA/QC samples}

5.4 Exceptions To Sampling Protocol

- This protocol defines the procedures to be followed during this sampling event. Exceptions to this protocol will be noted on the **[SIF or field logbook]**.

If there has been any potentially significant impact on sample integrity, then the potential impact for each parameter for each sample affected will be footnoted whenever the results are reported or referred to in the Sampling and Analysis Report.

5.5 Field Conditions

Field conditions during the sampling event will be recorded on the [SIF or field logbook]. The Sampling and Analysis Report will include a statement regarding the likelihood that any unusual field conditions had a significant impact on the integrity of results. Field conditions reported will include but not be limited to the following:

- air temperature
- wind speed/direction
- precipitation/moisture at the time of the sampling event, and if known, previous days' precipitation

- ambient odors
- airborne dust

6.0 SAMPLE PRESERVATION, HANDLING AND TRANSPORT

{For technical guidance, refer to page 96 of the MPCA Ground Water Sampling Guidance Document:, Chapter Four, Section 4.6: "SAMPLE PRESERVATION, HANDLING AND TRANSPORT"}

6.1 Sample Preservation

Samples will be preserved as shown in Table 2. All chemical preservatives, added to containers in the laboratory or field will be produced and controlled within the laboratory's QA/QC program as reflected in the Lab-QAPjP. Field supplies of preservatives and sample containers with pre-dosed preservatives will be discarded and replaced with fresh preservatives no later than 14 days after receipt from the laboratory.

<u>All samples will be thermally preserved in the field</u> immediately after sample collection by placing the samples in an insulated ice chest containing **[ice, Blue Ice]**. The ice chest <u>temperature will be checked [by measuring the temperature of the water within the temperature blank container] and recorded</u> upon receipt at the laboratory, to verify whether or not samples are kept refrigerated at approximately 4 degrees C.

6.2 Sample Handling And Transport

All ice chests shipped will be accompanied by an SI-FCCR form and contain a complete destination and return address on the outside of the cooler. The samples will be kept at approximately 4 degrees C during transport to laboratories.

Maintain the chain-of-custody according to procedures described in Section 5.2.

Table 1: Sample Containers, Filling Method, Preservation and Holding Times

{note: this is only an example; the protocol developer is responsible for laboratory coordination on these items}

PARAMETER[1]	*BOTTLE[2] VOLUME/TYPE*	*FILL METHOD[3]*	*PRESERVATION[4]*	*HOLDING TIME*
MAJOR & MINOR IONS	1L P	No head space	Cool	28 days
NITRATE	250 ml P	Leave head space	H_2SO_4/pH<2 Lab, Cool	28 days
CYANIDE	500 ml P	Leave head space	NaOH/pH>12 Lab, Cool	14 days
TRACE METALS (unfiltered)	500 ml P	Leave head space	HNO_3/pH<2 Lab, Cool	6 months
(mercury)				28 days
TRACE METALS (filtered)	500 ml P	Filter [5 micron] No head space	HNO_3/pH<2 Lab, Cool	6 months
(mercury)				28 days
CHROMIUM VI (unfiltered)	125 ml P	No head space	Cool	24 hours
CHROMIUM VI (filtered)	125 ml P	Filter [5 micron] No head space	Cool	24 hours
MISCELLANEOUS	1 L P	No head space	Cool	
(TDS and TSS)				7 days
(specific conductance)				28 days
(turbidity)				48 hours
VOLATILE ORGANICS	3 x 40 ml P & T	Positive meniscus	HCl/pH<2 Field, Cool	14 days to analysis
purgeable halocarbons purgeable aromatics non-halogenated volatiles				
NON-VOLATILE ORGANICS	2 x 1L AG	No head space	Cool	7 days/extraction 40 days/analysis
base-neutral/acid extractable organics phthalate esters				

PARAMETER[1]	*BOTTLE*[2] *VOLUME/TYPE*	*FILL METHOD*[3]	*PRESERVATION*[4]	*HOLDING TIME*
phenols				

Table 1: Sample Containers, Filling Method, Preservation, and Holding Times (continued)

{note: this is only an example; the protocol developer is responsible for laboratory coordination on these items}

PARAMETER	*BOTTLE[2] VOLUME/TYPE*	*FILL METHOD[3]*	*PRESERVATION[4]*	*HOLDING TIME*
polynuclear aromatic hydrocarbons chlorinated herbicides organochlorinated pesticides & PCBs organophosphorus pesticides acid herbicides carbamate pesticides				
DIOXINS AND DIBENZO FURANS	1L AG	No head space	Cool	7 days/extraction 40 days/analysis
EQUILIBRIUM GEOCHEMISTRY *pH* *alkalinity* [dissolved oxygen[5]] [Eh]	*2x 1 L P*	*Fill from bottom* *(do not filter for pH)* *Filter [5 micron]*	*Cool*	*2 hours*
TOTAL COLIFORM BACTERIA	125 ml P	Leave head space	Cool	6 hours
TOTAL ORGANIC CARBON	1 L G	Leave head space	H_2SO_4/pH<2 Lab, Cool	48 hours
TOTAL PHOSPHORUS	125 ml P	Leave head space	H_2SO_4/pH<2 Lab, Cool	28 days
SULFIDE	250 ml P	Leave head space	$Zn(C_2H_3O_2)2*2H_2O$ & NaOH/pH>9 Lab, Cool	7 days
RADIUM, GROSS ALPHA, GROSS BETA	1 Gallon P	Leave head space	HNO_3/pH<2 Lab	6 months

Table 1: Sample Containers, Filling Method, Preservation, and Holding Times (continued)

{note: this is only an example; the protocol developer is responsible for laboratory coordination on these items}

(1) PARAMETER NAMES/GROUPS

Some of these parameter names {e.g., "trace metals"} actually represent a set of several or many individual analytes. Specific analytes for each parameter/bottle type are listed in Appendix 1. *{Some laboratories may request separate containers (with preservatives) for anions and cations. }*

(2) BOTTLE TYPE

L:	liters;	P & T:	40 ml purge and trap vial fitted with a Teflon® septum;	GG:	glass bottle fitted with glass stopper
ml:	milliliters;	G:	glass bottle fitted with Teflon®-lined cap	AG:	amber glass bottle fitted with Teflon®-lined cap
P:	polyethylene;				

(3) FILL METHOD

Positive meniscus:	fill container completely with zero head space resulting in a positive meniscus with no air bubbles in container, add acid and cap container quickly;
No head space:	fill container completely; container will not be rinsed; overfilling will be minimized.
Leave head space:	fill container about 90 to 95 % full - do not allow preservative (if present) to be diluted by overfilling container
Fill from bottom:	fill container completely from the bottom of container using tubing; allow several bottle-volumes of water to overflow before sealing bottle
Filter [5 micron]:	filter in-line with positive pressure through a filter with [5] micron pore size.

(4) PRESERVATION

Cool:	place container inside sealed Zip-Lock bag; place in cooler with sufficient ice to quickly bring temperature down to 4 degrees C and hold at approximately 4 degrees C until received by laboratory personnel
HNO3/pH<2:	add a predetermined amount of high-purity HNO_3 to sample to bring the sample pH down to 2 or less;
HCl/pH<2:	add a predetermined amount of high-purity HCl to sample to bring the sample pH down to 2 or below;
NaOH/pH>12:	add a predetermined amount of high-purity NaOH to sample to bring the sample pH up to 12 or above; (for Cyanide, use 50% NaOH solution and add ascorbic acid if oxidizing agents are present)
Zn(C2H3O2)2*2H2O:	predetermined amount added by laboratory staff to prevent oxidation of sulfide
Field:	preservative added in the field by field personnel
Lab:	preservative added to container in laboratory before going into the field

(5) DISSOLVED OXYGEN

For Winkler method, if holding time might exceed 2 hours, field staff will make arrangements with the laboratory to prepare a separate 1 L glass stoppered (GG) bottle by adding preservatives in the field immediately after sample collection.

