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Remedial Investigation
for
Operable Unit 3

Naval Industrial Reserve Ordnance Plant
Fridley, Minnesota

VOLUME I OF IV
TEXT

Southern Division
Naval Facilities Engineering Command
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REMEDIAL INVESTIGATION
FOR
OPERABLE UNIT 3

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
Pittsburgh, Pennsylvania 15220

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PREPARED UNDER THE SUPERVISION OF:

MARK SLADIC, P.E.
TASK ORDER MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

DEBBIE WROBLEWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

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EXECUTIVE SUMMARY

This Remedial Investigation (RI) Report was prepared for the Naval Industrial Reserve Ordnance Plant in Fridley, Minnesota (NIROP Fridley) through the U.S. Navy (Navy) Southern Division Naval Facilities Engineering Command (NAVFAC) under Contract Task Order (CTO) 0002, for the Comprehensive Long-term Environmental Action Navy (CLEAN III), Contract Number N62467-94-D-0888. The overall goal of the environmental investigative work for OU3 at NIROP Fridley is to efficiently characterize environmental contamination to determine whether there is a risk to human health and the environment and therefore to (1) to identify all sources of contamination; (2) to identify the extent and magnitude of soil, subsoil, surface water, and groundwater contamination; (3) to gather all necessary data to support the Feasibility Study and Risk Assessment, and (4) to provide information and data needed for the selection and implementation of response actions at the Site.

This RI for Operable Unit 3 (OU3) is the third RI for the facility. The RIs for OU1 (groundwater) and OU2 (surface and subsurface soil outside of the outline of the building) were performed earlier. The decision to combine remedy selection and investigate the saturates zone beneath the building was made by the NIROP Partnering Team.

The following narratives give a brief synopsis of the site based on the results of this investigation. Included in the synopsis are a summary of the field investigations, sampling, and analysis; baseline human health risk assessment, OU2 RI conclusions, and initial screening of possible alternative response actions.

Although formal Data Quality Objectives (DQOs) were not used in design of the sampling program, the investigation produced adequate information to evaluate the decision rules identified herein.

NIROP FRIDLEY BASE-WIDE SUMMARY

The NIROP facility (site) is located in the Township of Fridley, in the southern-most tip of Anoka County, Minnesota. The site is currently active and consists of 82.6 acres of government-owned land, of which approximately 50 acres are paved or covered with buildings. The plant is bordered on the east by the Burlington Northern rail yard, on the north by various industrial facilities, on the south by United Defense, LP (UDLP), and on the west by East River Road and the Mississippi River. Located between East River Road, a four-lane highway, and the Mississippi River (west of the site) is the "Anoka County Regional Riverfront Park." The park is a day-use recreational facility on the river's edge, consisting of approximately 60 acres (RMT, June 1987).

GEOLOGY

The OU-3 remedial investigation field event focused on the unconsolidated overburden (Quaternary deposits) within the boundaries of the NIROP Plant. The unconsolidated overburden exists from the ground surface down to the top of the Ordovician age bedrock. The overburden ranges from 98.6 to 136.7 feet thick in the vicinity of the NIROP facility. Generally, from ground surface to approximately 45 to 50 feet below ground surface (bgs), the subsurface material is predominantly medium to coarse sand and fine sand with very few discontinuous clay layers. The thickness of the these discontinuous clay layers in this interval range from 1 to 17 feet. Below an approximate depth of 50 feet bgs to the top of bedrock (i.e., 98.6 to 136.7 feet bgs), the presence and thickness of the very fine grained material increases significantly in the central, west, and southwest portions of the site whereas in the north, east, and southeast portions of the site this material is very thin or is nonexistent. The thickness of the very fine grained material layers within this interval in the central, west, and southwest portions of the site range from 1 to 45 feet whereas in the north, east, and southeast the thickness ranges from 1 to 4 feet. The St. Peter Sandstone is present as the surficial bedrock in all areas of the site with the exception of the south-central portion of the site where the Shakopee Dolomite (Prairie du Chien Group) is present. Within the project area the St. Peter Sandstone ranges in thickness from 17 to 62.4 feet. The top of the St. Peter Sandstone is typically moderately to highly weathered.

HYDROGEOLOGY

The hydrogeology within the vicinity of the NIROP facility is consistent with the regional hydrogeology where four aquifers (or aquifer zones) govern groundwater movement through the subsurface. These aquifers are (from shallow to deep) the shallow Quaternary aquifer zone, the Prairie du Chien/Jordan aquifer (PCJ), the Franconia/Ironton/Galesville (FIG) aquifer, and the Mount Simon/Hinckley/Fond du Lac (MHF) aquifer. The RI was concerned with the hydrogeology of the Quaternary aquifer zone.

The Quaternary aquifer as defined by the University of Minnesota (1979) is referred to here as an aquifer zone because it consists of two poorly defined aquifers. Each of these two aquifers, namely the shallow unconfined aquifer which overlies a locally deep confined (or semi-confined) aquifer, vary significantly in thickness and hydraulic connection throughout the site. The shallow unconfined aquifer ranges in thickness between 41 and 93 feet, and the deeper confined (or semi-confined) aquifer ranges in thickness between 19 and 55 feet. The unconfined aquifer has been defined by the installation of shallow wells (S) in the upper portion of the unconfined aquifer and intermediate wells (I) installed in the lower portion of the unconfined aquifer; the deep confined (or semi-confined) aquifer has been defined by deep wells (D). The

two aquifer zones are separated by material having a low permeability (often referred to as an aquitard or confining unit), which varies significantly in thickness and horizontal extent.

The horizontal groundwater flow direction across the facility in the Quaternary aquifer zone is generally toward the south and southwest and discharges into the Mississippi River (OU3 Work Plan, Brown & Root Environmental, 1997). The natural groundwater flow direction at the site is altered significantly by the remedial wells actively pumping in both aquifers. As expected, due to the cones of depression created by these actively pumping remedial wells, the horizontal hydraulic gradient is greater in the south and southwest portions of the site than in the north and northeast where few pumping wells are active. The horizontal hydraulic gradient was one order of magnitude greater in the south and southwest than in the north and northeast portions of the site for both the shallow unconfined and the deep confined aquifers. An average of the gradients for the entire site was 0.00503 and 0.00689 for the shallow unconfined and the deep confined aquifers, respectively. As expected, wells located in the north and northeast portion of the site had an upward hydraulic gradient (or upward potential groundwater flow) which ranged from 0.0022 to 0.0096. However, in well clusters in the south and southwest portion of the site, which are directly affected by the remedial extraction wells, a downward hydraulic gradient is present that ranged from 0.0007 to 0.0676.

SUMMARY OF FIELD INVESTIGATIONS

Surface and subsurface RI activities took place from June 25, 1997 through March 25, 1998. The RI field event was divided into two phases, Phase I and Phase II, based on the sample collection techniques.

Phase I involved the collection of surface and subsurface soil samples and shallow groundwater samples. Phase I activities took place from June 25, 1997 through October 3, 1997. The soil sampling in Phase I was performed to (1) identify COPCs; (2) determine the concentration and general location of the COPCs; (3) evaluate the potential human health risk; (4) quantify the potential for migration of the COPC to groundwater; and (5) identify conditions that are indicative of the presence of free-product source areas. To achieve this task, a total of 48 soil borings was installed using direct-push techniques (DPT). Each of these borings were then converted to temporary groundwater monitoring wells. Background soil samples were also collected during this investigation phase. Background samples were collected at 10 locations using a stainless steel hand auger to supplement background samples collected during the OU2 RI.

Phase II involved the collection of additional geologic data and installation of permanent monitoring wells using the Rotosonic drilling methodology, collection of groundwater samples from these newly installed monitoring wells, aquifer testing, and groundwater level measurements. Phase II activities took place from

October 3, 1997 through March 25, 1998. Six new permanent monitoring well clusters were installed. Each well cluster consisted of three permanent monitoring wells: one shallow well screened in the upper portion of the unconfined aquifer, one intermediate well screened in the lower portion of the unconfined aquifer, and one deep well screened in the upper confined aquifer (totaling 18 wells).

Field activities were conducted during construction activities at the East Plating Shop during April 1995. At that time the East Plating Shop was being renovated, allowing access to this area for environmental sampling. The East Plating Shop Soil and Groundwater Investigation included the installation of seven borings and three temporary wells.

NATURE AND EXTENT OF CONTAMINATION

Prior to establishing the extent of contamination, an evaluation was performed to determine whether there is any likelihood of significant data gaps or false negatives in the soils and groundwater analytical results. The evaluation consisted of comparing detection limits for organic and inorganic substances to MPCA State Reference Values (SRVs) for soil and MPCA Health Risk Limits (HRLs) and Health Risk Values (HRVs) for groundwater. Additionally the detection limits were also compared to EPA MCLs for groundwater. In most circumstances, when the detection limits exceeds the established regulatory values, it is a result of analysis protocol that requires sample dilution in order to obtain usable data. In other cases, the regulatory values are risk based numbers and the required analytical method can not achieve these values. The results of the evaluation indicate it is not likely that there are significant data gaps resulting from elevated detection limits.

The following items summarize the nature and extent of contamination at NIROP Fridley:

- Among the seven categories of AOCs developed in the work plan, no AOC group is more likely than another to be responsible for releases in OU3 soils. Some COCs that contribute to significant risk are associated with a small subset of AOCs although the AOC groups do not show an increased potential for contamination, only about 20 of the 71 AOCs fit neatly into groups.

- Several VOCs (primarily chlorinated hydrocarbons, aromatic compounds, and ketones) were detected in surface (0 to 4 feet bgs), shallow subsurface (4 to 12 feet bgs), and deep subsurface (>12 feet bgs) soil samples. Relative detection frequencies for VOCs were similar among surface, shallow subsurface, and deep subsurface soil samples. However, no consistent pattern of concentrations was evident among the three categories of soil samples. Concentrations of 1,1-dichloroethane and carbon disulfide were at the same order of magnitude for all three categories of soil samples. The maximum concentration of 1,1,1-trichloroethane was detected in a surface soil sample. Maximum

concentrations of 1,2-dichloroethene (total), ethylbenzene, toluene, and xylenes were detected in shallow subsurface soil samples. Maximum concentrations of styrene, tetrachloroethene, and TCE were detected in deep subsurface soil samples. Maximum concentrations of TCE and tetrachloroethene in all three categories of soil samples were detected in samples collected from the East Plating Shop, indicating the possible presence of a "hot spot" of TCE and tetrachloroethene in this area. COCs do not seem to indicate wide spread contamination that exceeds risk based thresholds.

- Several SVOCs, primarily PAHs, were sporadically detected in surface and shallow subsurface soil samples. With few exceptions, concentrations and detection frequencies of SVOCs in surface soil samples exceeded those reported for shallow subsurface soil samples. Concentrations of PAHs in shallow subsurface soil samples ranged from 11 µg/kg to 2,300 µg/kg, while concentrations of PAHs in surface soil samples ranged from 10 µg/kg to 5,600 µg/kg. AOC 17 showed disproportionate responsibility for total site PAH contamination.

- Aroclor-1016 and Aroclor-1254 were detected in one and two, surface soil samples respectively, at concentrations ranging from 150 µg/kg to 290 µg/kg. No other PCBs were detected in any of the soil samples.

- All 22 TAL metals and cyanide were detected in surface soil samples, and cyanide and all but two TAL metals were detected in the shallow subsurface soil samples. Concentrations and detection frequencies of metals detected in surface and shallow subsurface samples were very similar. A majority of the metals were frequently detected (i.e., in greater than 90 percent of the samples). Concentrations of most metals and cyanide exceeded background concentrations in one or more soil samples. Of the deep subsurface soil samples, only the seven samples collected from the East Plating Shop were analyzed for metals and cyanide. Seventeen metals and cyanide were detected in the deep soil samples, with concentrations of 13 of these metals and cyanide exceeding background.

- The maximum concentrations of all detected chemicals in soil (0-to 12-feet in depth) were less than the MPCA SRVs for industrial exposures with the exception of lead in one surface soil sample and chromium in one subsurface soil sample. Estimated cumulative excess risks slightly exceed MPCA target risk levels.

- Based upon the field screening tests and analytical results it is unlikely that NAPLs are present in any of the subsurface soil sample locations. Although DNAPL was not identified in soils, based on

groundwater contaminant concentrations, it is apparent that DNAPLs are likely somewhere under the building.

- Chlorinated hydrocarbons were the primary chemicals detected in groundwater samples. TCE was detected most frequently and at the greatest concentrations in shallow, intermediate, and deep groundwater samples. Concentrations of TCE in groundwater samples ranged from 0.6 µg/L to 140,000 µg/L. The maximum concentration of TCE was detected in a shallow groundwater sample collected from monitoring well GW-01, located in the East Plating Shop. Review of the data collected from the six shallow, six intermediate, and six deep permanent wells, however, indicates that the greatest VOC concentrations are generally associated with the intermediate wells.

- Concentrations of TCE in shallow and intermediate groundwater samples and 1,2-dichloroethene in shallow groundwater samples from wells located in the former East Plating Shop exceeded 1 percent of their solubility limits indicating that potential DNAPL is present in the local vicinity of these wells.

Per the approved Work Plan, some site soil sampling locations were purposely located where impacts from releases from the sanitary or storm sewers could be observed, if present. There were no significant findings at these locations. Further, the sewer construction is reported to be vitrified clay pipe, which is usually expected to leak at joints. Running a camera through the larger diameter NIROP sewers has been proposed, but based on acceptance of the fact that these sewers typically leaked whether damaged or not, this exercise has not been completed because there is not much agreement about the value of the information that would be gained. Currently, no further action is planned regarding the plant sewers.

EVALUATION OF AOC GROUPS

The Field Sampling Plan (FSP) identified NIROP AOCs that could be effectively grouped into seven specific groups. There would remain several categorized as 'miscellaneous', and also those placed 'randomly' to promote more complete coverage of the plan area, but with these exceptions, the seven groups represented are the following. See Table 2-1 in the FSP for additional information on the grouping.

- (Group 1): 1,1,1-TCA/TCE storage, including AOCs 3, 4, 6, 7, and 14.
- (Group 2): Degreasing, including AOCs 8, 16, 18, 23, 39, 47, 58, and 74, plus supplemental points PO4 and PO8.
- (Group 3): heat treat, including AOC 46.
- (Group 4): Machining, including AOC 30 and70.
- (Group 5): Painting, including AOC 35 and 36.

- (Group 6): PEPSET storage tank, including AOC 63.
- (Group 7): Plating, including AOC 50 and supplemental point P11.

The following conclusions resulted from the evaluation of AOC groups:

- The selected AOCs for each group do adequately characterize each AOC group.
- The AOC groups do adequately characterize the various plant processes.
- The AOC grouping supports the assumption that the major source are for TCE under the main NIROP building is in or in the vicinity of the East and West Plating rooms.
- The miscellaneous AOCs grouping remains an assortment of processes around the NIROP which are not easily associated with other AOC groups.

Soil

This evaluation was completed by collecting the soil analytical results for the sampling parameters for each group identified. The soils sampling parameters were detailed in the FSP, and correspond to the 'anticipated contaminants' for each AOC - also described in the FSP. It was anticipated that a statistical exercise would then be completed for the groups, for example to compare each group's maximum concentrations and mean concentrations for a contaminant against the facility norms. This would satisfy the intended goal of identifying groups that were more likely to indicate a release to soils, to a maximum depth of twelve feet. As the data was assembled, it became apparent that the statistical exercise would not be necessary because of the generally low level of contaminants identified. The soil analytical results for each AOC group are summarized in Table ES-1 and discussed below.

GROUP 1: For Group 1, 1,1,1-TCA/TCE storage, consisting of five sampled AOCs, no chlorinated solvents or breakdown products were detected in the surrounding soils. However, xylenes and toluene were each detected at concentrations of 1 to 2 µg/kg in six of ten samples. This analysis concludes that soils in the vicinity of Group 1 AOCs do not indicate significant releases.

GROUP 2: Ten Group 2 AOCs were sampled. The maximum concentration of any VOC detected in this group was at AOC 58, where a duplicate sample was also collected. The analytical results for TCE in zero to four feet of soil at this location was 490 and 120 µg/kg. The measured concentrations of 1,1,1-TCA (the only other chlorinated solvent concentration greater than 10 µg/kg) was 56 and 21 µg/kg. At the next

depth interval, from four to eight feet, the TCE concentration was only 3 µg/kg, and no 1,1,1-TCA was detected. At AOC 16, TCE was detected at 12 µg/kg at zero to four feet, and was not detected in deeper soils. For all ten locations, no other chlorinated solvents or breakdown products in excess of 4 µg/kg were detected. However, at AOC 39, toluene was detected at 0 to 4 feet at 14 µg/kg, and at 8 to 12 feet at 19 µg/kg. Xylenes were detected in the same two intervals at concentrations of 7 and 10 µg/kg, respectively. No other BTEX parameters were detected in any other Group 2 AOCs at concentrations above 1 µg/kg. This analysis concludes that soils in the vicinity of Group 2 AOCs do not indicate significant releases.

GROUP 3: Only one Group 3 AOC was sampled. No PCBs were detected at AOC 46, and no metals concentrations were out of the normal range (for cadmium, chromium [III and VI], lead and zinc). There is no evidence of release at AOC 46.

GROUP 4: Two Group 4 AOCs were sampled. Toluene, xylenes, and TCE were detected at concentrations from 1 to 7 µg/kg in zero to four foot depth soils. None of these contaminants were detected in deeper soils, except for toluene at 1 µg/kg at 8 to 12 feet at AOC 30.

Aroclor 1016 was detected at 150 µg/kg at zero to four feet at AOC 30, and was not analyzed in deeper samples. No PCBs were detected at AOC 70. The PCB contamination at AOC 30 is significant, but because no PCBs were detected at AOC 70, and because no significant VOC releases were identified, Group 4 AOCs do not appear to have greater likelihood of releases than other AOCs.

GROUP 5: Two Group 5 AOCs were sampled. With the exception of TCE detected at 36 µg/kg at four to eight feet at AOC 35, all other chlorinated solvent or breakdown product concentrations were 3µg/kg or less. Additionally, metals concentrations appear elevated at 84 µg/kg for trivalent chrome, 6 µg/kg for hexavalent chrome, 150 µg/kg for lead, and 479 µg/kg for zinc. The chrome concentrations are about the same at AOC 36, while the lead and zinc concentrations are 70% less at AOC 36. The VOC concentrations do not appear to signify that these concentrations will be uniformly higher at Group 5 AOC, however, the metals concentrations for both Group 5 AOCs are elevated and could indicate that metals concentrations may be elevated at painting process AOCs. At AOC 35, the trivalent chrome concentration was 84 µg/kg; hexavalent chromium - 6 µg/kg; lead - 15 µg/kg; and zinc - 479 µg/kg.

GROUP 6: Only one Group 6 AOC was sampled. Tetrachloroethene was detected at 18 µg/kg in zero to four feet of soil, but was not detected in deeper soils. TCE was detected at 4 µg/kg, but was also not detected in deeper soil. Xylenes and toluene were detected at 1 µg/kg. There is no evidence of large releases from AOC 63.

GROUP 7: Toluene was detected at 12 µg/kg in duplicate samples at AOC 50 at zero to four feet. None was detected in soil samples at four to eight feet. No other chlorinated solvents were detected in any soil sample from either of the two AOCs sampled. All metals concentrations were within normal ranges. The Group 7 AOCs results do not indicate that significant releases are more likely from Group 7 AOCs than other AOCs.

In summary, the evaluation does not indicate that any AOC group is more likely than another to be responsible for releases in OU3 soils, with the exception of possibly elevated metals concentrations in the vicinity of the only two painting process AOCs which were sampled.

Groundwater

This evaluation was completed by collecting the unfiltered groundwater analytical results for the sampling parameters for each group identified. The groundwater sampling parameters were detailed in the FSP, and correspond to the 'anticipated contaminants' for each AOC – also described in the FSP. It was anticipated that a statistical exercise would then be completed for the groups, for example to compare each group's maximum concentrations for a contaminant against the normal concentrations found at the facility. This would satisfy the intended goal of identifying groups that were more likely to indicate a release to groundwater. This evaluation was completed in addition to, and parallel with, the soil evaluation to provide additional information and to provide a complete analysis of the media in the immediate vicinity of the AOCs.

GROUP 1: This group consists of five sampled AOCs. The maximum VOC concentration for this group was detected at AOC13/AOC14. The analytical result for TCE at this location was 1200 µg/L. The detected concentrations of TCE at the four other AOCs in this group ranged from 15 µg/L to 200 µg/L. 1,1,1-TCA was not detected at any of the locations in this group. The result of this analysis concludes that the groundwater in the vicinity of the Group 1 AOCs does not show evidence of a greater potential for release than the other groups.

GROUP 2: This group consists of eight sampled AOCs and two sampled supplemental points. TCE was detected in 10 of 11 samples (a duplicate sample was taken at AOC 47 with consistent results). The detected concentrations ranged from 8.9 µg/L to 1000 µg/L with the maximum concentration detected at AOC 16. 1,1,1-TCA was detected in 5 of 11 samples with a maximum concentration of 11 µg/L detected at AOC 58. BTEX parameters were detected at one location (P04) at concentrations of 34, 820, and 750 µg/L for Toluene, Ethylbenzene, and Xylene respectively. The result of this analysis concludes that

the groundwater in the vicinity of Group 2 AOCs and supplemental points do not show evidence of significant release.

GROUP 3: This group consists of one sampled AOC, AOC 46. No parameters were detected at elevated levels. There is no evidence of release at AOC 46.

GROUP 4: This group consists of two sampled AOCs, AOC 30 and AOC 70. No BTEX parameters were detected in any of the Group 4 samples. TCE was detected in both samples at concentrations of 3.8 µg/L and 860 µg/L at AOC 30 and AOC 70 respectively. No other chlorinated solvents or breakdown products were detected at elevated levels in this group. The result of this analysis concludes that the groundwater in the vicinity of Group 4 AOCs and supplemental points do not show evidence of significant release.

GROUP 5: This group consists of two sampled AOCs, AOC 35 and AOC 36. TCE was detected in 1 of 2 samples at a concentration of 20 µg/L at AOC 35. No other chlorinated solvents or breakdown products were detected at these AOCs. No BTEX parameters were detected in this group. Several metals, such as aluminum, chromium, cobalt, and lead, were detected at levels that are above the normal facility concentrations at AOC 36 but were detected at, or below, normal facility concentrations at AOC 35. Aluminum was detected in both samples at concentrations of 147 µg/L and 6110 µg/L at AOC 35 and AOC 36, respectively. The concentration detected at AOC 36 is above the normal facility concentrations and may represent a possible significant release. However, the concentration detected at AOC 35 is consistent, and slightly below, the detected concentrations at other AOCs. The result of this analysis concludes that Group 5 AOCs do not have a greater potential for release than the other groups.

GROUP 6: This group consists of one sampled AOC, AOC 63. No significant concentrations of BTEX or chlorinated solvents were detected at AOC 63. Only 1,1,1-TCA and TCE were detected, each at 0.6 µg/L. There is no evidence of significant release at AOC 63.

GROUP 7: This group consists of one sampled AOC, AOC 50, and one sampled supplemental point, P11. All metals concentrations were found to be within the normal ranges for the facility. TCE was detected at AOC 50 along with it's breakdown product, cis-1,2-DCE, at concentrations of 110 µg/L and 230 µg/L, respectively. These parameters were also detected at the sampled supplemental point, P11, at concentrations of 930 µg/L (TCE) and 56 µg/L (cis-1,2-DCE). These concentrations are consistent with the concentrations found in the other groups and, therefore, Group 7 does not appear to have a greater potential for release than the other groups.

In summary, the evaluation doesn't indicate that any AOC group is more likely to be responsible for releases to groundwater. Note that due to relatively shallow groundwater, and certain obstacles to placement of temporary wells in all locations, it is not surprising that groundwater contamination has migrated, masking it's point of origin.

HUMAN HEALTH RISK ASSESSMENT

Chemicals of potential concern evaluated in the risk assessment are presented in Table ES-2 for soil and Table ES-3 for groundwater.

OU3 Soil Risk Assessment:

The human health risk assessment considered exposures to industrial workers, major-infrequent construction workers, and minor-frequent construction workers. Potential exposure pathways for all receptors included incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive and volatile compounds. Cancer risks and hazard indices were estimated following MPCA methodology. The following bullets and Table ES-4 summarize the results of the human health risk assessment for soil:

- *Potential Risks to Industrial Workers* – The potential health risks for the industrial worker were estimated by comparing surface soil (0 – 4 feet) concentrations to the MPCA Soil Reference Values (SRVs). A site-wide upper 95 percentile confidence limit of the mean was used as the exposure point concentration. An incremental Excess Lifetime Cancer Risk (ELCR) of 0.35×10^{-5} was calculated for industrial workers. The calculated ELCR is below both the U.S. Environmental Protection Agency's (U.S. EPA) acceptable ELCR range of 1×10^{-4} to 1×10^{-6} and MPCA's acceptable chronic ELCR of 1×10^{-5}.

  The noncancer endpoint specific hazard indices (HI) ranged from 0.001 to 0.053. The noncancer chemical specific hazard quotients (HQ) ranged from <0.001 to 0.027. The calculated endpoint specific HI were below both the U.S. EPA and MPCA acceptable HI of 1 and the chemical specific HQs were below the MPCA acceptable HQ of 0.2.

  Since it is not known if deeper soils will be excavated at a later date, a screening risk evaluation utilizing the maximum detected concentration in soil within the top 12 feet was conducted. The screening HI (i.e., chemical specific HQs summed regardless of target endpoint) was below the acceptable level of 1, but the chemical specific HQ for chromium exceeded the acceptable HQ of 0.2. The calculated ELCR, 2×10^{-5}, was within U.S. EPA's acceptable ELCR range of 1×10^{-4} to 1×10^{-6}

but exceeded the MPCA acceptable ELCR is 1×10^{-5}. Carcinogenic PAHs (cPAHs) (0.8×10^{-5}), arsenic (0.6×10^{-5}) and hexavalent chromium (0.4×10^{-5}) were the major contributors to the ELCR. It should be noted that the maximum detected concentrations for these three contaminants occurred in different locations (different horizontally and vertically); arsenic concentrations exceeded background concentrations in only two percent of the 0 – 12 feet soil samples; and the chromium present was assumed to be in the more toxic hexavalent form.

- *Potential Risks to Major-Infrequent Construction Worker* – The potential health risks for the major-infrequent construction worker were estimated using Excel spreadsheets supplied by the MPCA staff. The maximum detected concentration in soil within the top 12 feet, regardless of spatial location, was utilized as the exposure point concentration. An incremental excess lifetime cancer risk (ELCR) of 2.1×10^{-6} was calculated. The calculated ELCR is within the U.S. EPA's acceptable ELCR range is 1×10^{-4} to 1×10^{-6} and but exceeds the MPCA's acceptable subchronic ELCR of 1×10^{-6}. The major contributors to the ELCR were cPAHs (0.7×10^{-6}), arsenic (0.5×10^{-6}), and hexavalent chromium (0.9×10^{-6}).

  The calculated noncancer screening HI (summed regardless of target endpoint) was 2.9, which exceeded both the EPA and MPCA acceptable HI of 1. The major contributors to the cumulative HI were hexavalent chromium (1.35), arsenic (0.3), copper (0.2) and mercury (0.46). The cumulative HI was estimated by adding all chemical specific HQs together regardless of target endpoint. The target endpoint specific HIs do not exceed 1. The noncancer chemical specific hazard quotients (HQ) ranged from <0.001 to 1.35. Only hexavalent chromium produced a HQ which exceeded the MPCA acceptable subchronic HQ of 1.

  It should be noted that the maximum detected concentrations for the major contributing contaminants occurred in different locations (different horizontally and vertically), arsenic concentrations exceeded background concentrations in only two percent of the 0 – 12 feet soil samples, and chromium was assumed to be in the more toxic hexavalent form.

- *Potential Risks to the Minor-Frequent Construction Workers* – The Potential health risks for the minor-frequent construction worker were estimated using Excel spreadsheets supplied by the MPCA staff. A site-wide upper 95 percentile confidence limit of the mean concentration within the top four feet of soil was used as the exposure point concentration. An incremental ELCR of 0.36×10^{-5} was calculated. The calculated ELCR is below the U.S. EPA's acceptable ELCR range of 1×10^{-4} to 1×10^{-6} and the MPCA acceptable chronic ELCR of 1×10^{-5}. The calculated screening noncancer HI (i.e., summed regardless of target endpoint) was 0.045. The calculated noncancer chemical specific HQ ranged

from <0.001 to 0.016. The calculated HI was below both the U.S. EPA and MPCA acceptable HI of 1 and the chemical specific HQs were below the MPCA acceptable HQ of 0.2.

Since it is not known if deeper soil will be excavated at a later date, a screening risk evaluation (i.e., methodology is intended to overestimated the potential risk) utilizing the maximum detected concentration in soil within the top 12 feet was conducted. The screening HI (0.646) and the chemical specific HQs (<0.001 to 0.37) were below the acceptable HI and HQ values with the exception of hexavalent chromium. The calculated ELCR, 1.8×10^{-5}, was within U.S. EPA's acceptable ELCR range of 1×10^{-4} to 1×10^{-6} but exceeded the MPCA acceptable ELCR is 1×10^{-5}. Carcinogenic PAHs (cPAHs) (1×10^{-5}), arsenic (0.6×10^{-5}) and hexavalent chromium (0.2×10^{-5}) were the major contributors to the ELCR. It should be noted that the maximum detected concentrations for these three contaminants occurred in different locations (different horizontally and vertically). Arsenic concentrations exceeded background concentrations in only two percent of the 0 – 12 feet soil samples and the chromium present was assumed to be in the more toxic hexavalent form.

Conclusion for Soil:

Based on the results of the human health risk assessment no Contaminant of Potential Concerns (COPCs) were retained as Contaminant of Concerns (COCs) in surface soil. In the absence of chemical speciation information, chromium was retained as a COC in 0 – 12 foot subsurface soil in the Former East Plating Shop area.

The risk evaluation for the industrial worker indicates that under the industrial land use scenario, there is not a need for controls to limit exposure of workers to surface soil (0 – 4 feet). The risk evaluations for the activities that involved contact with soils beyond four feet suggest that the need for exposure controls should be evaluated. The need for institutional controls (e.g., zoning restrictions, deed notifications) to ensure that future property uses or activities that may result in higher exposures or exposures to different receptors not occur without proper oversight should also be evaluated.

The human health risk assessment addressed potential direct contact with contaminated soil within the top 12 feet. No potential exposures were identified for soil at depths beyond 12 feet, therefore no risks were calculated for potential exposures to soil greater then 12 feet bgs. Concentrations of all chemicals in soil samples collected at depths beyond 12 feet were less than MPCA SRVs for industrial exposures with the exception of TCE in one soil sample (SB-07, 12 to 16 feet) collected at the former East Plating Shop. The boring logs suggest that this sample was collected from within the saturated zone, consequently this sample may be more representative of groundwater contamination than soil contamination.

OU-3 Ground Water Risk Assessment:

On-site ground water is not currently used as a potable water supply at NIROP Fridley. It may not be used in the future because a public water supply is available. Contaminated on-site ground water is a potential source of contamination for surface water in the Mississippi River. A screening evaluation of groundwater was performed following methodology and the Excel spreadsheet (DW1097.xls) supplied by MPCA staff. The following bullets summarize the results of the groundwater screening evaluation:

- *Upper Portion of the Unconfined Aquifer* – TCE, tetrachloroethene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, dichloromethane, 4-methylphenol, ethylbenzene, 1,1,1-trichloroethane, vinyl chloride, aluminum, beryllium, chromium, cobalt, cyanide, manganese, iron, selenium, thallium, and vanadium were present at concentrations exceeding screening levels and therefore were retained as COCs for the upper portion of the unconfined aquifer (see Table ES-5).

- *Lower Portion of the Unconfined Aquifer* – TCE, 1,1-dichloroethene, cis-1, 2-dichloroethene, vinyl chloride, aluminum, manganese, and iron were present at concentrations exceeding screening levels and therefore were retained as COCs for the lower portion of the unconfined aquifer (see Table ES-5).

- *Deep Aquifer* – Tetrachloroethene, TCE, and iron were present at concentrations exceeding screening levels and therefore were retained as COCs for the deep aquifer (see Table ES-5). Vinyl chloride will be retained as a COC for groundwater in the deep aquifer since it is a breakdown product of TCE and PCE and the detection limit of 0.3ug/l exceed the MPCA HRL of 0.2ug/l, although it should be noted that the reported detection limit for vinyl chloride is less than the EPA MCL of 2ug/l.

The cancer risk estimate presented for the typical industrial worker exposed to surface soil in the risk assessment was 3.5×10^{-6}. All hazard indices for each target endpoint were below the EPA and MPCA acceptable level of 1.0 and all individual hazard quotients were below the MPCA acceptable level of 0.2 Consequently, the need for access restrictions, zoning restrictions, and deed notifications to protect this receptor will not be evaluated.

The following decision rules were developed regarding the potential human health risks for a construction worker hypothetically exposed to surface soils:

- If the cumulative incremental cancer risk determined for a construction worker (either the major-infrequent construction worker or minor-frequent construction worker) exceeds 1 x 10^{-5} for an exposure unit or area of concern, then evaluate the need for and the feasibility of implementing appropriate remedies.

- If the cumulative Hazard Index determined for a construction worker (either the major-infrequent construction worker or minor-frequent construction worker) exceeds 1.0 for an exposure unit or area of concern, the re-evaluate the cumulative Hazard Index based on toxic endpoint/target organs. If the cumulative Hazard Index still exceeds 1.0, then evaluate the need for and the feasibility of implementing appropriate remedies. If the Hazard Quotient for any individual COPC exceeds 0.2, evaluate the need to include the parameter in the Feasibility Study.

The cancer risk for the major infrequent construction worker was 2.1 x 10^{-6}. The cumulative hazard index developed for this receptor was 2.9. Individual hazard quotients for arsenic (HI = 0.3), chromium VI (HI = 1.35), copper (HI = 0.23), and mercury (HI = 0.46) exceeded the MPCA acceptable level of 0.2. However, as detailed in the risk assessment, a hazard index of greater than 0.2 would be associated with only one or two of the arsenic, copper, and chromium detections. A hazard index greater than 0.2 would be associated with 9 mercury samples. (Note: One hundred and thirteen soil samples were analyzed for metals.) Additionally, the hazard quotient for chromium was developed assuming that chromium was present in the hexavalent state. However, it should be noted that hexavalent chromium was detected infrequently (3 of 50 soil samples, only) in surface and subsurface soil. As specified in the decision rule, an evaluation of the need for and the feasibility of implementing appropriate remedies is recommended based on the results of the risk evaluation of the major infrequent construction worker.

The cancer risk for the minor frequent construction worker was 3.6 x 10^{-6}. The cumulative hazard index was less than 1. All individual hazard quotients were below 0.2. An evaluation of the need for and the feasibility of implementing appropriate remedies would not be necessary based on the results of the 0-4 feet bgs risk evaluation of the minor frequent construction worker.

Since the area targeted in the OU3 investigation is either under roof or paved, the area is not conducive for wildlife. Within the OU3 investigation area, there are no known grass areas. The area is a fenced, highly industrialized area. Therefore, the lack of suitable habitat makes it unlikely that terrestrial receptors, if any, will actually be impacted.

OU2 RI CONCLUSIONS

The OU2 RI of the soils outside of the buildings and other structures was conducted by RMT, Inc., of Madison, Wisconsin in 1993 (RMT, 1993). In the OU2 RI, areas investigated included: Sub-Areas A1, A2, A3, and A4 located on the northern part of the property, in the general vicinity of the North 40; Sub-Areas B1 and B2 located in the northeast corner of the property; Area D located on the east side of the property, north of the tank farm; Sub-Areas E1 and E2 located on the east side of the property, south of the tank farm; and Sub-Areas F1 and F2 located near the southwest corner of the building.

The conclusions from the OU2 field investigations were as follows:

- Soils within Sub-Area A1 have not been impacted by site activities.
- Sub-Areas B1, B2, E1, E2, and F1 have been slightly impacted by site activities.
- Sub-Area A2 has been impacted by site activities because analytical results indicate elevated VOC concentrations in the shallow soils.
- Investigation results indicate two major areas of concern in Sub-Area A3, which includes the area around unexcavated anomalies #13 and #14. Elevated concentrations of contaminants, particularly VOCs, remain in soils in these areas as a result of wastes buried prior to 1983.
- Much of Sub-Area A4 has been impacted by site activities with the greatest impacts being located at previously excavated Anomaly #3. Previously excavated Anomalies #3 and #6 and unexcavated Anomalies #2 and #4 appear to be the major sources of these impacts.
- Area D is the site of a previously unidentified disposal trench. The reported impacts are considerably less than those observed in Sub-Areas A2, A3, and A4.
- Residual hydrocarbon-impacted soils remain in Sub-Area F2.

The conclusions for the OU2 ecological risk assessment were as follows:

- Although constituents are present at the site that are potentially toxic to terrestrial biota, the lack of suitable habitat and access restrictions makes it unlikely that large numbers of organisms will be affected.

SUPPLEMENTAL REMEDIAL INVESTIGATION INFORMATION REPORT

The Supplemental Remedial Investigation Information Report, dated September 2001 evaluated unsaturated soils outside of the buildings and other structures in September of 2001. In this report, ten sub areas were evaluated: sub areas A1, A2, A3, and A4 located on the northern part of the property in the general vicinity of the North 40; sub areas B1 and B2 located in the northeast corner of the property; sub area D, a previously unidentified disposal trench and former storage area C located n the east side of the property, north of the tank farm; sub area E located on the east side of the property south of the tank farm; sub area F located near the southwest corner of the building; and an additional sub area designated as "Other" located west of sub area A4 and between sub areas A1 and A2 which includes all samples not located in any of the above listed sub areas. The locations of the ten sub areas are presented in Figure 2-1 of the Supplemental Remedial Investigation Information Report.

The following bullets and Table ES-4 summarize the conclusions from the Supplemental Remedial Investigation Information Report.

- The results of the screening analysis indicated that HQs and/or ICRs for residential receptors exceeded MPCA and EPA risk acceptable levels at all sub areas with the exception of the "Other" sub area.

- HQs and ICRs for typical industrial workers exposed to surface soil and subsurface soil were within MPCA and EPA acceptable risk levels for all sub areas with the exception of subsurface soil at sub area A3 and surface soil at sub area A4. Tetrachloroethane, 1,1,1-trichloroethane, and xylenes in sample AT009D1 (8 to 10 feet bgs) and iron and manganese in sample AT007C (6 to 8 feet bgs) were the major contributors to the risk for subsurface soil at A3. The ICR for typical industrial workers exposed to surface soil at sub area A4 slightly exceeded the MPCA acceptable risk level but was within EPA's target risk range. Carcinogenic PAHs at boring AB032A (1 to 3 feet bgs) were the major contributor to the risk in surface soil at sub area A4.

- HQs and ICRs for minor frequent construction workers exposed to surface soil and subsurface soil were within MPCA and EPA acceptable risk levels for all sub areas with the exception of subsurface soil at sub area A3, surface soil at sub area A4, and surface soil at sub area E. Carcinogenic PAHs in sample AB043D (8 to 10 feet bgs); tetrachloroethene and 1,1,1-trichloroethane in sample AT009D1 (8 to 10 feet bgs); and iron and manganese in sample AT007C (6 to 8 feet bgs) were the major contributors to the risk for subsurface soil at sub area A3. The ICRs for minor frequent construction

workers exposed to surface soil at sub areas A4 and E slightly exceed the MPCA acceptable risk level, although the ICRs were was within EPA's target risk range. Carcinogenic PAHs at sampling location AB032A (1 to 3 feet bgs) in sub area A4 and EB004 A (1 to 3 feet bgs) in sub area E were the major contributors to the ICR.

- HQs and/or ICRs for major infrequent construction workers exposed to surface soil and subsurface soil were within MPCA and EPA acceptable risk levels for all sub areas with the exception of sub areas A3 and A4. Antimony, 2-butanone, 1,1-dichloroethane, iron, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, and xylenes were the major contributors to the risk at sub area A3. Carcinogenic PAHs and trichloroethene were the major contributors to the risk at sub area A4.

- Based on the results of the risk assessment, sub areas A1, A2, B1, B2, D, F, and "Other" are not a concern under industrial/restricted commercial use.

- In sub area A3 contamination in the vicinity of sample locations AT009, AT007, and AB042 at depths of approximately 6 to 10 feet bgs were mainly responsible for exceedances of the acceptable risk levels. These sample locations are located in the vicinity of where the drum removal occurred during the OU2 field investigation and where a decontamination pad exists.

- In sub area A4 contamination in the vicinity of sample locations AB032 and AT001 at depths of less than 3 feet bgs and AT004 at depths of 3 to 5 feet were mainly responsible for exceedances of the acceptable risk levels.

- In sub area E contamination in the vicinity of sample location EB004 at a depth of 1 to 3 feet bgs was mainly responsible for exceedances of the acceptable risk levels.

- Based on the bulleted results above residual contamination in sub areas A1, A2, B1, B2, D, F and "Other" are not of concern if the land use is limited to industrial/restricted commercial use. In the remaining sub areas (i.e., A3, A4 and E) localized areas of contamination (i.e., hot spots) result in potential risk levels that exceed levels of concern.

- In sub area A3, VOC contamination in the vicinity of sample locations AT009 and AB043 at depths of 8-10 feet bgs and iron at AT007 at depth of 6-8 feet bgs are largely responsible for the risk exceedances. These sampling locations are located in and near the near where drum removal occurred and where a decontamination pad exists. Examination of these samples indicates a localized area with significantly elevated levels of contamination. For example, at AT009 the

concentrations of 1,1,1-trichloroethane, 1,1-dichloroethane, 2-butanone, tetrachloroethene, toluene, trichloroethene, and xylenes correspond to ICR 15 times higher than the acceptable target risk level and hazard indices from approximately 3-14 times the target risk level. The concentrations of these contaminants at this location are also significantly (11-360 times) higher than the next highest concentration in sub area A3 suggesting a hot spot of contamination. In addition, the concentrations of 1,1,1-trichloroethane, tetrachloroethene, and xylenes exceed the default soil saturation limit suggesting that free product may be present. Removal of these sampling data points and recalculation of the 95 percent UCL mean exposure concentration produces risks within target risk levels.

- In sub area A4, cPAH contamination at AB032 at a depth of 1-3 feet bgs is largely responsible for the risk exceedance. Examination of this location indicates a localized are with significantly elevated levels. The concentration of cPAHs (as BaP equivalents) at this location corresponds to risk levels 10-20 times higher than the acceptable target risk level. The concentration is six times higher than the next highest concentration is sub area A4. Removal of this sampling data point and recalculation of the 95 percent UCL mean exposure concentration produces risks within target risk levels.

- In sub area E the number of sampling data points was insufficient to calculate a 95 percent UCL of the mean and therefore maximum concentrations were utilized as exposure concentrations in the refined risk assessment. Carcinogenic PAHs (as BaP equivalents) at sample location EB004 at a depth of 1-3 feet bgs is largely responsible for the risk exceedance. The concentration of cPAHs (as BaP equivalents) corresponds to approximately 1.5 times the target risk and is approximately two times higher than the next highest concentration in sub area E. Based on the limited data available EB004 does not appear to be a hot spot and the risk level associated with this specific location slightly exceeds the target risk.

INITIAL SCREENING OF POSSIBLE ALTERNATIVE RESPONSE ACTIONS

No COCs were identified in surface soil. Unacceptable risks were identified in subsurface soil under the main NIROP building. For subsurface soil, chromium was retained as a COC. Soil contaminated with chromium at an unacceptable level was found under the former East Plating Shop of the main NIROP building for the major infrequent construction worker scenario. Chromium exceeds the acceptable (target) risk number based on the assumption that a chromium is present in the hexavalent form. This assumption was made because soil samples analyzed for chromium were not speciated.

Possible remedial action alternatives include the no-action remedial alternative, an institutional control to restrict subsurface activity, and an engineering control response action combined with institutional controls.

TABLE ES-1

EVALUATIONOF AOC GROUPS
NIROP FRIDLEY, MINNESOTA

GROUP	OPERATIONS	ANTICIPATED CONTAMINANTS (FROM WORKPLAN)	AOC #	SAMPLE DEPTH	KEY MEASURED CONTAMINANT	COMMENT
1	1,1,1-TCA/TCE STORAGE	VOC	3	4-8 ft.	xylenes, 2 ug/kg	highest concentration of any chlorinated solvent or BTEX
2	DEGREASING	VOC, DRO/GRO	58	0-4 ft.	tce, 490 ug/kg	highest concentration of any chlor. solvent, BTEX, or SVOC -
						concentration at 4-8 ft. is only 3 ug/kg
2	DEGREASING	VOC, DRO/GRO	39	0-4 ft.	toluene, 14 ug/kg	also, xylenes at 7 ug/kg. No chlorinated solvents detected.
				8-12 ft.	toluene, 19 ug/kg	also, xylenes at 10 ug/kg. No chlorinated solvents detected.
2	DEGREASING	VOC, DRO/GRO	16	0-4 ft.	tce, 12 ug/kg	only chlorinated solvent greater than 10 ug/kg
3	HEAT TREAT	METALS, INORGANICS, PCBs	46			no PCBs detected, no metals out of normal range
4	MACHINING	VOC, DRO/GRO, PCBs	30	0-4 ft.	aroclor 1016, 150ug/kg	only PCB detect. No chlor solv, BTEX, or SVOC > 10 ug/kg
5	PAINTING	METALS, VOC	35	0-4 ft.	metals	chrome III/VI: 84/6 ug/kg, pb = 15 ug/kg, zn = 479 ug/kg
				8-12 ft.	tce, 36 ug/kg	only chlorinated solvent greater than 10 ug/kg
6	PEPSET STORAGE	VOC, SVOC	63	0-4 ft.	pce, 18 ug/kg	only chlorinated solvent greater than 10 ug/kg
7	PLATING	VOC, DRO/GRO, METALS	50	0-4 ft.	toluene, 12 ug/kg	only chlorinated solvent greater than 10 ug/kg

TABLE ES-2

CHEMICALS OF POTENTIAL CONCERN (COPCs)
SURFACE AND SUBSURFACE SOIL
NIROP FRIDLEY, MINNESOTA

Chemical	Surface Soil (0 to 4 Feet)	Subsurface Soil (4 to 12 Feet)	Subsurface Soil (>12 Feet)
VOLATILE ORGANIC COMPOUNDS			
1,1,1-Trichloroethane	X	X	X
1,1,2-Trichloroethane		X	
1,1-Dichloroethane	X	X	X
1,2-Dichloroethene (total)	X	X	X
2-Butanone	X	X	X
2-Hexanone	X	X	X
4-Methyl-2-pentanone	X	X	X
Acetone	X	X	X
Benzene		X	
Bromomethane	X	X	
Carbon Disulfide	X	X	X
Chlorobenzene			X
Chloromethane			X
Ethylbenzene	X	X	X
Styrene	X	X	X
Tetrachloroethene	X	X	X
Toluene	X	X	X
Trichloroethene	X	X	X
Xylenes, Total	X	X	X
SEMIVOLATILE ORGANIC COMPOUNDS			
2-Methylnaphthalene	X	X	
4-Chloro-3-methylphenol		X	
4-Methylphenol			X
Acenaphthene	X	X	
Acenaphthylene	X	X	
Anthracene	X	X	
Benzo(a)anthracene	X	X	
Benzo(a)pyrene	X	X	
Benzo(b)fluoranthene	X	X	
Benzo(g,h,i)perylene	X	X	
Benzo(k)fluoranthene	X	X	
Bis(2-Ethylhexyl)phthalate	X	X	X
Butylbenzyl Phthalate	X	X	
Carbazole	X	X	
Chrysene	X	X	
Di-n-butyl phthalate	X	X	X
Di-n-octyl phthalate	X	X	
Dibenzo(a,h)anthracene	X	X	
Dibenzofuran	X	X	
Fluoranthene	X	X	
Fluorene	X	X	
Indeno(1,2,3-cd)pyrene	X	X	

TABLE ES-2

CHEMICALS OF POTENTIAL CONCERN (COPCs)
SURFACE AND SUBSURFACE SOIL
NIROP FRIDLEY, MINNESOTA

Chemical	Surface Soil (0 to 4 Feet)	Subsurface Soil (4 to 12 Feet)	Subsurface Soil (>12 Feet)
Naphthalene	X	X	
Pentachlorophenol		X	
Phenanthrene	X	X	
Phenol	X	X	
Pyrene	X	X	
POLYCHLORINATED BIPHENYLS			
Aroclor-1016	X		
Aroclor-1254	X		
INORGANICS			
Aluminum	X	X	X
Antimony	X		
Arsenic	X	X	X
Barium	X	X	X
Beryllium	X	X	X
Cadmium	X	X	
Calcium	X	X	X
Chromium	X	X	X
Cobalt	X	X	X
Copper	X	X	X
Cyanide	X	X	X
Hexavalent Chromium	X		
Iron	X	X	X
Lead	X	X	X
Manganese	X	X	X
Manganese	X	X	X
Mercury	X	X	
Nickel	X	X	X
Potassium	X	X	X
Selenium	X	X	
Sodium	X	X	X
Thallium	X		
Vanadium	X	X	X
Zinc	X	X	X

Notes:
In accordance with MPCA guidance any chemical detected in at least one sample is considered a COPC.
An X indicates that the chemical was retained as a chemical of potential concern.

TABLE ES-3

CHEMICALS OF POTENTIAL CONCERN (COPCs)
GROUNDWATER
NIROP FRIDLEY, MINNESOTA

Chemical	Shallow Groundwater	Intermediate Groundwater	Deep Groundwater
VOLATILE ORGANIC COMPOUNDS			
1,1,1-Trichloroethane	X		
1,1,2-Trichloroethane	X		
1,1-Dichloroethane	X	X	X
1,1-Dichloroethene	X	X	X
1,2-Dichloroethane	X	X	
1,2-Dichloroethene (total)	X		
2-Butanone	X		
Acetone	X		
Benzene	X		
Carbon Disulfide	X		
Chloroform	X		
Chloromethane	X	X	X
cis-1,2-dichloroethene	X	X	X
Ethylbenzene	X	X	
Methylene Chloride	X		
Tetrachloroethene	X	X	X
Toluene	X	X	X
Trans-1,2-dichloroethene	X	X	X
Trichloroethene	X	X	X
Vinyl Chloride	X	X	
Xylenes, Total	X	X	
SEMIVOLATILE ORGANIC COMPOUNDS			
2,4-Dimethylphenol	X		
2-Methylnaphthalene	X		
2-Methylphenol	X		
4-Chloro-3-methylphenol	X		
4-Methylphenol	X		
Bis(2-Ethylhexyl)phthalate	X		
Butylbenzyl Phthalate	X		
Di-n-butyl phthalate	X		X
Di-n-octyl phthalate	X		
Diethyl Phthalate	X		
Naphthalene	X		
Pentachlorophenol	X		
Phenanthrene			
Phenol	X	X	
Pyrene			

TABLE ES-3

CHEMICALS OF POTENTIAL CONCERN (COPCs)
GROUNDWATER
NIROP FRIDLEY, MINNESOTA

Chemical	Shallow Groundwater	Intermediate Groundwater	Deep Groundwater
INORGANICS			
Aluminum	X	X	X
Antimony			
Arsenic	X	X	
Barium	X	X	X
Beryllium	X		
Calcium	X	X	X
Chromium	X	X	X
Cobalt	X		
Copper	X	X	
Cyanide	X	X	X
Iron	X	X	X
Lead	X		X
Manganese	X	X	X
Manganese	X	X	X
Mercury	X	X	
Nickel	X	X	
Potassium	X	X	X
Selenium	X		
Sodium	X	X	X
Thallium	X		
Vanadium	X	X	
Zinc	X	X	X

Notes:
In accordance with MPCA guidance any chemical detected in at least one sample is considered a COPC.
An X indicates that the chemical was retained as a chemical of potential concern.

TABLE ES-4

SUMMARY OF SOIL RISK CHARACTERIZATION AND IDENTIFICATION OF COCS FOR OU3 & OU2
NIROP FRIDLEY, MINNESOTA

Receptor	Cancer Risk			Noncancer Risk				
	Target Risk (1)	Calculated Risk	COCs (2)	Target Hazard Index (3)	Calculated Hazard Index	Target Hazard Quotient (3)	Calculated Hazard Quotient	COCs (2)
Baseline Evaluation OU3								
0 - 4 feet depth: Chronic exposure to 95% UCL average concentration throughout building								
Typical Industrial Worker	1×10^{-5}	0.35×10^{-5}	--	1	< 1	0.2	< 0.2	--
Minor Frequent Construction Worker	1×10^{-5}	0.36×10^{-5}	--	1	< 1	0.2	< 0.2	--
0 - 12 feet depth: Short-term exposure to maximum concentration in localized areas								
Major Infrequent Construction Worker	1×10^{-6}	**2.1×10^{-6}**	Maximum concentrations at different locations. Risks at individual locations less than 1×10^{-6}.	1	**2.9**	1	**1.4**	Chromium (located > 4 feet deep in East Plating Shop AOC. Evaluated as hexavalent chromium)
Screening Evaluation for OU3								
0 - 12 feet depth: Chronic exposure to maximum concentrations in localized areas								
Typical Industrial Worker	1×10^{-5}	**2×10^{-5}**	Maximum concentrations at different locations. Risks at individual locations less than 1×10^{-5}.	1	< 1	0.2	0.8	Chromium (located > 4 feet deep in East Plating Shop AOC. Evaluated as hexavalent chromium)
Minor Frequent Construction Worker	1×10^{-5}	**1.8×10^{-5}**	Maximum concentrations at different locations. Risks at individual locations less than 1×10^{-5}.	1	< 1	0.2	0.4	Chromium (located > 4 feet deep in East Plating Shop AOC. Evaluated as hexavalent chromium)
Refined Risk Evaluation for OU2 - Sub Areas A3, A4, and E (4)								
0 - 5 feet depth: Chronic exposure to 95% UCL average concentration								
Typical Industrial Worker	1×10^{-5}	**2×10^{-5}**	cPAHs in Sub Area A4	1	< 1	0.2	< 0.2	--
Minor Frequent Construction Worker	1×10^{-5}	**2×10^{-5}**	cPAHs in Sub Area A4 and E	1	< 1	0.2	< 0.2	--
0 - 12 feet depth: Short-term exposure to maximum concentration in localized areas								
Major Infrequent Construction Worker	1×10^{-6}	**2×10^{-5} (A3)** **2×10^{-5} (A4)**	1,1-DCA, PCE, & TCE in Sub Area A3, TCE & cPAHs in Sub Area A4	1	**> 1**	1	**> 1**	Antimony, Iron, Manganese, 2-Butanone, PCE, 1,1,1-TCA, Toluene, & Xylene in Sub Area A3.

Notes:
1 - Values presented are MPCA acceptable cancer risk levels. USEPA target risk range is 1×10^{6} to 1×10^{-4}.
2 - COPCs significantly contributing to calculated risks exceeding target risk levels were identified as COCs.
3 - Values presented are MPCA acceptable levels. USEPA target noncancer risk levels are a Hazard Index of 1 for multiple contaminants and a Hazard Quotient of 1 for individual contaminants.
4 - Only sub areas identified in the screening risk evaluation as requiring further analysis were evaluated in the refined risk evaluation.
1,1-DCA = 1,1-Dichloroethane.
PCE = Tetrachloroethane.
TCE = Trichloroethene.
1,1,1-TCA = 1,1,1-Trichloroethane.
cPAHs = Carcinogenic PAHs.

TABLE ES-5

CHEMICALS OF CONCERN (COCs)
GROUNDWATER
NIROP FRIDLEY, MINNESOTA

Chemical	Shallow Groundwater	Intermediate Groundwater	Deep Groundwater
VOLATILE ORGANIC COMPOUNDS			
1,1,1-Trichloroethane	X		
1,1-Dichloroethane	X		
1,1-Dichloroethene	X	X	
1,2-Dichloroethane	X		
cis-1,2-dichloroethene	X	X	
Ethylbenzene	X		
Methylene Chloride	X		
Tetrachloroethene	X		X
Trans-1,2-dichloroethene	X	X	
Trichloroethene	X	X	X
Vinyl Chloride	X	X	X
SEMIVOLATILE ORGANIC COMPOUNDS			
4-Methylphenol	X		
INORGANICS			
Aluminum	X	X	
Beryllium	X		
Chromium	X		
Cobalt	X		
Cyanide	X		
Iron	X	X	X
Manganese	X	X	X
Selenium	X		
Thallium	X		
Vanadium	X		

Notes:
An X indicates that the chemical was retained as a chemical of concern.
The chemicals of concern are those chemicals with maximum detected concentrations which exceed MPCA Health Risk Limits, Health Risk Values, and EPA Maximum Contaminant Levels.