Table 2: Order of Purging and Sampling of Wells

PURGING/SAMPLING SEQUENCE #	WELL NAME	CRITERIA*	ANALYTE SUITE**

{THIS TABLE MUST BE SAMPLING SITE/EVENT SPECIFIC}

{ For the "CRITERIA" column, specify sequence criteria with descriptive terms such as "background well", "previously clean", far from contamination source", "moderately contaminated", "very contaminated", etc.}*

{** For some sampling projects, the number or type of containers that need to be filled and analyzed may vary from one well to the next. When that is the case, Table 2 should be duplicated and modified to show two or more lists of containers (representing the analytical suites). Each list should be assigned an identifying name or number such as "Table 2, List a", "Table 2, List b", etc. Reference that identifier in the column above titled "ANALYTE SUITE". }

Figure 1: Location of Sampling Points

{Create a map showing locations of all sampling points}

Minnesota Pollution Control Agency
Site Remediation Section
520 Lafayette Road
St. Paul, Minnesota 55155-4194

APPENDIX A: SELECTED ANALYTICAL PARAMETERS, METHOD NUMBERS AND REPORTING LIMITS

{In order to create this appendix, edit (customize) Appendix B from the main body of the MPCA Ground Water Sampling Guidance Document or insert a table of parameters required by the applicable program. Indicate what analytical method and reporting limit will apply for each parameter. Appendix B was created in a computer spreadsheet and should be available on diskette along with the Appendix A text. While editing an electronic copy of Appendix B, unwanted parameters can quickly be deleted. Selected analytical methods can easily be "selected" by selecting appropriate cells and formatting them as "shaded".} {It is the responsibility of the end user to check the list of analytical parameters, methods and practical quantitation limits to verify that they are appropriate for the particular site and sampling event of interest.}

APPENDIX B: EXAMPLE FORMS

Sampling Information Form

Weather Conditions:
Cloud Cover_________________________
Wind Speed & Direction_____________
Temperature:______________________
Precipitation:_____________________

Facility ID#______________________
Facility Name_____________________
MPCA Master ID:__________________
Project Name:_____________________

Station ID#________________________
Location:__________________________
Well Depth (ft. Below TOC):__________
FID/PID reading @ Wellhead:_________
Depth to Water (below TOC):_________

Sample Date:______________________
Sample Time:______________________
Casing Diameter____________________
FID/PID Background Conc.:_________

Purge
Rate:____________________gpm

Well Volumes Removed Prior to Sampling___________________

Gallons per Lineal Foot 2"ID=0.163, 4"ID=.0661, 6"ID=1.5, 12"ID=5.88

Sampling Method:________Tap _________Submersible Pump _________Bailer Other (detail)_____

Pump intake or bailer set at ____________________ft. Below TOC.

Tubing Type:___________, New, Previously Used and Cleaned was used to collect all samples Y N

Flow Cell Used Y N

Purging and Stabilization Protocol Followed Y N

Sample Appearance (describe)____

Field Cleaning of Equipment Performed ______________________________________

Describe any deviations from Sampling Protocol_______________________________
____
____

Transportation (Thermal Preservation) Type:__________________________________

Comments:____
____

Form Completed By:______________________________ Well Sampled By:__________________

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Site Remediation Section
520 Lafayette Road
St. Paul, Minnesota 55155-4194

Purging and Stabilization Form

Facility ID#:______________ Site Name:_________________________ Date:___________________

Well #:__________________ Sampling Personnel:__________________ Time:___________________

Time	pH	Temp.	Cond.	Dis. O_2	Turb.	Notes

APPENDIX 3: WORKPLAN CHECKLIST FOR NATURAL ATTENUATION

The following is a list of tasks and data needed to demonstrate that natural attenuation is a remedy for chlorinated solvents in groundwater. Items are grouped by those required for an initial screening and those required for a detailed demonstration that natural attenuation is an acceptable remedy for the site.

Tasks that are considered essential for each phase of the evaluation are marked with a shaded box, while those that are optional (but may be necessary at a later stage in the investigation) are preceded by an open box. The collection of data beyond the required minimum may be attractive because of mobilization costs, time factors, or other site specific considerations.

A more detailed discussion of the purpose of these tasks can be found in the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* prepared for the Air Force Center for Environmental Excellence (AFSCEE), Technology Transer Division (15).

A. Screening Tasks

1. **Well/Groundwater locations and samples:**
   - ■ 1 background, upgradient from suspected source area
   - ■ 1 background, side-gradient to plume or source area
   - ■ 1 in source area
   - ■ 2 within area of dissolved portion of contaminant plume
   - ■ 1 downgradient of "toe" of plume

   Sample number and frequency:
   - ■ One round of sampling for each well

2. **Geochemical Data:**

   Field*:
   - ■ Oxygen (Field test kit and/or probe)
   - ■ Temperature
   - ■ Eh (oxidation/reduction potential)
   - ■ pH
   - ■ Reduced iron (FeII)
   - ■ Reduced manganese (MnII)
   - □ Carbon dioxide (CO_2)
   - □ Hydrogen (From PVC wells only. For a detailed discussion of this method, see references 8 and 15.)
   - □ Conductivity

   Laboratory:
   - ■ Nitrate (NO_3^{-2})
   - ■ Sulfate (SO_4^{-2})
   - ■ Sulfide (H_2S)
   - ■ Methane (CH_4)
   - ■ Chloride (Cl^-)
   - ■ Total organic carbon
   - □ Alkalinity

Contaminant

- ■ Tetrachloroethylene (PCE)
- ■ Trichloroethylene (TCE)
- ■ Trichloroethane (TCA)
- ■ Dichloroethane (DCA)
- ■ Chloroethane
- ■ Dichloroethylene (DCE)
  (*cis*-1,2-dichloroethylene and *trans*-1,2-dichloroethylene)
- ■ Vinyl chloride (VC)
- ■ Benzene, toluene, xylene, ethylbenzene (BTEX)
- ■ Ethene/Ethane
- □ Soil contaminant data, by depth in source area
- □ Soil total organic carbon

(See Table 2.1 in the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (15) for a compilation of analysis and sample preservation methods)

3. **Aquifer data:**
   - ■ Hydraulic conductivity
   - ■ Hydraulic gradient
   - ■ Summary of local geologic features (aquitards, aquifer types, etc.)
   - □ Vertical data on geochemistry
   - □ Risk analysis of downgradient receptors
   - □ Regulatory point of compliance

4. **Biodegradation potential**:
   - ■ Assumed conservative biodegradation rate from literature (13, 18).
   - □ Laboratory microcosm study (16, 17).
   - □ Site specific estimate using employing groundwater tracers (14).
   - □ Site specific estimate using regression analysis (6)

5. **Calculations:**
   - ■ Groundwater velocity estimate using hydraulic conductivity and hydraulic gradient data.
   - ■ Comparison of electron acceptor and chloride concentrations to background samples.
   - □ Site specific biodegradation rates.

6. **Screening/Modeling**
   - ■ "Score" site data on AFSCEE Protocol Table 2.3 (15).
   - □ Screening model, using "worst case" and "best case" scenarios of biodegradation rate, dilution, source mass, and groundwater velocity terms (10)**
   - □ Fate and transport modeling (provided that the necessary data has been collected to support this level of analysis. (1-5, 11)

** Field measurements can be made with a combination of probes and commercially available field test kits. Field analytical measurements using these kits must supported with quality control measures. This may include duplicate samples, occasional duplicate laboratory analysis for certain analytes (such as sulfate), standard samples of varying concentrations, field blanks, and rinseate controls. When not addressed in site-specific standard operating procedures, approval from regulatory QA/QC personnel is recommended prior to proceeding with field testing. This should include agreement on the level of data quality that these measurements will represent in subsequent analysis and decisions.*

*** These screening procedures are intended to provide a basis for deciding whether contaminant attenuation is occurring, and whether further sampling and analysis of this remedy is worthwhile. Though not essential, running a screening model is strongly encouraged. This work can minimize the cost and effort at sites where contaminant attenuation is unlikely to be occurring at rates necessary for a natural attenuation remedy.*

B. Verification

1. Wells/Groundwater samples:

(From the screening phase)

- 1 background, upgradient from suspected source area.
- 1 background, side-gradient to plume or source area.
- 1 in source area.
- 2 within area of dissolved portion of contaminant plume.
- 1 downgradient of "toe" of plume.
- Additional monitoring wells based on a Site specific analysis of data needs.
  (This might include: definition of the downgradient extent of the plume; well nests to determine the vertical distribution of contaminants and electron acceptors; estimation of DNAPL extent; contouring of groundwater electron acceptors, etc.)

Sample number and frequency:

For each well:

- a) Four rounds of groundwater samples, approximately 6 months apart,

  Or

  b) Based on the groundwater velocity term, determine the time needed for groundwater to travel the length of the plume. Sampling should occur at a minimum of four times within this "residence" time of groundwater flow:

  {Plume length (ft)]/Groundwater velocity (ft/year)}/ 4 = time between samples

2. Geochemical Data:

Field:

- ■ O_2
- ■ Temperature
- ■ Eh (oxidation/reduction potential)
- ■ pH
- ■ FeII
- ■ MnII
- ■ Hydrogen (from PVC wells only)
- □ Conductivity
- □ CO_2

Laboratory:

- ■ NO_3^{-2}
- ■ SO_4^{-2}
- ■ H_2S
- ■ CH_4
- ■ Cl^-
- ■ Total organic carbon
- □ Estimate of FeIII available in aquifer sediments
- □ Alkalinity
- □ Fatty acids

Contaminants‡

- ■ PCE
- ■ TCE
- ■ TCA
- ■ DCA
- ■ Chloroethane
- ■ DCE (*cis*-DCE and *trans*-DCE)
- ■ VC
- ■ BTEX
- ■ Ethene/Ethane

‡ *Subsequent sampling may reveal the presence of contaminants (or their reductive metabolites) not detected in the screening phase. However, this list may be amended to reflect particular site characteristics through consultation with the regulatory staff.*

Other contaminant information:

- ■ Estimate of DNAPL or LNAPL extent
- ■ Estimate of source area boundaries
- ■ Estimate of mass released in the source area based on historical data

Soil:

- ■ Soil contaminant data, by depth in source area
- □ Soil total organic carbon
  (may also be required to evaluate the potential leaching to groundwater)
- ■ Contaminant Kd or Koc values from literature (12)
  (required to calculate retardation constant for contaminants; may also be required to evaluate potential leaching to groundwater)
- ■ Soil density
- ■ Soil/sediment porosity

3. Aquifer data

- ■ Summary and analysis of local geologic features that may include: confining units; aquifer types; drinking water aquifers; analysis of boring logs; hydrogeologic section maps.
- ■ Depth of aquifer
- ■ Lithology
- □ Vertical data on geochemistry and contaminant concentrations†
- ■ Risk analysis of downgradient receptors, including ecological receptors and future exposure points
- ■ Regulatory point of compliance
- ■ Advection and dispersivity assumptions
- ■ Potentiometric water table maps
- ■ Isopleth maps of daughter products
- ■ Isopleth maps of electron acceptors
- ■ Isopleth maps of contaminants
- □ Isopleth maps of above subjects by depth, if warranted
- □ Identification of zones of high transmissivity and preferential flow paths through boring log analysis, cone penetrometer studies, or downhole flowmeter (9)†

† *Strongly recommended..*

4. **Biodegradation potential:**
    - ■ Field measurement of degradation using tracers.
      Or
    - ■ Using data from three monitoring wells, an analysis using regression analysis (6).
    - □ Laboratory microcosm study.

5. **Calculations:**
    - ■ Retardation coefficient
    - ■ NAPL/water partitioning constants
    - ■ Site specific biodegradation rate for each contaminant
    - ■ Refined estimates of groundwater velocity and direction based on additional data

6. **Modeling and Analysis:**
    - ■ Fate and transport modeling.
    - □ Soil leaching modeling for source area. (This can assist in determining the flux of contaminants to groundwater if needed to evaluate source removal options.)
    - ■ Refined three-dimensional conceptual model for the site (7).
    - ■ Evaluate source removal effect on attenuation processes.
    - ■ Conduct additional sampling and analysis to fill data gaps, if needed.

    - □ Evaluate "active" remedies to augment natural attenuation
    - ■ Compile "weight of evidence" arguments; solicit regulatory approval for a natural attenuation remedy.

C. Long term monitoring plan

1. **Wells/Groundwater samples:**
    - ■ Monitoring wells from verification phase (modified if necessary after modeling and development of refined conceptual model
    - ■ Sentinel well locations, based on analysis and modeling results

    Sample number and frequency:
    - ■ Quarterly during the first year
    - □ Annual sampling after one year if stable results from first year.

    Monitoring wells (in area of plume):
    - ■ Contaminants of concern
    - ■ O_2
    - ■ NO_3^{-2}
    - ■ FeII
    - ■ MnII
    - ■ SO_4^{-2}
    - ■ CH_4
    - ■ Water level
    - ■ NAPL thickness, if appropriate
    - ■ Other analyte of regulatory concern

    Sentinel or compliance monitoring wells (downgradient of plume):
    - ■ Contaminants of concern

2. **Other:**
    - ■ Contingency plans for unexpected plume expansion.

D. Sampling Recommendations.

The following is a compilation of the data needs for a natural attenuation evaluation, the methods of analysis, and recommendations for sample collection procedures. The types of samples and the methods of collection may vary depending on site-specific considerations. Thus, individual work plans for sampling should be approved before proceeding with sampling.

Table 1.

Analyte/parameter	Method[1]	Sampling comments and recommendations
Reduced iron (Fe+2)	Field test kit[2]	--
Reduced manganese (Mn+2)	Field test kit	--
Oxygen	Field test kit	--
	O2 Probe[3]	Use in flow cell apparatus.
Eh	Eh Probe	Use in flow cell apparatus.
pH	pH Probe Litmus paper	Use in flow cell apparatus.
Conductivity	Conductivity probe	Use in flow cell apparatus.
Temperature	Thermocouple or thermometer	Use in flow cell apparatus.
Carbon dioxide	Field test kit	--
Sulfide	Field test kit	--
Methane	Laboratory analysis[4]	40 ml serum bottle with crimp cap. Preserve sample with 5 drops of 50% H_2SO_4[5]
Dissolved organic carbon	EPA lab method 9060	40 ml serum bottle with crimp cap. Preserve sample with 5 drops of 50% H_2SO_4[6]
Alkalinity	Field test kit	--
	EPA lab method 310	Screw-cap plastic bottle, no preservative necessary
Sulfate	Field test kit	--
	EPA lab method 9035; 9036	Screw-cap plastic bottle, no preservative necessary

Chloride	Field test kit	--
	EPA lab method 9250; 9251	Screw-cap plastic bottle, no preservative necessary
Nitrate	Field test kit	--
	EPA lab method 352	250 ml Screw-cap plastic bottle, preserve with 5 drops H_2SO_4
Hydrogen	Field hydrogen analyzer	Sample collected via dissolved gas flow cell as per reference ( ) (7)
BTEX	EPA lab methods 465E; 8015; 8021B	40 ml VOA bottles, preserved with Hcl
Chlorinated VOCs	EPA lab methods 465E; 8121; 8260	40 ml VOA bottles preserved with Hcl

1. Laboratory methods may vary depending on the individual laboratory standard operating procedures. Consult with lab personnel to make sure sample collection is consistent with laboratory analytical standard procedures.

2. a) Several commercially available and reliable test kits are available. Ensure that the range of the test kit analysis is consistent with the expected range to be sampled.
   b) Provision for QA/QC requirements should be included in using field test kits. As for any other sampling protocol, sample blanks, duplicate sample analysis, and duplicate laboratory analysis (when possible) are appropriate in gathering data. Check with quality assurance personnel to verify QA/QC sampling, frequency of duplicates, and other precautions.

3. All probes and electronic instruments must be calibrated as per the manufacturers' instructions on a daily basis prior to making measurements.

4. The laboratory standard operating procedure for methane analysis followed by EPA Kerr labs is enclosed.

5. Preservative is added to reduce the pH so that any methane is not degraded biologically; the vials need to be sealed tightly to eliminate volatilization to the atmosphere

6. Preservative is added to reduce the pH so that organic carbon is not biologically degraded.

7. Can be collected only from PVC wells; cannot be collected using any electrical pump. Use peristaltic, or some form of pneumatic pump.