1.0 INTRODUCTION

This Remedial Investigation (RI) Report was prepared for Naval Industrial Reserve Ordnance Plant in Fridley, Minnesota (NIROP Fridley) through the U.S. Navy (Navy) Southern Division Naval Facilities Engineering Command (NAVFAC) under Contract Task Order (CTO) 0002, for the Comprehensive Long-term Environmental Action Navy (CLEAN III), Contract Number N62467-94-D-0888. The RI Feasibility Study (FS) is a requirement of the Federal Facilities Agreement (FFA), dated March 27, 1991, between the Minnesota Pollution Control Agency (MPCA), the United States Environmental Protection Agency (USEPA), and the United States Department of the Navy (Navy). This RI Report summarizes the environmental investigations of the Operable Unit 3 (OU3), which comprises the soils beneath the plant building. The Work Plan that directed the investigation described in this RI Report fully integrated the Data Quality Objectives (DQO) process, which focused sampling activities on cleanup objectives to make the sampling process more efficient. The site location is identified on Figure 1-1, Site Location Map.

1.1 PURPOSE OF THE RI REPORT

The overall goal of the environmental investigative work for OU3 at NIROP Fridley is to efficiently characterize environmental contamination to determine whether there is a risk to human health and the environment and therefore to (1) identify all sources of contamination; (2) identify the extent and magnitude of soil, subsoil, surface water, and ground water contamination; (3) gather all necessary data to support the FS and Risk Assessment, and (4) provide information and data needed for the selection and implementation of response actions at the Site.

Southern Division NAVFAC has the responsibility of ensuring that site investigation and restoration projects are performed efficiently in the most cost-effective and timely manner considering pertinent constraints such as the need to protect human health and the environment, site closure requirements, regulatory compliance, and funding limitations. For these reasons, clearly focused site investigations are required to help improve the efficiency of the investigation and restoration process. Therefore, Southern Division NAVFAC has developed a policy and approach to improve the efficiency of the site investigation and restoration process through the appropriate use of new guidance from USEPA (Guidance for the Data Quality Objectives Process, USEPA, September 1994), use of innovative technologies when warranted (e.g., direct penetration technology, onsite analyses), and new tools and methods for data analysis (e.g., geostatistics, geographic information systems [GIS]). Together, these provided for a more clearly focused, cost-effective site investigation.

In addition to the Work Plan, the following scoping documents were prepared and are part of the master work plan for the environmental investigative work at NIROP Fridley:

- Field Sampling Plan (FSP)
- Quality Assurance Project Plan (QAPP)
- Site Security and Health & Safety Plan (HASP)

The Installation Restoration (IR) Program investigation conducted pursuant to the Work Plan complied with applicable requirements established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Community Environmental Response Facilitation Act (CERFA). Additional guidance for these activities is contained in the USEPA Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (1988) and the Navy/Marine Corps Installation Restoration Manual (February 1992).

This RI for OU3 is the third RI for the facility. The RIs for OU1 (groundwater) and OU2 (surface and subsurface soil outside of the outline of the building) were performed earlier. The conclusions of the OU2 RI Report are also included in the report.

1.2 SITE BACKGROUND

1.2.1 Facility Description

NIROP Fridley is located on the southernmost tip of Anoka County, Minnesota. The plant is situated approximately one-quarter mile east of the Mississippi River and less than 1 mile south of Interstate 694 (Figure 1-1).

The site is currently active and consists of 80.35 acres of government-owned land, of which approximately 50 acres are paved or covered with buildings. The plant is bordered on the east by the Burlington Northern rail yard, on the north by various industrial facilities, on the south by United Defense Limited Partnership (UDLP) property, and on the west by East River Road. The 46 acre area adjacent to the southern border of the site is owned by UDLP, the NIROP (government-owned contractor operated) (GOCO) operator, and is designated USEPA Superfund Site Number 17 on Update 6 of the National Priorities List (NPL) (RMT, July 1988). The area encompassed within a 3-mile radius of the NIROP site includes parts of Minneapolis/St. Paul, New Brighton, St. Anthony, and most of Fridley and Brooklyn Center.

1.2.2 Facility History

NIROP Fridley dates back to 1940 when Northern Pump Company negotiated with the Navy for the construction of a new manufacturing plant on approximately 80.35 acres of land situated in the northern portion of the Minneapolis-St. Paul metropolitan area (Envirodyne, June 1983). Northern Pump had been under contract to the Navy throughout the 1930s. These defense contracts eventually reached a level where Northern Pump's existing plant in Minneapolis was inadequate. When Northern Pump received a contract from the Navy to produce 100 five-inch gun mounts, a move to a new manufacturing plant was needed (Envirodyne, June 1983).

The arrangement to construct the new plant was unique in that the plant was partially owned by the government and partially by Northern Pump Company. NIROP Fridley was the GOCO facility. The site chosen for the plant was a cornfield just north of the Minneapolis city limits, within the City of Fridley. The new plant was completed in just 60 days with machinery, office equipment, and records moved intact by flat car from the old plant. By January 1941, the plant was in full production (Envirodyne, June 1983). The general layout of the site is shown on Figure 1-2.

In June of 1942, Northern Pump Company established Northern Ordnance, Incorporated, as an operating subsidiary to conduct the government portion of Northern Pump's business. Thereafter, the facility was often referred to as Northern Ordnance, Inc., and later as Northern Ordnance Division (NOD) (Envirodyne, June 1983).

On January 31, 1964, Northern Ordnance was acquired from Northern Pump Company by FMC Corporation (FMC). Northern Ordnance was assigned divisional status within FMC's Ordnance Group (Envirodyne, June 1983). In 1994, FMC Corporation and Harsco Corporation formed UDLP, and the Armament Systems Division of UDLP currently operates the facility.

Production at the NIROP facility began in January 1941. During World War II, the plant was operated in two 12-hour shifts, 365 days a year, to produce gun mounts. A production level of about 150 single gun mounts and 20 twin gun mounts per month was eventually reached. During the height of the war, 11,400 people were employed at the plant. By the end of the war, more than 6,000 gun mounts had been produced, and the plant received awards annually from 1941 through 1946 from the Navy for meritorious production (Envirodyne, June 1983).

Following the end of the war, production of gun mounts dropped substantially, and the workforce at the plant was reduced to its pre-war level of less than 1,000 employees. The plant undertook various

overhaul projects for the Navy and designed a new, dual-purpose, 5-inch, 54-caliber, single gun mount, the Mark 42. This was one of the first fully automated gun mounts in the world. Production of the Mark 42 commenced in 1948 and was the major production activity at the plant for the next 10 years (Envirodyne, June 1983).

During the 1950s, the Navy had demand for new and advanced missile launching systems. Northern Ordnance responded to this need by producing the first automatic guided missile launching system in the world in 1956, the Mark 4. Other missile launching systems the Mark 7, Mark 10, Mark 13, Mark 22 and Mark 26 were also produced at the plant. These were all highly reliable shipboard systems designed to store, transfer, warm up, position, and launch the missiles. All of these systems were designed for the "3-T Missiles": Talos, Terrier, and Tarter (Envirodyne, June 1983). During this same period, a series of torpedo launching tubes, the Mark 23, Mark 24, and Mark 25, were produced at the plant (Envirodyne, June 1983).

After FMC Corporation's takeover of Northern Ordnance in 1964, the plant continued to produce gun mounts and advanced missile launching systems. However, there was a shift toward smaller, lighter systems. The plant produced a 5-inch, 54-caliber gun mount, the Mark 45, which was the smallest and lightest 5-inch gun mount in the world. This gun mount was used on the Navy's latest cruisers and destroyers. The Mark 75, which was a fast firing 76-millimeter, 62-caliber gun mount, was also produced at the plant (Envirodyne, June 1983).

The guided missile launching systems that were produced at the plant in the 1970s and 1980s, the Mark 13, Mark 26, and the Mark 41 Vertical Launching Systems (VLS), were designed for the Navy's newer, smaller class ships. However, today the mainstay of the Navy's launching platform is the MK41 VLS.

There were no major functional changes in the industrial operations at NIROP since the plant was constructed in 1941, although some of the operations were modernized or relocated. The processing, assembly, and manufacturing operations associated with the facility include plating, welding, heat treating, machining, and foundry. Testing facilities currently at NIROP include an electronics laboratory, a metallurgical laboratory, hydraulic test bays, and shock/vibration test equipment (Envirodyne, June 1983). These areas are shown on Figure 1-3.

The plant layout consists of 29 avenues that run west to east and north to south. Broadway is the main north-south avenue; it is located in the center of the plant. East of Broadway, building columns are

numbered from 1E to 21E; to the west, columns are numbered 1W to 29W. The Navy-owned portion of the plant extends from 5th Avenue to the north wall of the main building.

NIROP Fridley has previously stored and disposed of industrial wastes, scrap materials, drummed wastes, and chemicals at the facility. The following paragraphs discuss the former chemical and waste disposal, storage, and removal practices.

In 1975, an estimated 150 55-gallon drums of industrial waste were removed from NIROP. Prior to disposal, such waste material was collected and stored at a central waste storage area located outside near the northeastern corner of NIROP. The area consisted of a 30-foot by 30-foot asphalt and concrete pad graded toward the middle, which drained to a dry well that could be pumped if a spill occurred (Envirodyne, June 1983).

Two trenches were excavated at NIROP for waste disposal purposes in 1972 in the area north of the main plant building. The trenches were used on a one-time basis. Each trench was approximately 10 feet wide and 8 to 10 feet deep, with a combined length of 75 to 100 feet. Between 50 and 100 drums containing wastes were placed into the trenches on their sides, stacked two or three deep, and covered with excavated soils. The material potentially disposed of in the drums included waste oil, plating sludge, cleaning solvent, and degreasing solvent (Envirodyne, June 1983).

During the late 1960s or early 1970s, two borrow pits were used on a one-time basis for the disposal of drummed wastes on the northeast portion of NIROP: one near the railroad gate, the other near the first railroad switch. Each of the pits was approximately 8 feet deep and irregularly shaped and contained about 25 barrels containing the same types of wastes as disposed of in the trenches. In addition to the barrels, the disposal pits contained miscellaneous construction debris, such as metal scraps, lumber, and concrete (Envirodyne, June 1983).

Through various geophysical and remote sensing techniques, nine areas were selected for excavation based on their likelihood for containing drummed wastes in the northern portion of the outside property. These areas were excavated in the fall of 1983 and the spring of 1984. Forty-three excavated drums and 1,200 cubic yards of underlying soil were found to contain volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), oil and grease, pesticides, and metal-bearing wastes. The drums and contaminated soil were disposed of at a USEPA-approved landfill (RMT, Inc., February 1997).

Based on the results of a geophysical investigation conducted in 1995, a total of twenty-three 55-gallon drums and 12 smaller containers were found in the north 40 area. These drums were excavated during a

removal action conducted in April through June 1996. Eleven drums were determined to be non-hazardous, 11 drums contained contaminated soil, 1 drum contained hazardous waste, 4 1-gallon containers were determined to be non-hazardous, and 8 quart-sized containers contained ingredients such as brake fluid and paint thinner. The non-hazardous containers were disposed of as scrap metal by the UDLP metal recycling program, and their soil contents were placed in roll-offs for disposal as Special Waste [materials containing volatiles but having Toxic Characteristic Leaching Procedure (TCLP) results below hazardous levels as mandated in 40 CFR 261]. The remaining 13 drums and 8 containers, with contents, were sampled for disposal and sent to Emelle, Alabama for disposition and subsequent incineration at Port Arthur, Texas. In addition, approximately 100 cubic yards of soil and debris consisting of trash, scrap metal, tires, construction and demolition rubble, metal casting waste, equipment parts, and cast concrete structures were removed and disposed of as non-hazardous waste (Morrison Knudsen Corp, December 1996, see Appendix H).

During OU-2 sampling in the vicinity of a previously unexcavated area near the North 40, free liquids were encountered which resulted in a removal action. A total of 31 drums were sampled and overpacked in addition to several other empty and crushed drums which were removed with other debris. Elevated VOC concentrations were reported at depth.

In conjunction with the late 1991 excavation of contaminated soil from the proposed hazardous materials building addition at the (NIROP) an estimated 2,992 combined yards of contaminated soil and concrete were excavated.

Large quantities of sand are consumed in the casting process at NIROP. Foundry core butts contain mostly sand with minor amounts of metal and resin or binders. Most foundry core butt disposal operations occurred off Navy property. However, it was reported that core butts were disposed of in the northern portion of NIROP on a very limited basis. An analysis of the foundry sand, both before and after use, was performed in November 1978. This analysis did not show any hazardous materials (Envirodyne, June 1983).

In 1972, with the approval of the MPCA, foundry sand was used as one of the fill materials to raise the elevation of the land west of the site which is now part of the Anoka County Park.

A large storage lot and scrap yard were maintained at the north end of the facility since the plant was built in the early 1940s. A wide variety of scrap metal parts was found in the yard. Items include old gun barrels, cranes, machining jigs, and gun mounts (Envirodyne, June 1983).

In the location of the existing hazardous materials storage building, a metal shavings and milling waste loading area existed where the wastes were loaded for removal from the plant.

Plating chemical storage, oil/solvent storage, and cyanide storage areas were located on the west end of the plant on 22nd and 23rd Avenues. Cyanide was stored in this area from 1973 to 1988. Flammable materials were stored in the oil/solvent storage area until 1991.

Prior to the late 1980s, the plant used five interim storage areas named Storage Areas A through D. Storage Areas A, B, B', and D have been closed in accordance with MPCA and USEPA procedures. Storage Area C is currently undergoing final closure.

1.2.3 Previous Environmental Investigations

The NIROP Fridley site is divided into three Operable Units (OUs): OU1 addresses groundwater; OU2 addresses soil contamination outside the footprint of the building; and OU3 originally addressed only soil contamination under the footprint of the building. In a letter dated August 30, 1995, the MPCA requested that OU2 be incorporated into OU3 and that contamination sources [e.g., dense non-aqueous phase liquids (DNAPLs)] within the saturated zone be added to OU3. The MPCA believes that the best course of action for the site is to proceed with a more holistic approach to investigating and remediating the site. The Navy agreed to this approach. Therefore, OU3 will now include all sources in the unsaturated and saturated zones for remedy selection.

Previous investigations have identified contaminants of concern (COCs) for OU1 and OU2. COCs identified for OU1 (groundwater) include trichloroethene (TCE), tetrachloroethene (PCE), and 1,2-dichloroethene (1,2-DCE) (RMT, Inc., July 1988). COCs identified for OU2 include toluene, carcinogenic polyaromatic hydrocarbons (cPAHs), ethylbenzene, TCE, PCE, 1,2-DCE, 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (TCA), and 1,1-dichloroethane (1,1-DCA) (MPCA, January 1995). The following paragraphs and Table 1-1 are chronological summaries of events that have occurred at the NIROP facility from 1940 to the present.

In September 1980, Navy officials implemented the nationwide Navy Assessment and Control of Installation Pollutants (NACIP) program to identify and control environmental contamination from past waste management and disposal practices (USEPA, March 1991).

In March 1981, an anonymous telephone call to the MPCA led to the discovery of CERCLA hazardous substance TCE in the three NIROP Fridley water supply wells finished in the Prairie du Chien/Jordan

Dolomite aquifer. These onsite water supply wells were shut down on April 24, 1981. The groundwater flows west/southwest from NIROP Fridley, and then enters the Mississippi River. Sampling at the City of Minneapolis Mississippi River water intake plant also revealed measurable concentrations of TCE. The city of Minneapolis draws its municipal water from the Mississippi River approximately 2,000 feet downstream from the NIROP site (USEPA, March 1991).

The Navy Energy and Environmental Support Activity (NEESA) initiated the Initial Assessment Study (IAS) in June 1983. The IAS report (Envirodyne, June 1983) determined that drummed wastes had occasionally been buried in trenches or pits 8 to 10 feet below the surface on site in the northern portion of NIROP Fridley and that the area beneath NIROP Fridley production building might be contributing to groundwater contamination. The exact site location of the buried wastes was not recorded. As a result of the IAS recommendations, the Navy contracted with the U.S. Army Corps of Engineers (USACE), Omaha District, to continue investigations (USEPA, March 1991).

The cleanup activities involved excavation of nine areas that contained 43 drums and 1,200 cubic yards of underlying soils. The 43 drums and 1,200 cubic yards of underlying soils were found to contain volatile organic compounds (VOCs), PCBs, oil and grease, pesticides, and metal-bearing wastes. The excavated materials were disposed of at a USEPA-approved landfill (USEPA, March 1991).

Four phases of groundwater monitoring well installation were initiated in June 1983. The network consists of 53 monitoring wells. Shallow, intermediate, and deep monitoring wells were installed in the unconsolidated aquifer underlying NIROP Fridley. Monitoring wells were also installed in the Prairie du Chien/Jordan Dolomite aquifer, which underlies the unconsolidated aquifer under NIROP Fridley. The objective of the monitoring well network is to determine the physical and chemical characteristics of the unconsolidated and Prairie du Chien/Jordan Dolomite aquifers underlying NIROP and adjacent areas (USEPA, March 1991).

The OU1 Remedial Investigation Report (RMT, June 1987) was issued in June 1987 in partial fulfillment of an MPCA Request for Response Action issued to the Navy in May 1984. The purpose of the report was to use existing information to evaluate the impacts of past disposal practices on subsoils and groundwater. The report included evaluations of the eight sampling rounds and the no-action alternative. Results of the RI confirmed earlier findings that groundwater was contaminated with VOCs (primarily TCE) and that groundwater flow was primarily to the southwest toward the Mississippi River.

To address the need for further information defining the nature and extent of contamination, the Navy issued a Conceptual Work Plan for Additional Investigations in June 1987. Implementation of the

Conceptual Work Plan was completed between November 1987 and March 1988. The work consisted of installing and sampling of 16 new groundwater monitoring wells, testing soil pore gas, installing two shallow aquifer pumping wells, and sampling two storm sewers. The results of these investigations were included in the addendum to the RI Report issued for groundwater (OU1) in July 1988 (USEPA, March 1991).

RMT conducted a soil pore gas survey at the site to screen and identify areas of potential VOC contaminated soil that might be contributing to groundwater contamination. The results were included in the A-E Quality Control Summary Report for the Soil Gas Survey (RMT, February 1988) and concluded that the following three contiguous areas had the greatest concentrations in the pore space of the near-surface soils:

- Former disposal trench
- Permanent decontamination pad
- New water main trench area

The OU1 Feasibility Study (FS) Report (RMT, July 1988) was issued in July 1988. Based on the initial screening of alternatives, three remedial alternatives were recommended for detailed evaluations and comparison. These alternatives consisted of two source-control alternatives and an alternative addressing management of contaminant migration (USEPA, March 1991).

In August 1988, an Addendum to the Feasibility Report (RMT, August 1988) for OU1 was issued. This report accounted for the changes found in the Addendum to the RI Report and recommended a pumping and treating remedial action that was to be implemented in two phases (USEPA, March 1991).

On February 8, 1989, the Navy held the initial Technical Review Committee (TRC) meeting at NIROP Fridley. TRC membership included the following: USEPA, MPCA, U.S. Navy, Corps of Engineers, Anoka County (Minnesota), City of Fridley, FMC Corp., Metropolitan Waste Control Commission, Minnesota Department of Natural Resources, and RMT, Inc. The committee periodically met at NIROP Fridley to review progress of the RI/FS and Remedial Design/Remedial Action (RD/RA) (USEPA, March 1991).

Hazardous Waste Storage Area C, located on NIROP Fridley, was used for hazardous waste storage and was addressed by FMC Corporation, a Navy contractor. Soils in the storage area were remediated under the hazardous waste permit that was issued to FMC Corporation and the Navy pursuant to Minnesota Rules Ch. 7045. The closure plan and schedule in the permit required the removal and disposal of contaminated soil beneath the storage area. During April 1989, approximately 317 tons of contaminated

soil and debris were excavated and disposed of from Hazardous Waste Storage Area C. No soils outside the perimeter of Hazardous Waste Storage Area C were removed.

The Navy held a public information meeting to discuss the preferred alternative for groundwater remediation on May 22, 1989 (USEPA, March 1991).

On July 14, 1989, NIROP Fridley was proposed for placement on the National Priorities List (54 Fed. Reg. 29820, July 14, 1989) (USEPA, March 1991).

On July 31, 1989, the U.S. Navy established a Public Information Repository for documents relating to NIROP Fridley. The repository was initially located at the Anoka County Branch Library, 410 N.E. Mississippi Street, Fridley, Minnesota. The Transcript of Proceedings from the Public Forum held on May 22, 1989 was placed in the Information Repository at the Anoka County Branch Library, Fridley, Minnesota (USEPA, March 1991). The entire Public Information Repository is now maintained at NIROP.

On November 21, 1989, NIROP Fridley was placed on the National Priorities List (USEPA, March 1991) after receiving an HRS score of 28.5 or greater. Initial discovery/notification documented a release of VOCs into the groundwater beneath NIROP (USEPA, March 1991).

On May 1, 1990, the Proposed Plan for groundwater remediation was made available to the public by placing a copy of the Proposed Plan in the Public Information Repository. Prior to and on May 1, 1990, notice of the commencement of a period of public comment was provided by publication of a notice in local newspapers. Members of the public were notified that they had a period of 30 days in which they could provide oral or written comments to the USEPA or Navy concerning the Proposed Plan. A public meeting was held on May 9, 1990, in Fridley, Minnesota, during which representatives of the Navy, USEPA, and MPCA answered questions and solicited both written and oral comments from members of the public. The public comment period continued until May 30, 1990 (USEPA, March 1991).

A CERCLA ROD (USEPA, June 1986) was signed for OU1, groundwater remediation at NIROP, on September 28, 1990. The U.S. Navy entered into an FFA with the USEPA, the Navy, and the MPCA in March 1991.

On April 16, 1995, the first NIROP Fridley Restoration Advisory Board (RAB) meeting was held. The RAB was the expansion of the TRC with the addition of community members. The mission of the RAB is to establish and maintain a forum for the exchange of information, in an open and constructive atmosphere, concerning restoration activities at NIROP Fridley and to provide advice/comment on such activities.

Initial investigative activities related to environmental issues at NIROP Fridley began in 1981. After an initial assessment and focused drum removal action, the site issues were divided into three operable units (OUs). OU1 addressed the groundwater beneath the site. The OU1 Remedial Investigation/Feasibility Study (RI/FS) and Record of Decision (ROD) are complete, and implementation of the selected remedy is under way. The selected remedy includes installation and operation of groundwater containment and recovery wells, with a two-phased plan for disposal of the groundwater from the well system.

Under Phase I, the contaminated groundwater from the containment and recovery well system was discharged directly to the existing sanitary sewer system for treatment at the local wastewater treatment facility. Under Phase II, design and construction for a groundwater treatment system has been completed to permit discharge of treated groundwater to the Mississippi River via an NPDES storm sewer discharge.

A groundwater extraction (and containment) system has been constructed based on design documents approved by the USEPA Region V and the MPCA. A pumping capacity test was performed during construction at each of the four extraction wells and included groundwater sampling and analysis. The results indicated that groundwater pretreatment was required prior to discharge to the sanitary sewer to meet discharge limits. Therefore, a pretreatment system was also constructed at NIROP as part of the original facilities, for use during the interim Phase I discharge to the sanitary sewer.

The groundwater extraction system and pretreatment facilities began operating in September 1992. During the first 90 days of recovery system operation, data were collected to determine whether hydraulic containment of contaminated groundwater from the site was achieved. This determination was summarized in a document that was sent to the USEPA and MPCA in December 1992 (RMT, December 1992) for review and approval. In that document, it is concluded that one or more additional groundwater extraction wells would be needed to achieve effective hydraulic containment. A work plan for upgrading the original groundwater extraction system was prepared (RMT, January 1995) and approved by the USEPA and the MPCA. As provided in that Work Plan, two additional extraction wells were constructed and were placed into operation in June 1995. The combined groundwater extraction system, consisting of six extraction wells, is currently in operation.

The concentrations of TCE and other VOCs in the combined discharge from the extraction wells have decreased significantly since startup of the system in 1992. The concentrations decreased to levels where pretreatment of the groundwater was not necessary to comply with the Metropolitan Council Environmental Service (MCES) discharge permit limits. With the approval of the MCES, the pretreatment system was shut down in March 1995. The combined flow from the extraction well system was

discharged directly to the sanitary sewer without pretreatment from March 1995 (RMT, April 1996) until completion of Phase II in November 1998.

As specified in the FFA (USEPA, March 1991), an Annual Monitoring Report was submitted by the Navy to the USEPA and the MPCA in October 1995 (RMT, October 1995) to satisfy the requirement that an annual evaluation of the effectiveness of the groundwater extraction system be performed. The upgraded extraction well system flow rate is high enough to substantially improve the capture zone coverage over the pre-upgrade conditions, although the combined flowrate from the six wells is slightly less than the target flowrate (660 gpm) (RMT, October 1995). It was recommended that efforts be made to achieve sustainable pumping rates that total approximately 660 gpm so that the extraction well system will continue to effectively control the contaminant plume. The MPCA suspended review of the report pending receipt of particle tracking modeling output figures. The results of particle tracking are key to determining capture effectiveness. The Navy is required by the MPCA to modify the Evaluation of Groundwater Containment System Effectiveness Report (RMT, October 1995) to adequately indicate the capture effectiveness of the groundwater system and accurately locate the capture boundary. Determining capture effectiveness is a prerequisite to starting the Phase II design phase.

An Annual Monitoring Report for 1995 Groundwater Extraction and Pretreatment System (RMT, Inc., April 1996) was submitted to the USEPA and MPCA in April 1996, as specified in the FFA, to fulfill the requirements for submittal of data and information describing operation, maintenance, and monitoring of the groundwater extraction and pretreatment system from startup (September 1992) through 1995. Additional Annual Monitoring Reports have been issued each year since.

OU2 address the unsaturated soils outside of the building footprint area. The OU2 RI has been completed. A Draft FS for OU2 was submitted to the USEPA and MPCA for review (RMT, 1995). It was agreed that OU2 would be combined with OU3 and, therefore, the OU2 FS was finalized, but remedy selection was postponed until the OU3 evaluation was complete.

The final operable unit, OU3, has been defined to address sources in the unsaturated and saturated zones at NIROP Fridley. OU3 is the subject of this RI report.

In August 1995, efforts began to address OU3. Due to the size of the NIROP main building and limited understanding of past operations that could have released TCE into the environment, a site evaluation was conducted for OU3, and the Site Evaluation Report (Brown & Root Environmental, September 1995) presented the findings. The site evaluation consisted of a site visit, records search, and a personnel interview survey at the NIROP main building. The primary objective of the site evaluation was to identify

sites that could have been sources of potential TCE releases to the soil beneath the main building. The Site Evaluation Report (Brown & Root Environmental, September 1995) described and located 59 areas that were considered potential sources of TCE contamination within specific industrial operations. In addition, the sanitary and storm sewer systems were considered potential source areas for contamination. Nine additional potential areas of concern (AOCs 60-68), which were identified during the site evaluation but not included in the Site Evaluation Report because they were not suspected sources of TCE contamination, were added later. In addition, the locations of several previously identified AOCs were modified. An updated list of AOCs, updated AOC locations, and a description of each newly identified AOC were issued (Brown & Root Environmental, February 1996). The list of AOCs was further modified (Brown & Root Environmental, January 1997) to include seven additional AOCs (AOCs 69-75).

Ecological Risk Evaluation

Since the area targeted in the OU3 investigation is either under roof or paved, the area is not conducive for wildlife. Within the OU3 investigation area, there are no known grass areas. The area is a fenced, highly industrialized area. Therefore, the lack of suitable habitat makes it unlikely that terrestrial receptors, if any, will actually be impacted.

1.2.4 Areas of Concern at OU3

Hazardous materials were used in the industrial operations within the production areas. One of the most common hazardous materials used was TCE, which was used as a solvent to degrease parts for various activities such as welding, etc. TCE was used at NIROP until 1987 when TCA was substituted for TCE as a solvent for degreasing activities. Spills of TCE have been documented throughout the plant in the 1980s and are likely to have occurred during the entire period of plant operation. Sumps, pits, and drywells were included below as potential AOCs because these are areas where TCE spills may collect and be discharged to the soils.

The location of each of the AOCs is shown on Figure 1-4. A description and the basis for designating each specific industrial operations location as an AOC are included in the following paragraphs.

AOCs 1, 2, 4, 6, 7, 9 through 14, 24, and 25 - TCA Tanks

AOCs 1, 2, 4, 6, 7, 9 through 14, 24, and 25 are the former locations of TCA tanks. These tanks were listed on a TCA tank inventory (UDLP, January 1990).

AOC 3 - Sump in Receiving Area

AOC 3 is a sump located in the shipping and receiving department at 27th Avenue, on the western side of Column 17W. The sump is located at the end of the truck vestibule, which consisted of a ramp into the receiving department. It is not known what types of materials were handled in this area. The sump is approximately 4 feet long by 2 feet wide. The sump receives runoff from the pit ramp and discharges to the storm sewer (Drawing A-7, 1947). The sump was full of water with a green tint at the time of the TtNUS visit on August 24, 1995.

AOCs 5, 8, 19, 22, 31, 56, and 57 - TCA Vapor Degreasers

AOCs 5, 8, 19, 22, 31, 56, and 57 are the locations of vapor degreasers that used TCA. The locations of these degreasers were obtained from a TCA vapor degreaser inventory list (UDLP, 1990).

AOC 15 - Holding Tanks

AOC 15 is the location of holding tanks around 5th and 6th Avenues at Column 10E that allegedly were sites of leaks and dumping as described by current employees. It is not known if the tanks were above ground or underground, what was held in the tanks, or what chemicals were released from the tanks.

AOC 16 - Vapor Degreaser and Sump in Painting Area

AOC 16 is a former vapor degreaser and sump that were located within a painting area in the assembly department in the northern portion of the plant (United Defense SWMU Drawing, June 1995). During the TtNUS Environmental Baseline Survey (EBS) site visit, it was observed that the floor foundation was noticeably altered at 23rd Avenue between Columns 17W and 18W. The site is currently occupied by two paint booths. A current employee who works in the area as a painter indicated that the vapor degreaser was removed around 1983. This employee described that an underground sump below the degreaser had a capacity of approximately 200 gallons and was active from 1978 to 1983. Current employees indicated that many leaks of an unknown substance were reported in the current paint shop.

AOC 17 - Wash Rack Sump

AOC 17 is an active wash rack sump located on 23rd Avenue between Columns 13W and 14W. The site is currently used as a naphthalene spray booth for equipment. Naphthalene collected in the washrack discharges through a drain in the concrete floor to an underground sump. A current employee indicated

that the integrity of the sump was in question and that soil borings were drilled in the area during the mid-1980s.

AOC 18 - Vapor Degreaser and Sump Pit

AOC 18 is the location of a paint area vapor degreaser pit located on 22nd Avenue between Columns 13W and 14W. The pit is 9 feet long by 15 feet, 6 inches wide by 5 feet, 9-1/2 inches deep. The wall and floor of the degreaser pit are 8-inch-thick concrete. A sump located in the southeastern corner of the degreaser pit is 1 foot square and 3 feet deep (PE 898, 1984).

AOC 21 - Vapor Degreaser and Sump Pit

AOC 21 is the location of a vapor degreaser pit located on 21st Avenue between Columns 3W and 4W. The pit is 19 feet, 6-inches long by 10 feet wide by 9 feet, 10-1/2 inches deep. The wall and floor of the degreaser pit are 8-inch-thick concrete. A sump pit located in the northeastern corner of the degreaser pit is 1 foot square and 3 feet deep (PE 898, 1984).

AOC 23 - Vapor Degreaser and Sump

AOC 23 is the location of a former degreaser on 19th Avenue between Columns 3NE and 3SE. Currently, it is the location of a non-destructive testing area. Previously, the vapor degreaser sat on timbers at floor grade with a sump below the ground surface. Discharge gravity drained from the degreaser into the sump, and the liquid in the sump was pumped through a 55-gallon drum filled with carbon into the sanitary sewer. The system was in operation from at least 1984 through 1988. The start-up date is unknown.

AOC 26 - Solvent Booth Pit and Trench

AOC 26 is the location of a solvent booth pit and trench on 18th and 19th Avenues between Columns 4W and 5W. The trench is 16 feet long and 1 foot deep, with 6 inches of concrete around the bottom and sides. A 2-inch drain pipe leads from the trench to the pit. The concrete pit is 4 feet long by 2 feet wide and 3 feet deep (PE 144, 1965). This location is of potential concern because of the possible use of TCE as a solvent in the area.

AOC 27 - Sump for Gun Assembly

AOC 27 is the location of a sump in the machine shop on the corner of Avenue and Broadway. A maintenance employee indicated that the sump was unlined and was used in the 1970s as a plating bath for gun assembly activities.

AOC 28 - Drywell in Diesel Room

AOC 28 is the location of a drywell in the diesel room located on 17th Avenue. The 3-foot diameter, 5-foot deep drywell is located on the western side of Column 2W (Drawings C-27 and C-31, 1947).

AOC 29 - Pit and Drywell in Foundry

AOC 29 is the location of a pit north of 16th Avenue in the foundry at Columns 6E and 7E. A drywell is located in the pit with a depth of 5 feet, 6 inches below grade. The actual use of the pit is unknown but, based on drawings, it is probable that it was used as a sand hopper (PE 150, 1965). TCE was used in the foundry; therefore, possible spills of TCE could have collected and discharged in the drywell.

AOC 30 - Drywell in Machine Shop

AOC 30 is the location of a drywell on 16th Avenue between Columns 12E and 13E. The drywell is 3 feet deep and located in a pit that is 1 foot, 11-5/8 inches deep and holds a furnace and a multiconductor. The drywell is 10-inch vitrified clay pipe. A new sanitary sewer line was added to the existing sanitary sewer line when the pit was constructed. It is unknown if the drywell was constructed to drain into this new branch of the sanitary sewer (PE 43, 1963).

AOC 32 - Oil/Water Separator Sump

AOC 32 is the location of an active oil/water separator sump on the western end of 15th Avenue. It is located in a scrap shed that stores machine turnings (brass, steel, etc.) inside hoppers. Some of the hoppers may have coolant or oil in them. The hoppers are bordered on each side by a floor drain. The unit receives wastewater from leakage in the hoppers through a floor drain on the eastern side of the hoppers. A trap inside the sump ensures that the oil remains in the drain and is not pumped out. Approximately every 9 months, the sump is pumped out. The piping around the separator was removed approximately 4 years ago. The system was always used for the same function. The oil/water separator sump has a capacity of approximately 800 gallons. Wastes inside the oil/water separator before 1991

were pumped into the sanitary sewer. Currently, the unit is pumped manually to a coolant recycling system.

AOC 33 - Degreaser Pit in Foundry

AOC 33 is the location of a degreaser pit in the foundry area. The pit was located on the northern side of 14th Avenue between Columns 7E and 8E. The pit was 7 feet long by 6 feet, 10 inches wide and 3 feet 6 inches deep below grade (PE 150, 1965). The pit was in use until at least 1968 (PE 351, 1968).

AOC 34 - Sump in Maintenance

AOC 34 is the location of a sump on the northern side of 14th Avenue between Columns 20E and 21E in the maintenance department. It is known that TCE was used in this area (Envirodyne, 1983). This sump may have been a collection point for any TCE spills. The sump was located in a sand-blast area and discharged to a storm sewer to the south (Drawing C-20, 1947).

AOC 35 - Paint Storage, Mixing, and Spray and Drywell

AOC 35 is the location of a paint mixing and storage area located on 13th Avenue between Columns 19E and 20E. A paint spray area is located between Columns 20 E and 22 E on 13th Avenue. A drywell that receives runoff from drains located in the paint storage and mixing area is located in the paved court to the north (Drawing C-20, 1947). The drywell was 6 feet long by 4 feet wide and 3 feet deep. The drywell has been filled in with sand and electrical wiring. There are two storm sewers in the vicinity of the drywell.

AOC 36 - Paint Spray Pit

AOC 36 is the location of a paint spray pit on the southern side of 6th Avenue between Columns 21E and 22E (Drawing A-7, 1047). TCE was used to clean parts before they were painted; therefore, there is a potential that a TCE spill could have occurred in this area and collected in the pit.

AOC 37 - Methanol Sump

AOC 37 is the location of sump at the northeastern corner of 13th Avenue. A maintenance employee indicated that this unlined sump received methanol through underground lines.

AOC 38 - Trichloroethene Tank and Distribution System

AOC 38 is the former location of an 8,800-gallon-capacity above-ground TCE tank between Columns 31SW and 31NW on 12th Avenue (Envirodyne, 1983). The tank was mounted on an 11-foot square, 7-5/8-inch thick concrete pad in 1966 (PE 221, 1966). TCE was transported from the tank to locations within the plating department through underground lines.

AOCs 39, 40 and 41 - Vapor Degreaser Pits

AOCs 39, 40, and 41 are the locations of three vapor degreasers on 11th Avenue in the plating department. Originally, the plating shop had wooden catwalks and dirt floors without a filtering system. All the wastewater went through the sanitary sewer system. Prior to 1973, there was only one plating shop, and it encompassed an area that today consists of both east and west plating. The walls of the plating shop were approximately 12 feet north of their current position. AOC 39 is a degreaser that was within a pit on 11th Avenue between Columns 25W and 24W. The dimensions of this degreaser were 5 feet wide by 5 feet long by 8 feet tall. AOC 40 was a degreaser located at Columns 22W and 21W that was 8 feet long by 5 feet wide by 8 feet tall. A third degreaser, AOC 41, was located on 11th Avenue between Columns 20W and 19W; it was 12 feet wide by 4 feet long by 12 feet deep (PE 546.2, 1975).

AOC 42 - Degreaser Pit

AOC 42 is the former location of a degreaser pit on 11th Avenue North between Columns 17W and 16W in the plating department (Drawing B-20, 1947).

AOCs 43 and 51 - Vapor Degreasers in the East Plating Shop

AOCs 43 and 51 are the former locations of vapor degreasers in the former East Plating Shop located on 11th Avenue. The degreasers were located in an 8-foot, 6-inch wide by 50-foot, 6-inch long pit located between Columns 9W and 12W. The degreasers were located on the western end of the pit, and pickle tanks were located between Columns 11W and 10 W (Drawing B-20, 1947). AOC 43 had dimensions of 11 feet, 2 inches long by 5 feet, 6 inches wide by 8 feet, 3 inches tall, and AOC 51 had dimensions of 8 feet long by 5 feet, 2 inches wide by 8 feet tall (PE 444.7, 1973).

AOC 44 and 52 - Sump Pits in the East Plating Shop

AOCs 44 and 52 are the locations of sump pits in the former East Plating Shop located on 11th Avenue. AOC 44 is a former sump that was located northeast of a degreaser and pickle tank pit on the west side of

Column 9W (Drawing B-20, 1947). AOC 44 had a 36-inch manhole frame and cover. AOC 52 is the location of an existing set of sumps in the center of 11th Avenue at Column 7W (PE 1125.5, 1991)

AOCs 45 and 46 - Drywells in Heat Treating

AOCs 45 and 46 are drywells located in the heat treating department on 11th Avenue on Columns 3E and north 4E, respectively. AOC 45 was located on the western side of a pit furnace, and AOC 46 was located near quench tanks. The quench tanks held oil that was used to bathe red-hot parts that came out of the furnace.

AOC 47 - Degreaser Still

AOC 47 is a degreaser still located on 11th Avenue next to Column 18E. The still is located next to a wax pot in the plating department (PE 303, 1968). The wax pot was used to cover parts of metal that were not going to be painted.

AOC 48 - Degreaser and Parcolube Pit

AOC 48 is the former location of a vapor degreaser and parcolube pit in the plating department. The pit was located on the southern wall of 11th Avenue between Columns 25W and 22W. The pit was 56 feet, 6 inches long, 8 feet, 9 inches wide, and 8 feet, 4 inches deep. The degreaser was used for the parcolube line and had an approximate 150-gallon capacity. A sump was located in the tank pit just west of Column 23W. The sump was 8 feet deep, with a maximum width of 4 feet, 8 inches. The sump was concrete lined with an 8-inch-thick wall and had a 36-inch manhole frame and cover (Drawing B-20, 1947).

AOC 49 - Degreaser Still

AOC 49 is the location of a degreaser still in the plating department on 11th Avenue. The still was located next to tank pits on the southern wall directly west of Column 22W (Drawing B-20, 1947).

AOC 50 - Drywell in Plating

AOC 50 is the former location of a drywell in the plating department on 11th Avenue between Columns 18W and 19W. The drywell received runoff from drains located in the paint shop within the plating department. A paint spray booth located north of 11th Avenue on 12th Avenue near Column 18W south could also have drained through a drain located on the 11th Avenue North wall. This drain also

discharges to the drywell (Drawing C-19, 1947). The drywell had a sand bottom and was 10 feet, 6 inches deep with an 8-inch thick brick wall and 24-inch manhole cover and frame (Drawing B-14, 1947).

AOC 53 - Pit and Sump in Heat Treating

AOC 53 is the location of a sump in a pit in the heat treating department on 11th Avenue between Columns 5E and 6E (Drawing A-7, 1947).

AOC 54 - Sludge Pit

AOC 54 is the former location of a sludge pit in the paved court off 11th Avenue between Columns 16E and 17E outside the heat treat department. The sludge pit discharged to the storm sewer located to its west (Drawing C-20, 1947). It is not known what kind of sludge was collected in this pit. The area is currently covered with asphalt. There are two storm sewers in the vicinity.

AOC 55 - Drywell in Paved Court

AOC 55 is a drywell located in the paved court outside 11th Avenue between Columns 17E and 18E (Drawing C-20, 1947).

AOC 58 - Vapor Degreaser

AOC 58 is the location of a former vapor degreaser in the middle of 11th Avenue between Columns 4W and 3W North. The degreaser, which was located in the non-destructive testing area, was in a 9-foot long by 7-foot, 6-inch wide by 3-foot, 4-inch deep pit. The degreaser, which was 4 feet, 2 inches wide, was located in the southwestern corner of the pit. The pit had a 6-inch thick concrete wall and floor (PE 334, 1968). The location of the degreaser pit has been filled in with concrete. An above-ground aqueous cleaning system currently exists in the area.

AOCs 20 and 59 - Machine Oil Sumps

AOCs 20 and 59 are the present locations of two sumps that contain machine oil. The sumps are located on 6th Avenue 6NW and 6th Avenue 12 NE. The sumps are 3 feet long by 4 feet wide concrete vaults with a 1-inch diameter, 60-inch deep steel tub that contains the machine oil. A pump pulls the oil up into the machine, which is located directly above the sump, and then the oil drips from the machine back into the sump. A current employee indicated that the sumps are approximately 20 to 25 years old.

AOC 60 - Plating Chemical Storage

AOC 60 is the former location of the plating chemical storage area. Materials were labeled upon receipt and stored in their shipping containers. Items were segregated by type (acids, bases, solvents, etc.) into individually diked rooms (Envirodyne, 1983). This room is located at 23rd Avenue South Column 19W and is currently closed off with concrete blocks (Site visit August 10, 1995). The AOC was added in February 1996.

AOC 61- Oil/Solvent Storage Room

AOC 61 is the former location of an oil/solvent storage room which has also been called the flammable material storage area. The site is located at 22nd Avenue North between Columns 15W and 19W. During its period of operation, drums were stored in the room on their sides in racks. No flammable materials were stored in this area after 1991. As seen during the site visit conducted on August 10, 1995, the area is currently used for storage of nonhazardous materials. No floor drains were observed inside the storage room. A paint mixing room is located next to the storage area. The AOC was added in February 1996.

AOC 62 - Cyanide Storage

AOC 62 is the former location of a cyanide storage area. The site was located on 22nd Avenue North between Columns 20W and 21W. Cyanide was stored in drums that sat on pallets from 1973 to 1988 in an individually diked room. In 1988, the storage of cyanide ceased (Site visit August 10, 1995). Currently, the site is used for storing controlled nonhazardous waste. The AOC was added in February 1996.

AOC 63 and 64 - Pepset Tanks

AOCs 63 and 64 were the locations of 6,000-gallon, above-ground Pepset tanks. The tanks were located on the far east end of 22nd Avenue. Pepset is a phenolic-based resin binder used in molding sands. Various formulations consist of aromatic and aliphatic hydrocarbons, phenol, formaldehyde, polumeric diisocyanate, and pyridine (Envirodyne, 1983). The AOCs were added in February 1996.

AOC 65 - Waste Compactor

AOC 65 is the location of a waste compactor on the west end of 10th Avenue (Drawings A-3, B-1 and B-10, 1947). Currently, the site is used for hazardous waste storage. A new compactor is presently in use for municipal refuse compaction before being taken to a landfill. The AOC was added in February 1996.

AOC 66 - Incinerator Charging Room

AOC 66 is the location of an incinerator on the east end of 9th Avenue (Drawings B-2 and B-12, 1947). The incinerator was used for burning paper waste. According to present employees, the incinerator was also used in the past to burn TCE. The incinerator was shut down in 1969 (Site visit August 10, 1995). The AOC was added in February 1996.

AOC 67 - No. 2 Diesel Fuel Storage Tank

AOC 67 was the former location of a 500-gallon, No. 2 diesel fuel, below ground storage tank (Envirodyne 1983). The tank was located in the Diesel Room on 17th Avenue and was located just west of Column 1W (Drawing C-31, 1947). The AOC was added in February 1996.

AOC 68 - Industrial Wastewater Treatment Plant

AOC 68 was located adjacent to the East Plating Shop and was used to treat wastewater generated from metal plating operations. The treatment system was modernized in 1973. The rinse and plating solution tanks were drained below the floor of the plating shop into holding tanks for each of the four major categories of liquid waste (acid, caustic, chromium, and cyanide). Contents of the holding tanks were then manually or automatically pumped to the appropriate treatment unit prior to discharge to the sewer system. Separate collection, transfer and treatment units were provided for each major waste category. The continuous treatment system automatically treated approximately 100,000 gallons per day of liquid plating wastes (rinse water and spent plating solutions). The treatment plant employed chemical treatment to destroy cyanide, reduced hexavalent chromium to the trivalent state, neutralize acids and alkalis, and precipitate heavy metals. Sludge containing the heavy metal ions was drummed and retained in the fenced NIROP hazardous waste staging area prior to final disposition in an approved landfill. The treatment operation during the 1980s generated approximately 12 to 24 barrels of sludge annually. Clarified wastewater was discharged to the sanitary sewer. The AOC was added in February 1996.

AOC 69 - Trichloroethene Tank

AOC 69 is a trichloroethene tank formerly located on 21st Avenue near Column 2W. The AOC was added in January 1997.

AOC 70 - Vertical Boring Machine Sump

AOC 70 is vertical boring machine sump located on 7th Avenue near Column 27W. The AOC was added in January 1997.

AOC 71 - Drywell

AOC 71 is a drywell located in the fuel oil tank farm on the east side of the building. The drywell had been previously identified as from the UDLP SWMU list as SWMU No. 9. The AOC was added in January 1997.

AOC 72 - Waste Oil/Solvent Storage Tank

AOC 72 is a waste oil/solvent storage tank on 9th Avenue at the easternmost side of the building. The tank has a capacity of 1,000 gallons and the contents are injected into the boiler system. The tank had been previously identified as RCRA Permit SWMU No. 5. The AOC was added in January 1997.

AOC 73 - Coolant Recycling System

AOC 72 is a coolant recycling system on 11th Avenue near Column 29W. The system was installed in the mid-1970s. The system had been previously identified as RCRA Permit SWMU No. 9. The AOC was added in January 1997.

AOC 74 - Solvent Distillation Unit (Paint Room Kitchen)

AOC 74 is a solvent distillation unit located on 23rd Avenue between Column 14W and 15W in the Paint Room "Kitchen." Two units were installed in mid 1980s and were removed in 1993. The unit had been previously identified as RCRA Permit SWMU No. 15. The AOC was added in January 1997.

AOC 75 - 1,1,1 - TCA Distillation Unit

AOC 75 is a 1,1,1 - TCA distillation unit located on 22nd Avenue at Column 20W in the Controlled Waste Storage Room. The unit was installed in the mid 1980s and removed in1993. The unit had been previously identified as RCRA Permit SWMU No. 16. The AOC was added in January 1997.

Sanitary Sewer

The sanitary sewer system at NIROP was installed during the original site development. The lines are 4 to 6 feet below ground surface (bgs) on the northern end of the plant and 8 to 10 feet below ground surface on the southern end. The sewer system consists of various sizes of vitrified clay pipe that was installed in 3-foot sections. Reportedly, the joints were concrete grouted (Envirodyne, June 1983). The sewer system carried domestic and treated and untreated industrial wastes with a single 15-inch connection point to the Pig's Eye Plant.

In 1974, 600 gallons of TCE were allegedly discharged into a floor drain around the plating department. An employee indicated that the floor drain led to the sanitary sewer and that TCE was detected in an interceptor approximately 1 mile down the sewer line.

On August 11, 1984, approximately 200 gallons of TCE was released from a vapor degreaser in the plating department. The TCE flowed into a sump; a portion of the solvent was contained by the baffles, and some was pumped into the treatment system and possibly into the sanitary sewer.

The condition of the clay pipes that make up the sanitary sewer system for the plant is unknown. TCE discharged to the sanitary sewer system could have leaked to the soil if there were cracks in the pipe. Production areas within the NIROP facility discharged waste liquid directly to the sanitary sewer. These consisted of wastewater containing cyanide and metals generated by plating operations; spent cooling solutions from the machine shop; spent alkaline cleaner and phosphating solution used to clean parts in the paint shop; wash water containing detergents for cleaning small quantities of parts in the assembly area; water-based oils generated in the heat treating department; and wastewater from the boilers in the boiler plant (Envirodyne, June 1983). TCE discharge to the sanitary sewer was not specifically mentioned, but based on the amount of waste liquid discharged, the possibility exists that TCE was also intentionally discharged to the sanitary sewer through a manhole or drain. In addition, TCE spills have been documented in the assembly department, non-destructive testing area, and plating department for the 1980s. The only portion of the sanitary sewer system that is not of potential concern is the commissary located on the east side of 22nd and 23rd Avenues where there was no known TCE usage.

Storm Sewer

Current employees indicated that portable wash tanks that contained TCE were used throughout the plant. A crew cleaned and collected the sludge that settled in the bottom of these tanks. The tanks were 4.5 feet long by 2 feet wide and could store 30 to 50 gallons of TCE. Approximately 38 to 45 smaller degreasing tanks scattered throughout the assembly area contained Stoddard Solvent. Also, approximately 12 larger

degreasing units (75-gallon capacity) were located in the assembly area. Six of the larger units contained TCA, and the remaining contained Stoddard Solvent (Envirodyne, 1983). Possible spillage of these tanks could drain to the storm sewer system through manholes and drains located throughout the plant.

Several documented spills occurred in the NIROP facility between 1984 and 1986 that may have resulted in discharge of chemicals to the storm sewer system. Among these spills were a spill of 15 gallons of TCE from a tank in the assembly department; 200 gallons of TCE in the plating department; 15 gallons of TCE in the assembly department; 7 gallons of TCA from a ruptured hose in the assembly department; and 2 gallons of TCE from a loose filter in the assembly department in 1984. In 1985, 520 gallons of TCE were discharged during a steam valve leak in the non-destructive testing area. In 1986, 1 gallon of TCE was spilled when a portable tank was overfilled, 2 gallons of TCE were spilled in the non-destructive testing area when a maintenance hose fell out of a drum upon cleanout, and 25 gallons of TCE were lost to the floor in the plating department when a large vapor degreaser still float valve malfunctioned. Appendix A contains a copy of the NIROP spill history for 1984, 1985, and 1986 and several spill reports from 1984 and one from 1981.

The condition of the storm sewer system is unknown. Contaminants that entered the storm sewer could have leaked to the soil if there were cracks in the sewer pipe. The potential AOCs discussed above encompass most of the NIROP facility. Spills have been documented in the assembly department, non-destructive testing area, and plating department for the 1980s. Spills are likely to have occurred at NIROP from the 1940s through 1970s in similar production areas where TCE was transported or used.

1.3 REPORT ORGANIZATION

This Phase I RI Report for NIROP Fridley is divided into eight major sections. This introduction is Section 1.0. A description of the field investigation activities is presented in Section 2.0. The physical characteristics are described in Section 3.0. The nature and extent of contamination are described in Section 4.0. Contaminant fate and transport are described in Section 5.0. The baseline risk assessment is described in Section 6.0. The model used for the contaminant transport through the unsaturated zone beneath the building is described in Section 7.0. The conclusions and summary of the report are included in Section 8.0.

Appendix A provides field documentation, including sample log sheets for soil and groundwater samples, IDW samples and chain of custody forms. Appendix B provides boring and well records, including boring logs, direct push triangulation maps, monitoring well construction sheets, certificates of performance, and MDH well and boring records.

Appendix C contains aquifer characteristic calculations, including monitoring well development measurements, ground water level measurements, aquifer test data and calculations and hydraulic gradient and groundwater flow velocity calculations. Appendix D contains field screening methods and results. Appendix E contains a printout of the analytical database. Appendix F contains data validation memorandum. Appendix G contains supporting information for the human health risk assessment. Appendix H is a copy of the North 40 Removal Action report. Appendix I is a copy of the revised OU2 SESOIL modeling results. Appendix J provides a copy of the OU3 SESOIL modeling results.

TABLE 1-1

CHRONOLOGICAL SUMMARY OF EVENTS
NIROP FRIDLEY, MINNESOTA

Date	Event
1940 - 1941	Naval ordnance manufacturing facility was constructed.
1947	U.S. Navy purchased what is now the Federally-owned portion of NIROP.
1942 - 1964	Northern Ordnance, Inc., a subsidiary of Northern Pump Company, operated the naval ordnance manufacturing complex.
1964	FMC Corporation purchased the southern portion of the manufacturing facility property from Northern Pump Company.
Early 1970s	Limited disposal at NIROP of paint sludge and chlorinated solvents in pits and trenches was performed.
1980	
September	U.S. Navy implemented the NACIP program to identify and control environmental contamination from past use and disposal practices.
1981	
March	Anonymous phone call to the MPCA regarding disposal practices at the FMC-operated facility.
March 16 - April 23	Three production wells at the site were sampled by the MPCA. Analysis results showed 0.035 to 0.200 milligrams per liter (mg/L) of TCE detected (RMT, July 1988).
April 24	Wells FMC-1 and NIROP -2 and -3 were discontinued for drinking water usage. Well FMC-1 was intermittently used for process cooling water until June 1983.
December 31	TCE was detected at 0.0012 mg/L at the Minneapolis water supply intake. Earlier in 1981, TCE was detected at unquantifiable levels during four sample rounds.
	Storm sewer outfalls were sampled for several constituents. Quantifiable levels of volatiles were detected in the sanitary sewer and at National Pollutant Discharge Elimination System (NPDES) outfall 20200.
	The site was divided into the North Study area (government-owned property) and South Study Area (FMC-owned property) for additional investigations by Hickok and Associates (Hickok, 1981).
1982	
March 31	Investigation of the North Study area began.
1983	
May	U.S. Navy authorized the Installation Restoration (IR) Program.
June	Initial Assessment Study (IAS) for the NIROP site was completed by Envirodyne Engineers (June 1983).
	As a result of the IAS, the U.S. Army Corps of Engineers (USACE) was assigned to manage site remediation. The Corps installed 33 monitoring wells on and around the site over the next 3 years.

TABLE 1-1

CHRONOLOGICAL SUMMARY OF EVENTS
NIROP FRIDLEY, MINNESOTA

Date	Event
1983 - 1984	
November - March	Approximately 1,200 cubic yards of soil considered hazardous and 43 drums were excavated from the North 40 area and disposed of at an offsite Resource Conservation and Recovery Act (RCRA)-permitted facility. Samples were analyzed from the soils at the base of each excavation. Trenches 3, 6, and 7 showed greater than 1 mg/L total volatiles.
May 22, 1984	The MPCA issued a Request for Response Action at the site to the U.S. Navy and FMC Corporation.
1983 - 1986	Eight rounds of groundwater sampling were completed. The last round was conducted in November 1986 by RMT, Inc. (RMT).
1986	
June	RMT, Inc. was retained by the USACE to complete the Remedial Investigation/Feasibility Study for OU1 (groundwater).
	FMC established an agreement with the MPCA to pump contaminated groundwater until total volatile levels in certain wells were less than 0.270 mg/L. Pumped water was discharged to the Pig's Eye Wastewater Treatment Plant.
1987	
March	All use of trichloroethene at NIROP was discontinued. 1,1,1-trichloroethane was put into use in place of trichloroethene.
June	Remedial Investigation Report (RMT, June 1987) issued for OU1.
September	During excavation of an onsite utility trench, a strong odor was detected in the trench by construction workers. Soil exposed during the excavation was later monitored by MPCA using an HNu photoionization detector (PID). The trench is along the northern property line of NIROP.
	An anonymous phone call to FMC directed the MPCA's attention to a potential hazardous waste site in the vicinity of the Dealers Manufacturing facility located approximately 1,000 feet to the east of NIROP.
November	Results of soil pore gas survey included in the A-E Quality Control Summary Report for the Soil Gas Survey (RMT, February 1988).
1988	
July	Feasibility Study Report (RMT, July 1988) issued for OU1.
1989	
February 8	The U.S. Navy established the Technical Review Committee (TRC) for the project and convened the first meeting.
July 14	NIROP listed as a proposed site on the NPL by the USEPA.
November 21	NIROP listed as a final site on NPL by USEPA.