E. Recommended Field Sampling Procedure.

1. Record pH, temperature, Eh, and conductivity readings using a low flow cell apparatus and appropriate probes until readings are stable.
2. Fill (4) HCl preserved VOA vials for BTEX and solvent analysis.
3. Fill (2) 250 ml plastic screw cap bottles. Add H_2SO_4 to one and label this one as "preserved".
4. Completely fill (2) 40 ml serum crimp vials; add H_2SO_4 and immediately seal with crimp cap.
5. Perform all field test kit analyses.
6. Set up the glass equilibration vessel for hydrogen sampling at a flow rate of approximately 200 ml/min; allow 15 minutes for gas equilibration. After flushing the gas syringe once with the equilibrated gas contained within the vessel, extract 10cc of bubble for analysis on hydrogen analyzer.

APPENDIX 4: BAG HEADSPACE PROCEDURE (EXCERPTED FROM FACT SHEET #3.22)

MPCA

Tanks and Emergency Response Section

Minnesota Pollution Control Agency

Soil Sample Collection and Analysis Procedures

Fact Sheet #3.22

July 1996

This fact sheet provides procedures for field screening of petroleum contaminated soil and collection and laboratory analysis of soil samples.

I. FIELD SCREENING PROCEDURE

Minnesota Pollution Control Agency (MPCA) staff recommends the polyethylene bag headspace method described below as the field procedure for characterization of soil contamination. We no longer recommend using glass jars for this procedure because 1) the collapsible nature of bags allows more uniform flow of actual headspace gas into the field instrument resulting in more accurate readings and 2) the soil clumps can be broken up when bags are used.

1. Use photoionization detectors (PIDs) with a 10.2 eV (+/-) or greater lamp source, or flame ionization detectors (FIDs). Perform PID or FID instrument calibration on site and at least daily to yield "total organic vapors" in volume parts per million (ppm) of a benzene equivalent. Follow the manufacturer's instructions for operation, maintenance, and calibration of the instrument. Keep calibration records. MPCA staff reserve the right to request these records.

2. Use a self-sealing quart-size polyethylene freezer bag. Half-fill the bag with the sample to be screened so the volume ratio of soil to air is equal then immediately seal it. Manually break up the soil clumps within the bag. *Note:* Soil collected from a split spoon should be transferred to the bag immediately after opening the split spoon; soil collected from an excavation or soil pile should be collected from freshly exposed surfaces.

3. Allow headspace development for at least 10 minutes. Vigorously shake bags for 15 seconds both at the beginning and end of the headspace development period. Headspace development decreases with temperature. When temperatures are below the operating range of the instrument perform headspace development and analysis in a heated vehicle or building. Record the ambient temperature during headspace screening. *Complete headspace analysis within approximately 20 minutes of sample collection.*

4. Following headspace development introduce the instrument sampling probe through a small opening in the bag to a point about one-half of the headspace depth. Keep the probe free of water droplets and soil particles. (Syringe withdrawal of a headspace sample and injection to an instrument probe or septum-fitted inlet is acceptable, provided the method accuracy is proven by means of a test gas standard.)

5. Record the highest meter response. Maximum response usually occurs within about two seconds. Erratic meter response may occur at high organic vapor concentrations or if moisture is present. Note any erratic headspace data.

APPENDIX 5: POLICY ON EPA METHOD SW-846 5035

The latest approved update to EPA SW-846 contains a new method that changes the way volatile soils samples are taken. Method 5035 contains a number of methods that may be used to sample volatiles in soils depending on required reporting limits needed for a site. A number of laboratories and consultants have requested a formal position from the MN Pollution Control Agency (MPCA) on this method driving this policy letter. The following recommendations are made:

1. The MPCA approves the use of method 5035 and will require that this method be used on all Superfund, solid waste, emergency response, RCRA, and tank sites.

2. The methods used prior to this (jar packing) will be unacceptable for work to take place after 1 September 1998. Current work plans that use the old method should be updated to reflect the new method. (A few sites in the state that are doing comparative soils analysis may want to employ both methods.)

3. Environmental laboratories will be prepared for the transition to 5035 (most are already using the method). The laboratories will include a sheet with their bottles that outlines the exact procedure of sampling to be used (e.g. 5 grams of soils and 5 mls of methanol, etc.).

The method has four procedures used for sampling. Each of the procedures is specific to the data quality objective for the data. The following gives an outline of the different procedures used under 5035.

1. Methanol Preservation - This method is a high level method due to the reporting limits being at 100 ug/kg and greater. The method consists of sampling with a vial that is preweighed and labeled. The vial has a sample of soil added to it using a coring device (usually a cut syringe) to get roughly 10 grams of soil into the vial with minimal disturbance of the soil, and then adding (or already having in the vial) 10 mls of methanol. The sample is then shipped to the laboratory on ice (four degrees Celsius).

2. Sodium Bisulfate - This is a low level method similar to the methanol procedure, but instead of methanol being added, Sodium Bisulfate is used as a biocide (eliminating the dilution and giving a reporting limit of <100ug/kg). The sodium bisulfate is added at a rate of 0.2 grams of preservative to 1 gram of soil. Normally 5 grams of soil and 1 gram of sodium bisulfate are used Five milliliters of water is added to the vial after the soil and sodium bisulfate are present to form an acid which prevents biodegradation. The vial is then sealed in a cooler with ice, and shipped to the laboratory.

3. High Concentration Samples - This method is used for oily samples or samples of very high concentration. No preservative is used. The sample is taken and put in a container (normally 4 oz. jar) with zero headspace and shipped to the laboratory (on ice).

4. Encore Sampler - The Encore sampler may be used to sample the soil. The Encore is a device that allows for a zero headspace sample to be taken without "jar stuffing". The Encore is used to transport the sample to the laboratory. The laboratory then can do a direct purge (water and soil) on the sample, add methanol, or sodium bisulfate (thereby giving a <100 ug/kg reporting limit). The current accepted

method 5035 allows a 48 hour hold time on the Encore sample prior to analysis or transfer to a container with preservative in it. It is understood by the State of MN that EPA will be allowing a one week hold time on the Encore within the year. There are a few versions of the Encore that staff should be aware of. The old samplers were made of stainless steel with "o" rings used to seal the system. They were reusable (after being sent back to Enchem for baking and reassembly). The newer samplers are made of Teflon, are disposable, and packaged individually.

In considering which method to use the driving factor will be the reporting limits needed. These must be considered up front to avoid the possibility of resampling. Additionally, multiple samples should be taken (a minimum of three) by any method to allow for reanalysis. If employing the low level method, at least one methanol sample should also be taken too, as dilutions cannot be taken from a sample preserved by the sodium bisulfate. A sample for dry weight must also be taken to allow for this calculation.

At this time, most sites will allow for the use of either the methanol or low level method (or Encore). In reviewing the soil limits for Minnesota, only the leaching limits used on a site specific basis were found to be lower than the limits achievable by the use of methanol extraction (on a clean sample). As newer methods evolve with the introduction of PBMs (performance based methods), one can be certain that there will be other choices in the near future. Therefore, it is recommended that documentation on field sampling allow for these changes with wording to the effect of "use of methanol preservation or sodium bisulfate or equivalent per method 5035".

Any questions or comments on the policy can be directed to Luke Charpentier at (651) 296-8445.

Minnesota Pollution Control Agency
Site Remediation Section
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APPENDIX C

STRATEGIC EXIT PLAN

Draft

Strategic Exit Plan

Naval Industrial Reserve Ordnance Plant

Fridley, Minnesota

Southern Division

Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0057

March 2000

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1.0 INTRODUCTION

This Strategic Exit Plan (SEP) has been prepared by Tetra Tech NUS, Inc. (TtNUS) for the Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC) under the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0057. The Navy, U.S. Environmental Protection Agency (EPA), and Minnesota Pollution Control Agency (MPCA) provided input in developing the SEP.

The SEP is a document that identifies and describes the considerations, decision-making criteria, and steps necessary for the Navy to exit active Installation Restoration (IR) Program involvement at the Naval Industrial Reserve Ordnance Plant (NIROP), Fridley, Minnesota. The SEP can also be used to determine a schedule to exit such involvement. The SEP includes the following:

- Current and potential conditions requiring active IR Program involvement by the Navy.
- Actual and potential requirements resulting in the need for active IR Program involvement by the Navy.
- A step-by-step strategy, outlined in flow charts and detailed in text, for addressing the conditions and requirements.