TABLE 1-1

CHRONOLOGICAL SUMMARY OF EVENTS
NIROP FRIDLEY, MINNESOTA

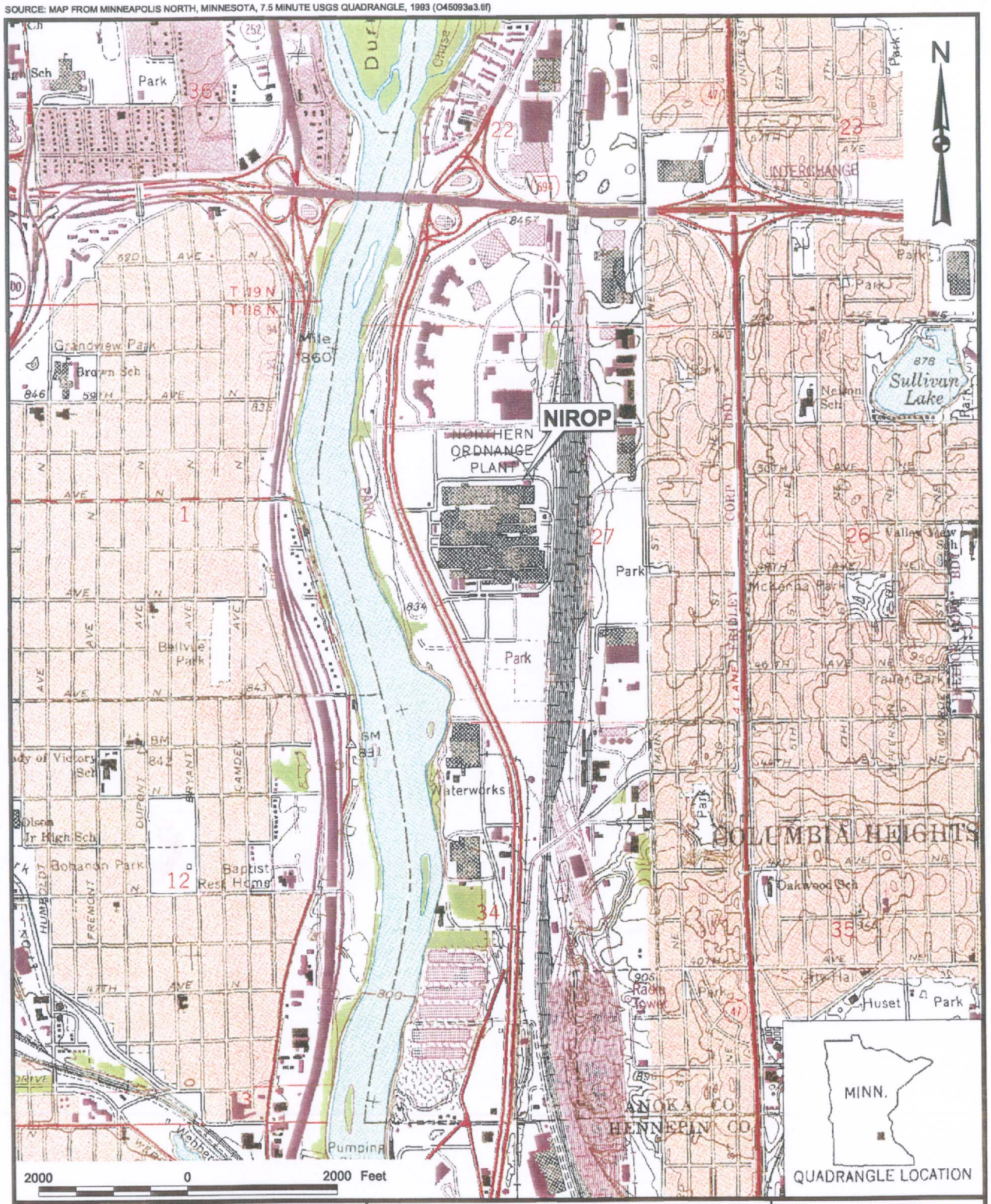
Date	Event
1990	
September	A Record of Decision (ROD) was signed for OU1. A groundwater pump-and-treat alternative was the alternative selected in the ROD.
October - November	Fifty-five soil borings were advanced to assess the extent of soil contamination in four specific areas (background area, North 40 area, Hazardous Waste Storage Area C, and the southeast area near Well 9-S). The North 40 area included 22 soil borings to investigate potential soil contamination due to past disposal practices, the locations of former Hazardous Waste Storage Area C included 28 soil borings to investigate potential soil contamination associated with the storage area, and the Southeast Area included four soil borings to attempt to delineate the source(s) of volatiles reported in groundwater monitoring wells in the area. The results reported the highest concentrations of volatiles, up to 62,000 micrograms per kilogram (µg/kg), from near the decontamination pad (RMT, February 1991)
1991	
March	Federal Facility Agreement (USEPA, March 1991) issued for NIROP Fridley
August	An initial aerial photographic review was conducted by RMT staff that included photographs spanning the period from 1945 to 1977.
	The installation of four groundwater recovery and containment wells, as well as additional groundwater monitoring wells, was completed in late 1991 for OU1.
December	A second review of the aerial photographs, including additional photographs, was performed jointly by representatives of the Navy, the USEPA, the MPCA, FMC, and RMT. As a result of the review and subsequent discussions, additional areas of investigation were included as part of the OU2 Remedial Investigation.
1992	
January	A Remedial Action Work Plan (RMT, January 1992) was issued for OU2. The RI of the soils operable unit addresses soil contamination in the unsaturated zone (i.e., above the water table) in areas of NIROP Fridley that are not covered by buildings or other surface structures. The scope of the soil RI was intended to investigate potential outdoor sources that may contribute to groundwater contamination.
August 20	Emergency Removal Operation (Bay West, August 1992) report issued which discussed the investigation of the area referred to as the North 40 area. A total of 31 drums were excavated, sampled, and overpacked, and the drums, along with approximately 900 cubic yards of soil and debris, were removed from the excavation. Excavated drums were disposed of via incineration at USEPA Superfund RCRA-licensed facility. Associated debris (screened material) was disposed of at a sanitary landfill or a RCRA-secure landfill according to analytical results.
September	The groundwater recovery system and monitoring for OU1 were started.
December	A 90-Day Determination Document (RMT, December 1992) was prepared which evaluated the effectiveness of the OU1 recovery system's operation over the first few months.
1993	
September	A Remedial Investigation Report (RMT, September 1993) was issued for OU2. Results indicated that volatile, semivolatile, pesticide, hydrocarbon, and metal contamination was present in the soils at several locations.

TABLE 1-1

CHRONOLOGICAL SUMMARY OF EVENTS
NIROP FRIDLEY, MINNESOTA

Date	Event
1994	
September	Results of East Plating Shop soil sampling were issued to the Southern Division of the Naval Facilities Engineering Command (NAVFACENGCOM) in a letter report (Bay West, September 1994). Two soil borings were completed, and several metals and cyanide were identified at concentrations greater than background levels determined during the OU2 RI.
1995	
March	A Work Plan (Halliburton NUS, March 1995) was issued for the East Plating Shop. Proposed field activities for the soil and groundwater investigation included the installation of six soil borings and three temporary monitoring wells.
April 16	First NIROP Fridley Restoration Advisory Board meeting was held.
May	Results of East Plating Shop soil and groundwater investigation were issued (Halliburton NUS, May 1995). The report identified soil and groundwater contamination under the East Plating Shop. TCE was the primary contaminant found. Other volatile organic compounds, including 1,1,1-trichloroethane (TCA), acetone, styrene, and metals such as chromium, lead, and cyanide, were detected at concentrations greater than background levels determined during the OU2 RI.
June	Thirty former areas of concern, located within the NIROP facility, were identified on a Solid Waste Management Unit (SWMU) map (UDLP, June 1995).
September	Results of a site evaluation conducted at the NIROP facility in August 1995 were presented in the Site Evaluation Report (Brown & Root Environmental, September 1995). Fifty-nine areas of concern, the sanitary sewer system, and the storm sewer system were identified as potential areas requiring further investigation.
1996	
February	Revisions to the Final Site Evaluation Report (Brown & Root Environmental, September 1995) identified nine additional potential areas of concern (AOCs 60-68) which were identified but not previously reported because they were not suspected sources of TCE contamination.

SOURCE: MAP FROM MINNEAPOLIS NORTH, MINNESOTA, 7.5 MINUTE USGS QUADRANGLE, 1993 (O45093a3.tif)

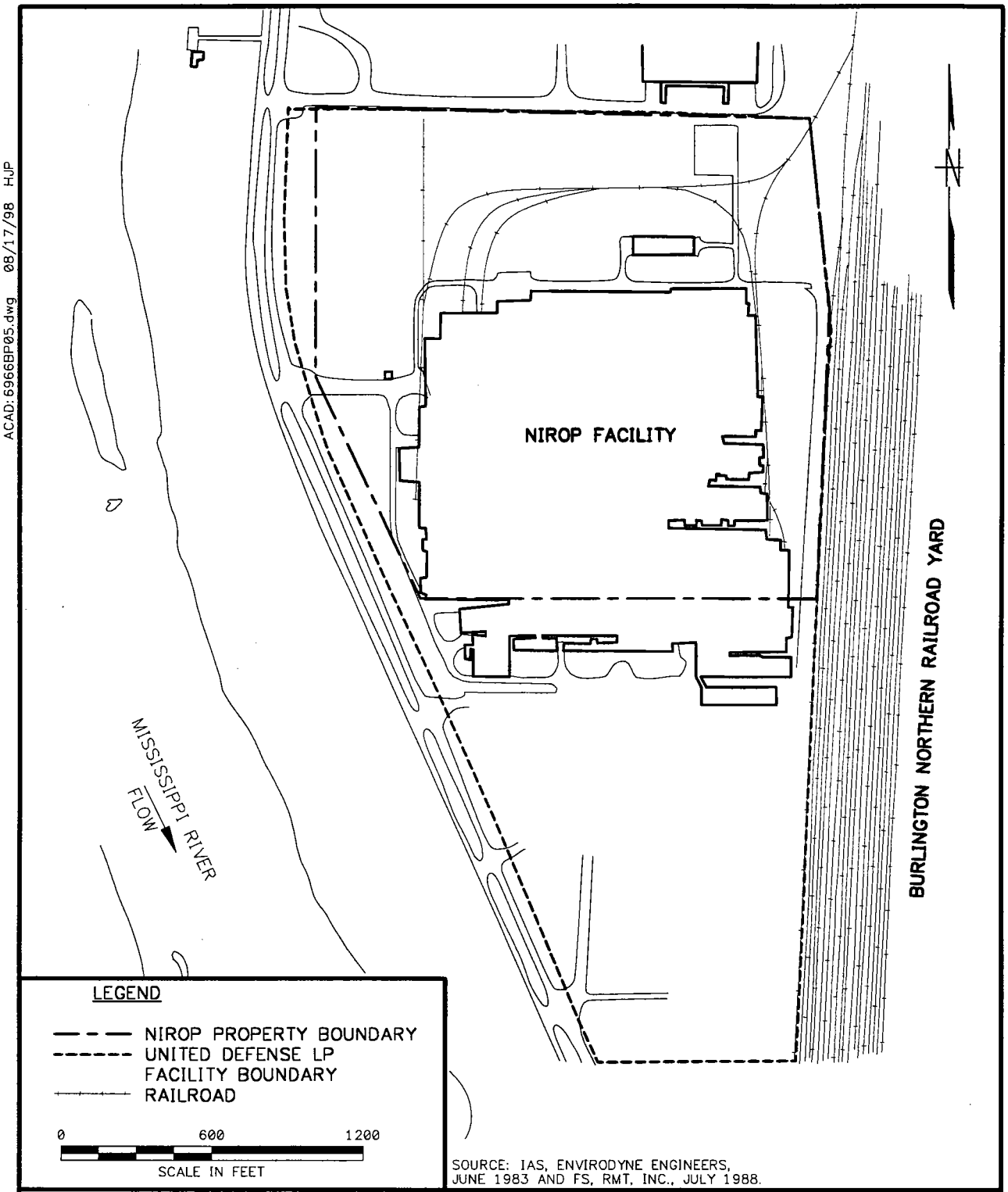


DRAWN BY D. PERRY	DATE 12-AUG-98	SITE LOCATION MAP NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA	CONTRACT NUMBER —
CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY DATE 8/12/94
SCALE AS NOTED			DRAWING NO. FIGURE 1-1 REV 0

DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD

P:\GIS\FRIDLEY\6966_SITE_ASSESSMENT.APR 12-AUG-98 DNP LOCATION MAP LAYOUT

ACAD:6966BP05.dwg 08/17/98 HJP

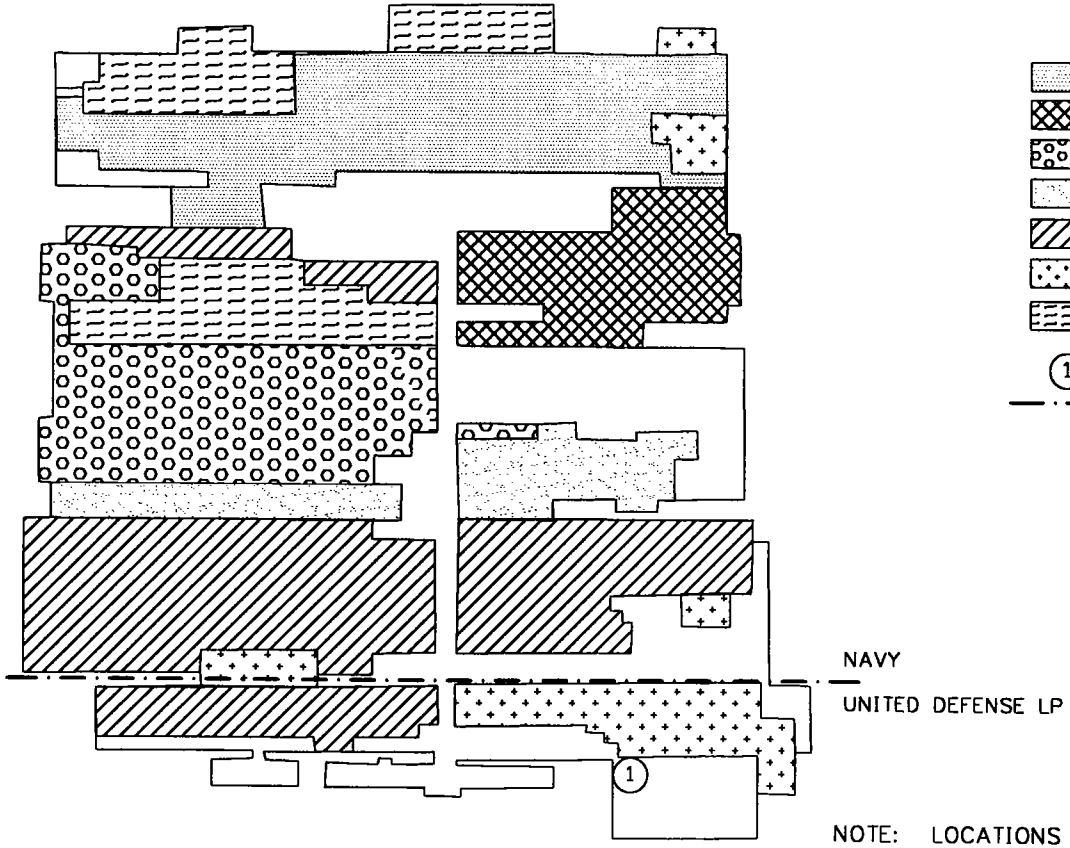


SOURCE: IAS, ENVIRODYNE ENGINEERS, JUNE 1983 AND FS, RMT, INC., JULY 1988.

DRAWN BY HJP 8/17/98	Tetra Tech NUS, Inc.	CONTRACT NO. 6966	OWNER NO. ----
CHECKED BY DATE	PROPERTY BOUNDARIES NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA	APPROVED BY	DATE
COST/SCHED-AREA		APPROVED BY	DATE 8/12/99
SCALE AS NOTED		DRAWING NO. FIGURE 1-2	REV. 0

FORM CADD NO. TtNUS_AV.DWG - REV 0 - 1/22/98

ACAD: 6966/95090501.dwg.DWG 10/09/97 HP



LEGEND

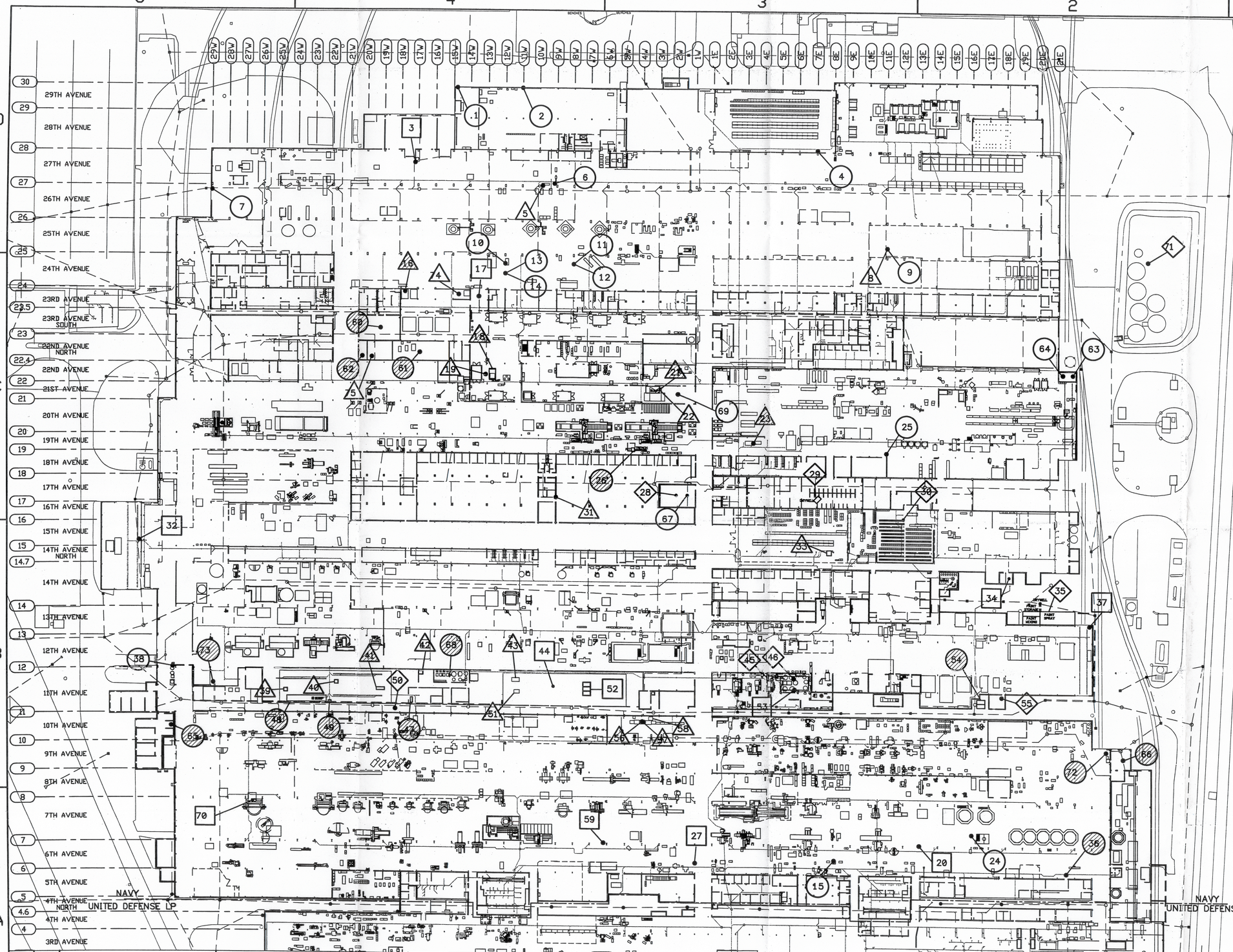
- ASSEMBLY & PAINTING
- FOUNDRY
- WELDING
- HEAT TREAT & PLATING
- MACHINE SHOP
- TEST & INSPECTION & QA
- SHIPPING, RECEIVING & STORAGE
- (1) PHOTO LAB
- PROPERTY LINE

NOTE: LOCATIONS OF THE PRODUCTION AREAS HAVE VARIED OVER TIME. THE DATE OF THE PROCESS AREA LAYOUT SHOWN IS NOT KNOWN.

REFERENCE: REMEDIAL INVESTIGATION REPORT, RMT, JUNE 1987

DRAWN BY HJP DATE 8/18/98	Tetra Tech NUS, Inc.	CONTRACT NO. N62467-94-D-0888	TASK NO. 0034
CHECKED BY DATE	FORMER INDUSTRIAL PROCESS AREAS WITHIN THE MAIN INDUSTRIAL PLANT BUILDING NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA	APPROVED BY	DATE
COST/SCHED-AREA		APPROVED BY	DATE 8/12/99
SCALE N.T.S.		DRAWING NO. FIGURE 1-3	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97



AOC	Description	Reference
1.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
2.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
3.	Sump in Receiving Area	Drawing A-7, 1947
4.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
5.	1,1,1-Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
6.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
7.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
8.	1,1,1-Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
9.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
10.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
11.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
12.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
13.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
14.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
15.	Holding Tanks	Interview with current employees, August 18, 1995
16.	Vapor Degreaser and Sump	United Defense SWMU Map, June 23, 1995
17.	Wash Rack Sump	United Defense SWMU Map, June 23, 1995
18.	Vapor Degreaser and Sump	Drawing PE 898, 1984
19.	1,1,1-Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
20.	Machine Oil Sump	Interview with current employee, August 24, 1995
21.	Vapor Degreaser and Sump	Drawing PE 898, 1984
22.	1,1,1-Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
23.	Vapor Degreaser and Sump	United Defense SWMU Map, June 23, 1995
24.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
25.	1,1,1-Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
26.	Solvent Bath Pit and Trench	Drawing PE 144, 1965
27.	Sump for Gun Assembly	Interview with retired employee, August 23, 1995
28.	Drywell in Diesel Room	Drawing C-31, 1947
29.	Pit and Drywell in Foundry	Drawing PE 158, number 2373-F, 1965
30.	Drywell in Machine Shop	Drawing PE 43, 1963
31.	1,1,1-Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
32.	Oil/Water Separator Sump	United Defense SWMU Map, June 23, 1995
33.	Degreaser Pit in Foundry	Drawings PE 158, number 2373-F, 1965 and PE 351, number 2868-F, 1968
34.	Sump in Maintenance	Drawing C-28, 1948
35.	Paint Storage, Mixing and Spray and Drywell	Drawings A-3 and C-28, 1947
36.	Paint Spray Pit	Drawing A-7, 1947
37.	Methanol Sump	Interview with retired employee, August 23,1995
38.	Trichloroethane Tank and Distribution System	Drawings A-3, 1947 and PE 221, 1986
39.	Vapor Degreaser Pit	Drawing PE 546.2, 1975
40.	Vapor Degreaser Pit	Drawings PE 1002 Sheet 1, 1986 and PE 546.2, 1975, and FMC Interoffice Trichloroethene Survey, March 1981
41.	Vapor Degreaser Pit and Sump	Drawings PE 1002 Sheet 1, 1986 and PE 546.2, 1975, and FMC Interoffice Trichloroethene Survey, March 1981
42.	Degreaser Pit	Drawing B-28, 1947
43.	Vapor Degreaser	FMC Interoffice Trichloroethene Survey, March 1981; and Drawing B-28, 1947and PE 444.7 Sheet 14, 1973
44.	Sump Pit in Plating	Drawings A-7 and B-28, 1947 and PE 1125.5, 1991
45.	Drywell in Heat Treating	Drawing C-28, 1947
46.	Drywell in Heat Treating	Drawing C-28, 1947
47.	Degreaser Still	Drawing PE 383, 1968
48.	Degreaser and Parcolube Pit	Drawings PE 383, 1968 and A-3, B-7and B-14, 1947
49.	Degreaser Still	Drawing B-28, 1947
50.	Drywell in Plating	Drawings A-3 and A-7, 1947, and PE 546.2 sheet 2, 1975
51.	Vapor Degreaser	FMC Interoffice Trichloroethene Survey, March 1981, and Drawings B-28, 1947 and PE 444.7 Sheet 14, 1973
52.	Sumps in Plating	Drawing PE 1125.5, 1991
53.	Pit and Sump in Heat Treating	Drawing A-7, 1947
54.	Sludge Pit	Drawings A-7, B-15, and C-28, 1947
55.	Drywell in Paved Court	Drawing C-28, 1947
56.	1,1,1-Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
57.	1,1,1-Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
58.	Vapor Degreaser	FMC Interoffice Trichloroethene Survey, March 1981, and Drawings PE 178, 1965 and PE 334, 1968
59.	Machine Oil Sump	Interview with current employee, August 24, 1995
60.	Plating Chemical Storage	United Defense SWMU Map, June 23, 1995
61.	Oil/Solvent Storage Room	United Defense SWMU Map, June 23, 1995
62.	Cyanide Storage	United Defense SWMU Map, June 23, 1995
63.	Pepsat Tank	Initial Assessment Study, Envirodyne, June 1983
64.	Pepsat Tank	Initial Assessment Study, Envirodyne, June 1983
65.	Waste Compactor	Drawings A-3, B-1 and B-18, 1947
66.	Incinerator Charging Room	Drawings B-2 and B-12, 1947
67.	No. 2 Diesel Fuel Storage Tank	Initial Assessment Study, Envirodyne, June 1983; Drawing C-31, 1947
68.	Industrial Wastewater Treatment Plant	Initial Assessment Study, Envirodyne, June 1983
69.	Trichloroethene Tank	Interview With Current Employee, August 18, 1995
70.	Vertical Boring Machine Sump	Telephone Conversation With United Defense LP
71.	Drywell	United Defense SWMU Map, June 23, 1995
72.	Waste Oil/Solvent Storage Tank	RCRA Permit, SWMU 5
73.	Coolant Recycling System	RCRA Permit, SWMU 9
74.	Solvent Distillation Unit in Paint Shop Kitchen	RCRA Permit, SWMU 15
75.	1,1,1-TCA Distillation Unit	RCRA Permit, SWMU 16

NOTE:

1. THE SANITARY SEWER SYSTEM AND STORM SEWER SYSTEM ARE ADDITIONAL AREAS OF CONCERN.

LEGEND

- STORM SEWER LINE
- SANITARY SEWER LINES
- ROOF DRAINS
- (12W) BUILDING SUPPORT COLUMN NUMBERS
- (1) AREA OF CONCERN (AOC) LOCATION
- PROPERTY LINE
- [34] SUMP
- (30) DRYWELL
- (33) DEGREASER
- (9) TANK
- (74) MISCELLANEOUS
- (42) DEGREASER AND SUMP
- TCE DISTRIBUTION SYSTEM

REV.	DATE	DESCRIPTION	REFERENCE	DWG. NO.	DATE
			BASE MAP PROVIDED BY UNITED DEFENSE, 1995		

0 60 120
SCALE IN FEET

ACAD:6966bp06.dwg 08/18/98 HJP 6966BP01.LAY

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

TITLE
SITE PLAN AND AOCS
OU3 RI REPORT

NIROP — FRIDLEY, MINNESOTA

CLIENT	CONTRACT
SOUTHNAVFACENGCOM	N62467-94-D-0888 CTO 0063
SCALE: 1"=60'	DATE: AUGUST 1998
DRAWING NO.: FIGURE 1-4	SHEET 1 OF 1
AGFILE NAME: \6966\6966BP01.DWG	REV. 1

2.0 REMEDIAL INVESTIGATION ACTIVITIES

2.1 INTRODUCTION

This section presents the general sampling operations and methods used during the field portion of the NIROP Fridley, OU3 RI/FS. The site investigation and the analytical results provide a basis for assessing the environmental conditions and the presence or absence of environmental contamination.

All activities were conducted to meet requirements of the QAPP, Work Plan (WP) and FSP, and Site HASP for the RI/FS, NIROP Fridley, Minnesota, (Brown & Root Environmental, April, 1997, June 1997, June 1997, and June 1997, respectively), and according to the TtNUS Standard Operating Procedures (SOPs).

This section will also provide a summary of the sampling and analytical program which was followed for the East Plating Shop investigation that was conducted by Brown and Root Environmental. All activities associated with the investigation were conducted to meet requirements of the East Plating Shop Soil and Groundwater Investigation (Halliburton NUS, 1995).

2.2 SCOPE OF ENVIRONMENTAL INVESTIGATION

The scope of the environmental investigation was developed in Partnering Meetings between the USEPA, MPCA, and the US Navy. These meetings provided a dedicated forum for discussion of site specific objectives, and continue to this day. At these meetings, initial organization of the workplans was developed, and then later, comments and suggested modifications to the draft work plans were resolved in this forum. This has proven itself to be a more efficient method of addressing these issues than conventional document and letter exchanges.

Surface and subsurface RI activities took place from June 25, 1997 through March 25, 1998. The investigation activities consisted of surface and subsurface soil sampling; installation of shallow, intermediate, and deep groundwater monitoring wells in unconsolidated overburden; groundwater sampling from these newly installed wells; groundwater level measurements; and aquifer parameter testing. Table 2-1 lists all of the borings, temporary and permanent monitoring wells installed, and background locations taken at the NIROP Fridley facility during the OU3 RI/FS field event. The RI field event was divided into two phases, Phase I and Phase II, based on the sample collection techniques. The following two sections describe the activities performed in each of these two sampling phases.

Surface and subsurface investigation activities also took place in a previous investigation at the East Plating Shop in June 1995 as a part of the East Plating Shop Soil and Groundwater Investigation (B&R Environmental, 1995). A subsequent section briefly summarizes the field investigation activites which took place during this investigation.

Phase I

Phase I involved the collection of surface and subsurface soil samples and shallow groundwater samples. Phase I activities took place from June 25, 1997 through October 3, 1997. The soil sampling in Phase I was performed to (1) identify COPCs; (2) determine the concentration and general location of the COPCs; (3) evaluate the potential human health risk; (4) quantify the potential for migration of the COPC to groundwater; and (5) identify conditions that are indicative of the presence of free-product source areas. To achieve this task, a total of 48 soil borings were installed using direct-push techniques (DPT). See Figure 2-1 for the location of these borings. From each of these borings one surface soil sample and one subsurface soil sample were collected for fixed-base laboratory analysis. Additional soil samples were collected for onsite laboratory analysis (see Section 2.3.3). Each of these borings was then converted to temporary groundwater monitoring wells. These temporary wells were all screened just below the water table surface in the upper portion of the unconfined aquifer. (Please see Section 3.8 for a description of the hydrogeology in the vicinity of the NIROP.) Subsequently, a groundwater sample was collected from each temporary monitoring well. Background soil samples were also collected during this investigation phase. These background samples were collected at 10 locations using a stainless steel hand auger. These background samples were used to supplement background samples collected during the Operable Unit 2 Remedial Investigation (OU2 RI; RMT, 1993). A summary of the Sampling and Analytical Program for Phase I is illustrated on Table 2-2.

Phase II

Phase II involved the collection of additional geologic data and installation of permanent monitoring wells using the Rotosonic drilling methodology, collection of groundwater samples from these newly installed monitoring wells, aquifer testing, and groundwater level measurements. Phase II activities took place from October 3, 1997 through March 25, 1998. Data from Phase II of the investigation provided additional information on the subsurface lithology, the vertical and horizontal magnitude and extent of chemical concentrations in the groundwater, a better understanding of the conditions which might indicate the presence of DNAPLs, and engineering parameters for the evaluation of potential remedial alternatives. To achieve this task, six new permanent monitoring well clusters were installed. Each well cluster consisted of three permanent monitoring wells: one shallow well screened in the upper portion of the unconfined

aquifer, one intermediate well screened in the lower portion of the unconfined aquifer, and one deep well screened in the upper confined aquifer (totaling 18 wells). (Please see Section 3.8 for a description of the hydrogeology in the vicinity of the NIROP.) See Figure 2-1 for the location of these borings and monitoring wells. Groundwater samples were then collected from each of the 18 wells. A summary of the Sampling and Analytical Program for Phase II is illustrated on Table 2-3.

2.2.3 East Plating Shop Investigation

Field activities were conducted during construction activities at the East Plating Shop during April 1995. At that time the East Plating Shop was being renovated, allowing access to this area for environmental sampling. See Figure 2-1 for the location of the East Plating Shop. The East Plating Shop Soil and Groundwater Investigation included the installation of seven borings and three temporary wells (see Figure 2-2). At least three subsurface soil samples were collected from each soil boring. One groundwater sample was collected from each temporary well. Samples were analyzed for chemicals that were potentially used during past plating operations. Groundwater was analyzed for VOC, SVOCs, total and dissolved metals, cyanide, and pH. Soil was analyzed for VOCs, SVOCs, metals, cyanide, pH, and PCBs (Halliburton NUS, 1995). A summary of the Sampling and Analytical Program for East Plating Shop investigation is illustrated on Table 2-4.

2.3 GENERAL PROCEDURES FOR SURFACE AND SUBSURFACE INVESTIGATION

Detailed information regarding the development of the sample design, the associated assumptions used in its development, and the DQOs can be found in the FSP (B&R Environmental, June, 1997). All drilling and well installation activities were supervised by a field geologist. The following paragraphs summarize the methods and procedures used in conducting the OU3 remedial field investigation activities. For a summary of the field methods and procedures used during the East Plating Shop Investigation please refer to the summary report for that field investigation. Manual interpolation of the results was used to develop iso-concentration maps for this investigation. The Manual Interpolation was equivalent to kriging.

2.3.1 Mobilization/Demobilization

Following approval of the FSP, TtNUS began mobilization activities. All field team members reviewed the Work Plan (WP), FSP, QAPP, and HASP prior to the start of project activities. In addition, a field team orientation meeting was held to ensure that all personnel were familiar with the scope of the field activities.

Prior to the initiation of field work, the FOL and Site Safety Officer (SSO) arrived at the site on June 25, 1997 and began onsite mobilization activities. These activities included the clearing of drilling locations

with utility personnel, coordination with base personnel, purchasing expendable equipment, and preparation of the field trailer. The majority of the equipment required for the field activities was driven from the TtNUS Pittsburgh warehouse to the site. All site preparation was coordinated with NIROP Fridley personnel.

After field activities were completed, the FOL demobilized the equipment and field trailer. Every effort was made by TtNUS and its subcontractors to minimize impacts to the site while performing and at the completion of field activities.

2.3.2 Drilling Procedures

Three different methods of advancing soil borings were employed: DPT, Rotosonic drilling, and hand augering. Using DPT, 48 shallow soil borings were advanced for unsaturated soil sampling and later converted to temporary monitoring wells during Phase I. In Phase II, Rotosonic drilling techniques were used to install 18 shallow, intermediate, and deep well borings, which were converted into permanent groundwater monitoring wells. Background samples were collected using a stainless steel hand augering. DPT and Rotosonic drilling techniques are discussed below. Hand augering techniques are briefly described in Sections 2.3.3.3 and 2.6.1.

2.3.2.1 Direct-Push Technology

DPT involves pushing sampling tools hydraulically or mechanically downward into the ground to a desired depth. The DPT sampling tube used was 4 feet in length and 1.5 inch inside diameter Geoprobe-type core sampler lined with a disposable clear plastic liner. The DPT was used to advance the boring at 4-foot continuous intervals from the ground surface to top of the water table. In most cases, borings were advanced beyond the water table in an attempt to encounter the first confining layer below the water table. If no confining layer was encountered, the boring was advanced to the maximum penetration depth (approximately 20 to 60 feet bgs). The maximum penetration depth was dependent upon the density/cohesiveness of the soil and the power/weight ratio of the direct-push equipment or if the field geologist determined that the hole caved.

All samples obtained from the boreholes were monitored immediately upon opening the clear plastic liner containing the soil sample with a flame ionization detector (FID). These readings were recorded on the boring logs. In addition, lithological description of the sampled material, sample moisture, depth to water, total depth of each borehole, and any other pertinent observations were included on each log. Further information regarding soil sampling procedures is available in Section 2.3.3.

After the completion of the boring to the desired depth, each direct-push boring was backfilled to ground surface. See Section 2.3.4.1 for details on temporary monitoring wells and soil boring abandonment.

2.3.2.2 Rotosonic Drilling Technology

Rotosonic drilling was used for the collection of additional geologic data from the 6 deep well borings and the subsequent conversion of all shallow, intermediate, and deep borings to permanent 2 inch monitoring wells. The rotosonic drilling technique provided a viable alternative method to hollow-stem augers, cable-tool, and rotary drilling techniques for a number of reasons. Drilling proceeds rapidly through all types of complex geology, unconsolidated or consolidated, and provides a high-quality, 5-foot continuous core sample for accurate lithologic and hydrologic information. Investigation derived waste (IDW) such as drilling fluids and drill cuttings were kept to a minimum. In addition, the Rotosonic drilling equipment required a total ceiling clearance for the drilling mast of approximately 25 feet and could be mounted on 10-ton dollies. This clearance was significantly less than most other drilling techniques available. The Rotosonic technique combines vibrational and rotational forces to advance the drill stem. The high-frequency vibration generated in the drill head can be adjusted for various drilling conditions so that penetration rates can be optimized.

All of the borings were advanced using two separate drill pipes. The drill bit was attached to the base of the 4-inch inside diameter (ID), 4.5-inch outside diameter (OD), 10-foot-long core barrel. The core barrel was connected to drill pipe of the same ID. When the core barrel reached the desired depth, a larger diameter outer 6-inch OD (5.875 inch OD) drill pipe was advanced to the same depth. For deep well borings 5-foot core barrel runs were taken, for the most part, with the 10-foot core barrel. This was done to increase the sample quality and to ensure that a confining unit was not completely penetrated which would create a contaminant migration pathway if DNAPLs were present. The sample (which, at this point was inside the inner core barrel), the inner core barrel, and the drill pipe were then retrieved. The 5-foot core sample was extruded from the 10-foot core barrel using vibration and/or hydraulic pressure into a dedicated plastic sheath. Each deep well boring core sample was therefore completely enclosed in the clear plastic sleeve. This facilitated lithologic classification, environmental sample collection, and vapor monitoring. In addition, it greatly reduced the exposure of the drill crew to potentially contaminated drill cuttings. This process was then repeated to the termination point of each deep well boring. For all shallow and intermediate wells the contents of most cores (usually 10-foot long runs) were discharged directly into 55-gallon drums. This was done with the exception of core samples taken from the intermediate well screening interval where the field geologist chooses to view the core intact.

Telescoping the surface casing three times (to account for two separate confining layers) was not performed as originally proposed in the FSP. Instead, as approved by the Minnesota Department of Health (MDH), only a 4-inch core tube and the 6-inch over-ride casing was used for drilling and well installation. The drilling contractor maintained a slightly positive pressure head of potable water, when needed, in the annular space between the 4-inch and 6-inch casing while drilling. This created an upward gradient along the outside wall of the 6-inch casing thereby eliminating potential downward migration of contaminants during drilling. This change in scope was due to the added time and cost of drilling additional boreholes (8-and 10-inch) for installation and grouting of surface casing and the generation of approximately 1,000 gallons of IDW water and soil cuttings each time a single additional surface casing is required. In addition to greatly reducing the time and cost of well installation, the wells were installed much faster which further eliminated the potential for cross contamination of the aquifer(s).

Controlled amounts of water were added, where necessary, to the drill stem during drilling operations to flush out cuttings in the annular space between the two drill pipes, to flush out cuttings at the bottom of the borehole after sample collection, or for offsetting hydraulic pressures of heaving sands. Any excess water used during these processes was collected in a container below the elevated drilling platform.

2.3.3 Soil Sampling Procedures

This section discusses the soil sample collection and field soil screening procedure performed at the 48 shallow soil borings installed using DPT, the soil sample collection performed during the installation of the 6 well clusters, and the background soil samples taken at the NIROP facility.

2.3.3.1 Soil Sampling and Screening Procedures for Direct-Push Borings

At each of the 48 DPT locations, continuous soil sampling was conducted using a 1.5-inch ID Geoprobe-type core sampler. Upon retrieval, the entire soil sample was screened with an FID, visually classified for lithology, moisture and other pertinent observations, and collected for chemical screening and potential fixed-base laboratory analysis. The portion of the core with the greatest FID detection, and each significant change in lithology within a core, was separated into three aliquots to allow for high-resolution, vertical distribution screening in accordance with the following procedures:

1. On-site field gas chromatograph (GC) analysis: This analytical procedure was performed on samples collected from ground surface to the termination depth of all DPT borings *only*. Results of the field GC analysis were used to select appropriate samples for fixed-based analysis and to screen the extent of contamination in soils for the protection of groundwater below 12 feet.

2. Fixed-base laboratory analysis: For DPT borings, this analytical procedure was performed on samples based upon the field GC results and were collected from samples 0 to 12 feet below ground surface *only*. See the text below and Table 2-2 for the exact sample depths at each boring.

3. Ultraviolet (UV) fluorescence test: This field screening analytical procedure was performed on samples collected from the ground surface to the termination depth of both the DPT and deep well borings. UV fluorescence has been shown to be an effective tool in screening soil samples for the presence of non-aqueous phase liquids (NAPL) such as TCE and PCE (Cohen, 1993). Soil samples containing a significant amount of NAPL, illuminated a fluorescent (frequently milky-white) color. Results of the UV fluorescence were noted on the soil sample log sheets (see Appendix A.1).

The first soil sample submitted for fixed-base chemical analysis was collected from approximately 0 to 2 feet below the concrete flooring. The second sample selected for fixed-base chemical analysis was the sample within the 4 to 8 or 8 to 12 foot interval with the highest concentration detected via the field GC analysis. For this reason, it was necessary to collect a potential fixed-base sample aliquot from each 4 foot sample interval that was field screened with the FID to a depth of 12 feet. If the field GC screening was inconclusive, and no NAPL presence was detected with the UV fluorescence field screening within the 4 to 8 foot interval, the second sample for fixed-base analysis was from the 8 to 12 foot interval. See Table 2-2 for the exact sample depths at each boring.

Both soil samples submitted for fixed-base laboratory were analyzed for the following parameters: Target Compound List (TCL) VOCs, TCL SVOCs, TCL PCBs, Target Analyte List (TAL) metals, and cyanide. Representative soil samples were analyzed for TOC and hexavalent chromium. Details of the chemical analyses are provided on the Table 2-2. Samples slated for volatile analyses were collected first and immediately sealed in appropriate containers so that minimal head space existed. SVOCs, PCB, metals, cyanide, hexavalent chromium, and TOC samples were collected next (in this specified order) and placed into the appropriate sample containers.

Data shown in Appendix A.1 revealed that positive ultraviolet (UV) fluorescence test results were encountered at three locations (borings located at Areas of Concern 26, 28, and 32) during the OU-3 RI. The UV field screening test is a visual test to determine in Non-Aqueous Phase Liquids (NAPLs) may be present in the soil.

Although the UV test results indicated that NAPLs may be present at these locations, the analytical results did not indicate that the detected contaminants exceeded benchmark criteria (defined in the RI report). As a result, definitive conclusions cannot be determined if NAPLs exist. However, based upon the analytical results, it is unlikely that NAPLs are present at these locations.

Among several visual methods, the UV test has proven to be one of the most effective means for direct visual identification of NAPLs (Cohen et al., 1992, and Cohen et al., 1993). However, due to the qualitative nature of the test, it is important to note that the UV light test should be used as a screening tool only. As Cohen et al. (1992) noted, one false positive in 22 blank tests and 3 false negatives in 45 samples were encountered during the UV light test evaluation.

The effectiveness of the UV screening tool was verified in the field by adding a small amount of oil to a sample aliquot of soil and placing it under the UV light. The sample fluoresced (with a milky white color) indicating that the field test was effective. The results of this field evaluation test and samples from field borings (AOCs 26, 28, and 32, and others which did not illuminate under the UV light) were shown to the USEPA oversight contractor (i.e., Black &Veatch) in the field. The oversight contractor agreed with the findings.

2.3.3.2 Soil Sampling and Screening Procedures for Well Borings

At each of the 6 deep well borings, continuous soil sampling was conducted at 10-foot intervals (i.e., two 5-foot rotosonic cores) using the rotosonic drilling method. Soil sampling was not performed in the shallow and intermediate well borings due to their close proximity to the deep well borings at each given well cluster. Upon retrieval, the entire soil sample was screened with an FID, visually classified for lithology, moisture and other pertinent observations, and a representative sample was collected for fixed-base laboratory analysis of TCL VOCs UV fluorescence (as described above) analysis from the section of sample with the highest FID reading within each 10-foot interval. All relevant information was recorded on the boring logs and sample log sheets. Details of the exact sample depth and chemical analyses performed are provided on Table 2-3.

2.3.3.3 Background Soil Sampling Procedures

One soil sample was collected from each of the 10 OU2 investigation background locations and submitted to the fixed base laboratory for hexavalent chromium and TOC analyses. For all other analytes, EPA and MPCA have previously agreed to apply OU2 background sample concentrations. The samples were

collected from a depth interval of 1 to 3 feet bgs using a stainless steel bucket hand auger. Details of the chemical analyses are provided on the Table 2-2.

2.3.4 Monitoring Well Installation

This section discusses the installation and construction details of temporary and permanent monitoring wells. All groundwater monitoring wells were installed in accordance with the State of Minnesota well requirements. Appropriate permits and variances were filed MDH, in accordance with MDH Code 4725. A copy of MDH boring and well records can be found in Appendix B.5.

2.3.4.1 Temporary Well Installation and Abandonment

All 48 direct-push soil borings were converted to temporary groundwater monitoring wells. This was achieved by the placement of a 0.75-inch I.D. hardened steel riser pipe and vertical slotted well screen directly in the open borehole once the boring was advanced approximately 6 to 8 feet below the water table surface. The well screens used were either 2.2 or 3.5 feet long with a 0.5 foot steel punch on the bottom. In some cases, the well screen length used was doubled so that a sufficient amount of sample could be collected from low permeability zones. The bottom of well screen was installed 6 to 8 feet below the water table surface of the shallow aquifer. No sand pack or bentonite seal were placed around the screens of the temporary monitoring wells.

Once the groundwater sample was obtained from the temporary well (described further in Section 2.3.6.1), the well riser and screen were removed and the boring was continued to the termination depth (see Section 2.3.2.1 for additional details). Backfilling was performed by pumping a bentonite-cement grout through a tremie pipe from the bottom up to the ground surface.

2.3.4.2 Permanent Monitoring Well Installation and Construction

Six monitoring well nests were installed as a part of the OU3 investigation. Each monitoring well nest consists of three monitoring wells: a shallow water table well (S), an intermediate well (I), and a deep well (D). A list of these wells is shown on Table 2-1. All of the permanent monitoring wells were completed with the Rotosonic drilling rig. At each monitoring well cluster, the deep well was installed first to characterize the zone of investigation, from surface to bedrock, before selecting depths for the installation of the shallow and intermediate wells. Based upon this geologic information and field screening results the approximate depth for installation of the shallow and intermediate wells was selected.

The shallow monitoring wells were installed with 10-foot long screens to straddle the water table surface. The 10-foot screened section was placed approximately 2 feet above and 8 feet below the static water level as determined during drilling by the field geologist. All of the shallow wells were screened within the 17 to 29 feet interval bgs. The intermediate monitoring wells were all screened with a 5-foot well screen ranging from 63 and 96 feet bgs. The deep monitoring wells were installed immediately above the top of bedrock, all with 5-foot well screens ranging from 95 to 136 feet bgs. Please see Table 2-5 for a summary of the permanent monitoring well construction for all wells installed at the NIROP facility during the OU3 investigation.

All of the monitoring well borings were installed using a Rotosonic 4-inch core tube and the 6-inch OD override casing. A slightly positive pressure head of potable water was maintained, when needed, in the annular space between the 4-inch and 6-inch casing while drilling. This positive head pressure created an upward gradient along the outside wall of the 6-inch casing, thereby eliminating potential downward migration of contaminants during drilling (see Section 2.3.2.2 for further details).

All 18 monitoring wells were constructed of 2-inch ID, carbon steel, flush-joint riser pipe, and 5 to 10 feet long (as described above), flush-joint, factory-slotted 316 stainless steel well screen. Each section of casing and screen was National Sanitation Foundation (NSF) approved. The well screens had a slot size of 0.01 inches (10 slot) and were supplied with a flush-joint bottom cap. Once the screens and riser pipes were in place, the annulus of the boring was backfilled with U.S. Standard Sieve size of No. 20/30 clean silica sand from the bottom of the boring to a minimum of 1.6 feet above the top of the well screen. In all cases, the 6-inch override casing was used to hold the borehole open as the sand was emplaced around the well screen. Resonance created from the drill head vibration allowed the sand pack to settle consistently around the well. As the sand pack was installed, the override casing was slowly retrieved to ensure an adequate sand pack around the well. A bentonite seal consisting of bentonite chips (minimum 2-foot thickness) was then installed above the sand pack and allowed to hydrate in accordance with the manufacturer's recommendations. The remainder of the annulus of the borehole (from the seal to the ground surface) was grouted by pumping a high solids bentonite grout through a tremie pipe until the grout level reached the level where the concrete apron was to be emplaced. The depths of the backfill materials were constantly monitored during the installation of the monitoring wells by using a weighted, stainless-steel or plastic tape to ensure that no bridging of the sand pack or bentonite seals occurred during the installation process. The nominal diameter of the 2-inch monitoring well borings was 6 inches.

An at-grade (flush mounted) protective steel casing equipped with a sealed, locked, and appropriately labeled cap was installed around all wells. At-grade covers were installed in accordance with MDH Code 4725 requirements. One protective apron installed at each cluster included all three wells. Each apron

was constructed of industrial grade concrete to facilitate heavy loads and traffic (e.g. fork lifts, etc.). The apron was 5 to 7.5 feet wide, 14.5 to 18 feet long by 9 to 12 inches thick and approximately 2 inches above grade in the center and tapered to grade at the edges. Please see Appendix B.3 and B.4 for the permanent monitoring well construction diagrams and Certificate of Conformance sheets, respectively. Certificate of Conformance sheets were completed for each permanent monitoring well to document conformance to material specifications.

2.3.5 Well Development

Permanent monitoring wells were developed in a two-stage approach. The initial stage was conducted no sooner than 24 hours after well completion to remove fine material from the sand filter pack and immediate area around the monitored interval of the well. Wells were developed with the use of a submersible pump and periodic surging. The pH, temperature, turbidity, and specific conductance of the purged water were measured after each saturated well volume was removed or at the discretion of the field geologist. The wells were considered to be developed after the readings became stabilized based on the following criteria: temperature ±1.0°C, pH ±0.1 unit, and specific conductivity ±5 percent or after 1 hour for the shallow wells, 2 hours for the intermediate wells, and 3 hours for the deep wells. The goal was to develop each monitoring well until the water was visually clear and the turbidity was below 5 NTU. Please see Appendix C.1 for monitoring well development records.

In each well drilling, fluid (i.e., water) was introduced into the well during installation (see Sections 2.3.2.2 and 2.3.4.2). This water was evacuated during the well development process in the second stage of well development. The process occurred in accordance with the SOUTHDIV Monitoring Well Design, Installation, Construction, and Development Guidelines (1997). This guideline states that five times the amount of drilling fluid (i.e., water) used during installation must be evacuated during the well development process. Please see Appendix C.1 for follow-up monitoring well development records and additional information pertaining to the volume of water evacuated from each well.

Upon completion of well development, specific capacity (SPECAP) tests were conducted on each of the permanent monitoring wells (see Section 2.3.10 for additional information on SPECAP tests). Temporary monitoring wells installed during this investigation were not developed.

2.3.6 Groundwater Sampling Procedures

Groundwater samples were obtained from 48 temporary well locations (installed using DPT) and 18 permanent well installations (installed using Rotosonic drilling techniques) at NIROP Fridley. This section

describes the sampling equipment and techniques used for groundwater sample collection from both types of installations. All groundwater sampling was conducted in accordance with the requirements of the Work Plan and FSP and in accordance with SOP SA-1.1 contained in Appendix B of the FSP (B&R Environmental, June 1997).

2.3.6.1 Temporary Monitoring Well Sampling Procedures

Upon opening the well cap, prior to purging and obtaining the groundwater sample, a reading of the organic vapor within the well pipe was taken using an FID. Immediately following the FID reading, the static water level in the well was measured to within 0.01 foot accuracy from the top of the well riser pipe. Using a peristaltic pump and dedicated polyethylene (PE) tubing, three to five well volumes of water were directly purged from the well. Field measurements of pH, temperature, specific conductance, DO, and turbidity were collected and recorded on a sample log sheet after each purge volume or at approximately in 5-minute intervals. Upon completion of the purging process, the temporary well points were then sampled directly with the peristaltic pump and dedicated PE tubing.

For the dissolved parameter samples, field filtration was necessary. Each sample for dissolved parameter analysis was filtered through an inline 0.45-micron disposable particulate filter prior to sample collection. All samples were then packaged according to Section 2.3.8 and shipped to the fixed-base laboratory. All information recorded during sample collection was recorded on sample log sheets. Groundwater sample log sheets can be found in Appendix A.2.

2.3.6.2 Permanent Monitoring Well Sampling Procedures

Upon opening the well cap, prior to obtaining the groundwater sample, a reading of the organic vapor within the well pipe was taken using an FID. Next, the water level inside the monitoring well was measured to within 0.01 foot accuracy from the marked location on the top of the well riser pipe using an electronic water-level indicator.

The permanent monitoring wells were purged and sampled using low-flow purging techniques in accordance with SOP-SA-1.1 (Groundwater Sample Acquisition) found in Appendix B of the FSP (B&R Environmental, 1997). The wells were purged and sampled using dedicated 1.66 inch diameter low-flow bladder type pumps (teflon-lined, PVC). The bladder pumps were installed in all 18 monitoring wells prior to the initiation of groundwater sampling. The pump was placed no less than 2 feet above the bottom of the well so as to not disturb any sediment which may have settled on the bottom of the well.

At the start of purging, the pumping rate was set at approximately 0.2 liters per minute, or lower if possible. The pumping rate was adjusted so as to not allow drawdown to exceed 0.3 feet during purging. During purging, water quality parameters (pH, temperature, specific conductance, turbidity, and DO) were measured and recorded every 5 minutes until all of the parameters stabilized and the minimum purge volume was removed (stabilized purge volume plus the extraction tubing volume). Stabilization of the above parameters were defined as follows: temperature ±1.0ºC, pH ±0.1 units, specific conductance ±5 percent. DO was not used to determine aquifer stabilization but rather as a general water quality parameter. The goal was to purge the permanent wells until the turbidity reached 5 NTU or less. However, if all of the other field parameters stabilized but the turbidity remained above 5 NTU the pumping rate was reduced, as appropriate, in order to reduce the turbidity. If the turbidity did not stabilize after reducing the pumping rate and the minimum purge volume was removed sampling initiated. The maximum total purge time for any individual well was 95 minutes.

Immediately prior to sampling, the temperature, pH, specific conductance, turbidity, and DO of the water sample was measured and recorded on the groundwater sample log sheet (included in Appendix A.2). All sample containers were filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. For the collection of filtered parameters samples (i.e., dissolved metals, dissolved chloride, etc.), the use of an in-line 0.45 micron, disposable particulate filter was used. All samples were then packaged according to Section 2.3.8 and shipped to the laboratory. Additional field parameters, as discussed in Section 2.3.6.3, were measured to evaluate natural attenuation of chlorinated solvents in the groundwater system. All information recorded during sample collection was recorded on sample log sheets. Groundwater sample log sheets can be found in Appendix A.2.

2.3.6.3 Field Parameter Sampling Procedures and Devices

This section describes the equipment and techniques used for collection of groundwater field parameters required for the evaluation of natural attenuation of chlorinated solvents in the groundwater system (Chapelle, 1996). The previously discussed groundwater field parameters are intended for generic determination of groundwater quality. The parameters discussed in the following paragraphs were specifically selected for the evaluation of natural attenuation processes.

Field parameters for natural attenuation evaluation were obtained from each of the 18 permanent monitoring wells installed at NIROP Fridley immediately following the parameters collected for fixed-base analysis. Low-flow bladder-type pumps were used for this field parameter collection. The following list summarizes those field parameters collected for the natural attenuation evaluation:

- pH
- temperature
- oxidation-reduction potential (Eh)
- DO
- dissolved ferrous (reduced) iron
- dissolved reduced manganese
- hydrogen sulfide (as sulfide)

Natural attenuation field parameters of temperature, Eh, and pH were analyzed first using a high-quality portable water quality meter (YSI® Model 3560 or equivalent). The portable water quality meter utilizes a flow-through sample chamber to reduce sample aeration and contact with the atmosphere. The discharge hose from the bladder pump was connected to the flow-through chamber with a Teflon or silicon fitting. All readings were recorded on groundwater sample log sheets which can be found in Appendix A.2.