The remainder of this SEP presents the flow charts (Appendix A) and descriptions of actions and decision points to address the conditions and requirements identified above. This report also describes criteria that can be used to make decisions. The SEP also contains requirements for property transfer. A table of Minnesota applicable or relevant and appropriate requirements (ARARs) is provided in Appendix B.

Site-related documents and the minutes of the Partnering Team and Restoration Advisory Board (RAB) meetings were reviewed to identify conditions and requirements that are applicable, or potentially applicable, to site conditions and remedial activities at NIROP Fridley. Although many conditions and requirements were identified, they can be summarized according to the media that has been, or could potentially be, affected by past releases at the site and activities that are related to the investigations and remedial actions that have already been implemented under operable unit (OU) 1 (groundwater) and OUs 2 and 3 (sources of groundwater contamination). Separate flow charts (Appendix A) were developed for each of these media (i.e., surface water, air, groundwater, and soil). All of the conditions and requirements identified are included in one or more of the flow charts. The only condition or requirement related to surface water and air is compliance with appropriate discharge and emission limits. As shown in Figure A-1, items and media related to groundwater include discharge of treated groundwater to surface water, air emissions from the groundwater treatment system, and groundwater monitoring. The general concern regarding the soil medium is whether remaining contaminants are a potential source of groundwater contamination.

Groundwater

The following general conditions and requirements are related to groundwater. It is anticipated that specific conditions and requirements would fall into one of these categories.

- Horizontal and vertical extent of groundwater contamination.
- Adequacy and effectiveness of groundwater containment system.
- Effects of the groundwater containment system on direction and rate of groundwater flow.
- Effects of upgradient groundwater contamination.
- Attainment of objectives in the Record of Decision (ROD), as modified by 5-year reviews.
- Remaining sources of groundwater contamination.
- Potential impacts to the Mississippi River from residual groundwater contamination in Anoka County Regional Park.

Soil

The following general conditions or requirements are related to soil. It is anticipated that any specific conditions and requirements would fall into one of these categories.

- Completion of ongoing activities for OU2/OU3 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

- Additional sources of groundwater contamination that could adversely affect the selected groundwater remedy.

2.0 DECISION AND ACTION PROCESSES

This section discusses the flow charts developed to aid in the decision-making process at the NIROP Fridley. It describes a general flow chart and references flow charts related to air, surface water, groundwater, and soil. It also provides actions to be taken and criteria to aid decision-making.

2.1 GENERAL

The flow chart that summarizes the media of concern (i.e., air, surface water, groundwater, and soil) at the NIROP Fridley is provided in Figure A-1. CERCLA actions at the site have been grouped into operable units. OU1 is groundwater contamination. For OU1, a ROD was signed in 1991, and a remedial action has been implemented. The remedial action consists of extracting groundwater by pumping to contain the onsite contaminant plume, treating the extracted contaminated groundwater by air stripping to remove volatile organic compounds (VOCs), and discharging the treated groundwater to surface water. Contaminated groundwater that is located off site is being allowed to naturally dissipate. However, the residual groundwater contamination in Anoka County Park is being further evaluated because the regulators are not satisfied with the rate of natural dissipation. Actions associated with OU1 include monitoring the discharge of treated groundwater to surface water and monitoring the groundwater to confirm the effectiveness of the remedial action. A 5-year review of the ROD, as required by CERCLA when hazardous substances remain on site above health-based levels, was completed and approved in October 1998.

OU2 and OU3 consist of onsite soils located around and beneath the main building. These OUs have been combined, and the remaining planned CERCLA actions will address all onsite soils. The remedial investigations (RIs) for OU2 and OU3 have been completed. Future planned CERCLA actions for OU2 and OU3 will be combined and include the Feasibility Study (FS), Proposed Remedial Action Plan (PRAP), ROD, and implementation of the selected remedial action. There is also a possibility that potential undiscovered sources of groundwater contamination are present on site. Actions associated with OU2/OU3 include soils currently under study and potential future sources of groundwater contamination.

2.2 EVALUATE AIR STRIPPER EMISSIONS

The flow chart related to air emissions monitoring is provided in Figure A-2.

Evaluation of the concentrations of VOCs in the emissions from the air stripper was required as part of the remedial action for OU1. This evaluation consisted of sampling the influent and effluent of the air stripping units for selected parameters during startup of the groundwater treatment facility. The emission rate for each parameter was calculated using the State-approved risk/exposure modeling criteria and was compared to the site-specific allowable emission rate (AER). Site-specific AERs are emission rate limits that ensure maximum offsite ambient air impacts are below regulatory-defined allowable offsite concentrations. Allowable offsite air concentrations are based on an increased cancer risk to the public of 1E-05. Site-specific AERs have been calculated for carcinogenic compounds that were identified as potentially emitted contaminants from the operation of the groundwater treatment facility (Morrison Knudsen Corporation, 1998). The AERs and corresponding groundwater concentrations are provided in Table 2-1.

The site-specific AERs and the corresponding allowable groundwater concentrations were calculated by "back modeling" from allowable offsite ambient air concentrations. The conservatively estimated allowable groundwater contaminant concentrations were well below previously measured groundwater concentrations. Therefore, it was concluded that no emission control measures would be required for operating the groundwater treatment facility.

Evaluation of air stripper emissions is not needed as part of the routine monitoring of the remedial action. However, if groundwater concentrations approach the "allowable" values presented in Table 2-1, the emission rate can readily be calculated. Air stripper influent concentrations for VOCs (in micrograms per liter [µg/L]) are multiplied by the air stripper influent flow rate (in liters per second [L/sec]) to obtain the emission rates (in micrograms per second [µg/sec]). The results will be reported to the MPCA and documented in the Annual Monitoring Report (AMR).

In the unlikely event that the calculated emission rate is above the AER for any of the VOCs in Table 2-1, system performance may need to be evaluated. Failure to meet the AERs could result in the need for air stripping emission controls to be evaluated. Any system modifications will be documented in the AMR.

2.3 MONITOR DISCHARGE TO SURFACE WATER

The flow chart related to monitoring the discharge of treated groundwater to surface water (i.e., Mississippi River) is provided in Figure A-3. Treated groundwater is discharged to the Mississippi River through outfall serial number 020. Routine monitoring of the concentrations of contaminants in the treated groundwater is required as part of the National Pollutant Discharge Elimination System (NPDES) permit (MPCA, 1996) and the remedial action for OU1. The monitoring data will be compared to the discharge limits established in the discharge permit (Table 2-2). Twice monthly monitoring for VOCs is required for the first year, after which a reduction in frequency may be requested in writing from the MPCA. According

TABLE 2-1

SITE-SPECIFIC ALLOWABLE EMISSION RATES AND GROUNDWATER CONCENTRATIONS NIROP FRIDLEY, MINNESOTA

Contaminant	Allowable Air Concentration (µg/m^3)	Allowable Emission Rate (µg/sec)	Allowable Groundwater Treatment Concentration (µg/L)	Maximum Anticipated Groundwater Concentration (µg/L)
1,1-Dichloroethane	500	1.35E+08	2,100,000	10
1,1-Dichloroethene	0.2	5.4E+4	850	5
Methylene chloride	20	5.4E+6	85,000	40
Tetrachloroethene	17.2	4.6E+6	73,000	10
Trichloroethene	5.9	1.6E+6	25,000	3,000

Source: Morrison Knudsen Corporation, 1998.

TABLE 2-2

NPDES DISCHARGE LIMITS - OUTFALL 020
NIROP FRIDLEY, MINNESOTA

Parameter	Daily Maximum Discharge Limit	Measurement Frequency
Flow (MGD)		Continuous
Temperature	26.5°C (80°F)	Monthly
Iron	--	Quarterly
Manganese	--	Quarterly
Methlyene chloride	5.0 µg/L	Twice monthly
Carbon disulfide	700 µg/L	Twice monthly
1,1-Dichloroethene	6.0 µg/L	Twice monthly
1,1-Dichloroethane	70 µg/L	Twice monthly
1,2-Dichloroethene (cis)	70 µg/L	Twice monthly
1,2-Dichloroethene (trans)	100 µg/L	Twice monthly
1,1,1-Trichloroethane	200 µg/L	Twice monthly
Trichloroethene	5.0 µg/L	Twice monthly
Tetrachloroethene	3.8 µg/L	Twice monthly

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored monthly by grab samples analyzed immediately.