The determination of DO was made in the field using a high-resolution, low-range test kit (modified Winkler titration test kit). The DO concentration in the groundwater is of significant importance when evaluating natural attenuation but is unfortunately the most difficult to accurately collect. The test kit for DO utilizes digital titration and modified-Winkler methodology and can obtain accurate determination of DO at concentrations down to 0.02 mg/L. Field measurements for dissolved ferrous (reduced) iron, dissolved reduced manganese, and hydrogen sulfide (as sulfide) were made using a portable digital colorimeter. Manufacturer recommendations were followed and documented during all analyses. All readings were recorded on groundwater sample log sheets (included in Appendix A.2).

2.3.6.4 Groundwater Sampling Order

Samples analyzed for dissolved methane (permanent wells only) were collected first and immediately sealed in a container so that no head space was present. HCl or H2SO4 preservatives (to prevent biodegradation of the methane) was not added to the samples, and the samples were not placed into vials that would have prevented the volatilization of methane prior to laboratory analysis. Although the sampling procedure adopted for this investigation was approved in the OU3 Work Plan, these factors may have resulted in the non-detection of methane in the groundwater samples. Samples slated for VOC analysis were then taken and immediately sealed in their appropriate containers so that no head space was present. Samples for DO, SVOC, PCB, and cyanide analyses were then collected. Following the collection of these parameters, the remaining unfiltered engineering and natural attenuation parameters were collected at permanent monitoring wells. This event was followed by collection of samples for total metals, dissolved metals, chloride, bromide, phosphate, and dissolved reduced manganese.

2.3.7 Quality Control (QC) Samples

QC samples were collected or generated during environmental sampling activities. Each type of field QC sample and laboratory QC analyses are discussed in the following sections.

2.3.7.1 Field Quality Control Samples

In addition to regular calibration of field equipment and appropriate documentation, QC samples were collected/generated during field sampling activities. QC samples include field duplicates, ambient condition blanks, equipment rinsate blanks, trip blanks, and source water samples. These types of QC samples are briefly described below:

- Field Duplicates. Field duplicates are two samples collected either (1) independently at a sampling location in the case of groundwater or (2) as a single sample split into two portions in the case of soil or sediment. Field duplicates were used to assess the overall precision of the sampling and analysis program. Field duplicates were collected with a frequency of 1 per every 10 environmental samples.

- Ambient Condition Blanks. Ambient blanks were collected while at the field sampling site by placing distilled water directly into the same type of container, preserved, and stored in the same manner as the field samples. Sampling equipment typically used to collect field samples was not used when collecting this sample. Ambient blank samples were analyzed to check for background contamination at the facility (e.g., vapors, dust, or exhaust fumes that are part of normal operations at the site), which may cause sample contamination. The exposure of the ambient blank to the ambient atmospheric conditions should be similar to the field sample exposure to the ambient atmospheric conditions. Ambient blanks were collected and analyzed based upon conditions at the time of sampling at the discretion of the FOL. Seven ambient blanks were collected during the RI field event.

- Equipment Rinsate Blanks. Equipment rinsate blanks were obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through or over sample collection equipment after decontamination and prior to use. One rinsate blank was collected for every 10 environmental samples of like matrix for each type of sampling equipment used (i.e., sample tubing, trowels, etc.). A sampling event is matrix specific; therefore, an equipment blank must be collected for each matrix sampled. Where pre-cleaned, dedicated, or disposable sampling equipment was used, one rinsate blank per type of equipment was collected as a "batch blank."

Rinsate blanks were analyzed for the same chemical constituents as the associated environmental samples. Rinsate blanks are not applicable for geochemical and engineering parameters.

- Trip Blanks. Trip blanks were used to determine whether sample contamination occurred during transit or storage of the field samples. Trip blanks were generated by the fixed-base laboratory subcontractor(s) and consisted of preserved aliquots of analyte-free water contained in sealed 40-milliliter VOA vials. These vials were shipped to the site and stored with the environmental samples as they were collected for VOC analysis. One set of trip blanks was returned to the laboratory with each shipment of samples collected for VOC analysis. Trip blanks are analyzed for VOCs only.

- Source Water Banks. Source water blanks consisted of the potable water used in decontamination and steam cleaning activities, and were obtained at the rate of one blank per potable water source. Source water blanks were analyzed for all organic and inorganic constituents under investigation, as a means of determining whether the source waters used in decontamination activities have introduced contaminants to the environmental samples collected. Source water blanks were not applicable for geochemical and engineering parameters. Source water blanks were evaluated in accordance with data validation protocol to determine whether false positive results may exist.

2.3.7.2 Matrix Spike/Duplicate Sample Aliquots

Matrix spike/matrix spike duplicate analyses were performed as internal QC checks. For organic analyses, the matrix spike (MS) is analyzed in duplicate (MSD). For inorganic analyses, an MS is analyzed as well as an (unspiked) laboratory duplicate (LD). To accommodate these laboratory QC analyses, the field crew provided extra aliquots of samples, as required by the laboratory. These extra sample aliquots were identified with the same sample location information as the selected environmental sample but were designated for MS/MSD analysis in the "comments" section on the chain-of-custody. Extra aliquots for MS/MSD analysis were provided to the laboratory with a frequency of one set per 20 samples of similar matrix for organic analyses and one set per 10 samples of like matrix for inorganic analyses.

2.3.8 Sample Handling, Packaging, and Shipping

Upon sample retrieval, sample containers were immediately secured in a sealed "Ziploc"-type plastic bag. The secured sample containers were then placed in a cooler lined with a large plastic liner. The cooler was packed with a noncombustible, cushioning material (vermiculite) to minimize the potential for container breakage. Samples were cooled with bagged ice placed around the shoulders of the sample

containers. The inside plastic liner was sealed with a knot and the chain-of-custody form was sealed in a "Ziploc"-type plastic bag and taped to the inside of the cooler lid. The cooler and its contents were sealed with strapping tape and custody seals and shipped overnight to the laboratory for analyses.

2.3.9 Water-Level Measurements

One round of synoptic water-level measurements were taken from all 18 newly installed and other select monitoring wells at the facility by TtNUS on March 3, 1998. A second round of synoptic water-level measurements were taken from a significantly larger number of monitoring wells located throughout the NIROP facility (including the 18 newly installed wells) by the U.S. Geological Survey as a part of their investigations at the facility on July 7, 1998 (USGS, 1998). Due to the larger number of data points taken the water level measurements taken during the July 7 event provided a more representative hydraulic head distribution of the groundwater flow regime at the facility than the March 3, 1998 measurement. Consequently, these data were used in this report for the generation groundwater flow maps and the calculation of hydraulic gradients and groundwater velocities (See Section 3.0). All measurements (during each of the synoptic measurements) were taken within a 24-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. The sequence of measuring water levels was determined in the field by the site geologist and/or field technician.

Measurements were taken with an electrical water-level indicator (M-scope or equivalent) using the top of the well casing (i.e., riser pipe) as the reference point for determining depths to water. Water-level measurements were taken from a notch made at the top of the casing to assure that various synoptic measurements are taken consistently. Water-level measurements were recorded to the nearest 0.01 foot in the appropriate field log book and on a groundwater-level measurement form, attached in Appendix C.2.

2.3.10 Specific Capacity Testing

SPECAP tests were performed on all of the newly installed monitoring wells (18) at the NIROP facility. SPECAP tests were used to determine a well's potential yield and to estimate the hydraulic conductivity and transmissivity of aquifer formation in which the monitoring well is screened. SPECAP is defined as yield divided by drawdown and is normally expressed as gallons per minute/feet of drawdown. The SPECAP test was conducted as described below. The well was pumped at a constant rate (or a near to constant as possible) until drawdown in the well stabilized (subjective determination; generally measurements within 0.03 feet over a ten minute interval can be considered stable). Both the pumping

rate and drawdown were then measured simultaneously in the tested well. Dividing the yield rate by the stabilized drawdown, when both were measured simultaneously, gives the SPECAP.

Both submersible and surface pumps were used to conduct the SPECAP tests. Measurement of the flow rate was determined using a graduated cylinder or bucket and stopwatch. The drawdown in the well was measured with the use of an electrical water level indicator and/or a pressure transducer and Hermit data logger. Refer to Appendix C.1 for drawdown measurement rate during SPECAP tests. Upon completion of the SPECAP test, the pump was shut off and the rise in water level or the residual drawdown was measured.

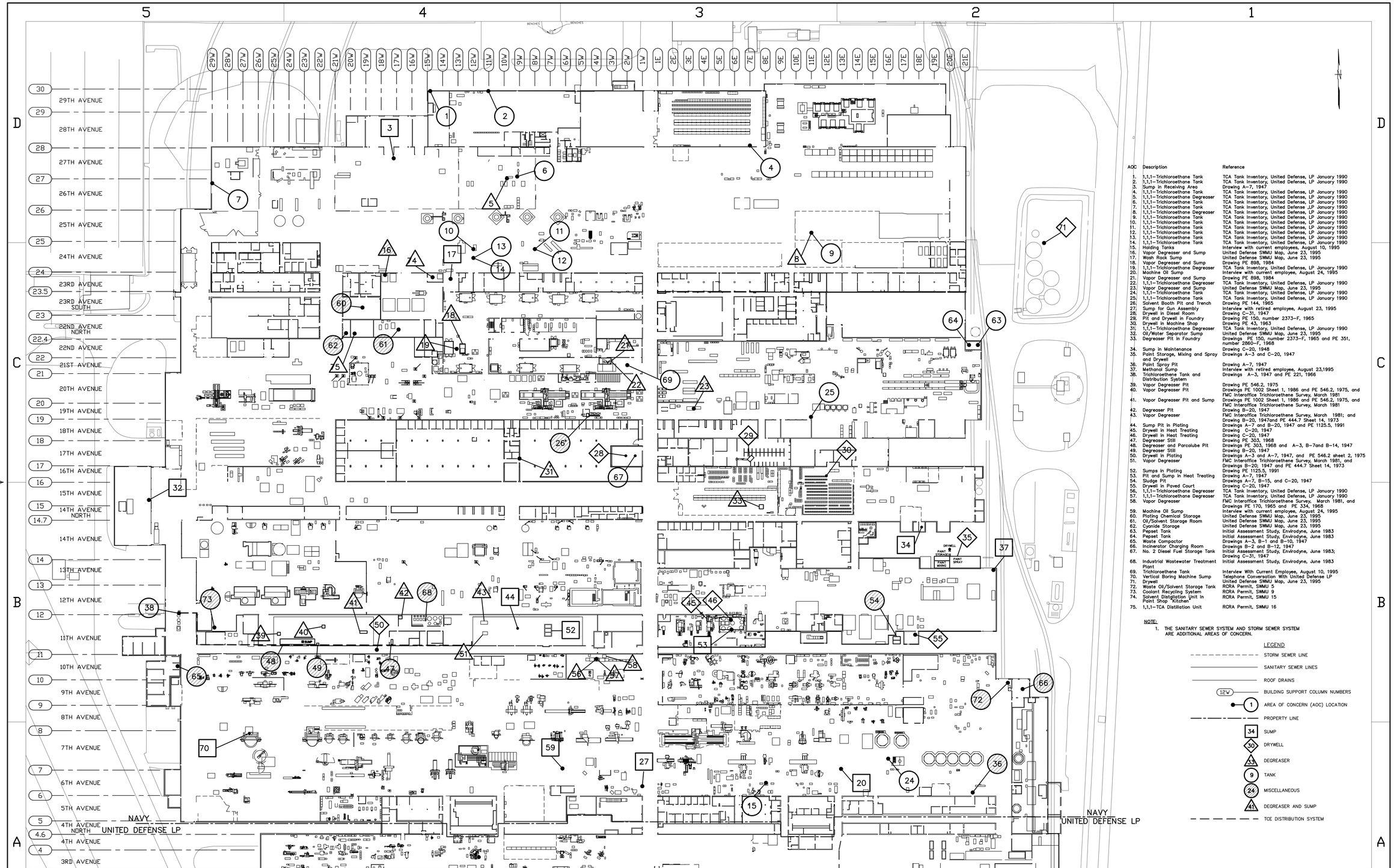
Aquifer parameters of hydraulic conductivity and transmissivity were calculated from the SPECAP test data using a computer program developed by Bradbury and Rothschild (1985) based on equations presented in Lohman (1972). Drawdown data from the well, as recorded by the data logger, were entered into the computer program along with required variables that characterize the aquifer (storage and well-loss coefficients), the pumping rate, and well dimensions. Based upon this information, the program estimated SPECAP, transmissivity, and hydraulic conductivity. Please refer to Appendix C.3 for additional information concerning SPECAP test analysis.

2.4 INVESTIGATION DERIVED WASTE (IDW) HANDLING

The field investigation generated five types of potentially contaminated residual material: personal protective equipment (PPE), drill rig decontamination fluids, sampling equipment decontamination fluids, purge water, and drummed waste.

1. PPE - PPE was double bagged and placed in trash receptacles at the facility provided by TtNUS. The refuse in the trash receptacles were disposed of properly in a municipal waste facility by a subcontractor to TtNUS. Note that dirty and/or soiled PPE was segregated and disposed of in 55 gallon drums consistent with item 5.

2. Drill Rig Decontamination Fluids - Drill rig decontamination fluids were temporarily containerized in a 2,000-gallon polymer fractionation tank and staged in an area established by TtNUS personnel and the Navy. One composite sample was collected from the drill rig decontamination fluids and analyzed at a fixed-based laboratory. Based on the results of this analysis and approval from the Metropolitan Council Environmental Services (MCES) TtNUS personnel disposed of the waste fluids into a sanitary sewer after balancing the pH.



AOC	Description	Reference
1.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
2.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
3.	Sump in Receiving Area	Drawing A–7, 1947
4.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
5.	1,1,1–Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
6.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
7.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
8.	1,1,1–Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
9.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
10.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
11.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
12.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
13.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
14.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
15.	Holding Tanks	Interview with current employees, August 10, 1995
16.	Vapor Degreaser and Sump	United Defense SWMU Map, June 23, 1995
17.	Wash Rack Sump	United Defense SWMU Map, June 23, 1995
18.	Vapor Degreaser and Sump	Drawing PE 898, 1984
19.	1,1,1–Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
20.	Machine Oil Sump	Interview with current employee, August 24, 1995
21.	Vapor Degreaser and Sump	Drawing PE 898, 1984
22.	1,1,1–Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
23.	Vapor Degreaser and Sump	United Defense SWMU Map, June 23, 1995
24.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
25.	1,1,1–Trichloroethane Tank	TCA Tank Inventory, United Defense, LP January 1990
26.	Solvent Booth Pit and Trench	Drawing PE 144, 1965
27.	Sump for Gun Assembly	Interview with retired employee, August 23, 1995
28.	Drywell in Diesel Room	Drawing C–31, 1947
29.	Pit and Drywell in Foundry	Drawing PE 150, number 2373–F, 1965
30.	Drywell in Machine Shop	Drawing PE 43, 1963
31.	1,1,1–Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
32.	Oil/Water Separator Sump	United Defense SWMU Map, June 23, 1995
33.	Degreaser Pit in Foundry	Drawings PE 150, number 2373–F, 1965 and PE 351, number 2860–F, 1968
34.	Sump in Maintenance	Drawing C–20, 1948
35.	Paint Storage, Mixing and Spray and Drywell	Drawings A–3 and C–20, 1947
36.	Paint Spray Pit	Drawing A–7, 1947
37.	Methanol Sump	Interview with retired employee, August 23,1995
38.	Trichloroethene Tank and Distribution System	Drawings A–3, 1947 and PE 221, 1966
39.	Vapor Degreaser Pit	Drawing PE 546.2, 1975
40.	Vapor Degreaser Pit	Drawings PE 1002 Sheet 1, 1986 and PE 546.2, 1975, and FMC Interoffice Trichloroethene Survey, March 1981
41.	Vapor Degreaser Pit and Sump	Drawings PE 1002 Sheet 1, 1986 and PE 546.2, 1975, and FMC Interoffice Trichloroethene Survey, March 1981
42.	Degreaser Pit	Drawing B–20, 1947
43.	Vapor Degreaser	FMC Interoffice Trichloroethene Survey, March 1981; and Drawing B–20, 1947and PE 444.7 Sheet 14, 1973
44.	Sump Pit in Plating	Drawings A–7 and B–20, 1947 and PE 1125.5, 1991
45.	Drywell in Heat Treating	Drawing C–20, 1947
46.	Drywell in Heat Treating	Drawing C–20, 1947
47.	Degreaser Still	Drawing PE 303, 1968
48.	Degreaser and Porcolube Pit	Drawings PE 303, 1968 and A–3, B–7and B–14, 1947
49.	Degreaser Still	Drawing B–20, 1947
50.	Drywell in Plating	Drawings A–3 and A–7, 1947, and PE 546.2 sheet 2, 1975
51.	Vapor Degreaser	FMC Interoffice Trichloroethene Survey, March 1981, and Drawings B–20; 1947 and PE 444.7 Sheet 14, 1973
52.	Sumps in Plating	Drawing PE 1125.5, 1991
53.	Pit and Sump in Heat Treating	Drawing A–7, 1947
54.	Sludge Pit	Drawings A–7, B–15, and C–20, 1947
55.	Drywell in Paved Court	Drawing C–20, 1947
56.	1,1,1–Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
57.	1,1,1–Trichloroethane Degreaser	TCA Tank Inventory, United Defense, LP January 1990
58.	Vapor Degreaser	FMC Interoffice Trichloroethene Survey, March 1981, and Drawings PE 170, 1965 and PE 334, 1968
59.	Machine Oil Sump	Interview with current employee, August 24, 1995
60.	Plating Chemical Storage	United Defense SWMU Map, June 23, 1995
61.	Oil/Solvent Storage Room	United Defense SWMU Map, June 23, 1995
62.	Cyanide Storage	United Defense SWMU Map, June 23, 1995
63.	Pepset Tank	Initial Assessment Study, Envirodyne, June 1983
64.	Pepset Tank	Initial Assessment Study, Envirodyne, June 1983
65.	Waste Compactor	Drawings A–3, B–1 and B–10, 1947
66.	Incinerator Charging Room	Drawings B–2 and B–12, 1947
67.	No. 2 Diesel Fuel Storage Tank	Initial Assessment Study, Envirodyne, June 1983; Drawing C–31, 1947
68.	Industrial Wastewater Treatment Plant	Initial Assessment Study, Envirodyne, June 1983
69.	Trichloroethene Tank	Interview With Current Employee, August 10, 1995
70.	Vertical Boring Machine Sump	Telephone Conversation With United Defense LP
71.	Drywell	United Defense SWMU Map, June 23, 1995
72.	Waste Oil/Solvent Storage Tank	RCRA Permit, SWMU 5
73.	Coolant Recycling System	RCRA Permit, SWMU 9
74.	Solvent Distgillation Unit in Paint Shop "Kitchen"	RCRA Permit, SWMU 15
75.	1,1,1–TCA Distillation Unit	RCRA Permit, SWMU 16

NOTE:

1. THE SANITARY SEWER SYSTEM AND STORM SEWER SYSTEM ARE ADDITIONAL AREAS OF CONCERN.

LEGEND

- STORM SEWER LINE
- SANITARY SEWER LINES
- ROOF DRAINS
- (12W) BUILDING SUPPORT COLUMN NUMBERS
- (1) AREA OF CONCERN (AOC) LOCATION
- PROPERTY LINE
- [34] SUMP
- (30) DRYWELL
- △33 DEGREASER
- (9) TANK
- (24) MISCELLANEOUS
- △41 DEGREASER AND SUMP
- TCE DISTRIBUTION SYSTEM

REV.	DATE	DESCRIPTION	REFERENCE	DWG. NO.	DATE
			BASE MAP PROVIDED BY UNITED DEFENSE, 1995		

ACAD:6966bp06.dwg 08/18/98 HJP 6966BP01.LAY

Tetra Tech NUS, Inc.

FOSTER PLAZA VII
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

TITLE

SITE PLAN AND AOCS
OU3 RI REPORT

NIROP — FRIDLEY, MINNESOTA

CLIENT	CONTRACT
SOUTHNAVFACENGCOM	N62467–94–D–0888 CTO 0003

SCALE	DATE	SHEET
1"=60'	AUGUST 1998	1 OF 1

DRAWING NO.	ACFILE NAME	REV.
FIGURE 1–4	\6966\6966BP01.DWG	1

3. Sampling Equipment Decontamination Fluids - Equipment decontamination fluids were containerized and handled in the same manner as the drill rig decontamination fluids.

4. Development/Purge Water - Development/purge water were temporarily containerized in 2,000 and 6,000-gallon polymer fractionation tanks and staged in an area established by TtNUS personnel and the Navy. Composite samples were collected from the development/purge water fluids and analyzed at a fixed-based laboratory. Based on the results of this analysis and approval from the MCES TtNUS personnel disposed of the waste fluids into a sanitary sewer.

5. Drummed waste - Drummed waste, which included drill/soil cuttings, onsite lab waste, glassware, purge water with high PID readings, sludge from decon area, and heavily soiled materials, was containerized in U.S. DOT-approved (Specification 17-C/H) 55-gallon drums and staged on wooden pallets in an area established by TtNUS personnel and the Navy. All drums were sealed, numbered, and labeled with site location, drum contents, date, volume, contact person, and emergency phone numbers. A subcontractor hired by TtNUS collected composite samples from the various types of waste and analyzed these samples to determine whether the material was hazardous or non-hazardous. Upon the receipt of this analysis, the subcontractor to TtNUS took possession and hauled the drummed waste off-site for proper treatment and/or disposal.

2.5 SURVEYING

All new permanent groundwater wells were surveyed by a Minnesota-certified land surveyor. Existing survey monuments within NIROP Fridley were used as reference points. Permanent monitoring well locations were surveyed horizontally to the nearest 0.10 foot and referenced to the Minnesota State Plane Coordinate System (SPCS). The top of the riser pipe (where notched), the top of the protective casing, and the ground surface elevation adjacent to the protective concrete pad at each permanent monitoring well location were surveyed to within 0.01-foot vertical accuracy. Vertical elevations are referenced to 1929 North American Datum.

2.6 DETERMINATION OF BACKGROUND CONCENTRATIONS

2.6.1 Background Data Collected as Part of Operable Unit 2 Remedial Investigation

Background soil samples were collected as part of the Remedial Investigation Report for The Soil Operable Unit at Naval Industrial Reserve Ordnance Plant (RMT, 1993). Ten background soil borings were installed to a depth of 10 feet each. All background samples were collected from off site. Six of the ten background soil borings were installed north of the site. Two were installed northwest of the NIROP

Fridley in the Anoka County Riverfront Regional Park, and two were installed just west of the northern NIROP employee parking lot. Two samples were collected per boring for a total of 20 samples. Samples were collected at the 1 to 3 foot and 8 to 10 foot intervals. The locations of the background soil borings can be found on Figure 2-1. The results of the background sampling are presented in Table 2-6.

MPCA has approved the use of the OU2 background data in the OU3 RI Report since MPCA had approved the OU2 RI Report. It should be noted that MPCA's approval for the use of the OU2 data in the OU3 RI Report does not mean that MPCA agrees that the OU2 background data is representative of true background conditions at the site.

2.6.2 Background Data Collected as Part of OU3 Remedial Investigation

Background soil sampling was conducted as part of the OU3 remedial investigation. This background soil sampling was conducted to supplement the background soil sampling conducted as a part of the OU2 RI (RMT, 1993). Ten soil borings (003-SU-B01 through 003-SU-B10) were advanced using a stainless steel bucket hand auger and sampled to serve as background samples. These are the same background sampling locations used in the OU2 investigation. One soil sample was collected from each of the 10 background locations and submitted to the fixed base laboratory for hexavalent chromium and TOC analyses. The samples were collected from a depth interval of 1 to 3 feet bgs. These background samples were used to supplement background samples collected during the OU2 RI (Table 2-6) (OU2 RI; RMT, 1993).

TABLE 2-1

SUMMARY LIST OF ALL SAMPLE LOCATIONS
OU3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NIROP FRIDLEY, MINNESOTA

SAMPLE LOCATION/NAME	DIRECT PUSH SOIL BORING	TEMPORARY MONITORING WELL	ROTOSONIC WELL BORING	PERMANENT MONITORING WELL	BACKGROUND SOIL BORING
AOC03	X	X			
AOC04	X	X			
AOC06	X	X			
AOC07	X	X			
AOC08/AOC09	X	X			
AOC13/AOC14	X	X			
AOC15	X	X			
AOC16	X	X			
AOC17	X	X			
AOC18	X	X			
AOC23	X	X			
AOC26	X	X			
AOC27	X	X			
AOC28	X	X			
AOC29	X	X			
AOC30	X	X			
AOC32	X	X			
AOC33	X	X			
AOC34	X	X			
AOC35	X	X			
AOC36	X	X			
AOC37	X	X			
AOC38	X	X			
AOC39	X	X			
AOC46	X	X			
AOC47	X	X			
AOC50	X	X			
AOC54	X	X			
AOC55	X	X			
AOC58	X	X			
AOC63	X	X			
AOC68	X	X			
AOC70	X	X			
AOC71	X	X			
AOC73	X	X			
AOC74	X	X			
P01	X	X			
P02	X	X			
P03	X	X			
P04	X	X			
P05	X	X			
P06	X	X			
P07	X	X			
P08	X	X			

TABLE 2-1

SUMMARY LIST OF ALL SAMPLE LOCATIONS
OU3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NIROP FRIDLEY, MINNESOTA

SAMPLE LOCATION/NAME	DIRECT PUSH SOIL BORING	TEMPORARY MONITORING	ROTOSONIC WELL BORING	PERMANENT MONITORING	BACKGROUND SOIL BORING
P09	X	X			
P10	X	X			
P11	X	X			
P12	X	X			
MS-28S			X(1)	X	
MS-28I			X(1)	X	
MS-28D			X(1)	X	
MS-29S			X(1)	X	
MS-29I			X(1)	X	
MS-29D			X(1)	X	
MS-30S			X(1)	X	
MS-30I			X(1)	X	
MS-30D			X(1)	X	
MS-31S			X(1)	X	
MS-31I			X(1)	X	
MS-31D			X(1)	X	
MS-32S			X(1)	X	
MS-32I			X(1)	X	
MS-32D			X(1)	X	
MS-33S			X(1)	X	
MS-33I			X(1)	X	
MS-33D			X(1)	X	
003-SU-B01					X
003-SU-B02					X
003-SU-B03					X
003-SU-B04					X
003-SU-B05					X
003-SU-B06					X
003-SU-B07					X
003-SU-B08					X
003-SU-B09					X
003-SU-B10					X

Notes:
AOC = Area of Concern
P = supplemental sampling point
S = shallow aquifer zone permanent monitoring well
I = intermediate aquifer zone permanent monitoring well
D = deep aquifer zone permanent monitoring well
SU-B = subsurface background sample
1 At each of the 6 deep well borings, continuous soil sampling was conducted. Soil sampling was not performed in the shallow and intermediate well borings due to their close proximity to the deep well borings at each given well cluster.

TABLE 2-2

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE I
NIROP FRIDELY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	TOC	Cr^{+6}	pH
SOIL SAMPLES COLLECTED FROM 0-4 FEET BGS								
003-SB-003-01	0.0 - 4.0'	X	X	X	X			
003-SB-004-01	0.0 - 4.0'	X	X	X	X	X	X	
003-SB-004-01-D	0.0 - 4.0'	X	X	X	X	X	X	
003-SB-006-01	0.0 - 4.0'	X	X	X	X	X		
003-SB-007-01	0.0 - 4.0'	X	X	X	X		X	
003-SB-008-01	0.0 - 4.0'	X	X	X	X		X	
003-SB-013-01	0.0 - 4.0'	X	X	X	X		X	X
003-SB-015-01	0.0 - 4.0'	X	X	X	X	X	X	X
003-SB-015-01-D	0.0 - 4.0'	X	X	X	X	X	X	
003-SB-016-01	0.0 - 4.0'	X	X	X	X	X		
003-SB-017-01	0.0 - 4.0'	X	X	X	X		X	X
003-SB-018-01	0.0 - 4.0'	X	X	X	X		X	
003-SB-023-01	0.0 - 4.0'	X	X	X	X			
003-SB-026-01	0.0 - 4.0'	X	X	X	X			
003-SB-027-01	0.0 - 4.0'	X	X	X	X	X		
003-SB-028-01	0.0 - 4.0'	X	X	X	X	X		
003-SB-029-01	0.0 - 4.0'	X	X	X	X		X	
003-SB-030-01	0.0 - 4.0'	X	X	X	X	X	X	X
003-SB-032-01	0.0 - 4.0'	X	X	X	X			
003-SB-033-01	0.0 - 4.0'	X	X	X	X			
003-SB-034-01	0.0 - 4.0'	X	X	X	X			
003-SB-035-01	0.0 - 4.0'	X	X	X	X	X	X	X
003-SB-036-01	0.0 - 4.0'	X	X	X	X		X	X
003-SB-037-01	0.0 - 4.0'	X	X	X	X			
003-SB-037-01-D	0.0 - 4.0'	X	X	X	X			
003-SB-038-01	0.0 - 4.0'	X	X	X	X			
003-SB-039-01	0.0 - 4.0'	X	X	X	X		X	
003-SB-046-01	0.0 - 4.0'	X	X	X	X	X	X	
003-SB-046-01-D	0.0 - 4.0'	X	X	X	X	X	X	
003-SB-047-01	0.0 - 4.0'	X	X	X	X			
003-SB-050-01	0.0 - 4.0'	X	X	X	X		X	X
003-SB-050-01-D	0.0 - 4.0'	X	X	X	X		X	
003-SB-054-01	0.0 - 4.0'	X	X	X	X			
003-SB-055-01	0.0 - 4.0'	X	X	X	X			
003-SB-058-01	0.0 - 4.0'	X	X	X	X			
003-SB-058-01-D	0.0 - 4.0'	X	X	X	X			
003-SB-063-01	0.0 - 4.0'	X	X	X	X	X	X	
003-SB-068-01	0.0 - 4.0'	X	X	X	X	X		
003-SB-070-01	0.0 - 4.0'	X	X	X	X	X	X	
003-SB-071-01	0.0 - 4.0'	X	X	X	X		X	
003-SB-073-01	0.0 - 4.0'	X	X	X	X			
003-SB-074-01	0.0 - 4.0'	X	X	X	X			
003-SB-074-01-D	0.0 - 4.0'	X	X	X	X			
003-SB-P01-01	0.0 - 4.0'	X	X	X	X			
003-SB-P02-01	0.0 - 4.0'	X	X	X	X			
003-SB-P03-01	0.0 - 4.0'	X	X	X	X			
003-SB-P04-01	0.0 - 4.0'	X	X	X	X			
003-SB-P05-01	0.0 - 4.0'	X	X	X	X			
003-SB-P06-01	0.0 - 4.0'	X	X	X	X			
003-SB-P07-01	0.0 - 4.0'	X	X	X	X			

TABLE 2-2

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE I
NIROP FRIDELY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	TOC	Cr^{+6}	pH
003-SB-P08-01	0.0 - 4.0'	X	X	X	X			
003-SB-P09-01	0.0 - 4.0'	X	X	X	X			
003-SB-P09-01-D	0.0 - 4.0'	X	X	X	X			
003-SB-P10-01	0.0 - 4.0'	X	X	X	X			
003-SB-P10-01-D	0.0 - 4.0'	X	X	X	X			
003-SB-P11-01	0.0 - 4.0'	X	X	X	X			
003-SB-P11-01-D	0.0 - 4.0'	X	X	X	X			
003-SB-P12-01	0.0 - 4.0'	X	X	X	X			
SOIL SAMPLES COLLECTED FROM 4-12 FEET BGS								
003-SB-003-02	4.0 - 8.0'	X	X	X	X			
003-SB-004-03	8.0 - 12.0'	X	X	X	X	X	X	
003-SB-006-03	8.0 - 12.0'	X	X	X	X	X		
003-SB-007-02	4.0 - 8.0'	X	X	X	X		X	
003-SB-007-03	8.0 - 12.0'	X						
003-SB-008-02	4.0 - 8.0'	X	X	X	X		X	
003-SB-013-02	4.0 - 8.0'	X	X	X	X		X	
003-SB-015-03	8.0 - 12.0'	X	X	X	X	X	X	
003-SB-016-03	8.0 - 12.0'	X	X	X	X	X		
003-SB-017-03	8.0 - 12.0'	X	X	X	X		X	
003-SB-018-02	4.0 - 8.0'	X	X	X	X		X	
003-SB-023-03	8.0 - 12.0'	X	X	X	X			
003-SB-026-03	8.0 - 12.0'	X	X	X	X			
003-SB-027-02	4.0 - 8.0'	X	X	X	X	X		
003-SB-027-03	8.0 - 12.0'	X	X	X	X	X		
003-SB-028-02	4.0 - 8.0'	X	X	X	X	X		
003-SB-029-02	4.0 - 8.0'	X	X	X	X		X	
003-SB-030-02	4.0 - 8.0'	X	X	X	X	X	X	
003-SB-030-03	8.0 - 12.0'	X						
003-SB-032-03	8.0 - 12.0'	X	X	X	X			
003-SB-033-03	8.0 - 12.0'	X	X	X	X			
003-SB-034-03	8.0 - 12.0'	X	X	X	X			
003-SB-035-02	4.0 - 8.0'	X	X	X	X	X	X	
003-SB-036-02	4.0 - 8.0'	X					X	
003-SB-036-03	8.0 - 12.0'	X	X	X	X		X	
003-SB-037-02	4.0 - 8.0'	X						
003-SB-037-03	8.0 - 12.0'	X	X	X	X			
003-SB-038-03	8.0 - 12.0'	X	X	X	X			
003-SB-039-03	8.0 - 12.0'	X	X	X	X		X	
003-SB-046-03	8.0 - 12.0'	X	X	X	X	X	X	
003-SB-047-03	8.0 - 12.0'	X	X	X	X			
003-SB-050-02	4.0 - 8.0'	X	X	X	X		X	
003-SB-054-02	4.0 - 8.0'	X	X	X	X			
003-SB-055-02	4.0 - 8.0'	X	X	X	X			
003-SB-055-03	8.0 - 12.0'	X	X	X	X			
003-SB-058-02	4.0 - 8.0'	X						
003-SB-058-03	8.0 - 12.0'	X	X	X	X			
003-SB-063-03	8.0 - 12.0'	X	X	X	X	X	X	
003-SB-068-03	8.0 - 12.0'	X	X	X	X	X		
003-SB-070-03	8.0 - 12.0'	X	X	X	X	X	X	
003-SB-071-03	8.0 - 12.0'	X	X	X	X		X	
003-SB-073-03	8.0 - 12.0'	X	X	X	X			

TABLE 2-2

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE I
NIROP FRIDELY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	TOC	Cr^{+6}	pH
003-SB-074-03	8.0 - 12.0'	X	X	X	X			
003-SB-P01-02	4.0 - 8.0'	X	X	X	X			
003-SB-P01-03-BR	8.0 - 12.0'	X						
003-SB-P02-02	4.0 - 8.0'	X						
003-SB-P02-03	8.0 - 12.0'	X	X	X	X			
003-SB-P03-03	8.0 - 12.0'	X	X	X	X			
003-SB-P04-03	8.0 - 12.0'	X	X	X	X			
003-SB-P05-02	4.0 - 8.0'	X	X	X	X			
003-SB-P06-02-BR	4.0 - 8.0'	X						
003-SB-P06-03	8.0 - 12.0'	X	X	X	X			
003-SB-P07-03	8.0 - 12.0'	X	X	X	X			
003-SB-P08-03	8.0 - 12.0'	X	X	X	X			
003-SB-P09-02	4.0 - 8.0'	X	X	X	X			
003-SB-P09-03	8.0 - 12.0'	X	X	X	X			
003-SB-P10-03	8.0 - 12.0'	X	X	X	X			
003-SB-P11-03	8.0 - 12.0'	X	X	X	X			
003-SB-P12-03	8.0 - 12.0'	X	X	X	X			
SOIL SAMPLES COLLECTED FROM >12 FEET BGS								
003-SB-007-05-BR	16.0 - 20.0'	X						
003-SB-007-11-BR	40.0 - 44.0'	X						
003-SB-023-05-BR	16.0 - 20.0'	X						
003-SB-023-15-BR	56.0 - 60.0'	X						
003-SB-027-05-BR	16.0 - 20.0'	X						
003-SB-027-06-BR	20.0 - 24.0'	X						
003-SB-030-04-BR	12.0 - 16.0'	X						
003-SB-036-05-BR	16.0 - 20.0'	X						
003-SB-036-05-BR-D	16.0 - 20.0'	X						
003-SB-036-07-BR	24.0 - 28.0'	X						
003-SB-037-05-BR	16.0 - 20.0'	X						
003-SB-037-10-BR	36.0 - 40.0'	X						
003-SB-055-05-BR	16.0 - 20.0'	X						
003-SB-058-05-BR	16.0 - 20.0'	X						
003-SB-058-05-BR-D	16.0 - 20.0'	X						
003-SB-058-15-BR	56.0 - 60.0'	X						
003-SB-063-04-BR	12.0 - 16.0'	X						
003-SB-063-14-BR	52.0 - 56.0'	X						
003-SB-P01-05-BR	16.0 - 20.0'	X						
003-SB-P01-09-BR	32.0 - 36.0'	X						
003-SB-P02-05-BR	16.0 - 20.0'	X						
003-SB-P02-05-BR-D	16.0 - 20.0'	X						
003-SB-P02-15-BR	56.0 - 60.0'	X						
003-SB-P06-05-BR	16.0 - 20.0'	X						
003-SB-P06-07-BR	24.0 - 28.0'	X						
003-SB-P09-05-BR	16.0 - 20.0'	X						
003-SB-P09-09-BR	32.0 - 36.0'	X						
003-SB-P12-05-BR	16.0 - 20.0'	X						
003-SB-P12-11-BR	40.0 - 44.0'	X						
BACKGROUND SOIL SAMPLES								
003-SU-B01-01	0.0 - 4.0'					X	X	
003-SU-B02-01	0.0 - 4.0'					X	X	
003-SU-B03-01	0.0 - 4.0'					X	X	

TABLE 2-2

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE I
NIROP FRIDELY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	TOC	Cr^{+6}	pH
003-SU-B04-01	0.0 - 4.0'					X	X	
003-SU-B05-01	0.0 - 4.0'					X	X	
003-SU-B05-01-D	0.0 - 4.0'					X	X	
003-SU-B06-01	0.0 - 4.0'					X	X	
003-SU-B07-01	0.0 - 4.0'					X	X	
003-SU-B08-01	0.0 - 4.0'					X	X	
003-SU-B09-01	0.0 - 4.0'					X	X	X
003-SU-B10-01	0.0 - 4.0'					X	X	
GROUNDWATER								
003-TW-003-01	shallow	X	X	X	X			
003-TW-003-F1	shallow			X				
003-TW-004-01	shallow	X	X	X	X			
003-TW-004-F1	shallow			X				
003-TW-006-01	shallow	X	X	X	X			
003-TW-006-F1	shallow			X				
003-TW-007-01	shallow	X	X	X	X			
003-TW-007-F1	shallow			X				
003-TW-008-01	shallow	X	X	X	X			
003-TW-008-F1	shallow			X				
003-TW-013-01	shallow	X	X	X	X			
003-TW-013-F1	shallow			X				
003-TW-015-01	shallow	X	X	X	X			
003-TW-015-F1	shallow			X				
003-TW-016-01	shallow	X	X	X	X			
003-TW-016-F1	shallow			X				
003-TW-017-01	shallow	X	X	X	X			
003-TW-017-F1	shallow			X				
003-TW-018-01	shallow	X	X	X	X			
003-TW-018-F1	shallow			X				
003-TW-023-01	shallow	X	X	X	X			
003-TW-023-F1	shallow			X				
003-TW-026-01	shallow	X	X	X	X			
003-TW-026-F1	shallow			X				
003-TW-027-01	shallow	X	X	X	X			
003-TW-027-F1	shallow			X				
003-TW-028-01	shallow	X	X	X	X			
003-TW-028-F1	shallow			X				
003-TW-029-01	shallow	X	X	X	X			
003-TW-029-F1	shallow			X				
003-TW-030-01	shallow	X	X	X	X			
003-TW-030-01-D	shallow	X	X	X	X			
003-TW-030-F1	shallow			X				
003-TW-030-F1-D	shallow			X				
003-TW-032-01	shallow	X	X	X	X			
003-TW-032-F1	shallow			X				
003-TW-033-01	shallow	X	X	X	X			
003-TW-033-F1	shallow			X				
003-TW-034-01	shallow	X	X	X	X			
003-TW-034-F1	shallow			X				
003-TW-035-01	shallow	X	X	X	X			
003-TW-035-F1	shallow			X				

TABLE 2-2

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE I
NIROP FRIDELY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	TOC	Cr^{+6}	pH
003-TW-036-01	shallow	X	X	X	X			
003-TW-036-F1	shallow			X				
003-TW-037-01	shallow	X	X	X	X			
003-TW-037-F1	shallow			X				
003-TW-038-01	shallow	X	X	X	X			
003-TW-038-F1	shallow			X				
003-TW-039-01	shallow	X	X	X	X			
003-TW-039-F1	shallow			X				
003-TW-046-01	shallow	X	X	X	X			
003-TW-046-F1	shallow			X				
003-TW-047-01	shallow	X	X	X	X			
003-TW-047-01-D	shallow	X	X	X	X			
003-TW-047-F1	shallow			X				
003-TW-047-F1-D	shallow			X				
003-TW-050-01	shallow	X	X	X	X			
003-TW-050-F1	shallow			X				
003-TW-054-01	shallow	X	X	X	X			
003-TW-054-F1	shallow			X				
003-TW-055-01	shallow	X	X	X	X			
003-TW-055-F1	shallow			X				
003-TW-058-01	shallow	X	X	X	X			
003-TW-058-F1	shallow			X				
003-TW-063-01	shallow	X	X	X	X			
003-TW-063-F1	shallow			X				
003-TW-068-01	shallow	X	X	X	X			
003-TW-068-F1	shallow			X				
003-TW-070-01	shallow	X	X	X	X			
003-TW-070-F1	shallow			X				
003-TW-071-01	shallow	X	X	X	X			
003-TW-071-F1	shallow			X				
003-TW-073-01	shallow	X	X	X	X			
003-TW-073-01-D	shallow	X	X	X	X			
003-TW-073-F1	shallow			X				
003-TW-073-F1-D	shallow			X				
003-TW-074-01	shallow	X	X	X	X			
003-TW-074-F1	shallow			X				
003-TW-P01-01	shallow	X	X	X	X			
003-TW-P01-F1	shallow			X				
003-TW-P02-01	shallow	X	X	X	X			
003-TW-P02-F1	shallow			X				
003-TW-P03-01	shallow	X	X	X	X			
003-TW-P03-F1	shallow			X				
003-TW-P04-01	shallow	X	X	X	X			
003-TW-P04-F1	shallow			X				
003-TW-P05-01	shallow	X	X	X	X			
003-TW-P05-F1	shallow			X				
003-TW-P06-01	shallow	X	X	X	X			
003-TW-P06-01-D	shallow	X	X	X	X			
003-TW-P06-F1	shallow			X				
003-TW-P06-F1-D	shallow			X				
003-TW-P07-01	shallow	X	X	X	X			

TABLE 2-2

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE I
NIROP FRIDELY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	TOC	Cr^{+6}	pH
003-TW-P07-F1	shallow			X				
003-TW-P08-01	shallow	X	X	X	X			
003-TW-P08-F1	shallow			X				
003-TW-P09-01	shallow	X	X	X	X			
003-TW-P09-F1	shallow			X				
003-TW-P10-01	shallow	X	X	X	X			
003-TW-P10-01-D	shallow	X	X	X	X			
003-TW-P10-F1	shallow			X				
003-TW-P10-F1-D	shallow			X				
003-TW-P11-01	shallow	X	X	X	X			
003-TW-P11-F1	shallow			X				
003-TW-P12-01	shallow	X	X	X	X			
003-TW-P12-F1	shallow			X				

Notes:
1 This table includes only samples analyzed at a fixed-base laboratory (i.e., sample list does not include field screening samples).
2 Pyridine was also included in the SVOC list.
3 Analysis for cyanide was not performed for filtered groundwater samples.
bgs - below ground surface
SB-U - background soil boring sample
SU - subsurface soil sample
TW - groundwater sample collected from temporary monitoring well
F1 - filtered sample for TAL Dissolved Metals
VOC- Volatile Organic Compounds
SVOC- Semivolatile Organic Compounds
Cr^{+6} - Hexavalent Chromium
TOC - Total Organic Carbon

TABLE 2-3

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE II
NIROP FRIDLEY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	Natural Attenuation and Engineering Parameters[4]
SOIL SAMPLES COLLECTED FROM 0-4 BGS						
003-SB-30D-01	0.0 - 5.0'	X				
003-SB-32D-01	0.0 - 5.0'	X				
SOIL SAMPLES COLLECTED FROM >4-12 FEET BGS						
003-SB-28D-01	5.0 - 10.0'	X				
003-SB-29D-01	5.0 - 10.0'	X				
003-SB-31D-01	5.0 - 10.0'	X				
003-SB-31D-02	10.0 - 15.0'	X				
003-SB-33D-01	5.0 - 10.0'	X				
003-SB-33D-02	10.0 - 15.0'	X				
SOIL SAMPLES COLLECTED FROM >12 FEET BGS						
003-SB-28D-03	25.0 - 30.0'	X				
003-SB-28D-04	35.0 - 40.0'	X				
003-SB-28D-05	45.0 - 50.0'	X				
003-SB-28D-06	50.0 - 55.0'	X				
003-SB-28D-07	60.0 - 65.0'	X				
003-SB-28D-08	70.0 - 75.0'	X				
003-SB-28D-09	80.0 - 85.0'	X				
003-SB-28D-10	95.0 - 100.0'	X				
003-SB-28D-10-D	95.0 - 100.0'	X				
003-SB-28D-11	105.0 - 110.0'	X				
003-SB-29D-02	15.0 - 20.0'	X				
003-SB-29D-03	25.0 - 30.0'	X				
003-SB-29D-04	30.0 - 35.0'	X				
003-SB-29D-05	40.0 - 45.0'	X				
003-SB-29D-06	55.0 - 60.0'	X				
003-SB-29D-06-D	55.0 - 60.0'	X				
003-SB-29D-07	65.0 - 70.0'	X				
003-SB-29D-08	75.0 - 80.0'	X				
003-SB-29D-09	80.0 - 85.0'	X				
003-SB-29D-10	95.0 - 100.0'	X				
003-SB-29D-11	100.0 - 105.0'	X				
003-SB-29D-12	115.0 - 120.0'	X				
003-SB-29D-13	125.0 - 130.0'	X				
003-SB-29D-14	130.0 - 135.0'	X				
003-SB-30D-02	15.0 - 20.0'	X				
003-SB-30D-03	20.0 - 25.0'	X				
003-SB-30D-04	35.0 - 40.0'	X				
003-SB-30D-05	45.0 - 50.0'	X				
003-SB-30D-06	50.0 - 55.0'	X				
003-SB-30D-07	65.0 - 70.0'	X				
003-SB-30D-08	70.0 - 75.0'	X				
003-SB-30D-09	80.0 - 85.0'	X				
003-SB-30D-10	90.0 - 95.0'	X				
003-SB-31D-03	20.0 - 25.0'	X				
003-SB-31D-04	30.0 - 35.0'	X				
003-SB-31D-05	40.0 - 45.0'	X				
003-SB-31D-05-D	40.0 - 45.0'	X				
003-SB-31D-06	55.0 - 60.0'	X				
003-SB-31D-07	65.0 - 70.0'	X				

TABLE 2-3

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE II
NIROP FRIDLEY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	Natural Attenuation and Engineering Parameters[4]
003-SB-31D-08	70.0 - 75.0'	X				
003-SB-31D-09	80.0 - 85.0'	X				
003-SB-31D-09-D	80.0 - 85.0'	X				
003-SB-31D-10	95.0 - 100.0'	X				
003-SB-31D-11	105.0 - 110.0'	X				
003-SB-31D-12	110.0 - 115.0'	X				
003-SB-31D-13	120.0 - 125.0'	X				
003-SB-32D-02	15.0 - 20.0'	X				
003-SB-32D-02-D	15.0 - 20.0'	X				
003-SB-32D-03	25.0 - 30.0'	X				
003-SB-32D-04	30.0 - 35.0'	X				
003-SB-32D-05	45.0 - 50.0'	X				
003-SB-32D-05-D	45.0 - 50.0'	X				
003-SB-32D-06	50.0 - 55.0'	X				
003-SB-32D-07	60.0 - 65.0'	X				
003-SB-32D-08	75.0 - 80.0'	X				
003-SB-32D-09	80.0 - 85.0'	X				
003-SB-32D-10	90.0 - 95.0'	X				
003-SB-32D-11	100.0 - 105.0'	X				
003-SB-32D-12	110.0 - 115.0'	X				
003-SB-32D-12-D	110.0 - 115.0'	X				
003-SB-32D-13	120.0 - 125.0'	X				
003-SB-33D-03	20.0 - 25.0'	X				
003-SB-33D-04	30.0 - 35.0'	X				
003-SB-33D-05	45.0 - 50.0'	X				
003-SB-33D-06	55.0 - 60.0'	X				
003-SB-33D-06-D	55.0 - 60.0'	X				
003-SB-33D-07	65.0 - 70.0'	X				
003-SB-33D-08	70.0 - 75.0'	X				
003-SB-33D-09	80.0 - 85.0'	X				
003-SB-33D-10	90.0 - 95.0'	X				
003-SB-33D-11	105.0 - 110.0'	X				
003-SB-33D-12	110.0 - 115.0'	X				
GROUNDWATER						
003-MS-28D-01	deep	X	X	X	X	X
003-MS-28D-F1	deep			X		
003-MS-28I-01	intermediate	X	X	X	X	X
003-MS-28I-F1	intermediate			X		
003-MS-28S-01	shallow	X	X	X	X	X
003-MS-28S-F1	shallow			X		X
003-MS-29D-01	deep	X	X	X	X	X
003-MS-29D-F1	deep			X		
003-MS-29I-01	intermediate	X	X	X	X	X
003-MS-29I-F1	intermediate			X		
003-MS-29S-01	shallow	X	X	X	X	X
003-MS-29S-F1	shallow			X		
003-MS-30D-01	deep	X	X	X	X	X
003-MS-30D-F1	deep			X		
003-MS-30I-01	intermediate	X	X	X	X	X
003-MS-30I-F1	intermediate			X		

TABLE 2-3

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM - OU3 RI PHASE II
NIROP FRIDLEY, MINNESOTA

SAMPLE[1]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC[2]	TAL Metals/ Cyanide[3]	TCL PCBs	Natural Attenuation and Engineering Parameters[4]
003-MS-30S-01	shallow	X	X	X	X	X
003-MS-30S-F1	shallow			X		
003-MS-31D-01	deep	X	X	X	X	X
003-MS-31D-F1	deep			X		
003-MS-31I-01	intermediate	X	X	X	X	X
003-MS-31I-F1	intermediate			X		
003-MS-31S-01	shallow	X	X	X	X	X
003-MS-31S-F1	shallow			X		
003-MS-32D-01	deep	X	X	X	X	X
003-MS-32D-F1	deep			X		
003-MS-32I-01	intermediate	X	X	X	X	X
003-MS-32I-01-D	intermediate	X	X	X	X	X
003-MS-32I-F1	intermediate			X		
003-MS-32I-F1-D	intermediate			X		
003-MS-32S-01	shallow	X	X	X	X	X
003-MS-32S-F1	shallow			X		
003-MS-33D-01	deep	X	X	X	X	X
003-MS-33D-F1	deep			X		
003-MS-33I-01	intermediate	X	X	X	X	X
003-MS-33I-01-D	intermediate	X	X	X	X	X
003-MS-33I-F1	intermediate			X		
003-MS-33I-F1-D	intermediate			X		
003-MS-33S-01	shallow	X	X	X	X	X
003-MS-33S-F1	shallow			X		

Notes:
1 This table includes only samples analyzed at a fixed-base laboratory (i.e., sample list does not include field screening samples).
2 Pyridine was also included in the SVOC list for soil samples.
3 Analysis for cyanide was not performed for filtered groundwater samples.
4 Natural attenuation parameters include fixed-base laboratory analysis for sulfate, nitrate, nitrite, dissolved chloride, dissolved bromide, dissolved phosphate, and dissolved methane as well as field analysis for dissolved oxygen, dissolved ferrous iron, dissolved reduced manganese, and hydrogen sulfide. Engineering parameters include total suspended solids (TSS), alkalinity as CaCO3, and hardness as CaCO3. Field measurements for pH, temperature, and oxidation/reduction potential (Eh) were also taken.

bgs - below ground surface
SB - soil boring sample
SU - subsurface soil sample
MS - groundwater sample collected from a permanent monitoring well
VOC- Volatile Organic Compounds
SVOC- Semi-Volatile Organic Compounds
PCB - Polycholorinated biphenyls
F1 - filtered samples for TAL dissolved metals

TABLE 2-4

SUMMARY OF FIXED BASED LABORATORY SAMPLING AND ANALYTICAL PROGRAM
EAST PLATING SHOP INVESTIGATION[1]
NIROP FRIDLEY, MINNESOTA

SAMPLE[2]	Depth (feet-bgs)/ Shallow	TCL VOC	TCL SVOC	TAL Metals/ Cyanide[3]	TCL PCBs	TOC	Cr^{+6}	pH
SOIL SAMPLES COLLECTED FROM 0-4 BGS								
SB-01-0001	0.0 - 1.0'	X	X	X	X			X
SB-01-0001-D	0.0 - 1.0'	X	X	X	X			X
SB-02-0001	0.0 - 1.0'	X	X	X	X			X
SB-02-0204	2.0 - 4.0'	X	X	X	X			X
SB-02-0204-D	2.0 - 4.0'		X	X	X			X
SB-03-0001	0.0 - 1.0'	X	X	X				X
SB-04-0001	0.0 - 1.0'	X	X[4]	X				X
SB-05-0001	0.0 - 1.0'	X	X[4]	X				X
SB-06-0002	0.0 - 2.0'	X	X	X				X
SOIL SAMPLES COLLECTED FROM >4-12 FEET BGS								
SB-01-0608	6.0 - 8.0'	X	X	X	X			X
SB-02-0406	4.0 - 6.0'	X	X	X	X			X
SB-02-0608	6.0 - 8.0'	X						
SB-03-1012	10.0 - 12.0'	X	X	X				X
SB-04-1012	10.0 - 12.0'	X	X	X	X			X
SB-05-1012	10.0 - 12.0'	X	X[4]	X				X
SB-06-0608	6.0 - 8.0'	X	X	X				X
SB-07-0406	4.0 - 6.0'	X	X	X	X			X
SOIL SAMPLES COLLECTED FROM >12 FEET BGS								
SB-01-1416	14.0 - 16.0'	X	X	X	X			X
SB-03-1214	12.0 - 14.0'	X	X[4]	X				X
SB-04-1214	12.0 - 14.0'	X	X	X	X			X
SB-05-1315	13.0 - 15.0'	X	X[4]	X				X
SB-06-1214	12.0 - 14.0'	X	X	X				X
SB-07-1416	14.0 - 16.0'	X	X	X	X			X
SB-07-2830	28.0 - 30.0'	X	X	X	X			X
GROUNDWATER								
GW-01	shallow	X	X	X	X			X
GW-01-F	shallow			X				
GW-02	shallow	X	X	X	X			X
GW-02-D	shallow	X	X	X	X			X
GW-02-F	shallow			X				
GW-02-F-D	shallow			X				
GW-03	shallow	X	X[4]	X				X
GW-03-F	shallow			X				

Notes:
1 Samples were taken during 1995 (after Halliburton NUS, 1995).
2 This table includes only samples analyzed at a fixed-base laboratory (i.e., sample list does not include field screening samples).
3 Analysis for cyanide was not performed for filtered groundwater samples.
4 This sample was analyzed for a limited list of SVOCs.
bgs - below ground surface
SB - soil boring sample
SU - subsurface soil sample
GW - groundwater sample collected from temporary monitoring well
VOC- Volatile Organic Compounds
SVOC- Semi-Volatile Organic Compounds
Cr^{+6} - Hexavalent Chromium
TOC - Total Organic Carbon
F1 - filtered samples for TAL dissolved metals

TABLE 2-5

SUMMARY OF MONITORING WELL CONSTRUCTION AND WATER LEVEL DATA
OU3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

Wells	Ground Surface (elevation)	Top of Well Casing (elevation)	Total Well Depth (feet-bgs)	Screened Interval		Screen Thickness (feet)	Depth to Water[1] (feet-bgs)	Water Level[1] (elevation)	Depth to Water[2] (feet-bgs)	Water Level[2] (elevation)
				Top of Screen (feet-bgs)	Bottom of Screen (feet-bgs)					
MS-28S	834.81	834.81	27.3	17.2	27.3	10.1	19.42	815.39	19.06	815.75
MS-28I	834.81	834.83	85.5	80.4	85.5	5.1	19.39	815.44	19.03	815.80
MS-28D	834.81	834.80	115.0	109.6	114.7	5.1	18.73	816.07	18.83	815.97
MS-29S	834.72	834.68	27.3	17.2	27.3	10.1	19.77	814.91	19.42	815.26
MS-29I	834.72	834.67	82.6	76.1	81.2	5.1	19.74	814.93	19.36	815.31
MS-29D	834.72	834.69	136.7	131.6	136.7	5.1	18.12	816.57	18.37	816.32
MS-30S	834.88	834.83	28.0	17.6	27.5	9.9	19.37	815.46	19.06	815.77
MS-30I	834.88	834.85	68.0	62.8	67.8	5.0	19.88	814.97	19.88	814.97
MS-30D	834.88	834.81	100.0	94.6	99.4	4.8	19.85	814.96	19.82	814.99
MS-31S	834.82	834.81	29.0	17.4	27.5	10.1	19.91	814.90	19.55	815.26
MS-31I	834.82	834.81	96.6	91.5	96.6	5.1	19.90	814.91	19.59	815.22
MS-31D	834.82	834.81	127.2	122.2	127.2	5.0	18.44	816.37	18.57	816.24
MS-32S	834.75	834.76	26.1	16.0	26.1	10.1	20.33	814.43	20.01	814.75
MS-32I	834.75	834.69	85.0	79.7	84.8	5.1	28.08	806.61	27.96	806.73
MS-32D	834.75	834.75	126.2	121.2	126.2	5.0	27.34	807.41	26.94	807.81
MS-33S	834.77	834.72	27.1	17.0	27.1	10.1	20.22	814.50	19.88	814.84
MS-33I	834.77	834.74	75.9	70.8	75.9	5.1	20.35	814.39	20.11	814.63
MS-33D	834.77	834.76	123.0	115.2	120.3	5.1	20.08	814.68	20.08	814.68

Notes:

bgs: below ground surface

1 Water level measurements taken on 3-1-98 by Tetra Tech NUS

2 Water level measurements taken on 7-7-98 by USGS, 1998

TABLE 2-6

LOCAL BACKGROUND CONCENTRATIONS OF INORGANIC CONSTITUENTS
FROM OU2 REMEDIAL INVESTIGATION
NIROP FRIDLEY MINNESOTA

Paremeter	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	Geometric Mean	95 % Upper Confidence Limit	Calculated Background Value
Aluminum	20/20	1200	5860	2490	3420	3420
Antimony	0/20	ND (2.0)	ND (2.0)	1.1	1.1	2.0 *
Arsenic	17/20	0.78	26.3	1.8	8.1	8.1
Barium (1)	13/19	10.4	241	22.8	128	128
Beryllium	0/20	ND (1.0)	ND (1.0)	0.53	0.55	1.0 *
Cadmium	1/20	3.4	3.4	0.57	0.75	1.0 *
Calcium	20/20	675	37300	7370	56400	56400
Chromium	20.20	3.6	15.2	7.3	9.3	9.3
Cobalt	2/20	13.8	22.3	6	7.5	10.1 *
Copper	8/20	4.7	16.6	3.3	5.7	5.7 *
Cyanide. Total	0/20	ND (2.5)	ND (2.5)	1.3	1.4	2.5 *
Iron	20/20	3750	23100	7560	11000	11000
Lead	20/20	1.1	9.9	3	4.8	4.8
Magnesium	20/20	895	14100	3570	8580	8580
Manganese (1)	19/19	44.7	2870	304	833	833
Mercury	0/20	ND (0.10)	ND (0.10)	0.053	0.055	0.10 *
Nickel	13/20	9.7	51.8	9.6	18.4	18.4
Potassium	13/20	113	1130	139	342	342
Selenium	1/20	6.1	6.1	0.37	0.63	0.63
Silver	1/20	4.4	4.4	1.2	1.4	2.0 *
Sodium	3/20	119	142	60.6	73.2	101 *
Thallium	0/20	ND (0.61)	ND (0.61)	0.32	0.33	0.61 *
Vanadium	15/20	10.9	42	12.5	20.6	20.6
Zinc	20/20	8.2	49.3	15.7	22.4	22.1

Notes:

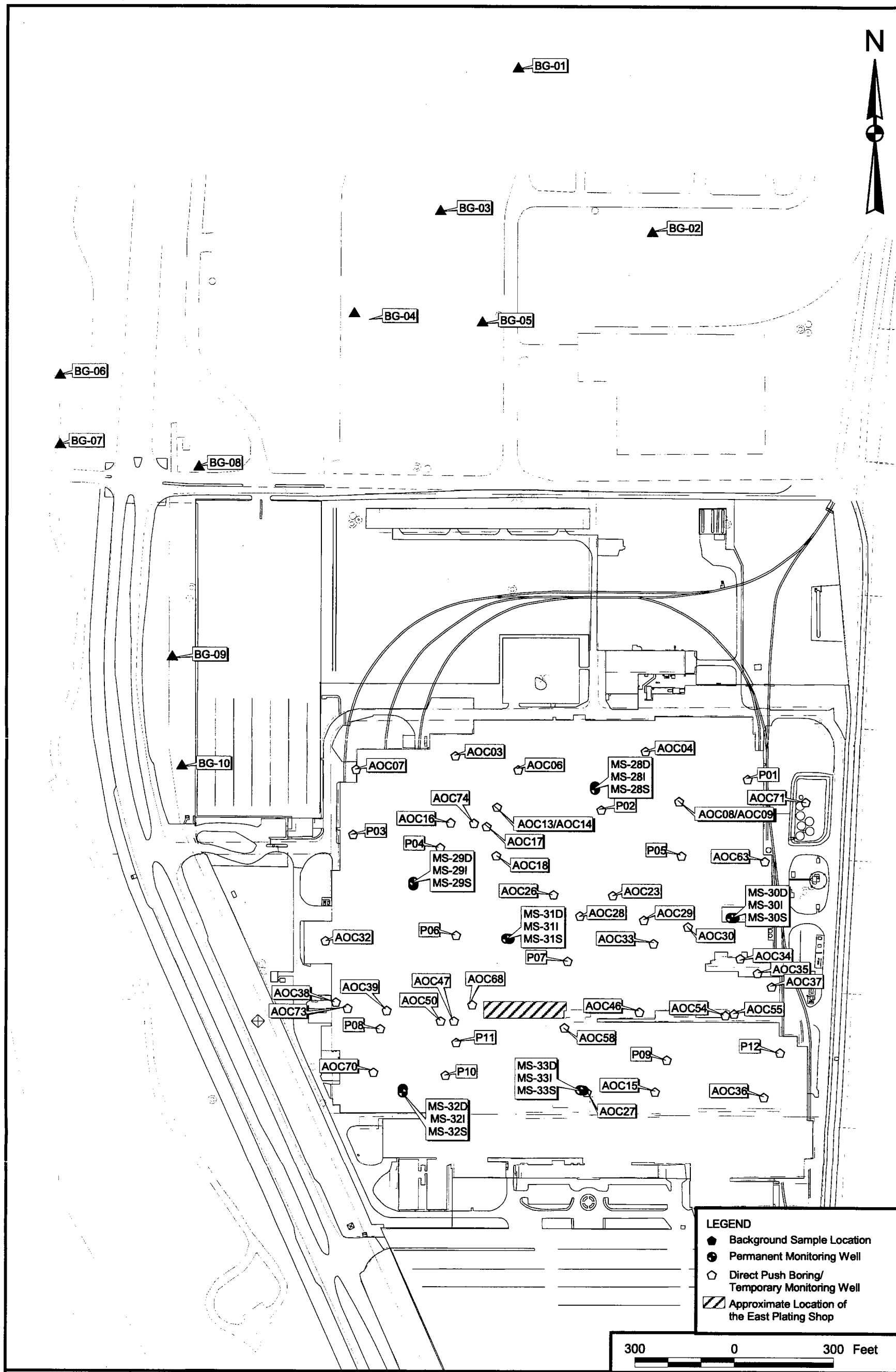
Source: Remedial Investigation Report for Soils Operable Unit, RMT, Inc., 1993.