There shall be no discharge of floating solids or visible foam other than in trace amounts.

The discharge shall not contain oil or other substances in amounts sufficient to create a visible color film on the surface of the receiving water.

The discharge shall not contain significant color in amounts to create a visible discoloration of the receiving water at the point of discharge.

to the discharge permit, monitoring reductions will only be granted if contaminant levels are consistently lower than the discharge limits. Likewise, monitoring for iron and manganese may be eliminated after one year of monitoring with written approval of the MPCA. Complete VOC monitoring shall be conducted on the effluent twice annually after startup of the treatment system. EPA Methods 601 and 602 shall be used for all analyses. All samples collected to determine compliance with the NPDES permit shall be analyzed by a laboratory certified by the Minnesota Department of Public Health as provided by Minnesota Rules part 4740.2040, Certified Test Categories.

The results will be documented in the monthly NPDES Discharge Monitoring Report (DMR) and the AMR.

If the contaminant concentrations in the discharge stream are higher than the discharge limits, the treatment system will be evaluated and adjustments will be made, as required, and reported to the MPCA and documented in the AMR.

2.4 GROUNDWATER AND SURFACE WATER MONITORING

2.4.1 Groundwater Monitoring

Routine monitoring of VOCs in the groundwater is required as part of the remedial action for OU1. Semiannual monitoring is conducted at selected monitoring wells and extraction wells as outlined in the Remedial Action Work Plan (RAWP) (TtNUS, 1999). The results are documented in the AMR.

Even when a detailed hydrogeologic investigation has been performed, the complex behavior of contaminants in groundwater, combined with the heterogeneity of hydrogeologic systems, makes predicting the effectiveness of remediation difficult. Performance evaluations of the remedial action, based on groundwater monitoring data, are conducted periodically to compare actual performance to expected performance. Conducting performance evaluations and modifying remedial actions is part of a flexible approach to attaining remedial action objectives. After evaluating whether cleanup levels have been, or will be, achieved, the following options should be considered:

- Discontinue operation.
- Upgrade or replace the remedial action to achieve the original remedial action objectives.
- Modify the remedial action objectives and continue remediation, if appropriate.

The flow chart related to evaluation of groundwater monitoring results is provided in Figure A-4. The following rationale was developed for groundwater located beneath the site that is being contained by the existing extraction system. The rationale can also be used to evaluate groundwater contamination beyond the capture zone of the containment system; however, discussions on the groundwater pumping system would not apply because offsite groundwater is being allowed to naturally dissipate.

The following recommendations regarding contaminated groundwater were presented in the Five Year Review Report (EPA, 1998):

- By September 1999, the Navy will confirm whether the present groundwater extraction system has achieved substantial hydraulic containment of the contaminant plume through evaluation of chemical and physical groundwater data and use of that data in a groundwater model. If the determination is made that a substantial amount of contaminated groundwater is flowing past the extraction well system, the extraction well system will be enhanced so that groundwater from the NIROP does not continue to flow into Anoka County Park.

- By September 1999, the Navy will fill data gaps in the existing groundwater-monitoring network and revise the RAMP to document the additional monitoring.

- By September 1999, the Navy will determine whether any potential sources of contamination exist in Anoka County Park that may impact residual groundwater contamination levels in the area where residual groundwater contamination is present.

- By September 1999, the Navy will determine what can be done to promote reduction of residual groundwater contamination in Anoka County Park to a level that will significantly reduce residual groundwater contamination. The Navy will also determine whether a response action will enhance the effectiveness of the selected remedy as it relates to residual groundwater contamination in Anoka County Park. If warranted, the Navy will conduct a response action that will significantly reduce residual groundwater contamination and enhance the effectiveness of the selected remedy as it relates to residual groundwater contamination from NIROP in Anoka County Park by September 2000.

2.4.1.1 Groundwater Quality Improving

This section describes actions, decisions, and criteria to be used if monitoring results show that groundwater quality is improving.

The goal of groundwater remediation is to achieve EPA Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) throughout the entire contaminant plume. If the results of groundwater monitoring indicate that the remediation goals have been attained throughout the affected area, the groundwater extraction will be stopped. The semiannual groundwater monitoring will continue for one year. If the remediation goals are still being attained after one year, no further action is recommended. If the groundwater concentrations are higher than the remediation goals (MCLs), groundwater extraction and treatment will be restarted, and groundwater monitoring would continue.

If the remediation goals have not been attained, then an evaluation will be made to determine whether contaminant concentrations are decreasing. If so, groundwater remediation and monitoring will continue.

The achievable concentration of any constituent in groundwater from a pumping program cannot be predicted with certainty. Despite ongoing remediation efforts, the concentration of trichloroethene (TCE) and other VOCs may decline and asymptotically approach a limiting low level that is still above the remediation goals. Operational results (e.g., incremental contaminant mass removal has reached insignificant levels) may indicate that it is technically impractical to achieve remediation goals in any foreseeable amount of time. If the results of the groundwater monitoring indicate that asymptotic conditions have been attained, the groundwater extraction will be stopped. The semiannual groundwater monitoring will continue for one year after remediation has been discontinued. If asymptotic conditions are still being attained (e.g., no increase in concentrations) after one year of additional monitoring, no further active remediation would be required. However, institutional controls to restrict groundwater use would need to be implemented and maintained. If groundwater contaminant concentrations have increased during the year remediation was discontinued, groundwater extraction and treatment would be restarted, and groundwater monitoring would continue.

The data from the monitoring well network will be evaluated as follows, as specified in the RAWP (TtNUS, 1999):

- TCE concentrations will be plotted against time for the wells being monitored and examined for discontinuities.

- If the resulting plot is linear (or may be fitted to a linear model in time) and shows no discontinuities, then a least-squares regression will be performed. The slope of the fitted curve will be calculated. In this case, the linear model will be used as a "French curve" to estimate the slope.

- If the resulting plot is nonlinear and shows no discontinuities, then an appropriate curve will be fitted to the data by nonlinear least-squares regression. The slope will be the first derivative of the curve calculated at a value of time of the last data point.

- The resulting residuals from the linear or nonlinear model will be examined for outliers, seasonal differences, and serial correlations. The residual sum of squares, after accounting for outliers, seasonal differences, and serial correlations, will be used to estimate error variance. This error variance will be used to make the interval estimates in the model parameters and forecasts. Type I and Type II error rates of $\alpha = 0.05$ and $\beta = 0.05$ will be used.

- A limiting or asymptotic concentration of TCE will be considered to be achieved if the slope estimated with the last data point using the least-squares estimates of the parameters for the linear or nonlinear model lies between zero and negative 25 µg/L TCE per year, and the interval estimate of the slope at the 95-percent confidence interval includes zero.

If groundwater remediation is not performing as anticipated, upgrades to the extraction system or implementation of other remedial actions to increase contaminant removal rates may be needed. In addition, there could be problems associated with upgradient or undiscovered sources of groundwater contamination that would make it difficult or impossible to achieve the remedial action objectives. These situations are described in the next section.

2.4.1.2 Options to be Considered if Groundwater Quality is Not Improving

TCE and other constituents have been detected in monitoring wells upgradient of known and potential contaminant sources at the NIROP Fridley, on property not owned by the Navy. Since there may be upgradient sources contributing TCE to the groundwater, monitoring data from onsite wells will be compared to upgradient "background" wells. If it is shown that upgradient sources are contributing TCE or other contaminants to the groundwater, the remediation goals will be adjusted, if needed, to reflect the contribution from upgradient sources. The Navy will not be responsible for remediation of such contamination. The Navy expects that any party responsible for upgradient contamination that affects the NIROP Fridley site will be responsible for the cleanup. The Navy will provide site access to such a responsible party to ensure that they remediate such upgradient contamination.