* Background value is the detection limit

ND (x) = Not detected. Value in parentheses is the detection limit.

1 Maximum detected value was determined to be an outlier and was not included in the background statistics.

P:\GIS\FRIDLEY\6966_SITE_ASSESSMENT.APR 13-AUG-98 DNP SAMPLE LOCATION W/ BACKGROUND LAYOUT



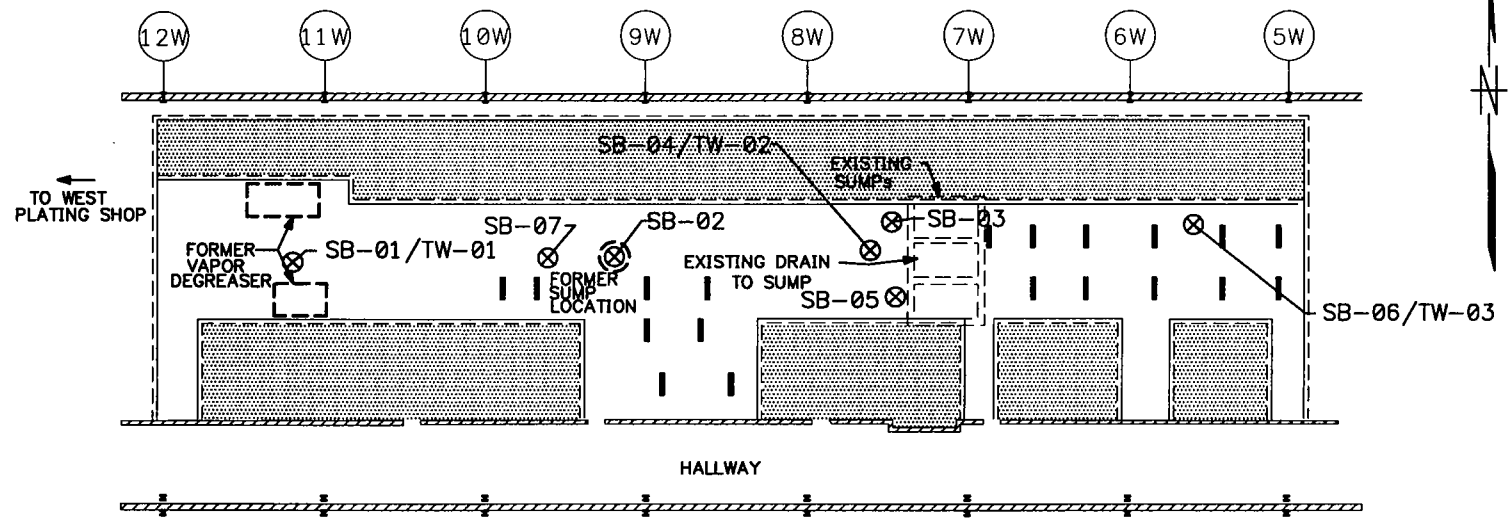
DRAWN BY	DATE
D. PERRY	13-AUG-98
CHECKED BY	DATE
COST/SCHEDULE-AREA	
SCALE	AS NOTED

SAMPLE LOCATION MAP
OU3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

CONTRACT NUMBER	
APPROVED BY	DATE
APPROVED BY	DATE 8/12/99
DRAWING NO. FIGURE 2-1	REV 0

ACAD: 6966gm09.dwg 08/17/98 HJP

DRAFT



LEGEND

9W	BUILDING COLUMN
	CONCRETE PIER
	FORMER SUMP LOCATION (PRE-1973)
	FORMER VAPOR DEGREASER LOCATION
SB-01/TW-01	SOIL BORING/ TEMPORARY WELL LOCATION

0 30 60
SCALE IN FEET

DRAWN BY HJP	DATE 8/17/98	SOIL BORING AND TEMPORARY WELLL LICATIONS EAST PLATING SHOP SOIL AND GROUNDWATER INVESTIGATION NIROP, FRIDLEY	CONTRACT NO. 6966
CHECKED BY	DATE		APPROVED BY / DATE
COST/SCHED-AREA			APPROVED BY / DATE 8/13/99
SCALE AS NOTED			DRAWING NO. FIGURE 2-2 / REV. 0

DEPARTMENT OF THE NAVY · NORTHERN DIV FACILITIES ENGINEERING COMD

FORM CADD NO. SDIV_AH.DWG - REV 0 - 1/20/98

3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section describes the location and physical environment of the NIROP Fridley facility. Descriptions of the site location, weather and climate, site topography, regional geology and hydrogeology, hydrology, water usage, and basewide geology and hydrogeology are included in this section.

3.1 SITE LOCATION

The NIROP Fridley facility is located in the Township of Fridley, in the southern-most tip of Anoka County, Minnesota. Fridley's population was estimated at 28,000 residents in 1990. Anoka County's population, according to 1990 estimates, was 244,000 people (RMT, September 1993). The site is currently active and consists of 82.6 acres of government-owned land, of which approximately 50 acres are paved or covered with buildings. The plant is bordered on the east by the Burlington Northern rail yard, on the north by various industrial facilities, on the south by UDLP, and on the west by East River Road and the Mississippi River (Figure 3-1). Located between East River Road (a four-lane highway) and the Mississippi River (west of the site) is the "Anoka County Regional Riverfront Park." The park is a day-use recreational facility on the river's edge, consisting of approximately 60 acres (RMT, June 1987).

The NIROP Fridley facility and the properties surrounding the site to the north, east, and south are zoned "heavy industrial." Access to the NIROP Fridley facility is strictly limited by an 8-foot-high fence and security patrols. The area adjacent to the southern border of the site, approximately 55 acres, is owned by UDLP, the NIROP operator.

The area encompassed within a 3-mile radius of the NIROP Fridley facility includes part of Minneapolis/St. Paul, New Brighton, St. Anthony, and most of Fridley and Brooklyn Center. The NIROP Fridley facility is located near the northern boundary of the metropolitan statistical area (as defined by the U.S. Bureau of Census) for Minneapolis-St. Paul, Minnesota-Wisconsin. The statistical area was estimated to contain a population of 2,350,000 people in 1990 (Rand McNally, 1992).

3.2 METEOROLOGY AND CLIMATOLOGY

The continental climate of the Minneapolis-St. Paul area is characterized by warm summers with ample rainfall; rather long, cold winters; and variable wind over the course of the year. The terrain is generally flat or gently rolling and is dotted by many lakes. These lakes are, for the most part, small and shallow, exerting little or no influence upon the air masses that pass over the area.

Temperature variations are quite extreme from season to season. Summer temperatures range from the upper 70s to low 80s, whereas winters are very cold with lows averaging between 3 and 7°F for January and February. The temperature extremes for the region range from -34 to 104°F.

The Minneapolis-St. Paul area lies near the northern edge of the influx of moisture from the Gulf of Mexico. The average annual precipitation is 25.94 inches. Of this annual precipitation, approximately 65 percent (16.9 inches) occurs during the months of May through September. Thunderstorms are the principal source of precipitation during these months. Winter snowfall can be very heavy and averages more than 40 inches per year.

Wind directions vary throughout the year. Northwesterly winds prevail from November through April; southeasterly winds are dominant in May, June, August, and October; and southerly winds dominate in July and September. Wind speeds are fairly constant throughout the year, averaging 10.5 miles per hour (Envirodyne, June 1983).

3.3 SITE TOPOGRAPHY

The NIROP facility lies on the east side of the broad, flat alluvial terrace deposit within the Mississippi River Valley floodplain. The terrain in the region surrounding the facility is generally flat or gently rolling and is marked by many small and shallow lakes.

The ground surface in the vicinity of the NIROP facility is generally flat, sloping very slightly from the east toward the west and southwest. The ground surface to the east and southeast of the East River Road (west of NIROP) decreases sharply as the flat alluvial terrace at 835 feet (National Geodetic Vertical Datum) meets the elevation of the Mississippi River at approximately 802 above mean sea level. The ground surface at the NIROP Fridley facility itself, however,is very flat. The elevation across the site is approximately 834 feet above mean sea level (msl) as shown on Figure 3-1. The elevation of the NIROP plant concrete floor is approximately 834.8 feet msl. Slopes throughout the site are five percent or less (Envirodyne, June 1983).

3.4 REGIONAL GEOLOGY

The NIROP Fridley facility lies on the northwestern side of a roughly circular structural basin that is known as the Twin Cities Basin. This tilting is so gentle that in many outcrops in the Minneapolis-St. Paul area the strata appear horizontal (Ojakangas and Matsch, 1982). At the NIROP, the dip of the bedrock is approximately 50 feet per mile to the south-southeast. There are no known regionally significant faults in

the bedrock in the vicinity of NIROP (Envirodyne, June 1983). No bedrock crops out in the immediate vicinity of the site (Envirodyne, June 1983).

The following subsections briefly describe the major stratigraphic units that exist at NIROP Fridley. Figure 3-2 presents a depiction of the generalized stratigraphic column for the site.

3.4.1 Unconsolidated Overburden

3.4.1.1 Quaternary Age Deposits

The unconsolidated overburden in the vicinity of the NIROP facility, as well the surrounding Minneapolis-St. Paul area, was deposited during the Pleistocene Epoch (a subdivision of the Quaternary Period). For most of the region, the surface is dominated by glacial sediments deposited as a result of a succession of glacial tongues present during the Pleistocene Epoch. Two primary ice advances and retreats during this time left rugged glacial moraines and numerous lake basins. Subsequent to the glacial period, the Minnesota and Mississippi Rivers reworked the landscape (Ojakangas and Matsch, 1982). During this post-glacial period, glacial melt-water caused the Mississippi River to flow at higher elevations than at present levels (Envirodyne, June 1983). Over time, several stages of high flow deposited layers of unconsolidated material in the Mississippi River floodplain. Subsequent river down-cutting resulted in alluvial terraces (Ojakangas and Matsch, 1982). The terrace deposits consist of a heterogeneous mixture of gravel, sand, silt, and clay. More specifically, these deposits primarily consist of coarse sand, fine to medium sand, and some gravelly sand with discontinuous layers of silt and clay present at various depths. The unconsolidated deposits are up to 130 feet thick in the vicinity of NIROP (Envirodyne, June 1983).

3.4.2 Bedrock

3.4.2.1 Ordovician Age Units

The unconsolidated Quaternary age terrace deposits directly overlie Ordovician age bedrock, a fact which indicates a significant geological unconformity between the two units. At NIROP, the upper surface of the bedrock was eroded prior to and during deposition of the overlying unconsolidated deposits. The erosion resulted in an uneven bedrock surface that slopes slightly toward the south. The bedrock formation that immediately underlies most of the NIROP facility is the St. Peter Sandstone.

The St. Peter Sandstone consists of a fine- to medium-grained, friable, well-sorted, white to yellow sandstone, with beds of siltstone and shale in the lower part of the formation. Texturally and mineralogically, the St. Peter Sandstone is very mature (uniform), an indication that its sands were well

sorted prior to and during deposition. Most of the quartz grains are from one-eighth to one-half millimeter in diameter. The sandstone is poorly cemented and consequently has a high porosity. A number of porosity determinations have been made, showing an average of approximately 28 percent for the upper half of the formation. Because of the small size of its quartz grains, the formation is not highly permeable (Theil, 1944).

As mentioned previously, much of the original thickness of the St. Peter Sandstone was eroded prior to and during deposition of the overlying unconsolidated deposits. Therefore, only the lower portion of the formation is present beneath the site. In the southwestern portion of NIROP, St. Peter Sandstone has been completely eroded, and the underlying Prairie du Chien Group has been exposed. The Prairie du Chien Group consists of the Shakopee Dolomite and the underlying Oneota Dolomite.

Limestone is a sedimentary rock that is composed of calcium and/or magnesium carbonate. Dolomite is the term used to refer to those limestones that possess 15 percent or greater magnesium carbonate. The Shakopee Dolomite is much less dolomitic (less magnesium) than the Oneota Dolomite. The basal beds of the Shakopee are sandy and, in many places, the succeeding layers are thinly bedded. Much of the formation is a massive, drab, dolomitic limestone with cavities filled with crystalline calcite. Calcareous ooids may be found throughout the Shakopee, although many of the ooids have been chemically altered to flint (Theil, 1944).

The Oneota Dolomite is thick-bedded, drab to buff, and in places pink, and may contain interbeds of sandstone or shale. The upper part may be cherty and, in many locations, is porous to cavernous. Many of the cavities and joints are lined with quartz crystals, and huge, calcite-lined pockets are common. In the southeastern counties where massive dolomite forms bluffs of the Mississippi and its tributaries, there are extensive solution channels, some of which reach the dimensions of caves penetrable for some distance (Theil, 1944).

Small quantities of water are found in the upper and more porous portion of the Oneota Dolomite, but great volumes are contained in the larger solution passages, such as enlarged joints or bedding planes. Some underground streams that issue as springs from the dolomite flow at a rate of more than 350 cubic feet per minute. The unit typically has negligible primary porosity and yields little water to wells except from the solution passages (Theil, 1944).

3.4.2.2 Cambrian Age Units

At the site, the Oneota Dolomite represents the base of the Ordovician System. The Jordan Sandstone (Cambrian Period) underlies the Oneota Dolomite throughout the region. The Jordan Sandstone is underlain, in turn, by the St. Lawrence Formation, the Fanconia Formation, and the Dresbach Formation. For this report, descriptions of rock units beneath the Jordan Sandstone are not necessary. Detailed descriptions of the deeper bedrock units are presented in the Initial Assessment Study (Envirodyne, June 1983).

The Jordan Sandstone is a loosely cemented, medium- to coarse-grained, white sandstone, which becomes yellow or brown by oxidation at outcrops and along jointing planes. It ranges from 75 to nearly 175 feet in thickness and is exposed in the valleys of the Minnesota River and tributary streams and in the lower part of the bluffs of the Mississippi River and its branches from near Hastings southward to the Iowa state line. Elsewhere it is deeply buried beneath younger rocks (Envirodyne, June 1983).

The Jordan Sandstone is made up of two members, the Norwalk below and the Van Oser above. The upper Van Oser Member is the coarser of the two. It consists of friable gray, white, pink, or brown sand grains, many which have recrystallized grain surfaces. The lower Norwalk Member is not present in the region (Envirodyne, June 1983).

3.5 REGIONAL HYDROGEOLOGY AND WATER USAGE

At NIROP, four aquifers (or aquifer zones) underlie the site as identified by the Minnesota Geological Survey (University of Minnesota, 1979). These aquifers consist of (from shallow to deep) the shallow Quaternary aquifer zone, the Prairie du Chien/Jordan aquifer (PCJ), the Franconia/Ironton/Galesville (FIG) aquifer, and the Mount Simon/Hinckley/Fond du Lac (MHF) aquifer (Envirodyne, June 1983).

The shallow Quaternary aquifer zone is comprised of the unconsolidated Quaternary deposits overlying bedrock in the region. It is referred to here as an aquifer zone because it consists of a poorly defined unconfined and a confined (or semi-confined) aquifer. The depth to the potentiometric surface in the Quaternary aquifer zone ranges from approximately 18 to 34 feet, depending upon precipitation levels and pumping wells. Groundwater flow in the Quaternary and the PCJ aquifers is generally toward the south and southwest and discharges into the Mississippi River (Work Plan, Brown & Root Environmental, 1997). Additional description of the Quaternary aquifer zone underlying the NIROP facility can be found in Section 3.7.

As mapped by Kanivetsky (University of Minnesota, 1979), the Quaternary aquifer at the NIROP is capable of a sustained yield of 100 to 500 gallons per minute (gpm) to a properly developed well. The Quaternary aquifer, though capable of yielding fairly high quantities of water to wells, is not commonly used for water supply purposes. It is easily contaminated due to relatively shallow depth from ground surface, and water of good quality and even higher yields is commonly available at comparable cost in the underlying PCJ aquifer (Envirodyne, June 1983).

Under the northern and eastern portions of NIROP, the PCJ (approximately 130 to 400 feet bgs) is confined by the lower portion of the St. Peter Sandstone. Under the southwestern part of the NIROP facility, the St. Peter Sandstone is fully eroded, and the PCJ exists as an unconfined (or semi-confined) aquifer. Where this occurs, the PCJ and the Quaternary aquifer may act as a single, hydraulically connected unit (Envirodyne, June 1983). Wells tapping the PCJ aquifer typically yield 500 to 1,000 gpm (University of Minnesota, 1978). Hydrogeologic parameters for the bedrock aquifers are shown in Table 3-1.

The PCJ aquifer is used for water supply purposes in the immediate vicinity of the NIROP. There are two wells at the plant that tap this aquifer (NIROP-2 and NIROP-3). These wells date back to the 1940s and were used to supply potable and industrial water for NIROP. The average pumping rate for these wells was 760 gpm. TCE contamination problems led to the shutdown of these wells in April 1981. There is also a well just south of the Navy Property, within the main industrial building, that taps the PCJ aquifer (FMC-1). This well was also shut down in April 1981 because of TCE contamination. The well was re-opened in August of 1981 and was intermittently used for non-contact cooling water for the NIROP facility until it was shut down again in June 1983 (Envirodyne, June 1983). Currently, all water used at the NIROP Fridley is obtained from the city. The City of Fridley has a well just beyond the northwest corner of the NIROP (Fridley-13) that taps the PCJ and is used for municipal water supply on a standby basis. This well dates back to 1970. It has a gas-powered pump and is used during power outages and during periods of peak demand. TCE has not been detected in well Fridley-13. The total population served by groundwater within a 3-mile radius of the NIROP is 29,000 residents (RMT, November 1995). Several other water supply wells in the general vicinity of the NIROP are believed to tap the PCJ aquifer (Envirodyne, June 1983). There are no groundwater supply wells or users downgradient of NIROP Fridley between the facility and the Mississippi River (RMT, November 1995).

The MHF and the FIG are both confined aquifers. Because of the depth of these aquifers (greater than 400 feet bgs), they are not used for water supply purposes in the immediate vicinity of the NIROP. The MHF, however, is used rather extensively as a water supply source north of the site, where it is more shallow (Envirodyne, June 1983).

3.6 SURFACE WATER HYDROLOGY

NIROP is situated on an alluvial terrace east of the Mississippi River. Much of this very flat surface is covered by buildings and pavement. Runoff from these hard-surfaced areas is collected by a series of storm sewers, which discharge into the Mississippi River, located approximately 800 feet west of the plant boundary (Envirodyne, June 1983).

As mentioned previously, the soils are very sandy and highly permeable. As such, and because of the flat topography, essentially all of the precipitation falling on these areas either infiltrates into the ground or is evaporated. There is little to no runoff from these areas, and no significant water courses, either perennial or intermittent, are present on the site (Envirodyne, June 1983).

The Mississippi River in the vicinity of the site flows to the south, where it is joined by the Minnesota River at a point approximately 15 river miles downstream from NIROP. At the U.S. Geological Survey (USGS) gaging station near Anoka (upstream from NIROP), the Mississippi River has had an average discharge of approximately 7,600 cubic feet per second (cfs) (Envirodyne, June 1983) and has an approximate stage elevation of 802 feet msl (USGS 7.5 minute Quad).

3.7 LOCAL GEOLOGY

This section describes the geology within the local vicinity of the NIROP Fridley facility. The OU3 remedial investigation field event focused on the unconsolidated deposits within the boundaries of the NIROP Plant. However, information from previous investigations provides additional geological information in the vicinity of the NIROP Plant facility. Figure 3-3 illustrates the location of five generalized geologic cross-sections across the NIROP facility and surrounding area. Cross sections A-A' and B-B' (Figures 3-4 and 3-5, respectively) are oriented in a northwest-southeast trend. Cross sections C-C', D-D' and E-E' (Figures 3-6, 3-7, and 3-8, respectively) are oriented in a southwest-northeast trend.

3.7.1 Unconsolidated Deposits

The unconsolidated deposits extend from the ground surface down to the top of the Ordovician age bedrock. These deposits range from 98.6 to 136.7 feet thick in the vicinity of the NIROP facility and primarily consist of medium to coarse sand and fine sand with gravel and discontinuous very fine-grained (i.e., clay, silty clay, sandy clay, and silt) interbeds. The very fine-grained material interbeds range from 1 to 45 feet in thickness and generally increase in thickness with depth.

Generally, from ground surface to approximately 45 to 50 feet bgs, the subsurface material is predominantly medium to coarse sand and fine sand with very few discontinuous clay layers. The thickness of the these discontinuous clay layers in this interval ranges from 1 to 17 feet. On cross-section A-A' (Figure 3-4), for example, each of the borings (from well cluster 2 in the northeast to well cluster 30 in the southeast) penetrated sand from ground surface to at least 55 feet bgs. Southeast of well cluster 30, however, clay and silt were encountered from ground surface to 10 feet bgs which was in turn underlain by sand and gravel. This same phenomena is present throughout the site as shown on cross sections B-B', C-C', and D-D,' and E-E' (Figures 3-5, 3-6, and 3-7, respectively) with the exception of a few localized areas. On B-B', for example, the subsurface (to ~50 feet bgs) is predominantly medium to coarse sand and fine sand; however, silty clay and silts were encountered locally in the northwest at P-03 from ground surface to approximately 14 feet bgs and locally at SB-04 and SB-07 (in the East Plating Shop) from 3 to 28 feet bgs. On C-C', the subsurface (~50 feet bgs) is mostly medium to coarse sand and fine sand. Silty clay was encountered locally in the southwest at 11-S and 6-D from 19 to 26.5 feet bgs and at AOC-73 and AOC-38 from ground surface to 9 feet bgs. Also shown on C-C', within the NIROP Plant, borings P-04, AOC-16, and AOC-03 encountered very fine grained sediments from 36.5 to at least 47 feet bgs (bottom of borings). Cross-section D-D' shows that the subsurface material is primarily sand (to ~50 feet bgs) with the exception at well AT-3A to the southeast, where clay was encountered from 18.1 to 31.6 feet bgs and at boring AOC-4 at the northern edge of the NIROP Building, where clay was encountered from 22 feet to at least the bottom of the boring at 28.5 feet bgs. And finally, on E-E', the subsurface material (to ~ 50 feet bgs) is only sand with no fine-grained material present.

Below an approximate depth of 50 feet bgs to the top of bedrock (i.e., 98.6 to 136.7 feet bgs), the presence and thickness of the very fine grained material increases significantly in the central, west, and southwest portions of the site whereas in the north, east, and southeast portions of the site the finer grained deposits are very thin or nonexistent. The thickness of the very fine grained layers within this interval in the central, west and southwest portions of the site range from 1 to 45 feet whereas in the north, east, and southeast the thickness ranges from 1 to 4 feet. In the western portion of the NIROP Building, at well cluster 29 for example, a significant silty clay to sandy clay unit was encountered from 81 to 117.2 feet bgs (as shown on cross-sections B-B' and C-C'). In the southwestern corner of the NIROP a clay layer was encountered at extraction well AT-2 from 41 to 85.5 feet bgs (as shown on cross-section C-C'). Similarly in well cluster 32, in the southwest corner of the facility, a silty clay layer was encountered from 56 to 75 feet bgs (as shown on cross-section D-D'). Approximately 600 feet south of well cluster 32, a 25 to 29 foot thick clay unit was encountered at depth (within a similar interval) at 17-D and AT-5B, respectively (shown on E-E'). It is important to note, however, that this clay layer encountered at well cluster 32 and at 17-D and AT-5B is not continuous because as cross-section D-D' (Figure 3-7) shows, well AT-3 between these two locations encountered primarily sand within this same interval.

Further still, on cross-section A-A' and D-D' (Figure 3-4 and 3-7) silty clay was encountered at well cluster 28 in the central portion of the facility from 84 to 95 feet bgs and 103.7 to 105.0 feet bgs. Silty clay interbedded with sand was also encountered at this boring from 76.5 to 79.2 feet bgs. At well cluster 31 (as shown on cross-sections B-B' and D-D') also in the central portion of the site, several thick layers of very fine-grained material were encountered. For example, a 16-foot silty clay layer was encountered from 50 to 66.1 feet bgs. Silty clay was also encountered at this cluster from approximately 88 to 95 feet bgs and from 96 to 109 feet, separated by a fine-grained sand layer. Silty clay was also encountered from 115 feet bgs to 126.7 feet where sandstone bedrock (St. Peter Sandstone) was encountered.

The depth interval below 50 feet bgs to the north, east, and southeast of the NIROP Building is also predominantly medium to coarse sand and fine sand, with little or no very fine grained material present. For example, to the north of the NIROP building (as shown on cross-sections C-C' and D-D') the subsurface materials are predominately medium to coarse sand and fine sand. Only at boring 1-D are two thin layers of sandy clay encountered from 66 to 71 feet and 85 to 87 feet bgs, respectively (as shown on D-D', Figure 3-7). Similarly, to the east of the NIROP building (as shown on cross-sections A-A' and E-E') the subsurface materials are predominately sand. Only at well cluster 30 and boring AOC-63 were two thin layers of clayey silt and silty clay encountered from approximately 52 to 56 feet and 67.5 to 69.7 feet bgs, respectively (as shown on E-E', Figure 3-7). Likewise, to the southeast of the NIROP facility sand was predominantly encountered down to the bedrock surface as is shown on cross-section B-B' (Figure 3-5).

Coarse-grained deposits (gravelly sand to gravel and cobbles) were encountered in several borings located to the east of the NIROP Building. For example, cross-sections A-A' and E-E' (Figures 3-4 and 3-7) illustrate a thick layer of very coarse, poorly sorted gravel from a depth of 65 feet bgs to the top of the bedrock surface at 98.6 feet bgs. A 5-foot-thick layer of gravelly sand was also encountered at boring 14-D from 50.5 to 55.5 feet bgs (A-A' on Figure 3-4).

3.7.1.1 Soil Classification

Generally, sand in the study area is classified as poorly graded sand (SP) under the Unified Soil Classification System (USCS).

Recent alluvial deposits occur in areas adjacent to the Mississippi River. These deposits show little development, and the texture varies widely. These deposits are frequently subjected to flooding (Envirodyne, June 1983).

NIROP is located in the southwestern most portion of Anoka County in a small strip of land referred to as the "Anoka County Boot." The Soil Conservation Service (SCS) has previously provided information on the soils present at NIROP. The SCS indicated that NIROP was located within the Hubbard-Nymore soil association, which is characterized by nearly level to gently sloping, excessively drained, sandy soils. The majority of the NIROP site has Hubbard soils, whereas small areas close to the Mississippi River are occupied by Becker and Chaska soils (Envirodyne, June 1983). A description of each of these soil types, obtained from the Anoka County soil survey, is provided as follows.

Hubbard Series

The Hubbard series consists of nearly level to slightly sloping, excessively drained soils formed in broad outwash sands. These soils are located on broad flats adjacent to drainage ways and large depressions in the sandy outwash plains. Hubbard soils have a black and very dark grayish-brown, coarse sandy surface layer approximately 20 inches thick. The subsoil is dark brown and yellowish-brown coarse sand. The underlying material, at a depth of approximately 44 inches, is pale brown, gravelly coarse sand. The permeability of these soils is high (Envirodyne, June 1983).

Becker Series

The Becker series consists of nearly level, moderately well drained to well-drained soils formed in loamy sediments underlain by sand. These soils are found on bottom land along rivers and streams. Permeability of these soils is moderately high, and the available water capacity is moderate. This soil is occasionally flooded for short periods. The surface layer is very dark brown, black, or dark grayish-brown, fine, sandy loam approximately 27 inches thick. The subsoil is dark brown and dark yellowish-brown, friable, very sandy loam approximately 17 inches thick. The underlying material is mottled, yellowish-brown, loose, coarse sand (Envirodyne, June 1983).

Chaska Series

The Chaska series consists of deep, poorly and somewhat poorly drained soils formed in loamy alluvium on flood plains. The surface layer is very dark gray silt loam approximately 8 inches thick. The substratum is 30 inches of very dark grayish-brown and very dark gray, mottled sand and silt loams. Slopes on these soils range from 0 to 2 percent. These soils are commonly subjected to periods of flooding. The permeability of these soils is moderate to moderately high (Envirodyne, June 1983).

3.7.2 Bedrock

The base of the unconsolidated deposits lies unconformably (i.e., an erosional surface) above the Ordovician age St. Peter Sandstone in most areas of the site. Investigation of the bedrock was not included in the scope of this investigation; however, some information is available from past studies at the site. Based on these past studies, the St. Peter Sandstone is present as the surfical bedrock in all areas of the site with the exception of the south-central portion of the site where the Shakopee Dolomite (Prairie du Chien Group) is present (as shown on cross-section E-E', Figure 3-7). As previously mentioned, the top of bedrock in the vicinity of the site ranges from 98.6 to 136.7 feet bgs. Within the project area the St. Peter Sandstone ranges in thickness from 17 to 62.4 feet. The top of the St. Peter Sandstone is typically moderately to highly weathered. For additional description on the bedrock in the vicinity of the NIROP Plant refer to Section 3.4.2.

3.8 LOCAL HYDROGEOLOGY

The hydrogeology within the vicinity of the NIROP facility is consistent with the regional hydrogeology where four aquifers (or aquifer zones) govern groundwater movement through the subsurface. These aquifers are (from shallow to deep) the shallow Quaternary aquifer zone, the Prairie du Chien/Jordan aquifer (PCJ), the Franconia/Ironton/Galesville (FIG) aquifer, and the Mount Simon/Hinckley/Fond du Lac (MHF) aquifer. This section will specifically discuss the hydrogeology of the Quaternary aquifer zone, which was the focus of this investigation. For information regarding the other aquifers at the site refer to Section 3.5.

As previously mentioned, the shallow Quaternary aquifer zone is comprised of the unconsolidated Quaternary deposits overlying bedrock at the site. The Quaternary aquifer as defined by the University of Minnesota (1979) is referred to here as an aquifer zone because it consists of two poorly defined aquifers. Each of these two aquifers, namely the shallow unconfined aquifer and the underlying deep confined (or semi-confined) aquifer, vary significantly in thickness and hydraulic connection throughout the site. The shallow unconfined aquifer ranges in thickness between 41 and 93 feet, and the deeper confined (or semi-confined) aquifer ranges in thickness between 19 and 55 feet. The unconfined aquifer has been investigated through the installation of shallow wells (S) in the upper portion of the unconfined aquifer and intermediate wells (I) installed in the lower portion of the unconfined aquifer; the deep confined (or semi-confined) aquifer has been investigated through deep wells (D) as shown on cross-sections A-A' through E-E' (Figures 3-4 to 3-7) and described by B&R Environmental (1998). Each of these two aquifer zones are separated by a fine-grained low permeability deposit aquitard or confining unit that varies significantly in thickness and horizontal extent. The thickness of the aquitard ranges between 0 and 36 feet. It

appears that the aquitard is the thickest and fairly laterally continuous in the central, west, and southwest portions of the site as shown by cross-sections B-B', C-C', D-D', and E-E' (Figures 3-5 through 3-7). However, in the north, east, and southeast portions of the site the aquitard is very thin or is nonexistent as shown by cross-sections A-A', B-B', C-C', D-D', and E-E' (Figures 3-4 through 3-7). In these areas the deep aquifer may no longer be confined but semi-confined or even unconfined, thus having some direct hydraulic connection with the overlying shallow unconfined aquifer. The importance of these fine-grained interbeds or aquitards is that they may impede or redirect the natural vertical migration of fluids in the aquifer. Downward migration of dense nonaqueous-phase liquids (DNAPLs) such as TCE can be redirected by the low permeability layers, even against the natural direction of groundwater flow.

The horizontal groundwater flow direction across the facility in the Quaternary aquifer zone is generally toward the south and southwest and discharges into the Mississippi River. Figures 3-8 and 3-9 illustrate the potentiometric surfaces for the shallow aquifer and the deep aquifer based upon measurements taken on July 7, 1998 (USGS, 1998), respectively. As both figures illustrate, the natural groundwater flow direction at the site is altered significantly by the remedial wells (i.e., AT-1A, AT-2, AT-5 on Figure 3-8, and AT-3A and AT-5B on Figure 3-9) actively pumping in both aquifer zones. Figure 3-8 illustrates that the groundwater flow direction is generally to the south-southwest with a westerly groundwater flow direction locally on the eastern side of the site. On both Figures 3-8 and 3-9, a cone of depression is evident at wells 1-IS and 10-D, respectively. At the present time it is unknown why this phenomena is occurring as no pumping wells exist at this location.

3.8.1 Horizontal Hydraulic Gradient

As expected, due to the cones of depression created by these actively pumping remedial wells, the horizontal hydraulic gradient is greater in the south and southwest portions of the site than in the north and northeast where few pumping wells are active. Table 3-2 illustrates the calculated horizontal hydraulic gradients based upon the water level measurements taken on July 7, 1998. As Table 3-2 illustrates, the horizontal hydraulic gradient was significantly higher in the south and southwest than in the north and northeast portions of the site for both the shallow unconfined and the deep confined aquifers. Average gradients for the entire site were 0.00503 and 0.00689 for the shallow unconfined and the deep confined aquifers, respectively. Please refer to Appendix C.4 for hydraulic gradient calculations.

3.8.2 Vertical Hydraulic Gradient

Vertical hydraulic gradients between the two aquifers were also calculated as shown on Table 3-3. These gradients were calculated using water level measurements from two wells screened in each of the two

aquifers from the same well cluster. As expected, wells located in the north and northeast portion of the site had an upward hydraulic gradient (or upward potential groundwater flow) which ranged from 0.0022 to 0.0096. This upward hydraulic gradient may be an indication of confining pressure on the underlying deep aquifer and/or of recharge to the shallow aquifer. However, in well clusters in the south and southwest portion of the site, which are directly affected by the remedial extraction wells, a downward hydraulic gradient is present which ranged from 0.0007 to 0.0676. Exceptions to the general rule include well cluster 30 on the east side of the Plant and cluster 26-S and 15D on the southwest side of the facility. Well cluster 30 has a downward hydraulic gradient of 0.0105, which is likely due to extraction well AT-1A located nearby. Well cluster 26-S and 15D has an upward hydraulic gradient of 0.0030, which may be indicative of confining pressure on the underlying deep aquifer and/or of recharge to the shallow aquifer and ultimately the Mississippi River. Please refer to Appendix C.4 for hydraulic gradient calculations.

3.8.3 Specific Capacity Results

Based upon the SPECAP tests conducted on each of the new wells installed by Tetra Tech NUS (well clusters 28 through 33) the transmissivity, hydraulic conductivity, and specific capacity were determined. For this study, these parameters were only determined for the aquifers, not the aquitards (i.e., confining units). The results of each test and the geometric mean of each parameter are illustrated on Table 3-4. Based upon these analyses, the transmissivity, hydraulic conductivity, and SPECAP range from 3.3 to 26,012 feet^2/day, 0.651 to 364.22 feet/day, and 0.0221 to 21.42 gallons per minute/feet (gpm/feet), respectively, for the unconfined aquifer. The transmissivity, hydraulic conductivity, and SPECAP range from 24.35 to 903.9 feet^2/day, 1.40 to 288.06 feet/day, and 4.71×10^{-2} to 8.82 gpm/feet, respectively, for the deep confined aquifer. Based upon the comparison of the geometric mean calculated for each aquifer, the aquifers appear to have similar characteristics with the shallow unconfined aquifer having slightly higher values (but within the same order of magnitude). Only the transmissivity is significantly higher between the two aquifers which, is probably due to the fact that the unconfined aquifer is significantly thicker than the deep confined aquifer. Please refer to Appendix C.3 for aquifer test data and calculations.

3.8.4 Groundwater Flow Velocity

Based upon the calculated hydraulic gradients and average hydraulic conductivities and an assumed porosity of 0.3, horizontal linear groundwater velocities were also calculated for each of the two aquifers at the site. As expected, due to the increased hydraulic gradient created by the actively pumping remedial wells, the horizontal groundwater velocities are greater in the south and southwest portions of the site than in the north and northeast where few pumping wells are active. Table 3-2 illustrates the calculated groundwater velocities. As Table 3-2 illustrates, the horizontal groundwater velocities were significantly

higher in the south and southwest than in the north and northeast portions of the site for both the shallow unconfined and the deep confined aquifers. Average velocities for the entire site were 1.139 feet/day and 0.8 feet/day for the shallow unconfined and the deep confined aquifers, respectively. Please refer to Appendix C.4 for hydraulic gradient calculations.

3.9 DEMOGRAPHY, LAND USE, AND ECOLOGY

The city of Fridley covers an area of approximately 15 square miles on the east bank of the Mississippi River in Anoka County, Minnesota. The city has an estimated population of 30,000, which has remained fairly stable since the 1970 census. Fridley is located approximately 8 miles north of downtown Minneapolis and is served by Interstate 694 and state highways 47 and 65.

Fridley's economic base is comprised largely of manufacturing and service industries, employing approximately 27,500 people. With employment exceeding its workforce, the city is a net importer of employees from the surrounding communities. The largest employer in Fridley is United Defense, L.P., Armament Systems Division (operator of both the United Defense facility and the NIROP), with approximately 2,800 employees. In 1991, other major employers included the following (in descending order): the Medtronics Corporation, manufacturing electro-medical equipment; Onan, a division of Hawker-Siddeley, manufacturing generators; Burlington Northern Railroad; Target Stores, Inc.; and the Unity Medical Center.

The 1990 population profile of the persons living within the area revealed a population cross-section that was approximately 95.6 percent White; 1.0 percent Black; and 0.4 percent other. Also, approximately 3.0 percent of the population is of American Indian, Eskimo, Aleut, Asia or Pacific Islander origin.

The average number of persons per household in the area of influence (i.e., City of Fridley, Minnesota) is 4.2 persons. The estimated average median household income in the region of influence is $36,855, with an estimated average per capita income of $16,347. An estimate of 383 families living within the region at or below poverty level.

The city of Fridley has a council-manager form of government, with a mayor and four council members elected by city voters. The council sets city policy, which is implemented by an appointed city manager through the city's departmental structure. The city provides municipal services, including public works; police and fire protection; parks and recreation; and water supply, treatment, and distribution. Wastewater service is provided by the Metropolitan Council Environmental Services (MCES), electric power is supplied by the Northern States Power Company, and solid waste service is privately contracted.

Natural resource use in the area is limited to recreational activities in the Anoka County Riverfront Region Park, which is directly across East River Road from the NIROP, adjacent to the Mississippi River. Use of these resources does not result in access to the NIROP itself, which is highly restricted by the Department of Defense. No federal or state freshwater wetlands are located within 1 mile of the site; and no critical habitats, endangered species, or national wildlife refuges have been identified in the vicinity of the site.

TABLE 3-1

HYDROGEOLOGIC PARAMETERS OF THE BEDROCK AQUIFER
NIROP FRIDLEY, MINNESOTA

Aquifer	Specific Capacity		Hydraulic Conductivity		Transmissivity		Storage Coefficient	Hydraulic Diffusivity	
	(gpm/ft)	(1/sec/m)	(gpd/ft^2)	(m/day)	(gpd/ft)	(m^2/day)		(gpd/ft)	(m^2/day)
St. Peter									
Mode	4	0.8	80	3	8,000	100			
Range of values:									
Low	1	0.2	25	1	2,500	30	10^{-3}	2.5×10^6	3×10^4
High	10	2	250	10	37,000	450	10^{-5}	3×10^9	4×10^7
Prairie du Chien-Jordan									
Mode	34	7	350	14	70,000	870			
Range of values:									
Low	3	0.7	40	1.5	7,000	90	10^{-3}	7.6×10^6	9×10^4
High	118	24	500	20	250,000	3,100	10^{-6}	2×10^9	2.5×10^7
Franconia-Ironton-Galesville									
Mode	15	3	200	8	30,000	370			
Range of values:									
Low	2	0.4	30	1	4,000	50	10^{-4}	4×10^6	5×10^4
High	37	8	250	10	80,000	1,000	10^{-6}	8×10^9	1×10^8
Mt. Simon-Hinckley-Fond du Lac									
Mode	15	3	200	8	30,000	370			
Range of values:									
Low	1	0.2	15	0.6	2,000	25	10^{-2}	2×10^4	2.5×10^2
High	33	7	175	7	70,000	870	10^{-6}	7×10^9	9×10^7

Source: University of Minnesota, 1979

TABLE 3-2

SUMMARY OF HORIZONTAL HYDRAULIC GRADIENTS AND GROUNDWATER VELOCITY[1]
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

Aquifer Zone	Portion of Site	Average Horizontal Hydraulic Gradient[4]	Average Horizontal Groundwater Velocity
Shallow Unconfined Aquifer Zone[2]	North and Northeast	0.00123	0.277
	South and Southwest	0.00884	2.000
	Average for entire site	0.00503	1.139
Deep Confined (or Semi-confined) Aquifer Zone[2]	North and Northeast	0.00298	0.345
	South and Southwest	0.01080	1.253
	Average for entire site	0.00689	0.800

Notes:

1 Refer to Appendix C.4 for calculations of the parameters listed above. Calculations based upon July 7, 1998 water level measurements (USGS, 1998).

2 Monitoring wells included in the shallow unconfined aquifer zone include shallow wells (S) and intermediate wells (I).

3 Monitoring wells included in the confined (or semi-confined) aquifer zone include deep wells (D).

4 Hydraulic gradient is a dimensionless ratio.

TABLE 3-3

SUMMARY OF VERTICAL HYDRAULIC GRADIENTS[1]
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

Aquifer Zones for Vertical Hydraulic Gradient	Well Pair	Location of Well Pair	Vertical Hydraulic Gradient[4]	Direction of Potential Groundwater Flow
Unconfined to Confined Aquifer Zone[2,3]	1-S and 1-D	north	0.0022	upward
Unconfined to Confined Aquifer Zone[2,3]	MS-28S and MS-28D	north	0.0024	upward
Unconfined to Confined Aquifer Zone[2,3]	MS-29S and MS-29D	north-central	0.0095	upward
Unconfined to Confined Aquifer Zone[2,3]	MS-30S and MS-30D	east	0.0105	downward
Unconfined to Confined Aquifer Zone[2,3]	MS-31S and MS-31D	central	0.0096	upward
Unconfined to Confined Aquifer Zone[2,3]	MS-32S and MS-32D	southeast	0.0676	downward
Unconfined to Confined Aquifer Zone[2,3]	MS-33S and MS-33D	south	0.0167	downward
Unconfined to Confined Aquifer Zone[2,3]	18-S and 8-D	southeast	0.0007	downward
Unconfined to Confined Aquifer Zone[2,3]	26-S and 15-D	southeast	0.0030	upward

Notes:

1 Refer to Appendix C.4 for calculations of the parameters listed above. Calculations based upon July 7, 1998 water level measurements (USGS, 1998).

2 Monitoring wells included in the shallow unconfined aquifer zone include shallow wells (S) and intermediate wells (I).

3 Monitoring wells included in the confined (or semi-confined) aquifer zone include deep wells (D).

4 Hydraulic gradient is a dimensionless ratio

TABLE 3-4

SUMMARY OF SPECIFIC CAPACITY TEST RESULTS
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

Monitoring Wells	Description of Material in Which Monitoring Well is Screened	Specific Capacity Test Analysis[1]		
		Transmissivity ($feet^2/day$)	Hydraulic Conductivity (feet/day)	Specific Capacity (gpm/feet)
MS-28S	f. to c. sand	26012.9	340.04	21.42
MS-28I	f. to m. sand, silty clay	763.8	149.75	2.46
MS-28D	sandy gravel, sand	1278.6	66.24	2.044
MS-29S	f. to m. sand	14283.2	176.34	11.4
MS-29I	f. to c. sand	23621.9	291.63	10.24
MS-29D	f. to m. sand, gravel	1675.0	85.9	2.57
MS-30S	v. f. to f. sand	3674.4	66.81	4.24
MS-30I	m. to v.c. sand & gravel	4152.1	364.22	10.113
MS-30D	gravel to w. sandstone	8555.5	288.06	8.82
MS-31S	f. to c. sand	10157.0	203.14	13.02
MS-31I	silty clay to f. sand	310.2	14.16	0.464
MS-31D[2]	silty clay & sand	24.35	1.40	4.71×10^{-02}
MS-32S	f. to c. sand	13712.8	244.87	15.73
MS-32I	f. sand	461.3	20.06	0.651
MS-32D	v. f. to f. sand	903.9	33.11	1.13
MS-33S	f. to c. sand	1183.5	16.43	1.06
MS-33I	v. f. sand to sandy silt	3.3	0.651	0.0251
MS-33D	m. to c. sand	140.7	23.44	0.697

Aquifer Zone	Geometric Mean Transmissivity	Geometric Mean Hydraulic Conductivity	Geometric Mean Specific Capacity
Shallow Unconfined Aquifer Zone[3]	2114.924	67.916	2.950
Deep Confined (or Semi-confined) Aquifer Zone[4]	619.868	34.811	1.094

Notes:

Abbreviations:

f = fine grained; m = medium grained; c = coarse grained

v = very; w = weathered; gpm = gallons per minute.