If it is suspected that the groundwater extraction system used for containment is not performing as anticipated, an evaluation of the containment system will be conducted. The groundwater model developed during past investigations and evaluations for the NIROP Fridley site will be used to determine whether horizontal and vertical capture of groundwater contamination is adequate. If the model suggests that groundwater capture is effectively containing the plume, groundwater monitoring will continue.

If the model indicates that groundwater capture is not effective in containing the plume, the extraction system will be modified, based on the results of the groundwater model. The groundwater model will be used to evaluate the effects of additional extraction wells, increased pumping rates, varied pumping rates, pulse pumping, and other scenarios, on plume containment. Once the extraction system has been modified, the effectiveness of the upgrade will be evaluated based on the results of semiannual groundwater monitoring. In any case, groundwater monitoring will continue until there is a change in groundwater quality.

If upgrades to the extraction system are not effective, there may be a possibility of undetected onsite sources of groundwater contamination that continue to contribute to the contaminant plume, which would require investigation. For purposes of this discussion, it is assumed that a remedial action will have already been implemented for OU2/OU3 soil, as needed, to protect human health and the environment. Other potential sources will be evaluated based on monitoring results for individual wells. Concentration increases at individual monitoring wells, when concentrations are decreasing at other wells, could trigger the need for investigation of potential sources. The potential source areas would likely be investigated according to the procedures used for the OU2/OU3 RI pending regulatory approval. If potential soil source areas are discovered, they would be evaluated in accordance with the procedures described in Section 2.5. If no potential sources are detected, the adequacy of the remedial action implemented for OU2/OU3 soil would need to be evaluated.

2.4.2 Surface Water Monitoring

Routine monitoring of surface water (i.e., Mississippi River) is not currently being conducted. Contaminated groundwater that is not captured by the onsite containment system is discharging to the river in the vicinity of the site. The Partnering Team has raised concerns that this discharge could adversely affect the water quality in the river, although past sampling has shown that state water quality standards are not being exceeded. The policy of the State of Minnesota is to protect all waters from significant degradation from point and non-point sources (Minn. Rule 7050.0185). The discharge of groundwater to the river meets the requirements for a non-point source discharge as defined in Minn. Rule 7050.0130; however, there are no permitting requirements as for point source discharges such as the discharge of treated groundwater discussed in Section 2.3. In addition, the state has no specific requirements on the compliance point to measure adverse impacts to surface water. The regulations state that in making an analysis to determine compliance with water quality standards, samples shall be collected in a manner and place to adequately reflect the effects of pollutants upon the specified use(s) of the water body (Minn. Rule 7050.0150); however, the details of monitoring are at the discretion of the MPCA on what is determined to be necessary. To date, the Navy has interpreted the MPCAs specified monitoring location to be the monitoring wells nearest the Mississippi River. The Navy has sought to install wells along the river where they were formerly lacking.

The most restrictive water quality classification for the Mississippi River near the NIROP Fridley site is Class 1, domestic consumption, and the water quality standards for the groundwater contaminants of concern are based on MCLs. Therefore, one of the goals of remediation at the site should be to ensure that state water quality standards are not being exceeded by site-related activities, especially since a potable water intake is located in the river downstream of the site.

In addition, the following recommendations regarding surface water monitoring were presented in the Five Year Review Report (EPA, 1998):

- By September 1999, the Navy will fill data gaps in the existing surface water monitoring network and will revise the RAWP to document the additional monitoring.

- The MPCA will conduct another surface water assessment to incorporate new groundwater sampling information and groundwater modeling information to determine whether surface water standards and criteria are exceeded. This work is to be conducted after the evaluations of the groundwater extraction system, the groundwater and surface water monitoring network, and potential sources of groundwater contamination in Anoka County Park have been completed.

It is recommended that surface water samples be collected from the Mississippi River upstream, in the vicinity of where groundwater discharges into the river, and downstream of the site. These samples should be collected at the same time as the semi-annual groundwater sampling and analyzed for the same parameters. The results of such sampling would provide continuing proof that the discharge of contaminated groundwater is not causing an exceedance of water quality standards.

2.5 OU2/OU3 SOIL AND FUTURE POTENTIAL RELEASES TO GROUNDWATER

The flow chart related to evaluation of soil contamination is provided in Figure A-5. The actions, decision points, and criteria presented in this section apply to potential sources of groundwater contamination that may be identified in Section 2.4.2 and also to OU2/OU3 soil. The field work for the OU2 and OU3 RIs has been completed. Soil cleanup goals for protection of groundwater were developed for OU2 soils outside the building. These concentrations are as follows:

- Trichloroethene - 4,986 micrograms per kilogram (μg/kg)
- Tetrachloroethene - 275 μg/kg
- 1,2-Dichloroethene - 6,036 μg/kg

Soil cleanup goals for protection of groundwater were developed for OU3 soils beneath the building. These concentrations are as follows:

- Trichloroethene – 39 μg/kg (no pumping condition); 600 μg/kg (pumping condition).
- Tetrachloroethene – 100 μg/kg (no pumping condition); 900 μg/kg (pumping condition).

There are some locations outside and beneath the building where soil contaminant concentrations exceed the respective OU2 and OU3 cleanup goals for protection of groundwater.

2.5.1 Soil Cleanup Goals for Protection of Groundwater

If soil contaminant concentrations outside the building are lower than the OU2 cleanup goals for protection of groundwater, no further action for such soil is needed to protect groundwater. If soil contaminant concentrations beneath the building are lower than the OU3 cleanup goals for protection of groundwater, no further action for such soil is needed to protect groundwater. These decisions do not preclude actions needed to protect human health from exposure to soil.

2.5.2 Feasibility Study

If soil contaminant concentrations are higher than the OU2/OU3 cleanup goals, or if remedial action is needed to protect human health, development and evaluation of remedial alternatives would be required. If there are sufficient data to evaluate potential remedial alternatives, an FS would be prepared. If not, or if a treatability study is needed to support this evaluation, then additional data would be collected.

The FS will be conducted according to 40 CFR 300.430 of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988). The main objective of the FS is to ensure that remedial alternatives are developed to provide a range of options that will address site concerns. The FS will be based on the information provided in the OU2/OU3 RI or data collected during performance evaluations of the OU1 groundwater remediation system (Section 2.4). The FS will address potential risks to human health and the environment as determined by the risk assessment conducted as part of the RI. Cleanup goals will have been developed during the RI for protection of human receptors under an industrial land use scenario and for protection of groundwater from migration of soil contaminants.

The cleanup goals will be used to estimate the volume of contamination and to evaluate remedial technologies and process options. The remedial technologies and process options will be screened to select those that can effectively mitigate the risks posed by site contaminants and that can be successfully implemented. Innovative, in-situ technologies may be needed to address soil beneath the buildings that is a continuing source of groundwater contamination. The technologies and process options that pass the screening step will be combined into remedial alternatives that address the site concerns.

The remedial alternatives will be screened based on effectiveness, implementability, and cost to reduce the number of alternatives that will be analyzed in detail, if necessary. During the detailed analysis, the alternatives are analyzed with respect to the evaluation criteria in the NCP and RI/FS guidance. These criteria include threshold, primary balancing, and modifying criteria. Threshold criteria include overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). Balancing criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Modifying criteria include EPA/State acceptance and community acceptance and are assessed following receipt of comments on the RI/FS and the PRAP.

Once the alternatives have been individually assessed against the evaluation criteria, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criteria. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs the decision-maker must balance can be identified.

Once the FS has been completed, the next step in the CERCLA process is preparation of decision documents (PRAP and ROD).

2.5.3 Decision Documents

Following the FS, a preferred alternative is identified prior to holding a formal public comment period on the proposed cleanup. The NCP specifies that the preferred alternative must be protective of human health and the environment and compliant with its respective ARARs (threshold criteria). The preferred alternative is identified as the protective, ARAR-compliant approach that is judged to provide the best balance of tradeoffs with respect to the primary balancing criteria. This evaluation should also consider EPA/State and community acceptance of each alternative, when such information is available.

The preferred alternative is presented to the public in the PRAP. The PRAP will be prepared according to the NCP (40 CFR 300.430) and *Guidance on Preparing Superfund Decision Documents* (EPA, 1989). The PRAP will briefly summarize all of the alternatives studied in the detailed analysis phase of the FS, highlighting the key factors that led to identifying the preferred alternative. The PRAP, as well as the RI/FS and other information, is made available for public comment in the Administrative Record. The PRAP should inform the public about the dates of the public comment period; date, time, and location of the public meeting; location of information repositories and the Administrative Record and the hours of availability; and names, telephone numbers, and addresses of the lead and support agency personnel who will receive comments or who can supply additional information.

A notice of the availability of the PRAP with guidance on procedures for public comment is then published in the local newspaper(s). Public comments are addressed in the Responsiveness Summary in the ROD. The nature of the public comments may require a revision to the preferred alternative.

A ROD will be completed to present and document the selected remedy. The ROD will be completed in accordance with the NCP (40 CFR 300.430) and *Guidance on Preparing Superfund Decision Documents* (EPA, 1989). The ROD serves to certify that the remedy selection process was carried out in accordance with CERCLA and the NCP. It describes the technical components of the remedy; the treatment, engineering, and institutional components to be implemented; and the remediation goals. The ROD also provides a consolidated source of information about the site and the selected remedy. If public comments result in changes to the remedy, then the changes should be clearly documented in the section of the ROD that describes significant changes from the PRAP. If a fundamental change to the remedy is made between the PRAP and ROD, then an amended PRAP should be issued, and a new public comment period must be opened.

Once the public comment period is closed and all significant comments and issues are addressed and no fundamental changes need to be made to the remedy, then the ROD is signed. After the ROD is signed, the remedial design (RD) stage is initiated to develop the actual design of the selected remedy, and the remedial action (RA) stage constructs the remedy.

2.5.4 Remedial Design/Remedial Action

A RD/RA will be conducted as directed in the ROD or other decision document for the site. The RD/RA includes the actual design and implementation of the selected remedy. In addition, certain remedial actions require a period of operation and maintenance (O&M) to achieve remediation goals and objectives. All RD/RA activities will be conducted in accordance with the NCP (40 CFR 300.435).

The RD will consist of an evaluation of site conditions versus the selected remedial action. It includes preparation of the necessary design documents including specifications, drawings, cost estimates, and schedules. In addition, the necessary planning documents (e.g., quality assurance/quality control [QA/QC] plan, health and safety plan, sampling and analysis plan, erosion and sedimentation control plan, stormwater management plan, etc.) will be prepared as part of the RD (or RA, depending on the specific scope of work). The design will be prepared in accordance with all applicable Federal, Minnesota, and local codes, requirements, and guidance, including SOUTHDIV architect-engineer guidance (SOUTHNAVFACENGCOM, 1997). The design will focus on issues such as specific site contaminants and material compatibility, the effects of site conditions on equipment and material selection, and attainment of site remediation goals within expected time frames. Additional site visits or investigations may be needed to review current site conditions and/or collect additional data.

The RA will consist of implementation of the design through construction of the selected remedy. Typically, the RA will require collection of field samples for verification or confirmation that cleanup goals have been achieved. Following construction of the RA, a period of O&M (including monitoring, sampling, maintenance) would be needed unless all contaminants are removed or treated to attain concentrations that protect human health and the environment. Confirmatory sampling and analysis may be required to confirm that site contaminants are no longer present above acceptable concentrations and to initiate site closure activities. Five-year site reviews must also be conducted following implementation of the RA if hazardous substances remain on site above risk-based levels.

2.6 DELETION FROM NATIONAL PRIORITIES LIST

EPA may delete a site from the National Priorities List (NPL) if it determines that no further response is required to protect human health or the environment. According to the NCP, a site may be deleted where no further response is appropriate if EPA, in conjunction with the State, has determined that responsible or other parties have implemented all appropriate response action required. Since 1986, EPA has used the following procedures for deleting a site from the NPL:

- The EPA Regional Administrator approves a "close-out report" that establishes that all appropriate response actions have been taken or that no action is required.

- The EPA Regional Office obtains State concurrence.

- EPA publishes a notice of intent to delete in the *Federal Register* and in a major newspaper near the community involved. A public comment period is provided.

- EPA responds to the comments and, if the site continues to warrant deletion, publishes a deletion notice in the *Federal Register.*

Sites that have been deleted from the NPL remain eligible for further remedial action in the unlikely event that conditions in the future warrant such action.

2.7 DELETION FROM PERMANENT LIST OF PRIORITIES

The MPCA permanent list of priorities is the state equivalent of the NPL. Requirements for deletion of sites from this list are contained in Minnesota Rule 7044.0950.

The MPCA shall delete a site from the permanent list of priorities at the next update if:

- All response actions, including operation and maintenance, required at the site have been completed or

- The MPCA determines that a site no longer poses a threat to public health or welfare, or the environment, from a release, or a threatened release, of a hazardous substance or pollutant or contaminant.

2.8 PROPERTY TRANSFER

Minnesota and EPA both have requirements and procedures for selling or transferring ownership of contaminated properties.

Minnesota Statute 115.B16, contained in the Environmental Response and Liability Act, contains requirements for disposition of facilities. No person shall use any property on or in which hazardous waste remains after closure in any way that disturbs the integrity of the final cover, liners, or any other components of any containment system, or the function of the monitoring system. Before any transfer of ownership of any property which is subject to extensive contamination by release of a hazardous substance, the owner shall record with the county recorder an affidavit containing a legal description of the property. An owner must also file an affidavit within 60 days after any material change in any matter required to be disclosed with respect to property for which an affidavit has already been recorded. The affidavit must disclose the following to any potential transferee:

- That the land has been used to dispose of hazardous waste or that the land is contaminated by a release of a hazardous substance.

- The identity, quantity, location, condition, and circumstances of the disposal or contamination to the full extent known or reasonable ascertainable.

- That the use of the property or some portion of it may be restricted as provided above.

Federal regulations (40 CFR 373.1) and CERCLA Section 120(h)(1) require notice whenever contaminated Federal property is sold or transferred. In the case of real property on which any hazardous substance was known to have been stored for one year or more, released, or disposed of, each deed entered into for the transfer of such property shall contain:

- A notice of the type and quantity of such hazardous substances.

- A notice of the time in which such storage, release, or disposal took place.

- A description of the remedial actions taken, if any.

- A covenant warning that all remedial action necessary to protect human health and the environment with respect to such substance remaining on the property has been taken before the date or such transfer, and any additional remedial action found to be necessary after the date of such transfer shall be conducted by the United States (unless to property is being transferred to a potentially responsible party).

The covenant may be deferred if EPA, with the concurrence of the Governor of Minnesota, determines that the property is suitable for transfer as long as the deed or other agreement proposed to govern the transfer contains assurances that:

- Provide for any necessary restrictions on the use of the property to ensure the protection of human health and the environment.

- Provide that there will be restrictions on use necessary to ensure that required remedial investigations, response action, and oversight activities will not be disrupted.

- Provide that all necessary response action will be taken and identify the schedules for investigation and completion of necessary response action.

The Navy had previously planned to sell the site, and a Covenant Deferral Request (CDR) was prepared in 1998. The CDR includes all Federal requirements, including those cited above, for property transfer.

APPENDIX D

FIELD FORMS

DOCUMENTATION OF FIELD CALIBRATION

PROJECT NAME : ______________________ PROJECT NUMBER : __________

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
				Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: ____________________
Project No.: ____________________

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: ____________________
[] QA Sample Type: ____________________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method:	Initial							
Monitor Reading (ppm):	1							
Well Casing Diameter & Material	2							
Type:	3							
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc. **GROUNDWATER LEVEL MEASUREMENT SHEET**

Project: ______________________ Project No.: ______________
Location: ______________________ Personnel: ______________
Weather: ______________________ Measuring Device: ______________
Date: ______________________ Remarks: ______________

Well Number	Time	(A) Elevation of Reference Point (feet)*	(B) Water Level Indicator Reading (feet)*	=(A)-(B) Groundwater Elevation (feet)*	Total Well Depth (feet)*	Comments

Notes: ____

*All measurements to the nearest 0.01 foot

Page ____ of ____

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER | PAGE ____ OF ______

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER	CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)

PRESERVATIVE USED

TYPE OF ANALYSIS

DATE YEAR	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS									COMMENTS

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUT. WHITE (ACCOMPANIES SAMPLE) YELLOW (FIE ϽPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001