1 Specific capacity test analysis conducted using Bradbury and Rothschild (1985).

2 Test results are suspect due to temporary pump shut-down.

3 Monitoring wells included in the shallow unconfined aquifer zone include shallow wells (S) and intermediate wells (I)

4 Monitoring wells included in the confined (or semi-confined) aquifer zone include deep wells (D).

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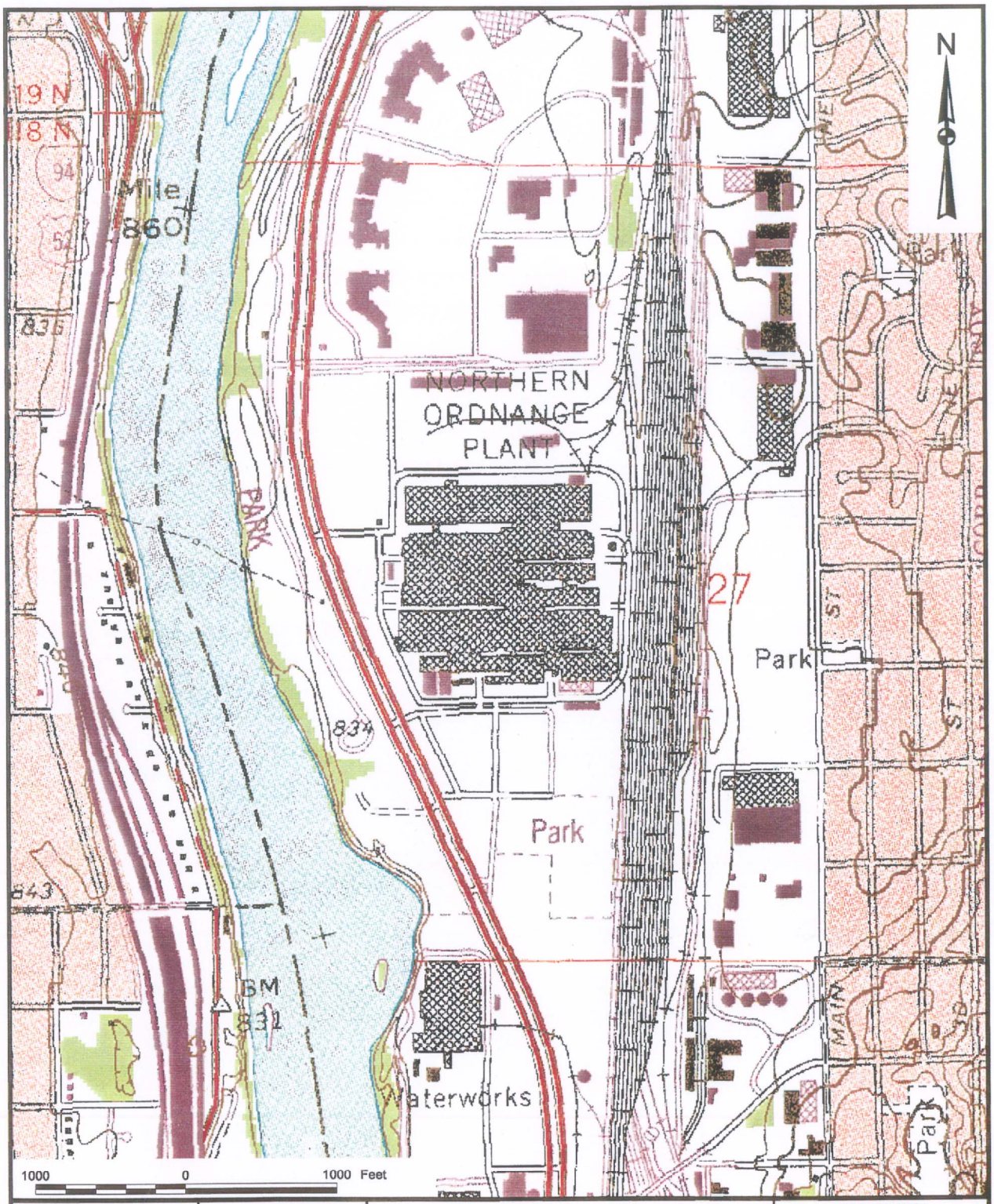


DRAWN BY D. PERRY	DATE 12-AUG-98	TOPOGRAPHIC MAP NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA	CONTRACT NUMBER —
CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY DATE 8/13/99
SCALE AS NOTED			DRAWING NO. FIGURE 3-1 REV 0

P:\GIS\FRIDLEY\6966_SITE_ASSESSMENT.APR 12-AUG-98 DNP TOPOGRAPHIC MAP LAYOUT

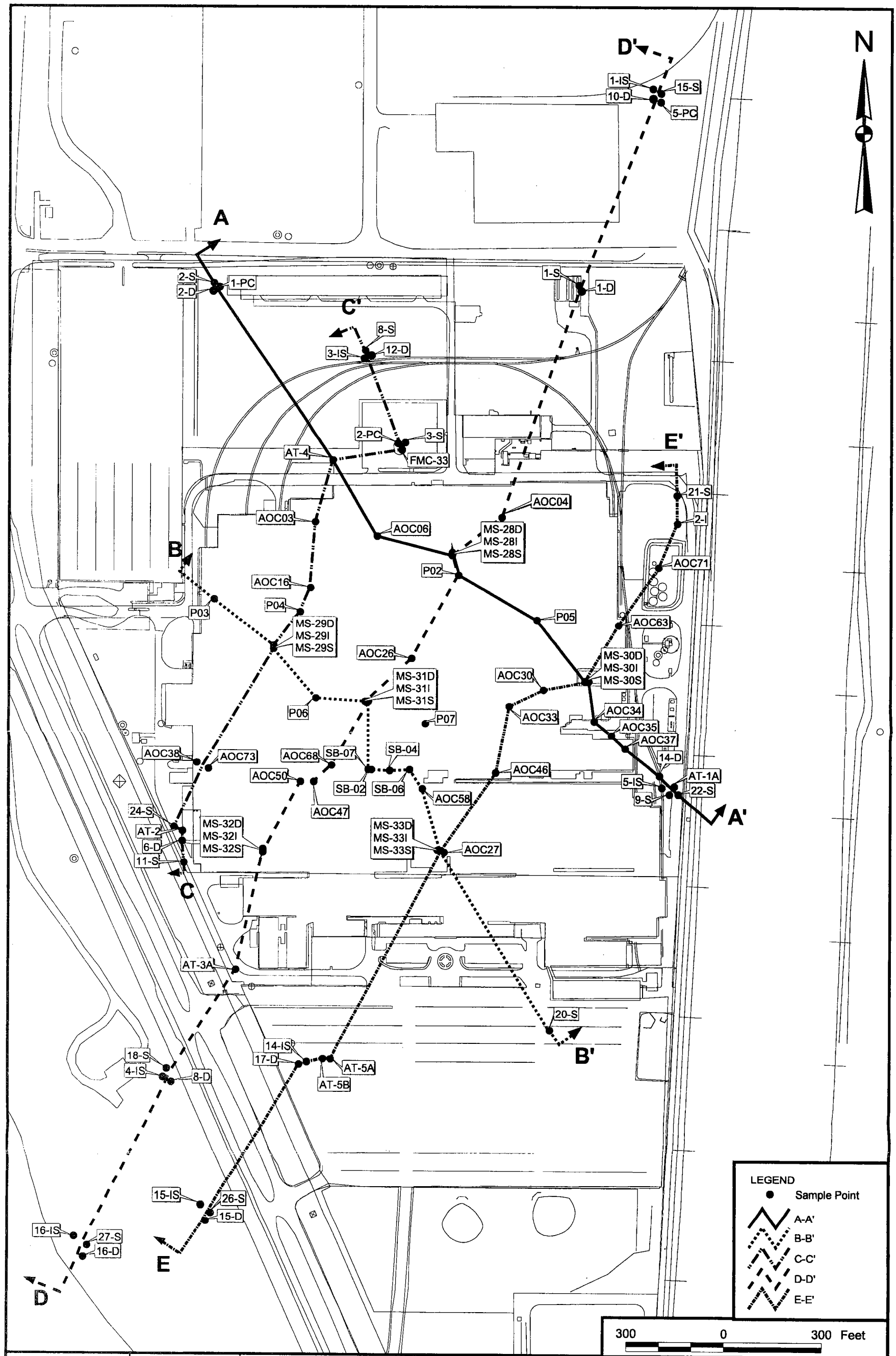
SYSTEM	GROUP	FORMATION	APPROX. THICKNESS (FEET)	COLUMNAR SECTION	DEPTH BGS (FEET)	LITHOLOGIC DESCRIPTION
QUATERNARY			100 - 130			medium to coarse SAND with gravel to clay interbeds.
					~50	clay interbeds typical between 50 - 90 feet.
					~90	
					~100	(unconformity)
ORDOVICIAN	St. Peter Group	St. Peter Sandstone	10 - 65			medium-to-fine grained friable white to yellow SANDSTONE with beds of siltstone and shale
					~130	
	Prairie du Chien Group	Shakopee Dolomite	45 - 75			drab, DOLOMITE with cavities filled with calcite
					~185	
		Oneota Dolomite	45 - 60			drab to buff (in places pink) DOLOMITE
					~240	
CAMBRIAN		Jordan Sandstone	75 - 175			medium-to-coarse-grained white SANDSTONE

FIGURE 3-2

GENERALIZED STRATIGRAPHIC COLUMN
NIROP, FRIDLEY, MN

TETRA TECH NUS, INC.

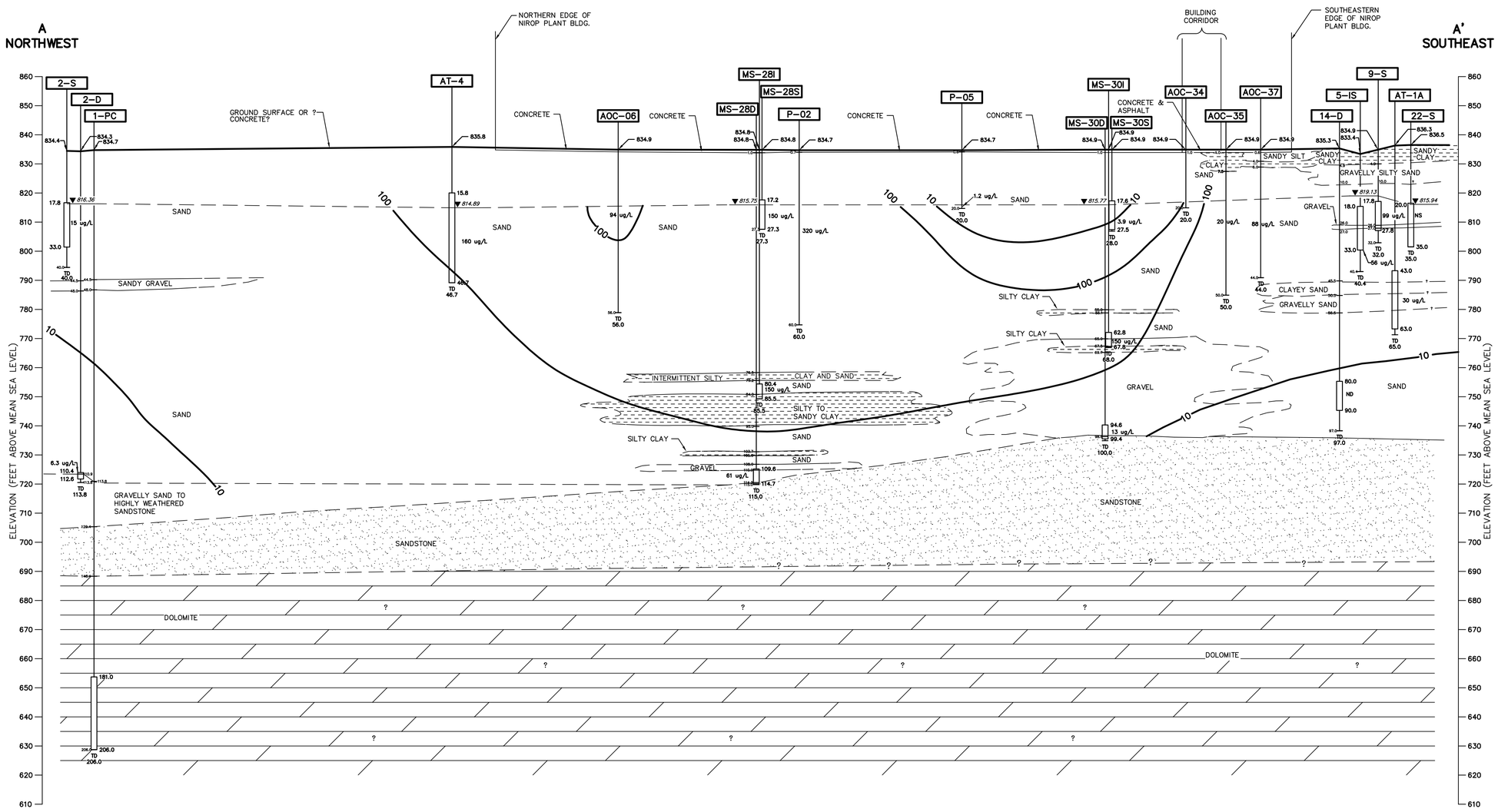
P:\GIS\FRIDLEY\6966_SITE_ASSESSMENT.APR 13-AUG-98 DNP XS BV LAYOUT



DRAWN BY	DATE
D. PERRY	13-AUG-98
CHECKED BY	DATE
K. HENN	16-JUN-98
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

GEOLOGIC CROSS-SECTION LOCATION MAP
OU3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

CONTRACT NUMBER	
—	
APPROVED BY	DATE
—	—
APPROVED BY	DATE
	8/12/99
DRAWING NO.	REV
FIGURE 3-3	0



NOTES:

1) SAND SHOWN IN CROSS-SECTION RANGES FROM SILTY SAND TO FINE AND COARSE GRAINED SAND.

2) SHALLOW POTENTIOMETRIC WATER LEVEL SURFACE MEASUREMENTS WERE TAKEN ON JULY 7, 1998 FROM MONITORING WELLS SCREENED IN THE SHALLOW AQUIFER ZONE.

3) LITHOLOGY SHOWN BETWEEN BORINGS WAS INTERPOLATED BASED UPON THE BORING LOGS.

4) TRICHLOROETHYLENE CONTOURS SHOWN WERE GENERATED FROM GROUNDWATER ANALYTICAL DATA COLLECTED FROM OU-3 RI TEMPORARY WELLS (SAMPLED FROM 7/97 TO 9/97) AND PERMANENT WELLS (SAMPLED FROM 2/98 TO 3/98), TEMPORARY WELLS IN THE EAST PLATING SHOP (SAMPLED IN 4/95), AND PERMANENT WELLS IN THE GROUNDWATER QUALITY MONITORING NETWORK (SAMPLED IN THE FIRST QUARTER 1998). THE NATURAL DISTRIBUTION OF CONTAMINANTS ILLUSTRATED MAY BE AFFECTED BY THE DIFFERENT CONSTURCTION OF THE MONITORING WELLS USED FOR SAMPLE COLLECTION (i.e., TEMPORARY VERSUS PERMANENT) AND DIFFERENT SAMPLING TECHNIQUES USED TO SAMPLE EACH WELL.

HORIZONTAL SCALE

0 100 200

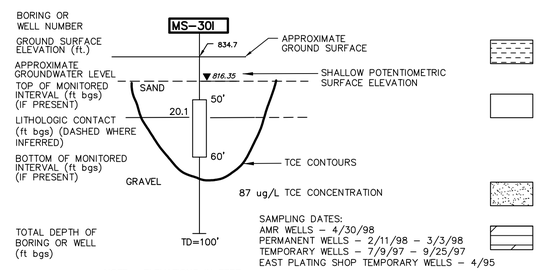
SCALE IN FEET

VERTICAL SCALE

0 20 40

SCALE IN FEET

LEGEND:



NOTE: ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT AMSL)
ND=NOT DETECTED
NS=NOT SAMPLED

UNCONSOLIDATED MATERIAL

CLAY, SILTY CLAY, SANDY CLAY, SILT CLAYEY SILT AND SANDY SILT AS SHOWN ON THE CROSS-SECTION (UNCONSOLIDATED MATERIAL HAVING A LOWER PERMEABILITY.)

SAND, CLAYEY SAND, GRAVELLY SAND, GRAVEL AND SANDY GRAVEL AS SHOWN ON CROSS-SECTION (UNCONSOLIDATED MATERIAL HAVING A HIGH PERMEABILITY)

BEDROCK

SANDSTONE BEDROCK (ST. PETER SANDSTONE)

DOLOMITE BEDROCK (PRAIRIE DU CHEIN GROUP)

ACAD: 78420X06.dwg 08/10/99 HJP

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSON DRIVE
PITTSBURGH, PA 15220

DSGN: K. HENN	DR: D. TOTH	CHK: K. HENN	
SUPV: M. SLADIC	CH ENG:		
SUBMITTED BY: M. SLADIC (PM, NAVFAC)	PROJECT MANAGER		8/98 (DATE)

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

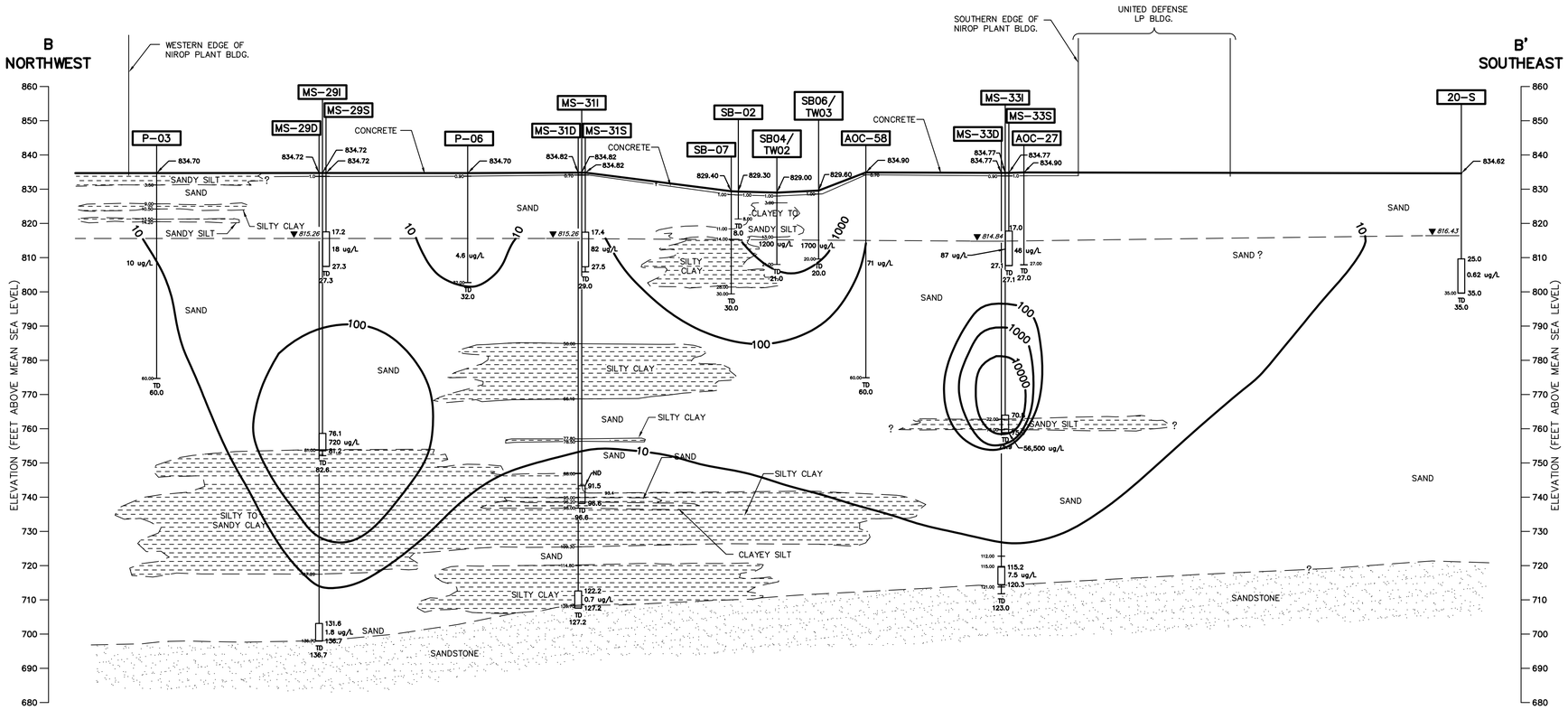
DEPARTMENT OF THE NAVY
NAVAL BASE
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHERN DIVISION
CHARLESTON, SC

NIROP FRIDLEY
OU-3 REMEDIAL INVESTIGATION REPORT
GENERALIZED GEOLOGIC CROSS SECTION A-A'

APPROVED FOR COMMANDER, NAVFAC
SOUTHDIV
DATE

SEAL AREA

SAT TO	DATE
CODE I.D. NO.	80091
SCALE :	
SPEC. NO. 04 -	
CONSTRN. CONTR. NO. N62472- -C-	
NAVFAC DRAWING NO.	
SHEET	OF
SIZE: D	DIS. SH. NO. 3-4



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HORIZONTAL SCALE

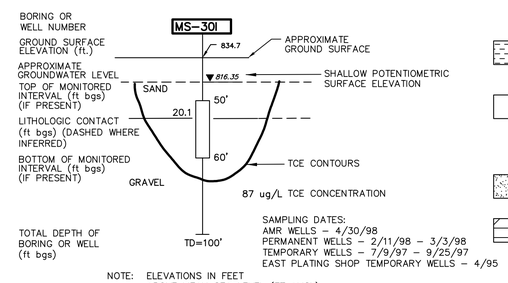
0 100 200

SCALE IN FEET

VERTICAL SCALE

0 20 40

SCALE IN FEET



NOTE: ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT AMSL)

ND=NOT DETECTED

UNCONSOLIDATED MATERIAL

CLAY, SILTY CLAY, SANDY CLAY, SILT CLAYEY SILT AND SANDY SILT AS SHOWN ON THE CROSS-SECTION (UNCONSOLIDATED MATERIAL HAVING A LOWER PERMEABILITY:)

SAND, CLAYEY SAND, GRAVELLY SAND, GRAVEL AND SANDY GRAVEL AS SHOWN ON CROSS-SECTION (UNCONSOLIDATED MATERIAL HAVING A HIGH PERMEABILITY)

BEDROCK

SANDSTONE BEDROCK (ST. PETER SANDSTONE)

DOLOMITE BEDROCK (PRAIRIE DU CHEIN GROUP)

ACAD: 78420X07.dwg 08/10/99 HJP

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSON DRIVE
PITTSBURGH, PA 15220

DSGN: K. HENN	DR: D. TOTH	CHK: K. HENN	
SUPV: M. SLADJIC	CH ENG:		
SUBMITTED BY: M. SLADJIC (TRIA ORDER)	PROJECT MANAGER (TITLE)		8/98 (DATE)

SOUTHDIV
DM:
PRE:
HD:
HD:
DIR:
OFFICER IN CHARGE
APPROVED

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

DEPARTMENT OF THE NAVY
NAVAL BASE
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SC
SOUTHERN DIVISION

NIROP FRIDLEY
OU-3 REMEDIAL INVESTIGATION REPORT
GENERALIZED GEOLOGIC CROSS SECTION B-B'

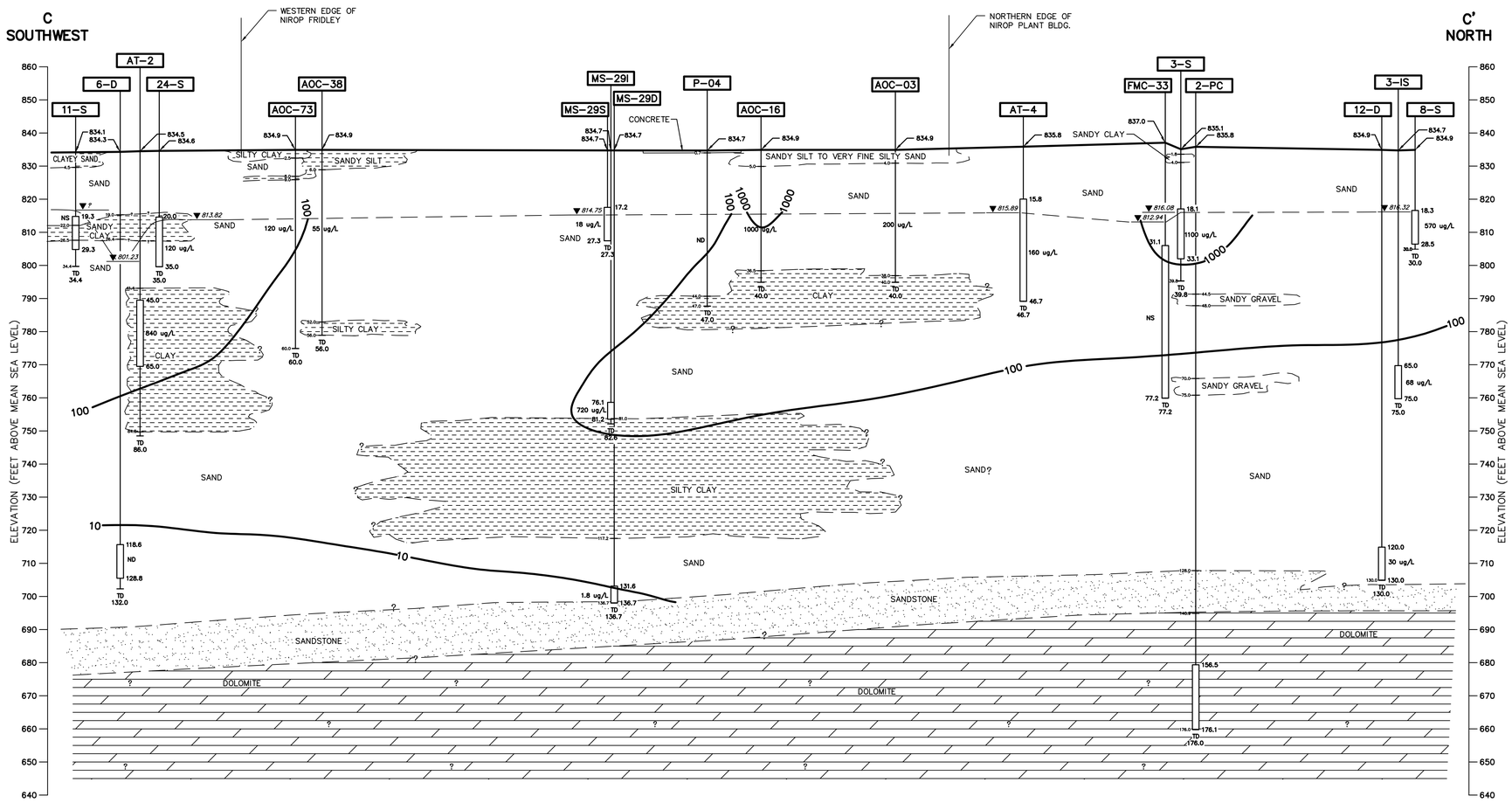
APPROVED
DATE
SOUTHDIV FOR COMMANDER, NAVFAC

SEAL AREA

SAT TO DATE

CODE I.D. NO. 80091
SCALE :
SPEC. NO. 04 -
CONSTRN. CONTR. NO. N62472- -C-
NAVFAC DRAWING NO.

SHEET OF
SIZE: D
DIS. SH. NO. 3-5



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HORIZONTAL SCALE

0 100 200

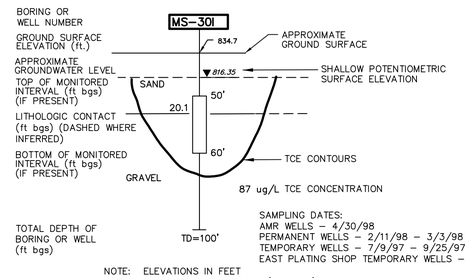
SCALE IN FEET

VERTICAL SCALE

0 20 40

SCALE IN FEET

LEGEND:



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NS=NOT SAMPLED

UNCONSOLIDATED MATERIAL

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BEDROCK

SANDSTONE BEDROCK (ST. PETER SANDSTONE)

DOLOMITE BEDROCK (PRAIRIE DU CHEIN GROUP)

ACAD: 7842GX08.dwg 08/10/99 HJP

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSON DR.
PITTSBURGH, PA 15220

DSGN: K. HENN	DR: D. TOTH	CHK: K. HENN	
SUPV: M. SLADIC	CH ENG:	PROJECT MANAGER (TITLE)	8/98 (DATE)
SUBMITTED BY: M. SLADIC (PM/LANDER)			

SOUTHDIV
DIV.:
FFE:
HD:
HD:
DIR:
OFFICER IN CHARGE
APPROVED

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

DEPARTMENT OF THE NAVY
NAVAL BASE
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SC

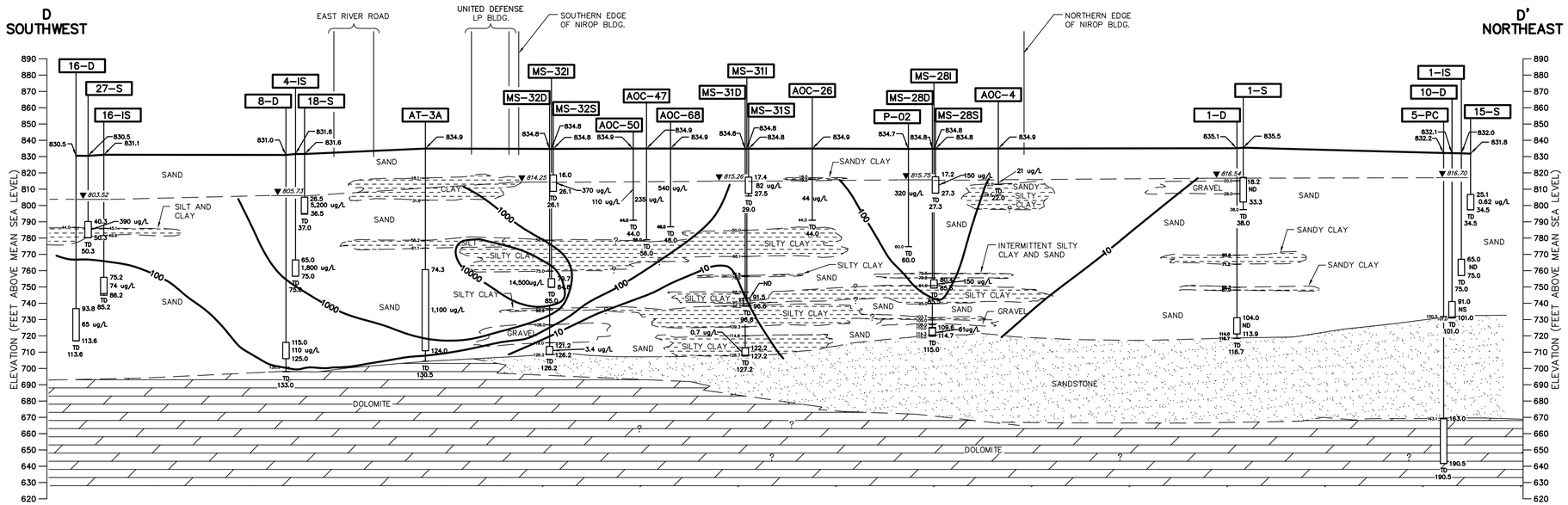
SOUTHERN DIVISION

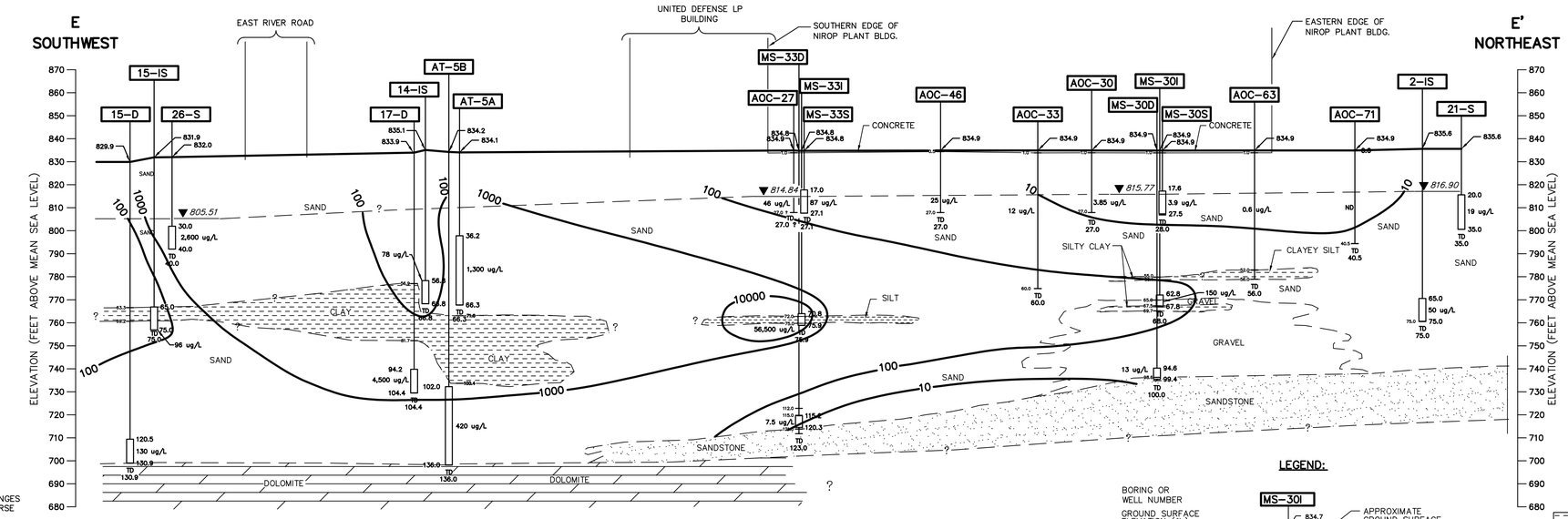
NIROP FRIDLEY
OU-3 REMEDIAL INVESTIGATION REPORT
GENERALIZED GEOLOGIC CROSS SECTION C-C'

SOUTHDIV FOR COMMANDER, NAVFAC
APPROVED
DATE

SEAL AREA

SAT TO	DATE
CODE I.D. NO.	80091
SCALE :	
SPEC. NO. 04 -	
CONSTRN. CONTR. NO. NG2472-	-C-
NAVFAC DRAWING NO.	
SHEET	OF
SIZE: D	DIS. SH. NO. 3-6





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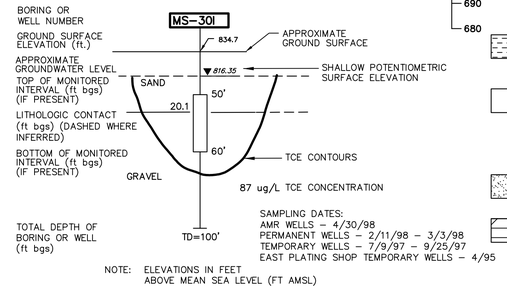
LEGEND:



SAMPLING DATES:
AMR WELLS – 4/30/98
PERMANENT WELLS – 2/11/98 – 3/3/98
TEMPORARY WELLS – 7/9/97 – 9/25/97
EAST PLATING SHOP TEMPORARY WELLS – 4/95

NOTE: ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT AMSL)
ND=NOT DETECTED
NS=NOT SAMPLED

UNCONSOLIDATED MATERIAL

CLAY, SILTY CLAY, SANDY CLAY, SILT CLAYEY SILT AND SANDY SILT AS SHOWN ON THE CROSS-SECTION (UNCONSOLIDATED MATERIAL HAVING A LOWER PERMEABILITY.)

SAND, CLAYEY SAND, GRAVELLY SAND, GRAVEL AND SANDY GRAVEL AS SHOWN ON CROSS-SECTION (UNCONSOLIDATED MATERIAL HAVING A HIGH PERMEABILITY)

BEDROCK

SANDSTONE BEDROCK (ST. PETER SANDSTONE)

DOLOMITE BEDROCK (PRAIRIE DU CHEIN GROUP)

ACAD: 7842GX09.dwg 08/10/99 HJP

Tetra Tech NUS, Inc.
10306 ROAD M
FEL ANDREA WEST
ALBUQUERQUE, NM 87190

DSGN: K. HENN	DR: D. TOTH	CHK: K. HENN	
SUPV: M. SLADIC	CH ENG:		
SUBMITTED BY: M. SLADIC (TINA JONES)	PROJECT MANAGER (TULSA)		8/28 (DATE)

SOUTHDIV
DM: HD:
PPE: HD:
DIR:
OFFICER IN CHARGE
APPROVED

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

DEPARTMENT OF THE NAVY
NAVAL BASE
SEAL AREA

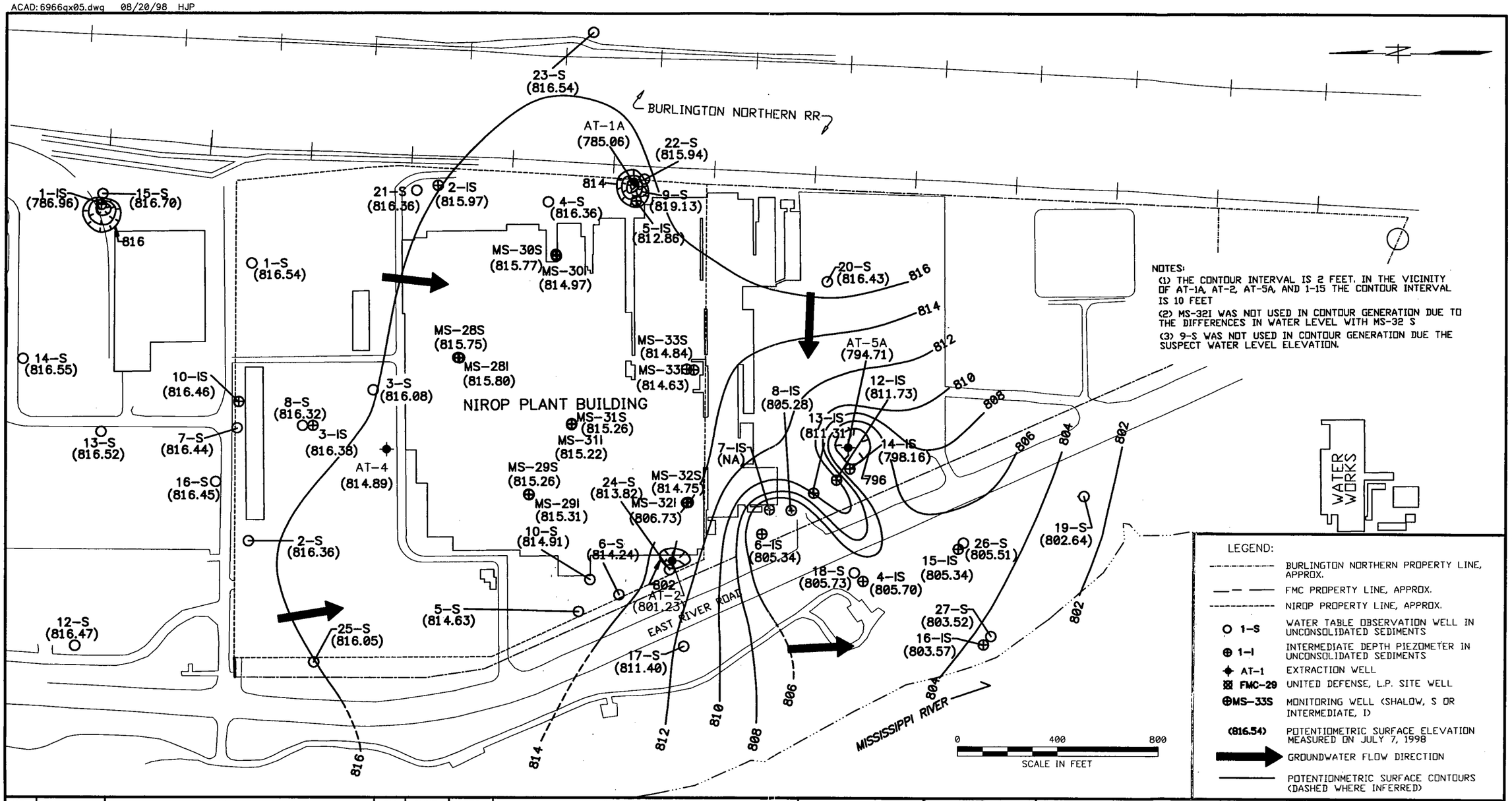
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SC
SOUTHERN DIVISION

NIROP FRIDLEY
OU-3 REMEDIAL INVESTIGATION REPORT
GENERALIZED GEOLOGIC CROSS SECTION D-D' AND E-E'

SOUTHDIV FOR COMMANDER, NAVFAC
DATE
APPROVED

SAT TO DATE
CODE I.D. NO. 80091
SCALE
SPEC. NO. 04 –
CONSTRN. CONTR. NO. N62472– –C–
NAVFAC DRAWING NO.
SHEET OF
SIZE: D
DIS. SH. NO. 3–7

ACAD:6966qx05.dwg 08/20/98 HJP



NOTES:

(1) THE CONTOUR INTERVAL IS 2 FEET. IN THE VICINITY OF AT-1A, AT-2, AT-5A, AND 1-15 THE CONTOUR INTERVAL IS 10 FEET

(2) MS-32I WAS NOT USED IN CONTOUR GENERATION DUE TO THE DIFFERENCES IN WATER LEVEL WITH MS-32 S

(3) 9-S WAS NOT USED IN CONTOUR GENERATION DUE THE SUSPECT WATER LEVEL ELEVATION.

LEGEND:

- BURLINGTON NORTHERN PROPERTY LINE, APPROX.
- FMC PROPERTY LINE, APPROX.
- NIROP PROPERTY LINE, APPROX.
- 1-S — WATER TABLE OBSERVATION WELL IN UNCONSOLIDATED SEDIMENTS
- 1-I — INTERMEDIATE DEPTH PIEZOMETER IN UNCONSOLIDATED SEDIMENTS
- AT-1 — EXTRACTION WELL
- FMC-29 — UNITED DEFENSE, L.P. SITE WELL
- MS-33S — MONITORING WELL (SHALOW, S OR INTERMEDIATE, D)
- (816.54) — POTENTIOMETRIC SURFACE ELEVATION MEASURED ON JULY 7, 1998
- GROUNDWATER FLOW DIRECTION
- POTENTIONMETRIC SURFACE CONTOURS (DASHED WHERE INFERRED)

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 8/8/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DEPARTMENT OF THE NAVY — SOUTHERN DIV FACILITIES ENGINEERING COMD

POTENTIOMETRIC SURFACE CONTOUR MAP
SHALLOW AQUIFER
OU-3 REMEDIAL INVESTIGATION
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

CONTRACT NO. 6966
APPROVED BY DATE
APPROVED BY DATE 8/12/99
DRAWING NO. FIGURE 3-8
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

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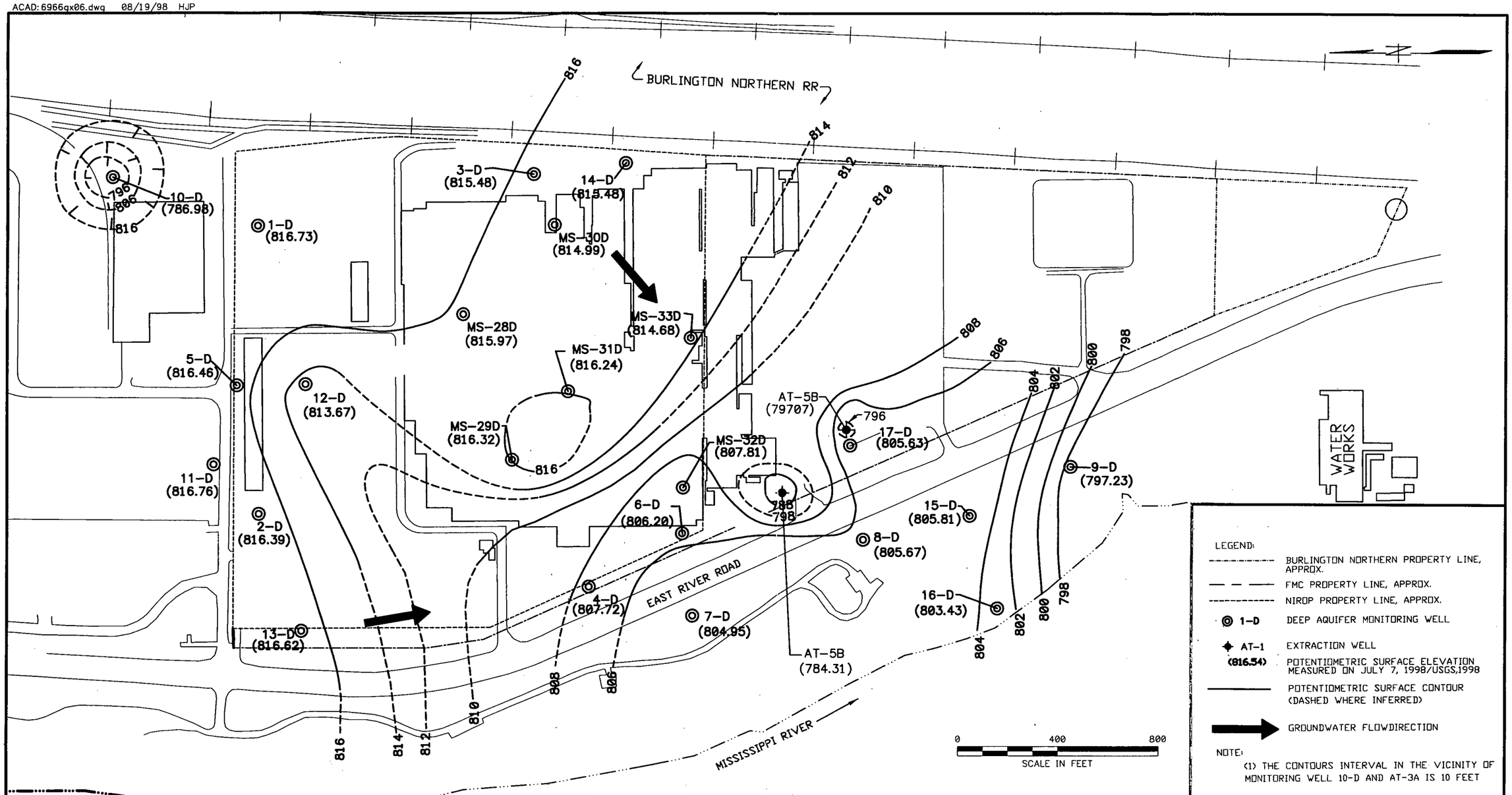
CTO 0003

ACAD:6966gx06.dwg 08/19/98 HJP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 8/19/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD

POTENTIOMETRIC SURFACE CONTOUR MAP
DEEP AQUIFER
OU-3 REMEDIAL INVESTIGATION
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

CONTRACT NO. 6966
APPROVED BY DATE
APPROVED BY DATE 8/12/99
DRAWING NO. FIGURE 3-9
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents the results of the collection and analysis of environmental samples from NIROP Fridley during the OU3 RI and the East Plating Shop Investigation, as described in Section 2.2. Tables 2-2 through 2-4 provided summaries of the analytical programs for all environmental samples collected for analysis by Laucks Testing Laboratories, Inc., during these investigations. Soil screening for VOC compounds, using a field gas chromatograph (GC) unit, was used to target environmental samples for analysis by Laucks Testing Laboratories, Inc., and to aid in defining the limits of VOC compounds in soil. Analytical results (fixed-base lab) for chemicals detected at least once in surface soil, shallow and deep subsurface soil, and unfiltered and filtered groundwater samples are summarized in Tables 4-1, 4-2, 4-3, 4-4, and 4-5 respectively. The complete analytical database for these samples is provided in Appendix E. A summary of field screening methods and associated field screening data are presented in Appendix D. All sampling locations are displayed in Figure 2-1.

4.1 DATA VALIDATION AND EVALUATION

As discussed in Appendix F, all data generated by Laucks Testing Laboratories, Inc., were validated according to EPA Region V guidelines. The data validation was performed by B&R Environmental validation chemists, who routinely validate data from numerous laboratories. An overall data validation summary as well as data validation memoranda summarizing the results of the data validation of each individual sample delivery group (SDG) are presented in Appendix F. A copy of the validation packages is available to the Navy, the Minnesota Pollution Control Agency, and EPA Region V upon request.

An evaluation was performed to determine whether there is any likelihood of significant data gaps or false negatives in the soils and groundwater database. The evaluation consisted of comparing detection limits for organic and inorganic substances to MPCA State Reference Values (SRVs) for soil and Health Risk Limits (HRLs) and Health Risk Values (HRVs) for groundwater to EPA MCLs for groundwater. These comparisons were performed to determine if any substances could possibly have escaped detection because levels were too low to be seen in a sample, but nonetheless still might be present at concentrations above health-based criteria. The MPCA SRVs, HRLs, HRVs, and EPA MCLs used in the evaluation are presented in Table 4-6. Tables 4-7 and 4-8 present a comparison of the range of detection limits reported for each substance analyzed in shallow (zero to 12 feet depth) and deep (greater than 12 feet depth) soil samples versus SRVs. Tables 4-9, 4-11, and 4-13 present the comparison of the range of detection limits of shallow, intermediate, and deep groundwater samples versus MPCA HRLs and HRVs for groundwater; Tables 4-10, 4-12, and 4-14 present a similar comparison of groundwater

detection limits to EPA MCLs. For groundwater, MPCA HRLs and HRVs were generally equal to or more conservative (lower in magnitude) than EPA MCLs, so the discussion of groundwater comparisons are based upon comparisons of state criteria.

Soils from 0 to 12 Feet Depth

A comparison of the reported detection limits for soil samples collected at depths of 0 to 12 feet to MPCA SRVs is presented in table 4-7. In soils from 0 to 12 feet depth, detection limits exceeded state criteria (MPCA SRVs for industrial exposures) at location AOC32, at depths of 8 to 12 feet for 4 SVOCs, at location AOC46, at depths of 8 to 12 feet for 6 SVOCs, at location SB-03, at depths of 10 to 12 feet for three chlorinated VOCs, and at location AOC28, at depths of 0 to 4 feet for one SVOC. Detection limits were below the state criteria for the remaining 140 VOC samples and 122 SVOC samples. The sample exhibiting elevated VOC detection limits contained TCE at a concentration of 11,000 µg/kg, and the analysis protocol required diluting this sample in order to obtain usable data within the calibrated range for TCE and to prevent severe contamination of the GC/MS instrument. Similarly, in the SVOC analysis of samples 003-SB-032-03 and 003-SB-028-01, positive results for the SVOCs 4-chloro-3-methylphenol at 11,000 µg/kg and bis(2-ethylhexylphthalate at 19,000 µg/kg necessitated dilution. Sample 003-SB-046-03 also required dilution due to non-target components present at elevated levels in the SVOC extract. Elevated detection limits occur whenever a sample is diluted and in this case represent only a small subset of the data (less than 1 percent of VOC samples and less than 3 percent of SVOC samples). These data gaps are therefore not expected to be significant.

Soils from Greater Than 12 Feet Depth

A comparison of the reported detection limits for soil samples collected at depths greater than 12 feet to MPCA SRVs is presented in table 4-8. In soils from greater than 12 feet depth, detection limits exceeded state criteria (MPCA SRVs for industrial exposures) at depths of 14 to 16 feet at location SB-01/TW-01 for three chlorinated VOCs, and at location SB-07 for 11 VOCs. Detection limits were below the state criteria for the remaining 106 samples. The two samples with elevated VOC detection limits contained TCE at concentrations of 55,000 µg/kg and 100,000 µg/kg, and the analysis protocol required diluting these samples in order to obtain usable data within the calibrated range for TCE and to prevent severe contamination of the GC/MS instrument. Elevated detection limits occur whenever a sample is diluted and in this case represent only a small subset (less than 2 percent) of the data points for affected compounds. These data gaps are therefore not expected to be significant.

Groundwater Exceedances for VOCs

The A comparison of the reported detection limits for groundwater samples to MPCA groundwater criteria and EPA MCLs is presented in Tables 4-9 and 4-10, respectively. Reported detection limits for 24 VOCs exceeded the MPCA groundwater criteria. The most notable of the VOCs exceeding the MPCA groundwater criteria are the degradation products of TCE (1,1-DCA, 1,1-DCE, 1,2-DCA, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, and chloroethane). The reported detection limits for 1,1-DCA exceeded the MPCA groundwater criteria in 2 out of 27 non detected samples. The reported detection limits for 1,1-DCE exceeded the MPCA groundwater criteria in 6 out of 28 non detected samples. The reported detection limits for 1,2-DCA exceeded the MPCA groundwater criteria in 7 out of 76 non detected samples. The reported detection limits for vinyl chloride exceeded the MPCA groundwater criteria in 58 out of 58 non detected samples. The reported detection limits for TCE, cis- and trans-1,2-DCE, and chloroethane were less than the MPCA groundwater criteria in all non-detected samples.

The majority of instances where VOC detection limits exceeded state criteria or MCLs occurred in shallow groundwater samples, although a small number of exceedances also occurred in intermediate and deep groundwater. VOC samples were analyzed by low concentration analysis protocols, which achieved typical detection limits of 0.3 µg/L or 1.0 µg/L for most VOCs and 5 µg/L for ketones. Vinyl chloride was the only VOC having a state criterion below 1 µg/L. Out of 58 groundwater samples that were nondetected for vinyl chloride, 50 exhibited detection limits less than twice the 0.2 µg/L state criterion (0.4 µg/L). The 8 remaining samples with vinyl chloride detection limits above 0.4 µg/L contained positive levels of TCE ranging from 930 µg/L to 140,000 µg/L or dichloroethene isomers at levels from 56 µg/L to 12,000 µg/L. In addition, 19 other samples contained positive levels of TCE and dichloroethenes at levels ranging from 47 µg/L to 59,000 µg/L. These two groups of (8 plus 19) samples having notable levels of chlorinated VOCs comprised all of the samples where VOC detection limits for compounds other than vinyl chloride exceeded state criteria. Therefore, VOC exceedances were generally attributed to the analysis protocol requiring sample dilutions in order to obtain usable data within the calibrated range for TCE and dichloroethenes and to prevent severe contamination of the GC/MS instrument. These data gaps are therefore not expected to be significant.

Groundwater Exceedances for SVOCs

A comparison of the reported detection limits for groundwater limits for groundwater samples to MPCA groundwater criteria and EPA MCLs is presented in tables 4-9 and 4-10, respectively. Reported detection limits for 17 SVOCs exceeded the MPCA groundwater criteria. The majority of instances where SVOC groundwater detection limits exceeded MPCA HRLs and HRVs or EPA MCLs occurred in shallow

groundwater samples, although a small number of exceedances also occurred in intermediate and deep groundwater.

Of these exceedances, there were 14 SVOCs associated with state criteria which are less than 5 µg/L, which corresponds to the lowest practical quantitation limit achievable using low-concentration routine GC/MS analysis protocols: 2,4-dinitrotoluene, 2,6-dinitrotoluene, 3,3'-dichlorobenzidine, hexachlorobenzene, hexachloroethane, pentachlorophenol, 4-methylphenol, and the PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. All groundwater sample detection limits exceeded state criteria for these 14 SVOCs, which is attributable to an inherent limitation of detection limits when using routine GC/MS low-concentration methods. Other alternative methods are available for selected SVOCs or PAHs, for example method 8330, but alternative GC and LC methods have the drawback of not always providing absolute identification of target analytes and are therefore not considered as reliable as the MS detector, which can positively identify target analytes. Therefore, these 14 SVOCs are not practically able to be measured at levels down to their restrictive state criteria, which are risk-based rather than based on available analytical methods.

The impact of these 14 SVOC exceedances is not expected to be significant for groundwater because, with the exception of the PAHs, compounds were not detected or prevalent at notable levels in soil or groundwater samples. (The only groundwater detections were 11 µg/L 4-methylphenol in sample GW-01and 1 to 3 µg/L pentachlorophenol in samples 003-TW-026-01 and 003-TW-047-01. There were only two soil detections and both were at low levels: 50 µg/kg pentachlorophenol in 003-SB-054-02 and 320 µg/kg 4-methylphenol in SB-07-1416.) In the case of PAH exceedances, the compounds having detection limit exceedances all possess very high affinities for organic carbon and relatively low solubilities, so that these compounds are not normally expected to migrate far enough in groundwater to represent a threat to more distant water supplies.

PCB Aroclor detection limits exceeded state criteria in all groundwater samples. In general, detection limits were based upon routine GC/ECD analysis methods and were approximately a factor of 5 to 12.5 times greater than state criteria in all but 4 samples. PCB detection limits varied depending on the sample matrix interferences found in each individual groundwater sample. However, Aroclors were not detected in any groundwater samples and were not prevalent in soils from the site (only three soil samples exhibited positive results for Aroclors, and all were present at low levels: 003-SB-30-01 (150 µg/kg), 003-SB-47-01 (230 µg/kg), and 003-SB-50-01 (260 µg/kg). In addition, PCBs possess very high affinities for organic carbon and relatively low solubilities; consequently, PCB mixtures are not normally expected to

migrate very far in groundwater. For these reasons, there does not appear to be a significant risk of false negatives for PCBs caused by the inability to measure levels below state criteria.

Two other SVOCs (1,4-dichlorobenzene and 2,4-dinitrophenol) exhibited detection limits exceeding state criteria only in selected samples (14 out of 77 samples and 45 out of 77 samples, respectively). However, no positive detections occurred for these SVOCs in any sample and in every case the 1,4-dichlorobenzene detection limits were not more than 10 percent above the state criterion and 2,4-dinitrophenol detection limits were not more than a factor of 2.6 greater than the criterion. Since values within a factor of one-half to one-third of the quantitation limit are typically detected and reported by laboratories following the GC/MS analytical protocols, it is not likely that any false negatives would have occurred at levels above state criteria for these SVOCs.

Groundwater Exceedances for Metals

A comparison of the reported detection limits for groundwater limits for groundwater samples to MPCA groundwater criteria and EPA MCLs is presented in tables 4-9 and 4-10, respectively. Reported detection limits for six inorganics exceeded MPCA groundwater criteria. Three metals exceeded state criteria in nearly all groundwater samples: antimony (77 out of 77samples), beryllium (70 out of 70 samples), and thallium (74 out of 74 samples). With antimony, no positive detections occurred in any groundwater sample and only 5 detections occurred in soil samples, all at levels at or below 3.4 mg/kg, which suggests that there does not appear to be a significant potential source of antimony from soils leaching to groundwater at the site. With beryllium, soil samples exhibited either non-detected or very low levels, at or below 0.7 mg/kg, and 14 groundwater samples exhibited positive results between 0.3 and 0.7 µg/L, which suggests that there does not appear to be a significant potential source of beryllium from soils leaching to groundwater at the site. With thallium, soil samples exhibited either non-detected or very low levels, at or below 0.24 mg/kg, and 6 groundwater samples exhibited positive results between 0.75 and 2.2 µg/L, which suggests that there does not appear to be a significant potential source of thallium from soils leaching to groundwater at the site. Because of the low frequency of detection and generally low concentrations found for these three metals in soil, the groundwater detection limit exceedances for antimony, beryllium, and thallium are not expected to be significant.

For cadmium, one out of 77 groundwater samples exhibited a detection limit above the state criterion of 4 µg/L. However, the detection limit (5.6 µg/L) was only slightly greater than the criterion, and cadmium was not found frequently or at notable levels in soil, which suggests that there does not appear to be a significant potential source of cadmium from soils leaching to groundwater at the site.

For iron, one groundwater sample out of 7 nondetected samples exhibited a detection limit exceeding the state criterion of 300 µg/L. However, 95 percent of groundwater samples were positively detected for iron, so there is not likely to be a significant data gap resulting from the one result having an elevated detection limit.

For aluminum, 10 groundwater samples out of 47 nondetected samples exhibited a detection limit exceeding the state criterion of 50 µg/L. However, only 5 samples exceeded the criterion by more than a factor of 2, and approximately two-thirds of groundwater samples were positively detected for aluminum, so there is not likely to be a significant data gap resulting from the one result having an elevated detection limit.

4.2 SURFACE AND SUBSURFACE SOIL

As discussed in Section 2.2.1, surface (0 to 4 feet bgs) and subsurface (>4 feet bgs) soil samples were collected at 4-foot intervals from 48 soil borings during Phase I of the OU3 RI. Most soil samples collected from these 48 borings were screened for VOCs on-site using a portable gas chromatograph (GC) unit in order to select samples to be submitted to the laboratory and to aid in defining the limits of VOCs in soil. As discussed in Section 2.2.1 and shown in Table 2-2, all surface soil samples and selected subsurface soil samples collected from these borings were submitted to Laucks Testing Laboratories, Inc, for analysis. In cases where the field GC was not in operation due to technical difficulties, soil samples from each interval were submitted to the fixed-base laboratory.

As discussed in Section 2.2.2, additional soil samples were collected at 5-foot intervals from six borings during the installation of the permanent monitoring wells. One soil sample (collected from the sampling tube at the point of the highest PID reading) from each two 5-foot intervals were submitted to Laucks Testing Laboratories for VOC analysis. Soil samples collected from the 0- to 5-foot intervals of these borings were considered to be surface soil samples. In addition, as discussed in Section 2.2.3, surface (0 to 4 feet bgs) and subsurface (>4 feet bgs) soil samples were collected from seven borings during the East Plating Shop investigation.

Analytical results for any parameter detected at least once are presented on a sample-by-sample basis for surface, shallow subsurface (4 to 12 feet), and deep subsurface (>12 feet) soil samples in Tables 4-1, 4-2, and 4-3, respectively. In addition, descriptive statistics (i.e., frequency of detection, concentration range detected, location of maximum positive detection) for surface, shallow subsurface, and deep subsurface soil samples are summarized in Table 4-15. Figures 4-1 and 4-2 depict the locations and concentrations of organic and inorganic chemicals, respectively, detected in surface soil samples. This same information

is depicted in Figures 4-3 and 4-4 for subsurface soil samples collected at depths ranging from 4 to 12 feet bgs. Figures 4-5 and 4-6 depict the locations and concentrations of volatile organic and inorganic chemicals, respectively, for subsurface soil samples collected from depths greater than 12 feet bgs. Positive results for SVOCs are not presented on Figure 4-5 because only seven of 97 subsurface soil samples collected at depths greater than 12 feet were analyzed for SVOCs and, as will be discussed in Section 4.1.3, very few SVOCs were detected. In addition, concentrations of the essential nutrients aluminum, calcium, iron, magnesium, potassium, and sodium were excluded from the figures that depict inorganic chemicals.

4.2.1 Surface Soil Characterization

As shown on Table 4-15, 15 VOCs, including 5 chlorinated hydrocarbons, 4 aromatic compounds, 4 ketones, bromomethane, and carbon disulfide, were detected in the 57 surface soil samples analyzed for this fraction. Seven of these VOCs (1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethene (total), 2-hexanone, bromomethane, ethylbenzene, and styrene) were each detected in 1 to 4 of the 57 samples at concentrations ranging from 1 µg/kg to 56 µg/kg. Carbon disulfide was detected in 8 of 57 samples at concentrations ranging from 1 µg/kg to 13 µg/kg. Toluene (1 µg/kg to 14 µg/kg) and total xylenes (1 µg/kg to 45 µg/kg), both aromatic compounds, were detected in 21 and 19, respectively, of 57 surface soil samples. Tetrachloroethene was detected in 9 of 57 surface soil samples at concentrations ranging from 1 µg/kg to 90 µg/kg.

TCE was detected in 24 of 57 surface soil samples. As shown on Figure 4-1, the five greatest concentrations of TCE reported for surface soil samples ([associated with locations SB-01, AOC58, SB02 (0 to 1 feet bgs), AOC73, and SB02 (2 to 4 feet bgs)] ranged from 71 µg/kg to 640 µg/kg, and four of these results were associated with samples collected from or just southeast of the East Plating Shop. The concentrations of the remaining 19 positive results for TCE ranged from 1 µg/kg to 22 µg/kg. This indicates the possible presence of a "hot spot" of TCE in the area of the East Plating Shop.

2-Butanone (1 µg/kg to 190 µg/kg), 4-methyl-2-pentanone (1 µg/kg to 120 µg/kg), and acetone (3 µg/kg to 770 µg/kg) were each detected in from 28 to 32 of the 57 surface soil samples. Acetone was also frequently detected in both field and laboratory blanks. Although the results for 2-butanone, 4-methyl-2-pentanone, and acetone were not qualified based on blank contamination for several samples during data validation, it should be noted that 2-butanone, 4-methyl-2-pentanone, and acetone, as well as 2-hexanone, are common laboratory contaminants associated with the analysis of soil samples. Therefore, the reported results for these four compounds may or may not be reflective of actual site conditions.

Twenty-four SVOCs, including 19 polyaromatic hydrocarbons (PAHs), four phthalates, and phenol, were sporadically detected in the surface soil samples. Phenol was detected in only two of 55 surface soil samples at concentrations of 45 µg/kg and 54 µg/kg. Bis(2-ethylhexyl)phthalate was detected in ten of 53 surface soil samples at concentrations ranging from 17 µg/kg to 1,200 µg/kg. The remaining three phthalates were detected in only one to three surface soil samples at concentrations ranging from 12 µg/kg to 40 µg/kg. All phthalates are common field and laboratory contaminants.

Concentrations of PAHs in surface soil samples ranged from 10 µg/kg (fluoranthene) to 5,600 µg/kg (also fluoranthene). Maximum concentrations of 16 of the 19 PAHs were detected in the surface soil samples collected from locations AOC 17 and P03. Locations AOC 17, a wash rack sump, and P03 are located along 23rd Avenue near columns 14W and 29W, respectively. Fluoranthene and pyrene were detected most frequently (in 18 and 19, respectively, of 53 samples). The remaining PAHs were detected in 2 to 15 samples.

Aroclor-1016 was detected at a concentration of 150 µg/kg in the surface soil sample collected from location AOC 30 (located on 16th Avenue near column 12E, at the drywell in the machine shop). Aroclor-1254 was detected at concentrations of 230 µg/kg and 290 µg/kg, respectively, in surface soil samples collected from locations AOC 47, a degreaser still, and AOC 50, a drywell in the plating shop; both of these locations are located on 11th Avenue near column 17W. No other PCBs were detected in the 51 surface soil samples analyzed for this analytical fraction.

All 22 TAL metals and cyanide were detected in the surface soil samples. Hexavalent chromium was also detected in 3 of the 17 surface soil samples analyzed for this parameter at concentrations ranging from 2 to 6 mg/kg. Antimony, beryllium, cadmium, cyanide, mercury, selenium, and thallium were detected in 5, 34, 3, 2, 9, 1, and 4 samples, respectively, while the remaining metals were each detected in from 50 to 55 of the 55 surface soil samples analyzed for metals.

As shown in Table 4-1, one or more reported concentrations of hexavalent chromium, cyanide, and all metals except calcium and thallium exceeded site-specific background concentrations. However, only from one to four results for arsenic, barium, and magnesium exceeded respective background concentrations, and from six to eight results for vanadium, nickel, and magnesium exceeded background concentrations. Reported results for copper exceeded background with the greatest frequency; 38 of 50 reported results for copper exceeded the associated site-specific background concentration (5.7 mg/kg). However, with the exception of the maximum detected concentration for copper (1,360 mg/kg in the

surface soil sample collected from AOC 35), all results for copper were less than 50 mg/kg. Maximum concentrations of chromium, copper, cyanide, lead, and zinc exceeded background concentrations by an order of magnitude or more.

The maximum detected concentrations of all chemicals detected in surface soil were less than the MPCA SRVs (Table 4-6) with the exception of lead in one soil sample. The maximum detected lead concentration of 733 mg/kg (SB-017) exceeded the MPCA SRV of 700 mg/kg for industrial exposures.

4.2.2 Shallow Subsurface Soil Characterization

As shown in Table 4-15, 17 VOCs were detected in the 73 shallow subsurface (4 to 12 feet bgs) soil samples analyzed for this fraction. With the exceptions of 1,1,2-trichloroethane and benzene, which were each detected in two shallow subsurface soil samples at concentrations ranging from 1 µg/kg to 24 µg/kg, the list of VOCs detected in shallow subsurface soils is the same as the list of VOCs detected in surface soils. Frequencies of detection of VOCs in shallow subsurface soil samples were also similar to those associated with surface soil samples. Concentrations of most VOCs in shallow subsurface soil samples were at the same order of magnitude as those reported for surface soil samples, although maximum concentrations of 1,2-dichoroethene, ethylbenzene, tetrachloroethene, toluene, and total xylenes in shallow subsurface soil samples were from approximately 8 (tetrachloroethene) to 1,000 (total 1,2-dichoroethene) times greater than respective maximum concentrations of these compounds in surface soil samples.

1,1,1-Trichloroethane, 1,1-dichloroethane, 1,2-dichloroethene (total), 2-hexanone, bromomethane, carbon disulfide, ethylbenzene, and styrene were each detected in only 1 to 6 of the 73 samples. Most of these compounds were detected at concentrations ranging from 1 µg/kg to 54 µg/kg; however, maximum concentrations of 1,2-dichloroethene (total) and ethylbenzene were 15,000 µg/kg and 720 µg/kg, respectively. Toluene (1 µg/kg to 1,000 µg/kg) and total xylenes (1 µg/kg to 7,300 µg/kg) were detected in 31 and 30, respectively, of 73 shallow subsurface soil samples. Tetrachloroethene was detected in 9 of 73 shallow subsurface soil samples at concentrations ranging from 1 µg/kg to 760 µg/kg, and TCE was detected in 20 of 73 shallow subsurface soil samples at concentrations ranging form 1 µg/kg to 1,100 µg/kg.

As noted for surface soil samples, analytical data for shallow subsurface soil samples suggest the presence of a hot spot of TCE in the area of the East Plating shop. As shown on Figure 4-3, the five greatest concentrations of TCE reported for shallow subsurface soil samples, ranging from 290 µg/kg to 1,100 µg/kg, were detected in samples collected from the East Plating Shop. These samples were

collected from locations SB-03 (10 to 12 feet bgs), SB-05 (10 to 12 feet bgs), SB02 (4 to 6 feet bgs), SB02 (6 to 8 feet bgs), and SB07 (4 to 6 feet bgs). The concentrations of the remaining positive results for TCE in shallow subsurface soils ranged from 1 µg/kg to 36 µg/kg. The two greatest results for tetrachloroethene (760 µ/kg and 740 µg/kg) were also associated with samples collected from a boring installed in the East Plating Shop (SB-02).

2-Butanone (1 µg/kg to 210 µg/kg), 4-methyl-2-pentanone (1 µg/kg to 150 µg/kg), and acetone (3 µg/kg to 1,700 µg/kg) were each detected in from 37 to 47 of the 73 shallow subsurface soil samples. Acetone was also frequently detected in both field and laboratory blanks. As previously noted for surface soil samples, although the results for 2-butanone, 4-methyl-2-pentanone, and acetone were not qualified based on blank contamination for several samples during data validation, it should be noted that 2-butanone, 4-methyl-2-pentanone, and acetone, as well as 2-hexanone, are common laboratory contaminants associated with the analysis of soil samples. Therefore, the reported results for these four compounds may or may not be reflective of actual site conditions.

As shown on Figure 4-3, maximum concentrations of seven VOCs (1,1-dichloroethane, total 1,2-dichloroethene, acetone, benzene, ethylbenzene, toluene, and total xylenes) were detected in the shallow subsurface soil sample collected from AOC 32, located near the western side of the NIROP building. The presence of the fuel-related hydrocarbons benzene, toluene, ethylbenzene, and xylenes (BTEX) is not unexpected at this sampling point since AOC 32 is the location of an oil/water separator sump.

Twenty-six SVOCs, including the 24 SVOCs detected in surface soil samples plus 4-chloro-3-methylphenol and pentachlorophenol, were detected in the shallow subsurface soil samples. With few exceptions, concentrations and detection frequencies of SVOCs in shallow subsurface soil samples were less than those associated with surface soil samples. All but five of the reported SVOCs were detected in from only one to four of 57 or 58 samples. Bis(2-ethylhexyl)phthalate, a common field and laboratory contaminant, was detected most frequently (in 13 of 57 shallow subsurface soil samples at concentrations ranging from 16 µg/kg to 4,400 µg/kg).

Maximum concentrations of 16 SVOCs, including 15 PAHs and pentachlorophenol, were detected in the subsurface soil sample collected from a depth interval of 4 to 8 feet from the boring at AOC 54. This AOC is the location of a sludge pit. Concentrations of PAHs in this subsurface soil sample ranged from 20 µg/kg (acenaphthylene) to 840 µg/kg (fluoranthene).

4-Chloro-3-methylphenol was detected in a single shallow subsurface soil sample (collected at a depth interval of 8 to 12 feet from AOC 32) at a concentration of 11,000 µg/kg. The maximum concentrations of 2-methylnaphthalene (720 µg/kg), anthracene (510 µg/kg), butylbenzylphthalate (a common field and laboratory contaminant, 3,600 µg/kg), and naphthalene (2,300 µg/kg) were also reported for this sample. As previously noted, AOC 32 is the location of an oil/water separator sump.

PCBs were not detected in any of the shallow subsurface soil samples.

Cyanide and all TAL metals except antimony and thallium were detected in the shallow subsurface soil samples. Hexavalent chromium was not detected in any of the 18 shallow subsurface soil samples analyzed for this parameter. In general, as shown in Table 4-15, detection frequencies of metals in shallow subsurface soil samples were very similar to detection frequencies of respective metals in surface soil samples. Concentrations of metals detected in surface and shallow subsurface soil samples were also very similar; most maximum concentrations associated with these two categories of samples were within a factor of two or three of each other. Notable exceptions include results for chromium and copper since the maximum concentration of chromium reported for shallow subsurface soils (618 mg/kg) is approximately seven times the maximum concentration of chromium reported for surface soils (91 mg/kg), and the maximum concentration of copper in surface soils (1,360 mg/kg) is approximately 24 times the maximum concentration of copper reported for shallow subsurface soils (57.7 mg/kg). However, with the exception of the maximum result, all results for chromium in shallow subsurface soil samples are less than 175 mg/kg, and as previously noted, with the exception of the maximum result, all results for copper in surface soil samples are less than 50 mg/kg. Therefore detected concentrations of chromium and copper are also generally similar when comparing surface and subsurface soil sample results.

The highest concentration of chromium in subsurface soil was detected in boring SB-02 located in the former east plating shop. Boring SB-02 was installed in the vicinity of a former sump (AOC 44). Discolored soil that was stained blue and green was encountered in SB-02 to a depth of approximately 8 feet. During the installation of SB-02, an obstruction was encountered at approximately 7.5 feet below ground surface. Soil boring SB-02 may have been completed directly through this former sump and may therefore have encountered the cement floor of this sump. This corresponds to the approximate depth of the bottom of the former sump. The discolored soil encountered in this boring may represent a sump used before the 1973 reconfiguring of the East Plating Shop that was filled without being completely drained. The elevated levels of chromium appear to be limited in extent to this area. Concentrations of total chromium in shallow soil collected from this boring were 20 mg/kg (0 to 2 feet) and 73.6 mg/kg (2 to

4 feet). Chromium speciation was not performed for these samples so it is not known if the detected chromium concentrations represent total chromium or hexavalent chromium.

The maximum detected concentration of all chemicals in subsurface soil were below the MPCA SRVs (Table 4-6) for industrial exposures with the exception of chromium in one sample. The maximum detected total chromium concentration of 618 mg/kg (SB-02) exceeded the MPCA SRV of 155 mg/kg for industrial exposures to hexavalent chromium.

4.2.3 Deep Subsurface Soil Characterization

Sixteen VOCs, including 6 chlorinated hydrocarbons, 5 aromatic compounds, 4 ketones, and carbon disulfide, were detected in the 97 deep subsurface (greater than 12 feet bgs) soil samples analyzed for this fraction. As shown in Table 4-15, 2-butanone, 4-methyl-2-pentanone, and acetone were detected most frequently (in from 55 to 61 of 97 samples). However, as previously noted, 2-butanone, 4-methyl-2-pentanone, and acetone, as well as 2-hexanone, are common laboratory contaminants associated with the analysis of soil samples. Therefore, the reported results for these four compounds may or may not be reflective of actual site conditions. 1,1,1-Trichloroethane, 1,1-dichloroethane, chlorobenzene, and chloromethane were each detected in only one sample at concentrations ranging from 1 µg/kg to 4 µg/kg.

As shown on Figure 4-5, all detected concentrations for tetrachloroethene, at concentrations ranging from 1 µg/kg to 3,800 µg/kg, were associated with samples collected from the East Plating Shop. In addition, TCE was detected at concentrations of 100,000 µg/kg, 55,000 µg/kg, and 13,000 µg/kg in three of the samples collected from the East Plating Shop. These results indicate a localized area of tetrachloroethene and TCE contamination in the deep soils located beneath the East Plating Shop. The maximum concentrations of tetrachloroethene and TCE were detected in the soil sample collected from a depth interval of 14 to 16 feet from boring SB-07. TCE was detected at a concentration of 14,000 µg/kg in the subsurface soil sample collected from a depth interval of 70 to 75 feet from the boring for permanent monitoring well MS-33D, located southeast of the East Plating Shop. All other results reported for TCE in the deep soil samples ranged from 1 µg/kg to 2,000 µg/kg.

The depth to groundwater at the East Plating Shop is approximately 15 feet. Soil samples with elevated TCE concentrations were collected from within the saturated zone and may be more representative of groundwater contamination than soil contamination.

Concentrations of the remaining VOCs detected in deep subsurface soil samples (total 1,2-dichloroethene, carbon disulfide, ethylbenzene, styrene, toluene, and xylenes) ranged from 1 µg/kg to 290 µg/kg.

Only the seven deep subsurface soil samples collected during the East Plating Shop investigation were analyzed for SVOCs, and two of these samples were analyzed for a limited list of SVOCs. 4 Methylphenol was detected (320 µg/kg) in a single sample collected at a depth interval of 14 to 16 feet (SB-07-1416). Bis(2-ethylhexyl)phthalate and di-n-butylphthalate, both common field and laboratory contaminants, were detected in four and one samples, respectively, at concentrations ranging form 43 µg/kg to 210 µg/kg. No other SVOCs were detected in the deep subsurface soil samples. PCBs were not detected in the four deep subsurface soil samples analyzed for this fraction.

Only the seven deep subsurface soil samples collected during the East Plating Shop investigation were analyzed for metals and cyanide. Analytical results for these samples are depicted on Figure 4-6. Cyanide was detected in one sample at a concentration of 2.9 mg/kg. Seventeen metals were detected. Concentrations of aluminum, chromium, cyanide, iron, lead, magnesium, nickel, vanadium, and zinc reported for one or two samples exceeded background concentrations; concentrations of beryllium, copper, potassium, and sodium reported for three to five samples exceeded background; and concentrations of cobalt in all seven samples exceeded background. As shown on Table 4-15 and depicted on Figure 4-6, maximum concentrations of all metals were detected in the samples collected from a depth interval of 14 to 16 feet bgs from locations SB-01 and SB07, located in the western portion of the East Plating Shop.

4.2.4 Presence of Non-Aqueous Phase Liquids in Subsurface Soil

As described in Section 2, the ultraviolet fluorescence test (UV test) is a visual field screening procedure performed on soil samples to determine if non-aqueous phase liquids (NAPL) may be present in the subsurface. Among several visual methods, the UV test has proven to be one of the most effective means for direct visual identification of NAPLs such as TCE and PCE (Cohen et al., 1992, and Cohen et al., 1993). However, due to the qualitative nature of the test, it is important to note that the UV light test should be used as a screening tool only. As Cohen et al. (1992) noted one false positive in 22 blank tests and 3 false negatives in 45 samples were encountered during the UV light test evaluation. The effectiveness of the UV field screening tool was verified during the OU-3 field event by adding a small amount of oil to a sample aliquot of soil and placing it under the UV light. The sample fluoresced (with a milky-white color) indicating that the field test was effective. The results of this field evaluation test and samples from field

borings (both positive and negative UV test results) were shown to and agreed by the USEPA oversight contractor (i.e., Black & Veatch) in the field.

Data shown in Appendix A.1 illustrates that positive UV test results were encountered at three borings located at Areas of Concern 26, 28, and 32 (i.e., SB-26, SB-28, SB-32, respectively) during the OU-3 RI field event. Although the UV test results indicated that NAPLs may be present at these locations, the analytical results did not correspond with these results. None of the NAPL related chemicals detected exceeded State Reference Values (Table 6-6) nor were the concentrations greater than 1% of the soil mass (USEPA, 1992). Furthermore, at no locations where soil samples were collected and analyzed did NAPL related chemicals exceed State Reference Values or 1% of the soil mass. Based upon the field screening tests and analytical results it is unlikely that NAPLs are present in any of the subsurface soil sample locations. However, based on groundwater contaminant concentrations, subsurface soils somewhere under the building likely are contaminated by DNAPL.

4.3 GROUNDWATER

As described in Section 2.2, 48 shallow groundwater samples were collected from temporary wells during Phase I of the OU3 RI. Groundwater samples were collected from six shallow, six intermediate, and six deep permanent monitoring wells during Phase II of the OU3 RI. In addition, shallow groundwater samples were collected from three temporary wells during the East Plating Shop investigation. Tables 4-4 and 4-5 present positive results for the unfiltered and filtered groundwater samples collected from these wells. In addition, descriptive statistics (i.e., frequency of detection, concentration range detected, and location of maximum positive detection) for unfiltered and filtered groundwater samples are summarized in Tables 4-16 and 4-17. The locations and concentrations of the positive results exceeding MPCA Health Risk Limits (HRLs), MPCA Health Risk (HRVs) Values, and EPA Maximum Contaminant Levels (MCLs) depicted for groundwater samples collected from shallow, intermediate, and deep wells in Figures 4-7, 4-8, and 4-9, respectively. Iso-concentration contour plots of a select number of groundwater contaminants have also been prepared. The selected plots were based upon the most significant contaminants of concern shown on Table 6-10. Contour plots of trichloroethylene in the shallow, intermediate, and deep intervals are shown on Figures 4-10, 4-11, and 4-12, respectively. Contour plots of 1,1-dichloroethylene in the shallow and deep intervals are shown on Figures 4-13 and 4-14, respectively. Contour plots of vinyl chloride in the shallow and deep intervals are shown on Figures 4-15 and 4-16, respectively. These contour plots are discussed in the following section.

It is noted that monitoring wells MS-31I and MS-31D have been included on these maps for illustration purposes only. According to MPCA (1999) these data are not to be used to quantitatively characterize

groundwater conditions at the site because they are not fully screened in typical aquifer material. The lithologic description from MS-31D indicates that the MS-31I well screen was set in low permeability deposits (i.e., silty clay). However, according to the lithologic description (written in the field logbooks) from MS-31I, 2 feet out of the 5 foot well screen was exposed to high-permeability aquifer material (i.e., fine to medium grained sand). Due to the slight offset of MS-31I from MS-31D, there was a slight difference in the lithologic materials encountered at MS-31I. MS-31D on the other hand was screened in fine-grained deposits at the base of the unconsolidated aquifer.

4.3.1 Shallow Wells Screened in the Upper Portion of the Unconfined Aquifer

As shown in Table 4-7, 21 VOCs were detected in the shallow groundwater samples. Thirteen of these VOCs (1,1,2-trichloroethane, 1,2-dichloroethane, 2-butanone, acetone, benzene, carbon disulfide, chloroform, chloromethane, ethylbenzene, methylene chloride, m/p-xylenes, o-xylene, and toluene) were detected in only one to five shallow groundwater samples, and all reported results for six of these VOCs (1,1,2-trichloroethane, 1,2-dichloroethane, acetone, benzene, chloroform, and chloromethane) were at concentrations less than 10 µg/L. Iso-concentration plots for trichloroethene 1,1-dichloroethene, and vinyl chloride are shown in Figures 4-10, 4-13, and 4-15, respectively.

TCE was detected in 54 of 57 shallow groundwater samples. With the exception of groundwater samples collected from location GW-01 (140000 µg/L) during the East Plating Shop investigation and from location P10 (39,000 µg/L), located at 7th Avenue near column 19W near the southwest corner of the NIROP main building, concentrations of TCE in the shallow groundwater samples ranged from 0.6 µg/L to 2,000 µg/L. Degradation products of TCE, such as cis- and trans-1,2-dichloroethene, 1,1-dichloroethene, and vinyl chloride, as well as other chlorinated hydrocarbons were also frequently detected as shown in the following table. The TCE concentrations detected at GW-01 and P10 exceed 1% of the solubility of TCE in water (Table 5-1) indicating that potential DNAPL is present, in the local vicinity of these wells (USEPA, 1992). There is no evidence that TCE exists as a DNAPL in other locations of the shallow monitoring interval.

Parameter	Frequency of Detection	Concentration Range (µg/L)
1,1,1-Trichloroethane	22/57	0.2 - 690
1,1-Dichloroethane	39/57	0.2 - 110
1,1-Dichloroethene	37/57	0.2-380
1,2-Dichloroethene (total)	3/3	100 - 12000
cis-1,2-Dichloroethene	42/54	0.2 - 1500

trans-1,2-Dichloroethene	36/54	0.2 - 1900
Tetrachloroethene	28/57	0.2 - 160
Vinyl Chloride	13/57	0.2 - 40

Note that cis- and trans-1,2-dichoroethene were reported as individual isomers for groundwater samples collected during the OU3 RI but were reported as 1,2-dichloroethene (total) for groundwater samples collected during the East Plating Shop investigation. Also note that, as was true for TCE, the sum of the maximum concentrations of cis- and trans-1,2-dichloroethene detected during the OU3 RI (3,400 µg/L) is more than 3.5 times less than the maximum concentration of total 1,2-dichloroethene (12,000 µg/L) detected in samples collected from the East Plating Shop (GW-01) during the East Plating Shop investigation. The 1,2-DCE concentration detected at GW-01 exceeds 1% of the solubility (of cis- and trans 1,2-DCE) indicating that potential DNAPL is present in the local vicinity of the East Plating Shop (USEPA, 1992).

Thirteen SVOCs, including six phenols, two PAHs, and five phthalates, were detected in the shallow groundwater samples. However, as shown on Table 4-16, these parameters were infrequently detected (in 1 to 7 of 56 or 57 samples). With the exception of one result for naphthalene at a concentration of 120 µg/L, SVOC concentrations in shallow groundwater samples ranged from 1 µg/L to 11 µg/L. In addition, phthalates are common field and laboratory contaminants. The reported results for phthalates in the shallow groundwater samples, ranging from 1 µg/L to 6 µg/L, are likely to be due to external contamination of the samples in the field or at the laboratory.

PCBs were not detected in any of the shallow groundwater samples.

Twenty metals and cyanide were detected in the unfiltered shallow groundwater samples. Maximum concentrations of cyanide and nine of the metals (aluminum, arsenic, barium, chromium, copper, iron, potassium, vanadium, and zinc) were detected in the shallow groundwater sample from location GW-01, collected during the East Plating Shop investigation. Maximum concentrations of five metals (beryllium, cobalt, lead, nickel, and selenium) were detected in the shallow groundwater sample collected from temporary well TW-036, the location of a paint spray pit in the southeast corner of the NIROP main building. The operations performed in these locations are likely to be associated with metals contamination. Barium, chromium, iron, manganese and the essential nutrients calcium, magnesium, potassium, and sodium were each detected in 45 to 57 of 57 unfiltered groundwater samples. The remaining metals and cyanide were detected in less than half of the groundwater samples.

As shown on Table 4-17, 19 metals were detected in filtered shallow groundwater samples. Maximum concentrations of metals were associated with filtered groundwater samples from various sampling locations. Maximum concentrations of aluminum, chromium, copper, lead, and vanadium were 7 to 52 times less than maximum concentrations of these respective metals in unfiltered shallow groundwater samples, suggesting that the concentrations detected in unfiltered groundwater samples may be due, in part, to suspended solids in the groundwater samples.

4.3.2 Intermediate Wells Screened in the Lower Portion of the Unconfined Aquifer

As previously noted, groundwater samples were collected from six intermediate-depth permanent monitoring wells during the OU3 RI. As shown on Table 4-16, 13 VOCs, including nine chlorinated hydrocarbons, ethylbenzene, toluene, m+p-xylenes, and o-xylene, were detected in the intermediate groundwater samples. Maximum concentrations of all of these VOCs except 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, and trans-1,2-dichloroethene were detected in the groundwater sample or field duplicate sample collected from well 003-MS-33I, located near the southern end of the NIROP main building near 11th Ave and Column 10E.

Review of Table 4-16, which evaluates shallow groundwater samples from temporary and permanent wells collectively, indicates that reported concentrations of VOCs in shallow groundwater samples are generally greater than respective concentrations of VOCs reported for intermediate and deep groundwater samples. However, as illustrated in the following summary table, which evaluates data associated with the permanent wells only, concentrations of VOCs in the groundwater samples collected from the intermediate permanent monitoring wells were generally greater than concentrations of VOCs detected in the groundwater samples collected from the shallow and deep permanent monitoring wells.

Permanent Monitoring Wells			
Analyte	**Concentration Range (µg/L)**		
	Shallow	**Intermediate**	**Deep**
1,1,1-Trichloroethane	0.3	ND	ND
1,1-Dichloroethane	0.2-5	2.4-17	0.9
1,1-Dichloroethene	0.2-1.9	0.9-13	0.3
1,2-Dichloroethane	ND	1.7	ND
Chloromethane	0.3-0.5	0.3-1.2	0.2-0.6
cis-1,2-Dichloroethene	54-200	5-580	1.2-11
Ethylbenzene	ND	0.2-0.3	ND
m+p-Xylenes	ND	0.2-0.7	ND
o-Xylene	ND	0.3-1	ND

Permanent Monitoring Wells			
Analyte	Concentration Range (µg/L)		
	Shallow	Intermediate	Deep
Tetrachloroethene	2.1	3.8-6.8	0.3-22
Toluene	0.4-0.5	0.6-1.6	0.2
trans-1,2-Dichloroethene	6-110	0.7-1400	0.3-1.6
Trichloroethene	3.9-370	150-59000	0.7-61
Vinyl Chloride	0.4	0.4-9.5	ND

ND - not detected

This suggests that, although concentrations of VOCs may vary horizontally, VOC concentrations may be greater vertically in the area of the intermediate well screens. Iso-concentration plots for trichloroethene, 1,1-dichloroethene, and vinyl chloride are shown in Figures 4-11, 4-14, and 4-16, respectively.

TCE was detected in five of the six intermediate groundwater samples at concentrations ranging from 150 µg/L to 59,000 µg/L. With the exception of the concentration of TCE (140,000 µg/L) detected in shallow temporary well GW-01 during the East Plating Shop investigation, the maximum concentration of TCE detected in the groundwater samples collected from the intermediate wells exceeds the concentrations of TCE detected in all shallow groundwater samples. TCE concentrations detected at MS-32I (15,000 µg/l) and MS-33I (59,000 µg/L) exceed 1% of the solubility of TCE in water (Table 5-1) indicating that potential DNAPL is present in the local vicinity of these wells (USEPA, 1992) in the southern end of the NIROP building. There is no evidence to suggest that TCE exists as a DNAPL in other locations of the NIROP facility in the intermediate monitoring interval. The TCE concentration detected in other wells (MS-28I through MS-30I) ranged from nondetect to 720 µg/L.

Phenol was detected at a concentration of 1 µg/L in a single intermediate-depth groundwater sample. No other SVOCs or PCBs were detected in any of the groundwater samples collected from the intermediate monitoring wells.

As shown in Table 4-17, 15 metals and cyanide were detected in the six unfiltered groundwater samples collected from the intermediate wells, although aluminum, copper, cyanide, mercury, nickel, and vanadium were each detected in only one or two of the six samples. The maximum detected concentrations were associated with samples collected from various wells. As shown on Figure 4-8, reported concentrations of iron and manganese in all intermediate groundwater samples and of aluminum in one intermediate groundwater sample exceed benchmark criteria.

Table 4-17 indicates that 13 metals were detected in the unfiltered groundwater samples collected from the intermediate wells. Concentrations of most metals detected in the filtered groundwater samples were only slightly less than respective concentrations of metals detected in the unfiltered groundwater samples.

4.3.3 Deep Wells Screened in the Upper Confined Aquifer

Eight VOCs (1,1-dichloroethane, 1,1-dichloroethene, chloromethane, cis-1,2-dichloroethene, tetrachloroethene, toluene, trans-1,2-dichloroethene, and TCE) were detected in the six groundwater samples collected from the deep permanent monitoring wells. 1,1-Dichloroethane, 1,1-dichloroethene, and toluene were each detected in only one sample (from well MS-28D) at low concentrations (ranging from 0.2 µg/L to 0.9 µg/L). With the exception of tetrachloroethene (22 µg/L), maximum concentrations of all VOCs were less than concentrations of respective VOCs detected in groundwater samples collected from shallow and intermediate wells. TCE was detected in all six groundwater samples at concentrations ranging from 0.7 µg/L to 61 µg/L. An Iso-concentration plot for trichloroethene is presented in Figure 4-12. Based upon the concentrations with respect to the solubility limit there is no evidence to suggest that DNAPLs are present in the deep monitoring interval.

Di-n-butyl phthalate, a common field and laboratory contaminant, was detected at a concentration of 1 µg/L in a single deep groundwater sample. No other SVOCs or PCBs were detected in the six groundwater samples collected from deep monitoring wells.

Eleven metals and cyanide were detected in the six deep groundwater samples. As shown in Table 4-16, with the exceptions of cyanide and lead, maximum concentrations of all inorganic analytes detected in the deep groundwater samples were less than maximum concentrations of respective analytes detected in the shallow and intermediate groundwater samples. Figure 4-9 indicates that reported concentrations of only iron and manganese exceed benchmark criteria.

As shown on Table 4-17, nine metals were detected in the six filtered deep groundwater samples. Zinc was detected in only one sample. The remaining metals (barium, calcium, chromium, iron, magnesium, manganese, potassium, and sodium) were each detected in all six samples. However, five of these metals (calcium, iron, magnesium, potassium, and sodium) are essential nutrients.

4.3.4 Evaluation of AOC Groups

The Field Sampling Plan (FSP) identified NIROP AOCs that could be effectively grouped into seven specific groups. There would remain several categorized as 'miscellaneous', and also those placed

'randomly' to promote more complete coverage of the plan area, but with these exceptions, the seven groups represented are the following. See Table 2-1 in the FSP for additional information on the grouping.

- (Group 1): 1,1,1-TCA/TCE storage, including AOCs 3, 4, 6, 7, and 14.
- (Group 2): Degreasing, including AOCs 8, 16, 18, 23, 39, 47, 58, and 74, plus supplemental points PO4 and PO8.
- (Group 3): heat treat, including AOC 46.
- (Group 4): Machining, including AOC 30 and70.
- (Group 5): Painting, including AOC 35 and 36.
- (Group 6): PEPSET storage tank, including AOC 63.
- (Group 7): Plating, including AOC 50 and supplemental point P11.

The following conclusions resulted from the evaluation of AOC groups:

- The selected AOCs for each group do adequately characterize each AOC group.
- The AOC groups do adequately characterize the various plant processes.
- The previous East Plating room investigation is considered conservatively representative of NIROP plating operations for both East and West plating areas.
- The AOC grouping supports the assumption that the major source are for TCE under the main NIROP building is in or in the vicinity of the East and West plating rooms.
- The miscellaneous AOCs grouping remains an assortment of processes around the NIROP which are not easily associated with other AOC groups.

SOILS

This evaluation was completed by collecting the soil analytical results for the sampling parameters for each group identified. The soils sampling parameters were detailed in the FSP, and correspond to the 'anticipated contaminants' for each AOC - also described in the FSP. It was anticipated that a statistical exercise would then be completed for the groups, for example to compare each group's maximum concentrations and mean concentrations for a contaminant against the facility norms. This would satisfy the intended goal of indicating if a group had a disproportionate propensity for exhibiting characteristics of a release to soils, to a maximum depth of twelve feet. As the data was assembled, it became apparent that the statistical exercise would not be necessary because of the generally low level of contaminants identified. The soil analytical results for each group are summarized on Table 4-18 and are discussed below.

GROUP 1: For Group 1, 1,1,1-TCA/TCE storage, consisting of five sampled AOCs, no chlorinated solvents or breakdown products were detected in the surrounding soils. However, xylenes and toluene were each detected at concentrations of 1 to 2 µg/kg in six of ten samples. This analysis concludes that soils in the vicinity of Group 1 AOCs do not indicate significant releases.

GROUP 2: Ten Group 2 AOCs were sampled. The maximum concentration of any VOC detected in this group was at AOC 58, where a duplicate sample was also collected. The analytical results for TCE in zero to four feet of soil at this location was 490 and 120 µg/kg. The measured concentrations of 1,1,1-TCA (the only other chlorinated solvent concentration greater than 10 µg/kg) was 56 and 21 µg/kg. At the next depth interval, from four to eight feet, the TCE concentration was only 3 µg/kg, and no 1,1,1-TCA was detected. At AOC 16, TCE was detected at 12 µg/kg at zero to four feet, and was not detected in deeper soils. For all ten locations, no other chlorinated solvents or breakdown products in excess of 4 µg/kg were detected. However, at AOC 39, toluene was detected at 0 to 4 feet at 14 µg/kg, and at 8 to 12 feet at 19 µg/kg. Xylenes were detected in the same two intervals at concentrations of 7 and 10 µg/kg, respectively. No other BTEX parameters were detected in any other Group 2 AOCs at concentrations above 1 µg/kg. This analysis concludes that soils in the vicinity of Group 2 AOCs do not indicate significant releases.

GROUP 3: Only one Group 3 AOC was sampled. No PCBs were detected at AOC 46, and no metals concentrations were out of the normal range (for cadmium, chromium [III and VI], lead and zinc). There is no evidence of release at AOC 46.

GROUP 4: Two Group 4 AOCs were sampled. Toluene, xylenes, and TCE were detected at concentrations from 1 to 7 µg/kg in zero to four foot depth soils. None of these contaminants were detected in deeper soils, except for toluene at 1 µg/kg at 8 to 12 feet at AOC 30.

Aroclor 1016 was detected at 150 µg/kg at zero to four feet at AOC 30, and was not analyzed in deeper samples. No PCBs were detected at AOC 70. The PCB contamination at AOC 30 is significant, but because no PCBs were detected at AOC 70, and because no significant VOC releases were identified, Group 4 AOCs do not appear to have greater likelihood of releases than other AOCs.

GROUP 5: Two Group 5 AOCs were sampled. With the exception of TCE detected at 36 µg/kg at four to eight feet at AOC 35, all other chlorinated solvent or breakdown product concentrations were 3µg/kg or less. Additionally, metals concentrations appear elevated at 84 µg/kg for trivalent chrome, 6 µg/kg for

hexavalent chrome, 150 µg/kg for lead, and 479 µg/kg for zinc. The chrome concentrations are about the same at AOC 36, while the lead and zinc concentrations are 70% less at AOC 36. The VOC concentrations do not appear to signify that these concentrations will be uniformly higher at Group 5 AOC, however, the metals concentrations for both Group 5 AOCs are elevated and could indicate that metals concentrations may be elevated at painting process AOCs. At AOC 35, the trivalent chrome concentration was 84 µg/kg; hexavalent chromium - 6 µg/kg; lead - 15 µg/kg; and zinc - 479 µg/kg.

GROUP 6: Only one Group 6 AOC was sampled. Tetrachloroethene was detected at 18 µg/kg in zero to four feet of soil, but was not detected in deeper soils. TCE was detected at 4 µg/kg, but was also not detected in deeper soil. Xylenes and toluene were detected at 1 µg/kg. There is no evidence of large releases from AOC 63.

GROUP 7: Toluene was detected at 12 µg/kg in duplicate samples at AOC 50 at zero to four feet. None was detected in soil samples at four to eight feet. No other chlorinated solvents were detected in any soil sample from either of the two AOCs sampled. All metals concentrations were within normal ranges. The Group 7 AOCs results do not indicate that significant releases are more likely from Group 7 AOCs than other AOCs.

In summary, the evaluation does not indicate that any AOC group is more likely than another to be responsible for releases in OU3 soils, with the exception of possibly elevated metals concentrations in the vicinity of the only two painting process AOCs which were sampled.

GROUNDWATER

This evaluation was completed by collecting the unfiltered groundwater analytical results for the sampling parameters for each group identified. The groundwater sampling parameters were detailed in the FSP, and correspond to the 'anticipated contaminants' for each AOC – also described in the FSP. It was anticipated that a statistical exercise would then be completed for the groups, for example to compare each group's maximum concentrations for a contaminant against the normal concentrations found at the facility. This would satisfy the intended goal of indicating if a group had a disproportionate propensity for exhibiting characteristics of a release to groundwater. This evaluation was completed in addition to, and parallel with, the soil evaluation to provide additional information and to provide a complete analysis of the media in the immediate vicinity of the AOCs.

GROUP 1: This group consists of five sampled AOCs. The maximum VOC concentration for this group was detected at AOC13/AOC14. The analytical result for TCE at this location was 1200 µg/L. The

detected concentrations of TCE at the four other AOCs in this group ranged from 15 µg/L to 200 µg/L. 1,1,1-TCA was not detected at any of the locations in this group. The result of this analysis concludes that the groundwater in the vicinity of the Group 1 AOCs does not show evidence of a greater potential for release than the other groups.

GROUP 2: This group consists of eight sampled AOCs and two sampled supplemental points. TCE was detected in 10 of 11 samples (a duplicate sample was taken at AOC 47 with consistent results). The detected concentrations ranged from 8.9 µg/L to 1000 µg/L with the maximum concentration detected at AOC 16. 1,1,1-TCA was detected in 5 of 11 samples with a maximum concentration of 11 µg/L detected at AOC 58. BTEX parameters were detected at one location (P04) at concentrations of 34, 820, and 750 for Toluene, Ethylbenzene, and Xylene respectively. The result of this analysis concludes that the groundwater in the vicinity of Group 2 AOCs and supplemental points do not show evidence of significant release.

GROUP 3: This group consists of one sampled AOC, AOC 46. No parameters were detected at elevated levels. There is no evidence of release at AOC 46.

GROUP 4: This group consists of two sampled AOCs, AOC 30 and AOC 70. No BTEX parameters were detected in any of the Group 4 samples. TCE was detected in both samples at concentrations of 3.8 µg/L and 860 µg/L at AOC 30 and AOC 70 respectively. No other chlorinated solvents or breakdown products were detected at elevated levels in this group. The result of this analysis concludes that the groundwater in the vicinity of Group 4 AOCs and supplemental points do not show evidence of significant release.

GROUP 5: This group consists of two sampled AOCs, AOC 35 and AOC 36. TCE was detected in 1 of 2 samples at a concentration of 20 µg/L at AOC 35. No other chlorinated solvents or breakdown products were detected at these AOCs. No BTEX parameters were detected in this group. Several metals, such as aluminum, chromium, cobalt, and lead, were detected at levels that are above the normal facility concentrations at AOC 36 but were detected at, or below, normal facility concentrations at AOC 35. Aluminum was detected in both samples at concentrations of 147 µg/L and 6110 µg/L at AOC 35 and AOC 36, respectively. The concentration detected at AOC 36 is above the normal facility concentrations and may represent a possible significant release. However, the concentration detected at AOC 35 is consistent, and slightly below, the detected concentrations at other AOCs. The result of this analysis concludes that Group 5 AOCs do not have a greater potential for release than the other groups.

GROUP 6: This group consists of one sampled AOC, AOC 63. No significant concentrations of BTEX or chlorinated solvents were detected at AOC 63. Only 1,1,1-TCA and TCE were detected, each at 0.6 µg/L. There is no evidence of significant release at AOC 63.

GROUP 7: This group consists of one sampled AOC, AOC 50, and one sampled supplemental point, P11. All metals concentrations were found to be within the normal ranges for the facility. TCE was detected at AOC 50 along with it's breakdown product, cis-1,2-DCE, at concentrations of 110 µg/L and 230 µg/L, respectively. These parameters were also detected at the sampled supplemental point, P11, at concentrations of 930 µg/L (TCE) and 56 µg/L (cis-1,2-DCE). These concentrations are consistent with the concentrations found in the other groups and, therefore, Group 7 does not appear to have a greater potential for release than the other groups.

089811/P

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-003-01	003-SB-004-01	003-SB-DP1-01	003-SB-006-01	003-SB-007-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/13/97	07/22/97	07/22/97	07/08/97	08/21/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC03	AOC04	AOC04	AOC06	AOC07	
FIELD DUPLICATE OF:			003-SB-004-01			
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	11 U	
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	11 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	10 U	10 U	11 U	
2-BUTANONE	2 J	5 J	3 J	10 UJ	11 U	
2-HEXANONE	10 UJ	10 U	10 U	10 UJ	11 U	
4-METHYL-2-PENTANONE	1 J	2 J	1 J	10 UJ	11 U	
ACETONE	33 J	32 U	13 U	3 J	31 J	
BROMOMETHANE	10 U	10 U	10 U	10 U	11 U	
CARBON DISULFIDE	10 U	10 U	10 U	10 U	11 U	
ETHYLBENZENE	10 U	10 U	10 U	10 U	11 U	
STYRENE	10 U	10 U	10 U	10 U	11 U	
TETRACHLOROETHENE	10 U	10 U	10 UJ	10 U	11 U	
TOLUENE	10 U	10 U	10 U	10 U	1 J	
TRICHLOROETHENE	10 U	10 U	10 U	10 U	11 U	
XYLENES, TOTAL	1 J	1 J	10 U	10 U	11 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	340 U	340 U	350 U	12 J	
ACENAPHTHENE	340 U	340 U	340 U	350 U	20 J	
ACENAPHTHYLENE	340 U	340 U	340 U	350 U	350 U	
ANTHRACENE	340 U	340 U	340 U	20 J	31 J	
BENZO(A)ANTHRACENE	340 U	11 J	340 U	210 J	110 J	
BENZO(A)PYRENE	340 U	340 U	340 U	120 J	84 J	
BENZO(B)FLUORANTHENE	340 U	340 U	340 U	180 J	91 J	
BENZO(G,H,I)PERYLENE	340 U	340 U	340 U	65 J	50 J	
BENZO(K)FLUORANTHENE	340 U	340 U	340 U	120 J	65 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

CTO 0003

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-003-01	003-SB-004-01	003-SB-DP1-01	003-SB-006-01	003-SB-007-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/13/97	07/22/97	07/22/97	07/08/97	08/21/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC03	AOC04	AOC04	AOC06	AOC07	
FIELD DUPLICATE OF:			003-SB-004-01			
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	340 U	340 U	350 U	350 U	
BUTYLBENZYL PHTHALATE	340 U	340 U	340 U	350 U	350 U	
CARBAZOLE	340 U	340 U	340 U	350 U	20 J	
CHRYSENE	340 U	13 J	340 U	180 J	97 J	
DI-N-BUTYL PHTHALATE	340 U	340 U	340 U	350 U	350 U	
DI-N-OCTYL PHTHALATE	340 U	340 U	340 U	350 U	350 U	
DIBENZO(A,H)ANTHRACENE	340 U	340 U	340 U	36 J	29 J	
DIBENZOFURAN	340 U	340 U	340 U	350 U	350 U	
FLUORANTHENE	340 U	19 J	340 U	320 J	240 J	
FLUORENE	340 U	340 U	340 U	350 U	15 J	
INDENO(1,2,3-CD)PYRENE	340 U	340 U	340 U	73 J	54 J	
NAPHTHALENE	340 U	340 U	340 U	350 U	350 U	
PHENANTHRENE	340 U	340 U	340 U	76 J	180 J	
PHENOL	340 U	340 U	340 U	350 U	350 U	
PYRENE	340 U	21 J	340 U	290 J	190 J	
PCBs (µg/kg)						
AROCLOR-1016	34 U	34 U	34 U	34 U	35 U	
AROCLOR-1254	34 U	34 U	34 U	34 U	35 U	
METALS (mg/kg)						
ALUMINUM	3120 J	2880 J	2500 J	*3770 J	*4140 J	3420
ANTIMONY	3 UJ	3.3 UJ	3.3 UJ	3 UJ	3.6 UJ	ND (2.0)
ARSENIC	3.4 J	4.2	4.3	2.2 J	3.5	8.1
BARIUM	74.4 J	94.7 J	86.6 J	52.8 J	49.5 J	128
BERYLLIUM	*0.16	*0.19	*0.19	*0.16	*0.24	ND (1.0)
CADMIUM	0.32 U	0.35 U	0.34 U	0.32 U	0.37 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
`ank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-003-01	003-SB-004-01	003-SB-DP1-01	003-SB-006-01	003-SB-007-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/13/97	07/22/97	07/22/97	07/08/97	08/21/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC03	AOC04	AOC04	AOC06	AOC07	
FIELD DUPLICATE OF:			003-SB-004-01			
METALS (mg/kg)						
CALCIUM	6320 J	9350 J	10800 J	13300 J	9090 J	56400
CHROMIUM	7.8	6.6	5.8	9.1	7.5	9.3
COBALT	*5.5 J	*8.1 J	*6.2 J	*7 J	*5.3 J	ND (10.1)
COPPER	*6.3	*6.8 J	5.4 J	*8.8	*8.8	5.7
CYANIDE	0.26 U	0.26 U	0.26 U	0.26 U	0.27 U	ND (2.5)
HEXAVALENT CHROMIUM		2 U	2 U		2 U	ND (2.0)
IRON	*11800 J	*12900 J	*12500 J	10900 J	9680 J	11000
LEAD	3.8	*11.4 J	*5.4 J	3.6	*40.3	4.8
MAGNESIUM	2970 J	3440 J	4420 J	4560 J	2310 J	8580
MANGANESE	676 J	*1020 J	*983 J	554 J	439 J	833
MERCURY	*0.08 J	0.05 U	0.05 U	*0.16 J	*0.05 J	ND (0.1)
NICKEL	10.7	16.4	14.6	15.2	10.9	18.4
POTASSIUM	300 J	298 J	288 J	*412 J	*350 J	342
SELENIUM	0.15 U	0.16 UJ	0.17 UJ	0.14 U	0.18 UJ	0.63
SODIUM	*95.5	*72 J	42.9 U	*119	*65.4 J	ND (101)
THALLIUM	0.15 U	0.16 U	0.19 U	0.14 UJ	0.18 U	ND (0.61)
VANADIUM	12.1	13.6 J	11.4 J	13.5	15.4 J	20.6
ZINC	16.6 J	18.1 J	16.3 J	19.5 J	*28.8 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON		1800 J	1500 J	1800 J		15157.38

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-008-01	003-SB-013-01	003-SB-015-01	003-SB-DP1-09	003-SB-016-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/21/97	07/14/97	09/22/97	09/22/97	07/26/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC08/AOC09	AOC13/AOC14	AOC15	AOC15	AOC16	
FIELD DUPLICATE OF:				003-SB-015-01		
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	10 U	100 U	100 UJ	11 U	
1,1-DICHLOROETHANE	10 U	10 U	100 U	100 UJ	11 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	100 U	100 UJ	11 U	
2-BUTANONE	3 J	5 J	100 U	100 UJ	2 J	
2-HEXANONE	10 U	10 UJ	100 U	100 UJ	11 U	
4-METHYL-2-PENTANONE	10 U	2 J	100 U	100 UJ	10 J	
ACETONE	11 U	52 J	270	230 J	29 U	
BROMOMETHANE	10 U	10 U	100 U	100 UJ	11 U	
CARBON DISULFIDE	10 U	10 U	100 U	100 UJ	1 J	
ETHYLBENZENE	10 U	10 U	100 U	100 UJ	11 U	
STYRENE	10 U	10 U	100 U	100 UJ	11 U	
TETRACHLOROETHENE	10 UJ	10 U	100 U	100 UJ	11 U	
TOLUENE	10 U	1 J	100 U	100 U	1 J	
TRICHLOROETHENE	1 J	10 U	100 U	100 UJ	12	
XYLENES, TOTAL	10 U	1 J	9 J	100 UJ	11 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	340 U	330 U	330 U	370 U	
ACENAPHTHENE	340 U	340 U	330 U	330 U	370 U	
ACENAPHTHYLENE	340 U	340 U	330 U	330 U	370 U	
ANTHRACENE	340 U	340 U	330 U	330 U	370 U	
BENZO(A)ANTHRACENE	340 U	340 U	330 U	330 U	19 J	
BENZO(A)PYRENE	340 U	340 U	330 U	330 U	22 J	
BENZO(B)FLUORANTHENE	340 U	340 U	330 U	330 U	19 J	
BENZO(G,H,I)PERYLENE	340 U	340 U	330 U	330 U	15 J	
BENZO(K)FLUORANTHENE	340 U	340 U	330 U	330 U	25 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-008-01	003-SB-013-01	003-SB-015-01	003-SB-DP1-09	003-SB-016-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/21/97	07/14/97	09/22/97	09/22/97	07/26/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC08/AOC09	AOC13/AOC14	AOC15	AOC15	AOC16	
FIELD DUPLICATE OF:				003-SB-015-01		
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	340 U	330 U	330 U	370 U	
BUTYLBENZYL PHTHALATE	340 U	340 U	330 U	330 U	370 U	
CARBAZOLE	340 U	340 U	330 U	330 U	370 U	
CHRYSENE	340 U	340 U	330 U	330 U	26 J	
DI-N-BUTYL PHTHALATE	340 U	340 U	330 U	330 U	370 U	
DI-N-OCTYL PHTHALATE	340 U	340 U	330 U	330 U	370 U	
DIBENZO(A,H)ANTHRACENE	340 U	340 U	330 U	330 U	11 J	
DIBENZOFURAN	340 U	340 U	330 U	330 U	370 U	
FLUORANTHENE	340 U	13 J	330 U	330 U	29 J	
FLUORENE	850 U	340 U	330 U	330 U	370 U	
INDENO(1,2,3-CD)PYRENE	340 U	340 U	330 U	330 U	19 J	
NAPHTHALENE	340 U	340 U	330 U	330 U	370 U	
PHENANTHRENE	340 U	340 U	330 U	330 U	370 U	
PHENOL	340 U	340 U	330 U	330 U	370 U	
PYRENE	340 U	13 J	330 U	330 U	26 J	
PCBs (µg/kg)						
AROCLOR-1016	34 U	34 U	33 U	33 U	36 U	
AROCLOR-1254	34 U	34 U	33 U	33 U	36 U	
METALS (mg/kg)						
ALUMINUM	2270 J	2530 J	2390	1980	*5260 J	3420
ANTIMONY	3.4 UJ	2.8 UJ	2.9 UJ	2.2 UJ	4.1 UJ	ND (2.0)
ARSENIC	1.5	0.91 U	1.1 U	1.2 U	2.8 J	8.1
BARIUM	18.2 J	32.7 J	11.9	10.2	*135 J	128
BERYLLIUM	*0.2	*0.07	*0.18	*0.15	0.26 U	ND (1.0)
CADMIUM	0.36 U	0.29 U	0.36 U	0.28 U	0.43 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-008-01	003-SB-013-01	003-SB-015-01	003-SB-DP1-09	003-SB-016-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/21/97	07/14/97	09/22/97	09/22/97	07/26/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC08/AOC09	AOC13/AOC14	AOC15	AOC15	AOC16	
FIELD DUPLICATE OF:				003-SB-015-01		
METALS (mg/kg)						
CALCIUM	22400 J	4240 J	12600	13000	5920 J	56400
CHROMIUM	7.1	6.3	8.1 J	6.2 J	7.4	9.3
COBALT	*3.5 J	*4.8 J	*3.5	*3.2	*6.3	ND (10.1)
COPPER	3.6 U	3.8	2.1	1.7	5.2 J	5.7
CYANIDE	0.25 U	0.25 U	0.25 U	0.25 U	0.28 U	ND (2.5)
HEXAVALENT CHROMIUM	2 U	2 U	2 U	2 U		ND (2.0)
IRON	4900 J	6440 J	5440 J	4810 J	*14300 J	11000
LEAD	1.8 J	2.8	2.8 J	2.7 J	3.5 J	4.8
MAGNESIUM	4930 J	2130 J	3330 J	3560 J	1790 J	8580
MANGANESE	225 J	285 J	107 J	95.9 J	*1910 J	833
MERCURY	0.04 U	*0.19 J	0.04 U	0.04 U	0.05 U	ND (0.1)
NICKEL	7.3	8.2	7.9	6.8	11.6 J	18.4
POTASSIUM	249 J	276 J	253	212	327 J	342
SELENIUM	0.19 UJ	0.15 U	0.16 UJ	0.17 UJ	0.2 UJ	0.63
SODIUM	*75 J	*55.3	*96.9 J	*78.6 J	*141 J	ND (101)
THALLIUM	0.24 U	0.15 U	0.16 UJ	0.17 U	0.2 U	ND (0.61)
VANADIUM	8.9 J	9.9	9.5	8.3	19.6 J	20.6
ZINC	11.1 U	13.4 J	12.4 J	11.1 J	19.1 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON			970 J	740 J	*19000 J	15157.38
GENERAL CHEMISTRY						
PH		7.9	11.3			

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-017-01	003-SB-018-01	003-SB-023-01	003-SB-026-01	003-SB-027-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/25/97	07/26/97	08/09/97	09/20/97	08/22/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC17	AOC18	AOC23	AOC26	AOC27	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	10 U	10 U	100 U	100 U	
1,1-DICHLOROETHANE	11 U	10 U	10 U	100 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	11 U	10 U	10 U	100 U	100 U	
2-BUTANONE	5 J	1 J	10 U	100 U	100 U	
2-HEXANONE	11 U	10 U	10 U	100 U	100 U	
4-METHYL-2-PENTANONE	2 J	10 U	10 U	100 U	100 U	
ACETONE	53 U	10 U	8 J	200	100 U	
BROMOMETHANE	11 U	10 U	10 U	100 U	100 U	
CARBON DISULFIDE	11 U	10 U	10 U	100 U	100 U	
ETHYLBENZENE	11 U	10 U	10 U	100 U	100 U	
STYRENE	11 U	10 U	10 U	100 U	100 U	
TETRACHLOROETHENE	11 U	1 J	10 U	100 U	100 U	
TOLUENE	1 J	10 U	1 J	100 U	100 U	
TRICHLOROETHENE	11 U	2 J	4 J	6 J	100 U	
XYLENES, TOTAL	1 J	10 U	10 U	100 U	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	120 J	340 U	340 U	340 U	330 U	
ACENAPHTHENE	210 J	340 U	340 U	340 U	330 U	
ACENAPHTHYLENE	760	340 U	340 U	340 U	330 U	
ANTHRACENE	640	340 U	340 U	340 U	330 U	
BENZO(A)ANTHRACENE	2700	340 U	340 U	340 U	330 U	
BENZO(A)PYRENE	1700	340 U	340 U	340 U	330 U	
BENZO(B)FLUORANTHENE	2100	340 U	340 U	340 U	330 U	
BENZO(G,H,I)PERYLENE	640	340 U	340 U	340 U	330 U	
BENZO(K)FLUORANTHENE	1300	340 U	340 U	340 U	330 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-017-01	003-SB-018-01	003-SB-023-01	003-SB-026-01	003-SB-027-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/25/97	07/26/97	08/09/97	09/20/97	08/22/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC17	AOC18	AOC23	AOC26	AOC27	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	350 U	340 U	340 U	340 U	25 J	
BUTYLBENZYL PHTHALATE	350 U	340 U	340 U	340 U	330 U	
CARBAZOLE	400	340 UJ	340 U	340 U	330 U	
CHRYSENE	1700	340 U	340 U	340 U	330 U	
DI-N-BUTYL PHTHALATE	28 J	340 U	340 U	340 U	330 U	
DI-N-OCTYL PHTHALATE	350 U	340 U	340 U	340 U	330 U	
DIBENZO(A,H)ANTHRACENE	400	340 U	340 U	340 U	330 U	
DIBENZOFURAN	250 J	340 U	340 U	340 U	330 U	
FLUORANTHENE	5600	340 U	340 U	340 U	330 U	
FLUORENE	400	340 U	340 U	340 U	330 U	
INDENO(1,2,3-CD)PYRENE	830	340 U	340 U	340 U	330 U	
NAPHTHALENE	55 J	340 U	340 U	340 U	330 U	
PHENANTHRENE	4500	340 U	340 U	340 U	330 U	
PHENOL	350 U	340 U	340 U	340 U	330 U	
PYRENE	4000	340 U	340 U	340 U	330 U	
PCBs (µg/kg)						
AROCLOR-1016	35 U	34 U	34 U	33 U	33 U	
AROCLOR-1254	35 U	34 U	34 U	33 U	33 U	
METALS (mg/kg)						
ALUMINUM	3300 J	2860 J	2500 J	1660	2550 J	3420
ANTIMONY	*3.4 J	3.4 UJ	3.3 UJ	2.8 UJ	3.5 UJ	ND (2.0)
ARSENIC	2.7 J	0.54 J	1.2 J	1.8 J	0.6	8.1
BARIUM	27.5 J	23 J	12.1 J	10.5	9.1 J	128
BERYLLIUM	0.15 U	0.18 U	*0.18	*0.11	*0.15	ND (1.0)
CADMIUM	1.5 U	0.36 U	0.35 U	0.35 U	0.37 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
"-" - Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-017-01	003-SB-018-01	003-SB-023-01	003-SB-026-01	003-SB-027-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/25/97	07/26/97	08/09/97	09/20/97	08/22/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC17	AOC18	AOC23	AOC26	AOC27	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	5780 J	6020 J	4490 J	23500	1490 J	56400
CHROMIUM	*12.6	7.5	6.7 J	6.5 J	8.2	9.3
COBALT	*7.1 J	*7.9	*4.5	*5	*6.4 J	ND (10.1)
COPPER	*60.7 J	*10.2 J	*7.6	0.93	1.3	5.7
CYANIDE	0.27 U	0.26 U	0.25 U	0.25 U	0.25 U	ND (2.5)
HEXAVALENT CHROMIUM	2 U	2 U				ND (2.0)
IRON	*48400 J	5140 J	6480 J	4190 J	4300 J	11000
LEAD	*733 J	*6.4 J	2.9 J	1.6 J	2	4.8
MAGNESIUM	2630 J	2980 J	2220 J	6050 J	1390 J	8580
MANGANESE	341 J	138 J	117 J	276 J	43.8 J	833
MERCURY	0.03 U	0.05 U	0.04 U	0.04 U	*0.06 J	ND (0.1)
NICKEL	*20.6 J	18 J	8.5	7.1	9.5	18.4
POTASSIUM	*411 J	287 J	282 J	159	230 J	342
SELENIUM	0.14 UJ	0.18 UJ	0.18 UJ	0.16 UJ	0.19 UJ	0.63
SODIUM	*156 J	42.5 U	*94.7 J	*58.2 J	*77.9 J	ND (101)
THALLIUM	0.15 U	0.2 U	0.18 UR	0.16 UJ	0.19 U	ND (0.61)
VANADIUM	*23 J	11.4 J	*21.1	7.6	10.6 J	20.6
ZINC	21 J	18.8 J	13.4 J	9.6 J	15.4 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON					960 J	15157.38
GENERAL CHEMISTRY						
PH	8.4					

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-028-01	003-SB-029-01	003-SB-030-01	003-SB-032-01	003-SB-033-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/16/97	09/15/97	08/23/97	08/25/97	09/07/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC28	AOC29	AOC30	AOC32	AOC33	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	100 U	51 U	11 U	100 U	
1,1-DICHLOROETHANE	100 U	100 U	51 U	11 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	100 U	100 U	51 U	11	100 U	
2-BUTANONE	100 U	50 J	32 J	11 U	100 U	
2-HEXANONE	100 U	100 U	51 U	11 U	100 U	
4-METHYL-2-PENTANONE	34 J	51 J	34 J	5 J	100 U	
ACETONE	100 U	160 U	200	20	100 U	
BROMOMETHANE	100 U	100 U	51 U	11 U	100 U	
CARBON DISULFIDE	100 U	13 J	51 U	11 U	100 U	
ETHYLBENZENE	100 U	100 U	51 U	11 U	100 U	
STYRENE	100 U	100 U	51 U	11 U	100 U	
TETRACHLOROETHENE	100 U	100 U	51 U	1 J	100 U	
TOLUENE	100 U	100 U	3 J	1 J	100 U	
TRICHLOROETHENE	100 U	100 U	51 U	1 J	100 U	
XYLENES, TOTAL	100 U	100 U	6 J	11 U	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	1000 J	350 U	340 U	360 U	340 U	
ACENAPHTHENE	650 J	350 U	340 U	360 U	340 U	
ACENAPHTHYLENE	3500 U	350 U	340 U	360 U	340 U	
ANTHRACENE	110 J	350 U	340 U	360 U	340 U	
BENZO(A)ANTHRACENE	3500 U	18 J	340 U	36 J	92 J	
BENZO(A)PYRENE	3500 U	15 J	340 U	25 J	58 J	
BENZO(B)FLUORANTHENE	3500 U	12 J	340 U	33 J	73 J	
BENZO(G,H,I)PERYLENE	3500 U	350 U	340 U	21 J	34 J	
BENZO(K)FLUORANTHENE	3500 U	14 J	340 U	25 J	64 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-028-01	003-SB-029-01	003-SB-030-01	003-SB-032-01	003-SB-033-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/16/97	09/15/97	08/23/97	08/25/97	09/07/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC28	AOC29	AOC30	AOC32	AOC33	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	19000 U	350 U	60 J	18 J	340 U	
BUTYLBENZYL PHTHALATE	3500 U	350 U	340 U	360 U	340 U	
CARBAZOLE	3500 U	350 U	340 U	360 U	340 U	
CHRYSENE	3500 U	21 J	340 U	21 J	70 J	
DI-N-BUTYL PHTHALATE	3500 U	350 U	340 U	360 U	340 U	
DI-N-OCTYL PHTHALATE	3500 U	350 U	340 U	360 U	340 U	
DIBENZO(A,H)ANTHRACENE	3500 U	350 U	340 U	360 U	33 J	
DIBENZOFURAN	3500 U	350 U	340 U	360 U	340 U	
FLUORANTHENE	100 J	39 J	340 U	49 J	88 J	
FLUORENE	760 J	350 U	340 U	360 U	340 U	
INDENO(1,2,3-CD)PYRENE	3500 U	350 U	340 U	15 J	46 J	
NAPHTHALENE	3500 U	350 U	340 U	360 U	340 U	
PHENANTHRENE	1200 J	29 J	340 U	32 J	340 U	
PHENOL	3500 U	350 U	340 U	360 U	340 U	
PYRENE	340 J	35 J	340 U	43 J	78 J	
PCBs (µg/kg)						
AROCLOR-1016	34 U	34 U	150	35 U	34 U	
AROCLOR-1254	34 U	34 U	34 U	35 U	34 U	
METALS (mg/kg)						
ALUMINUM	3150 J	2840 J	2700 J	*3910 J	1510 J	3420
ANTIMONY	2.4 UJ	2.6 UJ	3.5 UJ	3.3 UJ	3 UJ	ND (2.0)
ARSENIC	1.6	0.97	1	2	0.74	8.1
BARIUM	29.5 J	21.2 J	19.7 J	40.2 J	7.5 J	128
BERYLLIUM	0.2 U	0.21 U	*0.16	*0.22	0.17 U	ND (1.0)
CADMIUM	0.31 U	0.32 U	0.37 U	0.34 U	0.38 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

089811/P

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-028-01	003-SB-029-01	003-SB-030-01	003-SB-032-01	003-SB-033-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/16/97	09/15/97	08/23/97	08/25/97	09/07/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC28	AOC29	AOC30	AOC32	AOC33	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	34100 J	5260 J	14500 J	4350 J	1460 J	56400
CHROMIUM	*9.7	8.8	6.5	6.1	3.6	9.3
COBALT	*5	*4.1	3.2 U	*6 J	*2.4	ND (10.1)
COPPER	*26.2 J	*23.1 J	*7.3	*6.5	2.3 U	5.7
CYANIDE	0.26 UJ	0.26 UJ	0.25 U	0.27 U	0.25 U	ND (2.5)
HEXAVALENT CHROMIUM		2 U	2 U			ND (2.0)
IRON	7200 J	6470 J	6260 J	8310 J	3750 J	11000
LEAD	4.3	*10.3	2.1	*14.5	1.7 J	4.8
MAGNESIUM	7000 J	2040 J	4550 J	2260 J	857 J	8580
MANGANESE	210 J	163 J	164 J	295 J	33.6 J	833
MERCURY	0.04 U	0.04 U	*0.05 J	0.05 U	0.04 U	ND (0.1)
NICKEL	8.4	8.8	7.6	11.9	4.9	18.4
POTASSIUM	*497	306	*374 J	*381 J	166	342
SELENIUM	0.18 UJ	0.2 U	0.18 UJ	0.88 UJ	0.19 UJ	0.63
SODIUM	*364 J	*93.5 J	*188 J	*94.9 J	*74.6	ND (101)
THALLIUM	0.19 U	0.2 U	0.18 U	0.18 U	0.19 U	ND (0.61)
VANADIUM	11 J	17.1 J	14 J	12.3 J	11.5	20.6
ZINC	20.6 J	*52.7 J	14 J	*49.7 J	7.9 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	2000 J		780 J			15157.38
GENERAL CHEMISTRY						
PH			10.8			

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-034-01	003-SB-035-01	003-SB-036-01	003-SB-037-01	003-SB-DP1-03	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/29/97	07/28/97	08/12/97	08/06/97	08/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC34	AOC35	AOC36	AOC37	AOC37	
FIELD DUPLICATE OF:					003-SB-037-01	
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	11 U	10 U	29 U	29 U	
1,1-DICHLOROETHANE	10 U	11 U	10 U	29 U	29 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	11 U	10 U	29 U	29 U	
2-BUTANONE	10 U	3 J	8 J	81	29 U	
2-HEXANONE	10 U	11 U	1 J	29 U	29 U	
4-METHYL-2-PENTANONE	10 U	11 U	7 J	21 J	29 U	
ACETONE	10 U	24 U	9 J	340	42	
BROMOMETHANE	10 U	11 U	10 U	29 U	29 U	
CARBON DISULFIDE	10 U	11 U	10 U	29 U	29 U	
ETHYLBENZENE	10 U	11 U	10 U	2 J	29 U	
STYRENE	10 U	11 U	10 U	29 U	29 U	
TETRACHLOROETHENE	10 U	11 UJ	10 U	16 J	7 J	
TOLUENE	1 J	1 J	10 U	5 J	3 J	
TRICHLOROETHENE	10 U	3 J	10 UJ	22 J	10 J	
XYLENES, TOTAL	10 U	11 U	1 J	6 J	29 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	350 U	380 U	340 U	390 U	390 U	
ACENAPHTHENE	350 U	380 U	340 U	390 U	390 U	
ACENAPHTHYLENE	350 U	380 U	340 U	390 U	390 U	
ANTHRACENE	350 U	380 U	340 U	390 U	390 U	
BENZO(A)ANTHRACENE	350 U	39 J	340 U	390 U	390 U	
BENZO(A)PYRENE	350 U	26 J	340 U	390 U	390 U	
BENZO(B)FLUORANTHENE	350 U	47 J	340 U	390 U	390 U	
BENZO(G,H,I)PERYLENE	350 U	17 J	340 U	390 U	390 U	
BENZO(K)FLUORANTHENE	350 U	26 J	16 J	390 U	390 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-034-01	003-SB-035-01	003-SB-036-01	003-SB-037-01	003-SB-DP1-03	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/29/97	07/28/97	08/12/97	08/06/97	08/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC34	AOC35	AOC36	AOC37	AOC37	
FIELD DUPLICATE OF:					003-SB-037-01	
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	350 U	380 U	340 U	390 U	390 U	
BUTYLBENZYL PHTHALATE	350 U	380 U	340 U	390 U	390 U	
CARBAZOLE	350 U	380 U	340 U	390 UJ	390 UJ	
CHRYSENE	350 U	39 J	11 J	390 U	390 U	
DI-N-BUTYL PHTHALATE	350 U	380 U	340 U	390 U	390 U	
DI-N-OCTYL PHTHALATE	350 U	380 U	340 U	390 U	390 U	
DIBENZO(A,H)ANTHRACENE	350 U	380 U	340 U	390 U	390 U	
DIBENZOFURAN	350 U	380 U	340 U	390 U	390 U	
FLUORANTHENE	350 U	92 J	10 J	390 U	390 U	
FLUORENE	350 U	380 U	340 U	390 U	390 U	
INDENO(1,2,3-CD)PYRENE	350 U	21 J	340 U	390 U	390 U	
NAPHTHALENE	350 U	380 U	340 U	390 U	390 U	
PHENANTHRENE	350 U	49 J	340 U	390 U	390 U	
PHENOL	350 U	380 U	340 U	390 U	390 U	
PYRENE	350 U	65 J	12 J	390 U	390 U	
PCBs (µg/kg)						
AROCLOR-1016	34 U	38 U	33 U	38 U	39 U	
AROCLOR-1254	34 U	38 U	33 U	38 U	39 U	
METALS (mg/kg)						
ALUMINUM	*4870	*5890	*3460	*6880	*7830	3420
ANTIMONY	3.5 UR	3.6 UR	3.6 U	3.8 UJ	3.2 UJ	ND (2.0)
ARSENIC	1.4 J	2.5 J	0.93 J	4.7	5.9	8.1
BARIUM	19.6 J	108 J	29.2	67.4 J	63.2 J	128
BERYLLIUM	0.2 U	0.41 U	*0.15	0.42 U	0.27 U	ND (1.0)
CADMIUM	0.37 U	*0.75	0.38 U	0.4 U	0.34 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-034-01	003-SB-035-01	003-SB-036-01	003-SB-037-01	003-SB-DP1-03	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/29/97	07/28/97	08/12/97	08/06/97	08/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC34	AOC35	AOC36	AOC37	AOC37	
FIELD DUPLICATE OF:					003-SB-037-01	
METALS (mg/kg)						
CALCIUM	2960 J	31600 J	9720 J	26200 J	20900 J	56400
CHROMIUM	*14.3	*84	*91 J	*15 J	*20.3 J	9.3
COBALT	*6 J	*5.4 J	*5.5	*6.8 J	*7.1 J	ND (10.1)
COPPER	*49.4	*1360	*6.8	*9.8	*11.7	5.7
CYANIDE	0.26 U	0.28 U	0.25 U	0.29 U	0.29 U	ND (2.5)
HEXAVALENT CHROMIUM		*6	*5			ND (2.0)
IRON	9880 J	10600 J	5380 J	*13300 J	*14300 J	11000
LEAD	*5.7	*150	*31.6 J	*5.8 J	*5.2 J	4.8
MAGNESIUM	2710 J	*14100 J	3690 J	*11200 J	*10600 J	8580
MANGANESE	105 J	323 J	104 J	500 J	348 J	833
MERCURY	0.04 U	*0.1	0.04 U	0.05 U	*0.05	ND (0.1)
NICKEL	12.6 J	*33.5 J	9.9	16.3 J	*24.7 J	18.4
POTASSIUM	*505 J	*906 J	*515 J	*1130 J	*832 J	342
SELENIUM	0.93 UR	0.21 UR	0.19 UJ	0.88 UR	0.8 UR	0.63
SODIUM	*147 J	*176 J	*184 J	*256 J	*339 J	ND (101)
THALLIUM	0.19 UJ	0.21 UJ	0.19 U	0.18 U	0.16 U	ND (0.61)
VANADIUM	18.1	*23.4	11.3	*28.7	*23.8	20.6
ZINC	*29.2 J	*479 J	*102 J	*35.7 J	*30.6 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON		1200 J				15157.38
GENERAL CHEMISTRY						
PH		8.6	9.1			

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-038-01	003-SB-039-01	003-SB-046-01	003-SB-DP1-08	003-SB-047-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/23/97	09/25/97	09/19/97	09/19/97	09/23/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC38	AOC39	AOC46	AOC46	AOC47	
FIELD DUPLICATE OF:				003-SB-046-01		
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	110 U	100 U	100 U	110 U	
1,1-DICHLOROETHANE	11 U	110 U	100 U	100 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	11 U	110 U	100 U	100 U	110 U	
2-BUTANONE	2 J	51 J	100 U	100 U	65 J	
2-HEXANONE	1 J	110 U	100 U	100 U	110 U	
4-METHYL-2-PENTANONE	2 J	30 J	100 U	100 U	47 J	
ACETONE	18 U	400	59 J	280	500	
BROMOMETHANE	11 U	110 U	100 U	100 U	110 U	
CARBON DISULFIDE	1 J	110 U	100 U	100 U	110 U	
ETHYLBENZENE	11 U	110 U	100 U	100 U	110 U	
STYRENE	11 U	110 U	100 U	100 U	110 U	
TETRACHLOROETHENE	1 J	110 U	100 U	100 U	110 U	
TOLUENE	11 U	14 J	100 U	100 U	110 U	
TRICHLOROETHENE	22	110 U	100 U	100 U	110 U	
XYLENES, TOTAL	11 U	7 J	100 U	13 J	110 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	370 U	350 U	340 U	340 U	370 U	
ACENAPHTHENE	11 J	29 J	340 U	340 U	370 U	
ACENAPHTHYLENE	370 U	350 U	340 U	340 U	370 U	
ANTHRACENE	24 J	50 J	340 U	340 U	370 U	
BENZO(A)ANTHRACENE	140 J	330 J	340 U	340 U	370 U	
BENZO(A)PYRENE	110 J	170 J	340 U	340 U	370 U	
BENZO(B)FLUORANTHENE	120 J	300 J	340 U	340 U	370 U	
BENZO(G,H,I)PERYLENE	100 J	140 J	340 U	340 U	370 U	
BENZO(K)FLUORANTHENE	90 J	140 J	340 U	340 U	370 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-038-01	003-SB-039-01	003-SB-046-01	003-SB-DP1-08	003-SB-047-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/23/97	09/25/97	09/19/97	09/19/97	09/23/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC38	AOC39	AOC46	AOC46	AOC47	
FIELD DUPLICATE OF:				003-SB-046-01		
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	370 U	350 U	340 U	770 U	370 U	
BUTYLBENZYL PHTHALATE	370 U	350 U	340 U	340 U	370 U	
CARBAZOLE	16 J	31 J	340 U	340 U	370 U	
CHRYSENE	140 J	190 J	340 U	340 U	370 U	
DI-N-BUTYL PHTHALATE	370 U	350 U	340 U	340 U	370 U	
DI-N-OCTYL PHTHALATE	370 U	350 U	340 U	340 U	370 U	
DIBENZO(A,H)ANTHRACENE	49 J	96 J	340 U	340 U	370 U	
DIBENZOFURAN	370 U	11 J	340 U	340 U	370 U	
FLUORANTHENE	320 J	570	340 U	340 U	370 U	
FLUORENE	17 J	25 J	340 U	340 U	370 U	
INDENO(1,2,3-CD)PYRENE	100 J	170 J	340 U	340 U	370 U	
NAPHTHALENE	370 U	350 U	340 U	340 U	370 U	
PHENANTHRENE	270 J	340 J	340 U	340 U	370 U	
PHENOL	370 U	350 U	340 U	54 J	370 U	
PYRENE	300 J	440	340 U	340 U	370 U	
PCBs (µg/kg)						
AROCLOR-1016	37 U	35 U	34 U	34 U	36 U	
AROCLOR-1254	37 U	35 U	34 U	34 U	230 J	
METALS (mg/kg)						
ALUMINUM	*5780 J	3240 J	*4170	*3590	*4040	3420
ANTIMONY	3.6 UJ	3.2 UJ	2.5 UJ	*3.2 J	3 UJ	ND (2.0)
ARSENIC	3	2.9	2.4 J	2.4 J	2.5 J	8.1
BARIUM	72.9 J	33.9 J	37.8	37.2	81.1	128
BERYLLIUM	*0.38	*0.16	*0.25	*0.21	*0.23	ND (1.0)
CADMIUM	0.38 U	0.4 U	0.31 U	0.37 U	0.38 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

089811/P

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-038-01	003-SB-039-01	003-SB-046-01	003-SB-DP1-08	003-SB-047-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	07/23/97	09/25/97	09/19/97	09/19/97	09/23/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC38	AOC39	AOC46	AOC46	AOC47	
FIELD DUPLICATE OF:				003-SB-046-01		
METALS (mg/kg)						
CALCIUM	6930 J	16400 J	29100	23500	26800	56400
CHROMIUM	*12.4	*45.1 J	*16.9 J	9 J	*10.8 J	9.3
COBALT	*5.2 J	*5	*4.6	*4	*5.6	ND (10.1)
COPPER	*16.6 J	*9.1	5.3	5.1	*13.2	5.7
CYANIDE	0.28 U	0.27 U	0.26 U	0.26 U	0.27 U	ND (2.5)
HEXAVALENT CHROMIUM		*2	2 U	2 U		ND (2.0)
IRON	*11500 J	7970 J	*11200 J	10100 J	9070 J	11000
LEAD	*9.6 J	*5 J	4.4 J	2.8 J	*10.3 J	4.8
MAGNESIUM	2840 J	6380 J	*11000 J	8550 J	2830 J	8580
MANGANESE	511 J	388 J	387 J	363 J	669 J	833
MERCURY	0.05 U	0.04 U	0.04 U	0.04 U	0.05 U	ND (0.1)
NICKEL	11.7	13.2	12.3	9.4	16.7	18.4
POTASSIUM	293 J	223	*437	*421	*388	342
SELENIUM	0.19 UJ	0.21 UJ	0.19 UJ	0.78 UJ	0.2 UJ	0.63
SODIUM	*101 J	*90.9 J	*235 J	*193 J	*116 J	ND (101)
THALLIUM	0.27 U	0.21 U	*0.22 J	0.16 UJ	*0.24 J	ND (0.61)
VANADIUM	19.2 J	14.2 J	16	13.3	14.3	20.6
ZINC	*25.3 J	19.6 J	18.8 J	18.6 J	*36.4 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON			850 J	1300 J		15157.38

CTO 0003

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-050-01	003-SB-DP1-10	003-SB-054-01	003-SB-055-01	003-SB-058-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/24/97	09/24/97	08/04/97	08/24/97	08/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC50	AOC50	AOC54	AOC55	AOC58	
FIELD DUPLICATE OF:		003-SB-050-01				
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	110 U	1 J	11 U	56	
1,1-DICHLOROETHANE	110 U	110 U	11 U	11 U	9 J	
1,2-DICHLOROETHENE (TOTAL)	110 U	110 U	11 U	11 U	4 J	
2-BUTANONE	52 J	110 U	4 J	7 J	12 U	
2-HEXANONE	110 U	110 U	11 U	11 U	12 U	
4-METHYL-2-PENTANONE	44 J	39 J	3 J	8 J	10 J	
ACETONE	350	440	25 U	14	12 U	
BROMOMETHANE	110 U	110 U	2 J	11 U	12 U	
CARBON DISULFIDE	110 U	110 U	1 J	11 U	1 J	
ETHYLBENZENE	110 U	110 U	1 J	11 U	12 U	
STYRENE	110 U	110 U	11 U	11 U	12 U	
TETRACHLOROETHENE	110 U	110 U	11 U	11 U	4 J	
TOLUENE	12 J	12 J	1 J	11 U	12 U	
TRICHLOROETHENE	110 U	110 U	11 U	11 U	490	
XYLENES, TOTAL	110 U	110 U	2 J	11 U	12 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	360 U	360 U	350 U	350 U	400 U	
ACENAPHTHENE	360 U	360 U	24 J	350 U	400 U	
ACENAPHTHYLENE	360 U	360 U	350 U	350 U	400 U	
ANTHRACENE	360 U	360 U	40 J	350 U	400 U	
BENZO(A)ANTHRACENE	360 U	360 U	120 J	350 U	400 U	
BENZO(A)PYRENE	360 U	360 U	85 J	350 U	400 U	
BENZO(B)FLUORANTHENE	360 U	360 U	110 J	350 U	400 U	
BENZO(G,H,I)PERYLENE	360 U	360 U	40 J	350 U	400 U	
BENZO(K)FLUORANTHENE	360 U	360 U	59 J	350 U	400 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-050-01	003-SB-DP1-10	003-SB-054-01	003-SB-055-01	003-SB-058-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/24/97	09/24/97	08/04/97	08/24/97	08/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC50	AOC50	AOC54	AOC55	AOC58	
FIELD DUPLICATE OF:		003-SB-050-01				
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	340 U	350 U	20 J	17 J	
BUTYLBENZYL PHTHALATE	360 U	360 U	350 U	350 U	400 U	
CARBAZOLE	360 U	360 U	28 J	350 U	400 U	
CHRYSENE	360 U	360 U	110 J	350 U	400 U	
DI-N-BUTYL PHTHALATE	360 U	360 U	350 U	350 U	400 U	
DI-N-OCTYL PHTHALATE	360 U	360 U	350 U	350 U	400 U	
DIBENZO(A,H)ANTHRACENE	360 U	360 U	38 J	350 U	400 U	
DIBENZOFURAN	360 U	360 U	350 U	350 U	400 U	
FLUORANTHENE	360 U	360 U	320 J	350 U	400 U	
FLUORENE	360 U	360 U	19 J	350 U	400 U	
INDENO(1,2,3-CD)PYRENE	360 U	360 U	60 J	350 U	400 U	
NAPHTHALENE	360 U	360 U	350 U	350 U	400 U	
PHENANTHRENE	360 U	360 U	230 J	350 U	400 U	
PHENOL	360 U	360 U	350 U	350 U	400 U	
PYRENE	360 U	360 U	230 J	350 U	400 U	
PCBs (µg/kg)						
AROCLOR-1016	35 U	35 U	35 U	35 U	39 U	
AROCLOR-1254	230	290	35 U	35 U	39 U	
METALS (mg/kg)						
ALUMINUM	*3490 J	*3610 J	3050	2590 J	*6670 J	3420
ANTIMONY	3.3 UJ	3.3 UJ	3.8 UR	4 UJ	4 UR	ND (2.0)
ARSENIC	2.5	2.8	2.9 J	0.89	5.1	8.1
BARIUM	38.6 J	123 J	18.1 J	18.5 J	72.4 J	128
BERYLLIUM	*0.17	*0.21	0.2 U	*0.15	*0.7 J	ND (1.0)
CADMIUM	*0.46	*0.58	0.4 U	0.42 U	*0.59	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-050-01	003-SB-DP1-10	003-SB-054-01	003-SB-055-01	003-SB-058-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/24/97	09/24/97	08/04/97	08/24/97	08/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC50	AOC50	AOC54	AOC55	AOC58	
FIELD DUPLICATE OF:		003-SB-050-01				
METALS (mg/kg)						
CALCIUM	11700 J	11900 J	11000 J	19000 J	6940 J	56400
CHROMIUM	*19.5 J	*13.1 J	7.6	8.1	*11.1 J	9.3
COBALT	*6.5	*5.5	*5.7 J	3.9 U	*9.1 J	ND (10.1)
COPPER	*9.6	*9	*5.8	*8.2	*13.3	5.7
CYANIDE	0.27 U	0.27 U	0.27 U	0.26 U	0.3 U	ND (2.5)
HEXAVALENT CHROMIUM	2 U	2 U				ND (2.0)
IRON	10500 J	10200 J	6980 J	6740 J	9810 J	11000
LEAD	*8.7 J	*7.1 J	3.9	1.9	*7.7 J	4.8
MAGNESIUM	4050 J	4170 J	5450 J	5960 J	1670 J	8580
MANGANESE	473 J	*1060 J	168 J	199 J	185 J	833
MERCURY	0.04 U	0.04 U	0.04 U	*0.12	0.04 U	ND (0.1)
NICKEL	18.2	14.3	10.6 J	8.5	*32.6	18.4
POTASSIUM	309	334	341 J	*505 J	297	342
SELENIUM	0.21 UJ	0.21 U	0.19 UR	0.84 UJ	*1.3 J	0.63
SODIUM	*99.3 J	*94.8 J	*74.3 J	*113 J	*106 J	ND (101)
THALLIUM	0.21 U	0.21 U	0.19 UJ	0.17 U	0.31 U	ND (0.61)
VANADIUM	15.2 J	16 J	11.4	10.9 J	*33.5 J	20.6
ZINC	*27.3 J	*24.7 J	15.9 J	14.8 U	*25 J	22.4
GENERAL CHEMISTRY						
PH	8.9					

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-DP1-04	003-SB-063-01	003-SB-068-01	003-SB-070-01	003-SB-071-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/19/97	08/05/97	09/21/97	09/03/97	09/18/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC58	AOC63	AOC68	AOC70	AOC71	
FIELD DUPLICATE OF:	003-SB-058-01					
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	21	28	110 U	100 U	110 U	
1,1-DICHLOROETHANE	2 J	11 U	110 U	100 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	3 J	11 U	110 U	100 U	110 U	
2-BUTANONE	12 U	3 J	110 U	100 U	110 U	
2-HEXANONE	12 U	11 U	110 U	100 U	110 U	
4-METHYL-2-PENTANONE	12 U	1 J	31 J	100 U	58 J	
ACETONE	12 U	21	340	100 U	110 U	
BROMOMETHANE	12 U	11 U	110 U	100 U	110 U	
CARBON DISULFIDE	12 U	11 U	110 U	100 U	110 U	
ETHYLBENZENE	12 U	11 U	110 U	100 U	110 U	
STYRENE	12 U	11 U	110 U	100 U	110 U	
TETRACHLOROETHENE	1 J	18	110 U	100 U	110 U	
TOLUENE	12 U	1 J	110 U	100 U	13 U	
TRICHLOROETHENE	120	4 J	110 U	7 J	110 U	
XYLENES, TOTAL	12 U	1 J	110 U	100 U	110 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	400 U	350 U	370 U	340 U	360 U	
ACENAPHTHENE	400 U	350 U	370 U	340 U	360 U	
ACENAPHTHYLENE	400 U	350 U	370 U	340 U	360 U	
ANTHRACENE	400 U	350 U	370 U	340 U	360 U	
BENZO(A)ANTHRACENE	400 U	350 U	370 U	340 U	360 U	
BENZO(A)PYRENE	400 U	350 U	370 U	340 U	360 U	
BENZO(B)FLUORANTHENE	400 U	350 U	370 U	340 U	360 U	
BENZO(G,H,I)PERYLENE	400 U	350 U	370 U	340 U	360 U	
BENZO(K)FLUORANTHENE	400 U	350 U	370 U	340 U	360 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-DP1-04	003-SB-063-01	003-SB-068-01	003-SB-070-01	003-SB-071-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/19/97	08/05/97	09/21/97	09/03/97	09/18/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC58	AOC63	AOC68	AOC70	AOC71	
FIELD DUPLICATE OF:	003-SB-058-01					
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	71 J	350 U	370 U	340 U	360 U	
BUTYLBENZYL PHTHALATE	400 U	350 U	370 U	340 U	360 U	
CARBAZOLE	400 U	350 U	370 U	340 U	360 U	
CHRYSENE	400 U	350 U	370 U	340 U	360 U	
DI-N-BUTYL PHTHALATE	400 U	27 J	470 U	340 U	360 U	
DI-N-OCTYL PHTHALATE	400 U	350 U	370 U	340 U	360 U	
DIBENZO(A,H)ANTHRACENE	400 U	350 U	370 U	340 U	360 U	
DIBENZOFURAN	400 U	350 U	370 U	340 U	360 U	
FLUORANTHENE	400 U	350 U	370 U	340 U	360 U	
FLUORENE	400 U	350 U	370 U	340 U	360 U	
INDENO(1,2,3-CD)PYRENE	400 U	350 U	370 U	340 U	360 U	
NAPHTHALENE	400 U	350 U	370 U	340 U	360 U	
PHENANTHRENE	400 U	350 U	370 U	340 U	360 U	
PHENOL	400 U	350 U	370 U	340 U	360 U	
PYRENE	400 U	350 U	370 U	340 U	360 U	
PCBs (µg/kg)						
AROCLOR-1016	39 U	35 U	37 U	34 U	36 U	
AROCLOR-1254	39 U	35 U	37 U	34 U	36 U	
METALS (mg/kg)						
ALUMINUM	*6350 J	2430	*3790	2710 J	*5000 J	3420
ANTIMONY	4.2 UR	3.1 UJ	2.6 UJ	2.8 UJ	2.6 UJ	ND (2.0)
ARSENIC	4.1	0.68	2.4 J	1.7	*13.8	8.1
BARIUM	85.5 J	10 J	82.8	18.7 J	43.5 J	128
BERYLLIUM	*0.67 J	0.18 U	*0.19	0.11 U	*0.33	ND (1.0)
CADMIUM	0.45 U	0.33 U	0.32 U	0.35 U	0.33 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-DP1-04	003-SB-063-01	003-SB-068-01	003-SB-070-01	003-SB-071-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/19/97	08/05/97	09/21/97	09/03/97	09/18/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC58	AOC63	AOC68	AOC70	AOC71	
FIELD DUPLICATE OF:	003-SB-058-01					
METALS (mg/kg)						
CALCIUM	6780 J	13400 J	1610	6530 J	13200 J	56400
CHROMIUM	*10.3 J	7.2 J	*9.4 J	5.9	*11.6	9.3
COBALT	*10.4 J	*3.9 J	*7.2	*5.1	*8.6	ND (10.1)
COPPER	*11.3	5.5	*10.9	*8 J	*40.1	5.7
CYANIDE	0.3 U	0.26 U	0.28 U	0.26 U	0.27 U	ND (2.5)
HEXAVALENT CHROMIUM		2 U		2 U	2 U	ND (2.0)
IRON	10200 J	6160 J	*13600 J	6470 J	*27700 J	11000
LEAD	*9.4 J	3.1 J	3.8 J	2.6 J	*10.8 J	4.8
MAGNESIUM	1640 J	5790 J	1940 J	3420 J	7570 J	8580
MANGANESE	199 J	74.1 J	*881 J	180 J	580 J	833
MERCURY	0.05 U	0.04 U	0.05 U	0.04 U	0.04 U	ND (0.1)
NICKEL	*31.2	8 J	16.8	10.8	*20.7	18.4
POTASSIUM	288	280 J	295	207	*349	342
SELENIUM	*0.8 J	0.19 UR	0.18 UJ	0.18 UJ	0.15 UJ	0.63
SODIUM	*109 J	*107 J	*94.4 J	*110	*166 J	ND (101)
THALLIUM	0.28 U	0.19 U	*0.18 J	0.18 U	0.15 U	ND (0.61)
VANADIUM	*35.6 J	10.4	17.7	12	*26.5	20.6
ZINC	*25.7 J	15.1 J	21.5 J	14.7 J	*34 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON		1200 J	1100 J	940 J		15157.38

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-073-01	003-SB-074-01	003-SB-DP1-02	003-SB-30D-01	003-SB-32D-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 5.0'	0.0 - 5.0'	
SAMPLE DATE:	07/24/97	07/27/97	07/27/97	10/23/97	12/08/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC73	AOC74	AOC74	MS-30D	MS-32D	
FIELD DUPLICATE OF:			003-SB-074-01			
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	1 J	11 U	11 U	100 U	100 U	
1,1-DICHLOROETHANE	11 U	11 U	11 U	100 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	15	11 U	11 U	100 U	100 U	
2-BUTANONE	4 J	5 J	9 J	190	100	
2-HEXANONE	11 U	11 U	11 U	100 UJ	100 U	
4-METHYL-2-PENTANONE	2 J	2 J	2 J	120	49 J	
ACETONE	26 U	22 U	59 U	280 U	770 J	
BROMOMETHANE	11 U	11 U	11 U	100 U	100 UJ	
CARBON DISULFIDE	11 U	11 U	11 U	100 U	100 U	
ETHYLBENZENE	11 U	11 U	11 U	100 U	10 J	
STYRENE	11 U	11 U	11 U	100 U	33 J	
TETRACHLOROETHENE	3 J	2 J	11 UJ	100 U	100 U	
TOLUENE	1 J	11 U	2 J	100 U	7 J	
TRICHLOROETHENE	110	3 J	11 U	100 U	100 U	
XYLENES, TOTAL	1 J	11 U	1 J	100 U	45 J	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	370 U	360 U	360 U			
ACENAPHTHENE	370 U	360 U	360 U			
ACENAPHTHYLENE	370 U	360 U	360 U			
ANTHRACENE	370 U	360 U	360 U			
BENZO(A)ANTHRACENE	370 U	360 U	360 U			
BENZO(A)PYRENE	370 U	360 U	360 U			
BENZO(B)FLUORANTHENE	370 U	360 U	360 U			
BENZO(G,H,I)PERYLENE	12 J	360 U	360 U			
BENZO(K)FLUORANTHENE	370 U	360 U	360 U			

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-073-01	003-SB-074-01	003-SB-DP1-02	003-SB-30D-01	003-SB-32D-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 5.0'	0.0 - 5.0'	
SAMPLE DATE:	07/24/97	07/27/97	07/27/97	10/23/97	12/08/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC73	AOC74	AOC74	MS-30D	MS-32D	
FIELD DUPLICATE OF:			003-SB-074-01			
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	370 U	360 U	360 U			
BUTYLBENZYL PHTHALATE	370 U	360 U	360 U			
CARBAZOLE	370 U	360 U	360 U			
CHRYSENE	370 U	360 U	360 U			
DI-N-BUTYL PHTHALATE	370 U	360 U	360 U			
DI-N-OCTYL PHTHALATE	40 J	360 U	360 U			
DIBENZO(A,H)ANTHRACENE	370 U	360 U	360 U			
DIBENZOFURAN	370 U	360 U	360 U			
FLUORANTHENE	12 J	360 U	360 U			
FLUORENE	370 U	360 U	360 U			
INDENO(1,2,3-CD)PYRENE	370 U	360 U	360 U			
NAPHTHALENE	370 U	360 U	360 U			
PHENANTHRENE	370 U	360 U	360 U			
PHENOL	370 U	360 U	360 U			
PYRENE	12 J	360 U	360 U			
PCBs (µg/kg)						
AROCLOR-1016	36 U	35 U	35 U			
AROCLOR-1254	36 U	35 U	35 U			
METALS (mg/kg)						
ALUMINUM	*4140 J	*4770	*4520			3420
ANTIMONY	*3.1 J	3.1 UR	3.6 UR			ND (2.0)
ARSENIC	2.6 J	2.5 J	2.1 J			8.1
BARIUM	79.6 J	56.9 J	48.1 J			128
BERYLLIUM	0.19 U	0.25 U	0.27 U			ND (1.0)
CADMIUM	0.31 U	0.33 U	0.38 U			ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-073-01	003-SB-074-01	003-SB-DP1-02	003-SB-30D-01	003-SB-32D-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 5.0'	0.0 - 5.0'	
SAMPLE DATE:	07/24/97	07/27/97	07/27/97	10/23/97	12/08/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC73	AOC74	AOC74	MS-30D	MS-32D	
FIELD DUPLICATE OF:			003-SB-074-01			
METALS (mg/kg)						
CALCIUM	6600 J	5100 J	6090 J			56400
CHROMIUM	9	8.9	*11.2			9.3
COBALT	*7.6	*6.8 J	*6.6 J			ND (10.1)
COPPER	*8.1 J	*9	*10.8			5.7
CYANIDE	0.27 U	0.27 U	0.27 U			ND (2.5)
IRON	*13500 J	8750 J	9500 J			11000
LEAD	*4.9 J	4.4	4.1			4.8
MAGNESIUM	4020 J	2130 J	2670 J			8580
MANGANESE	829 J	661 J	505 J			833
MERCURY	0.05 U	0.04 U	0.05 U			ND (0.1)
NICKEL	13.5 J	13.4 J	15.3 J			18.4
POTASSIUM	*436 J	*476 J	*595 J			342
SELENIUM	0.16 UJ	0.2 UR	0.19 UR			0.63
SODIUM	*80.3 J	*92.4 J	*74.5 J			ND (101)
THALLIUM	0.17 U	0.2 UJ	0.19 UJ			ND (0.61)
VANADIUM	15.8 J	15	15.5			20.6
ZINC	*23.9 J	18.4 J	*23.6 J			22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P01-01	003-SB-P02-01	003-SB-P03-01	003-SB-P04-01	003-SB-P05-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/07/97	08/18/97	07/12/97	09/06/97	09/17/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P01	P02	P03	P04	P05	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	25 U	11 U	110 U	100 U	
1,1-DICHLOROETHANE	100 U	25 U	11 U	110 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	100 U	25 U	11 U	110 U	100 U	
2-BUTANONE	100 U	25 U	17 J	74 J	74 J	
2-HEXANONE	100 U	25 U	11 UJ	110 U	100 U	
4-METHYL-2-PENTANONE	100 U	25 U	2 J	85 J	100 U	
ACETONE	100 U	170 J	91 J	180	140	
BROMOMETHANE	100 U	25 U	11 U	110 U	100 U	
CARBON DISULFIDE	100 U	25 U	1 J	110 U	100 U	
ETHYLBENZENE	100 U	25 U	1 J	110 U	100 U	
STYRENE	100 U	25 U	11 U	110 U	100 U	
TETRACHLOROETHENE	100 U	25 U	11 U	110 U	100 U	
TOLUENE	100 U	25 U	1 J	110 U	17 U	
TRICHLOROETHENE	100 UJ	3 J	1 J	110 U	100 U	
XYLENES, TOTAL	100 U	4 J	3 J	110 U	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	330 U	340 U	78 J	350 U	340 U	
ACENAPHTHENE	330 U	37 J	380	350 U	340 U	
ACENAPHTHYLENE	330 U	340 U	19 J	350 U	340 U	
ANTHRACENE	330 U	51 J	610	350 U	340 U	
BENZO(A)ANTHRACENE	330 U	180 J	3500	350 U	340 U	
BENZO(A)PYRENE	330 U	130 J	1500	350 U	340 U	
BENZO(B)FLUORANTHENE	330 U	170 J	3600	350 U	340 U	
BENZO(G,H,I)PERYLENE	330 U	47 J	820	350 U	340 U	
BENZO(K)FLUORANTHENE	330 U	120 J	910	350 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P01-01	003-SB-P02-01	003-SB-P03-01	003-SB-P04-01	003-SB-P05-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/07/97	08/18/97	07/12/97	09/06/97	09/17/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P01	P02	P03	P04	P05	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	330 U	20 J	380 U	350 U	340 U	
BUTYLBENZYL PHTHALATE	330 U	340 U	350 U	350 U	340 U	
CARBAZOLE	330 U	35 J	530	350 U	340 U	
CHRYSENE	330 U	170 J	1600	350 U	340 U	
DI-N-BUTYL PHTHALATE	330 U	340 U	13 J	350 U	340 U	
DI-N-OCTYL PHTHALATE	330 U	12 J	350 U	350 U	340 U	
DIBENZO(A,H)ANTHRACENE	330 U	340 U	370	350 U	340 U	
DIBENZOFURAN	330 U	340 U	150 J	350 U	340 U	
FLUORANTHENE	330 U	390	5200	350 U	340 U	
FLUORENE	330 U	23 J	290 J	350 U	340 U	
INDENO(1,2,3-CD)PYRENE	330 U	86 J	1100	350 U	340 U	
NAPHTHALENE	330 U	340 U	78 J	350 U	340 U	
PHENANTHRENE	330 U	300 J	5000	350 U	340 U	
PHENOL	330 U	45 J	350 U	350 U	340 U	
PYRENE	330 U	290 J	4800	350 U	340 U	
PCBs (µg/kg)						
AROCLOR-1016	33 U	33 U	35 U	35 U	34 U	
AROCLOR-1254	33 U	33 U	35 U	35 U	34 U	
METALS (mg/kg)						
ALUMINUM	*4270	3020 J	*5120 J	2550 J	2800 J	3420
ANTIMONY	*3.2 J	3.4 UR	3 UJ	3.2 UJ	3 UJ	ND (2.0)
ARSENIC	0.56	1.5	3.1 J	1.1	1.5	8.1
BARIUM	14.4 J	57.1 J	61.2 J	28.5 J	22.6 J	128
BERYLLIUM	0.23 U	0.16 U	*0.25	0.12 U	*0.15	ND (1.0)
CADMIUM	0.33 U	0.36 U	0.31 U	0.4 U	0.38 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P01-01	003-SB-P02-01	003-SB-P03-01	003-SB-P04-01	003-SB-P05-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/07/97	08/18/97	07/12/97	09/06/97	09/17/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P01	P02	P03	P04	P05	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	18400 J	1580 J	6900 J	3810 J	12900 J	56400
CHROMIUM	*15.1 J	7.2 J	*10.9	7.2	7.8	9.3
COBALT	*7 J	*5.4 J	*7 J	*3.1	*5.7	ND (10.1)
COPPER	4.7	3	*14.5	4.8 U	*6.6	5.7
CYANIDE	0.25 U	0.25 U	0.27 U	0.26 U	0.26 U	ND (2.5)
IRON	8560 J	6460 J	10900 J	6070 J	7420 J	11000
LEAD	2.9 J	3.3 J	*21	2.6 J	3.4 J	4.8
MAGNESIUM	*8710 J	1640 J	3520 J	1910 J	5470 J	8580
MANGANESE	219 J	327 J	561 J	171 J	234 J	833
MERCURY	0.04 U	0.04 U	0.1 U	0.04 U	0.04 U	ND (0.1)
NICKEL	12.3 J	11.6	14.7	6.4	11.6	18.4
POTASSIUM	*369 J	*383	*456 J	174	273	342
SELENIUM	0.94 UR	0.2 UJ	0.17 U	0.21 UJ	0.19 UJ	0.63
SODIUM	*104 J	*76.6 J	*165	*69	*79.6 J	ND (101)
THALLIUM	0.19 U	0.2 UJ	0.17 U	0.21 U	*0.23	ND (0.61)
VANADIUM	19.7	9.6 J	16.3	10.8	10.1	20.6
ZINC	20.1 J	18.7 J	*35.6 J	12 J	19.6 J	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P06-01	003-SB-P07-01	003-SB-P08-01	003-SB-P09-01	003-SB-DP1-05	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/07/97	07/10/97	09/02/97	08/23/97	08/23/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P06	P07	P08	P09	P09	
FIELD DUPLICATE OF:					003-SB-P09-01	
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	51 U	11 U	100 U	100 U	100 UJ	
1,1-DICHLOROETHANE	51 U	11 U	100 U	100 U	100 UJ	
1,2-DICHLOROETHENE (TOTAL)	51 U	11 U	100 U	100 U	100 U	
2-BUTANONE	8 J *	5 J	100 U	100 U	100 UJ	
2-HEXANONE	51 U	11 UJ	100 U	100 U	100 U	
4-METHYL-2-PENTANONE	51 U	11 UJ	29 J	100 U	100 U	
ACETONE	81 U	36 J	170	100 U	100 UJ	
BROMOMETHANE	51 U	11 U	100 U	100 U	100 UJ	
CARBON DISULFIDE	4 J	11 U	100 U	100 U	100 UJ	
ETHYLBENZENE	51 U	11 U	100 U	100 U	100 U	
STYRENE	51 U	11 U	100 U	100 U	100 U	
TETRACHLOROETHENE	51 U	11 U	100 U	100 U	100 U	
TOLUENE	51 U	11 U	100 U	9 J	100 U	
TRICHLOROETHENE	51 UJ	1 J	100 U	100 U	100 U	
XYLENES, TOTAL	51 U	11 U	100 U	6 J	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	360 U	340 U	330 U	340 U	
ACENAPHTHENE	340 U	360 U	340 U	330 U	340 U	
ACENAPHTHYLENE	340 U	360 U	340 U	330 U	340 U	
ANTHRACENE	340 U	360 U	340 U	330 U	340 U	
BENZO(A)ANTHRACENE	340 U	360 U	340 U	330 U	340 U	
BENZO(A)PYRENE	340 U	360 U	340 U	330 U	340 U	
BENZO(B)FLUORANTHENE	340 U	360 U	340 U	330 U	340 U	
BENZO(G,H,I)PERYLENE	340 U	360 U	340 U	330 U	340 U	
BENZO(K)FLUORANTHENE	340 U	360 U	340 U	330 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P06-01	003-SB-P07-01	003-SB-P08-01	003-SB-P09-01	003-SB-DP1-05	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/07/97	07/10/97	09/02/97	08/23/97	08/23/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P06	P07	P08	P09	P09	
FIELD DUPLICATE OF:					003-SB-P09-01	
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	360 U	340 U	26 J	22 J	
BUTYLBENZYL PHTHALATE	16 J	360 U	340 U	330 U	340 U	
CARBAZOLE	340 U	360 U	340 U	330 U	340 U	
CHRYSENE	340 U	360 U	340 U	330 U	340 U	
DI-N-BUTYL PHTHALATE	340 U	360 U	340 U	330 U	340 U	
DI-N-OCTYL PHTHALATE	340 U	360 U	340 U	330 U	340 U	
DIBENZO(A,H)ANTHRACENE	340 U	360 U	340 U	330 U	340 U	
DIBENZOFURAN	340 U	360 U	340 U	330 U	340 U	
FLUORANTHENE	340 U	360 U	340 U	330 U	340 U	
FLUORENE	340 U	360 U	340 U	330 U	340 U	
INDENO(1,2,3-CD)PYRENE	340 U	360 U	340 U	330 U	340 U	
NAPHTHALENE	340 U	360 U	340 U	330 U	340 U	
PHENANTHRENE	340 U	360 U	340 U	330 U	340 U	
PHENOL	340 U	360 U	340 U	330 U	340 U	
PYRENE	340 U	360 U	340 U	330 U	340 U	
PCBs (µg/kg)						
AROCLOR-1016	33 U	36 U	34 U	33 U	33 U	
AROCLOR-1254	33 U	36 U	34 U	33 U	33 U	
METALS (mg/kg)						
ALUMINUM	2270	2640 J	2450 J	1900 J	2020 J	3420
ANTIMONY	3.5 UJ	3.4 UJ	2.7 UJ	3.6 UJ	3.4 UJ	ND (2.0)
ARSENIC	1.6	0.29 U	1	0.9 J	0.62	8.1
BARIUM	11.9 J	10.5 J	14.5 J	7.3 J	7.3 J	128
BERYLLIUM	0.13 U	*0.11	0.15 U	*0.15	*0.16	ND (1.0)
CADMIUM	0.37 U	0.36 U	0.34 U	0.38 U	0.36 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P06-01	003-SB-P07-01	003-SB-P08-01	003-SB-P09-01	003-SB-DP1-05	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	08/07/97	07/10/97	09/02/97	08/23/97	08/23/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P06	P07	P08	P09	P09	
FIELD DUPLICATE OF:					003-SB-P09-01	
METALS (mg/kg)						
CALCIUM	18600 J	1830 J	1900 J	13400 J	15200 J	56400
CHROMIUM	8.9 J	*9.6	6.8	6.1	6.4	9.3
COBALT	*6 J	*3.3 J	*4.1	3.5 U	*2.9 J	ND (10.1)
COPPER	1.4	0.99	2.7 U	2.1	0.8	5.7
CYANIDE	0.25 U	0.27 U	0.25 U	0.25 U	0.25 U	ND (2.5)
IRON	5430 J	3950 J	5020 J	4980 J	5210 J	11000
LEAD	2.2 J	3.1	4.1 J	1.9	1.9	4.8
MAGNESIUM	5260 J	1260 J	1550 J	6360 J	7170 J	8580
MANGANESE	192 J	31.3 J	68.6 J	196 J	211 J	833
MERCURY	0.04 U	0.09 U	0.04 U	0.04 U	0.04 U	ND (0.1)
NICKEL	10 J	5.1	7.7	9.2	7.2	18.4
POTASSIUM	196 J	231 J	210	187 J	169 U	342
SELENIUM	0.16 UR	0.19 U	0.19 U	0.18 UJ	0.17 UJ	0.63
SODIUM	*78.1 J	*70.1	*43.6	*59.5 J	*57.8 J	ND (101)
THALLIUM	0.16 U	0.19 UJ	0.19 U	0.18 U	0.17 U	ND (0.61)
VANADIUM	8.3	9.6	10.2	7.3 J	8.2 J	20.6
ZINC	11.8 J	11.2 J	13.9 J	12.7 U	11.7 U	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P10-01	003-SB-DP1-06	003-SB-P11-01	003-SB-DP1-07	003-SB-P12-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/05/97	09/05/97	09/08/97	09/08/97	08/10/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P10	P10	P11	P11	P12	
FIELD DUPLICATE OF:		003-SB-P10-01		003-SB-P11-01		
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	100 U	110 U	110 U	11 U	
1,1-DICHLOROETHANE	100 U	100 U	110 U	110 U	11 U	
1,2-DICHLOROETHENE (TOTAL)	100 U	100 U	110 U	110 U	11 U	
2-BUTANONE	100 U	40 J	110 U	93 J	2 J	
2-HEXANONE	100 U	100 U	110 U	26 J	11 U	
4-METHYL-2-PENTANONE	43 J	56 J	110 U	110	11 U	
ACETONE	160	130	110 U	150 U	8 J	
BROMOMETHANE	100 U	100 U	110 U	110 U	11 U	
CARBON DISULFIDE	100 U	100 U	6 J	110 U	11 U	
ETHYLBENZENE	100 U	100 U	110 U	110 U	11 U	
STYRENE	100 U	100 U	110 U	110 U	11 U	
TETRACHLOROETHENE	100 U	100 U	110 U	110 U	11 U	
TOLUENE	100 U	100 U	110 U	110 U	1 J	
TRICHLOROETHENE	100 U	100 U	110 U	110 U	11 U	
XYLENES, TOTAL	100 U	100 U	110 U	110 U	11 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	340 U	370 U	360 U	350 U	
ACENAPHTHENE	340 U	340 U	370 U	360 U	350 U	
ACENAPHTHYLENE	340 U	340 U	370 U	360 U	350 U	
ANTHRACENE	340 U	340 U	370 U	360 U	350 U	
BENZO(A)ANTHRACENE	340 U	340 U	370 U	360 U	350 U	
BENZO(A)PYRENE	340 U	340 U	370 U	360 U	350 U	
BENZO(B)FLUORANTHENE	340 U	340 U	370 U	360 U	350 U	
BENZO(G,H,I)PERYLENE	340 U	340 U	370 U	360 U	350 U	
BENZO(K)FLUORANTHENE	340 U	340 U	370 U	360 U	350 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P10-01	003-SB-DP1-06	003-SB-P11-01	003-SB-DP1-07	003-SB-P12-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/05/97	09/05/97	09/08/97	09/08/97	08/10/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P10	P10	P11	P11	P12	
FIELD DUPLICATE OF:		003-SB-P10-01		003-SB-P11-01		
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	340 U	370 U	510 U	36 U	
BUTYLBENZYL PHTHALATE	340 U	340 U	370 U	360 U	350 U	
CARBAZOLE	340 U	340 U	370 U	360 U	350 U	
CHRYSENE	340 U	340 U	370 U	360 U	350 U	
DI-N-BUTYL PHTHALATE	340 U	340 U	370 U	360 U	350 U	
DI-N-OCTYL PHTHALATE	340 U	340 U	370 U	360 U	350 U	
DIBENZO(A,H)ANTHRACENE	340 U	340 U	370 U	360 U	350 U	
DIBENZOFURAN	340 U	340 U	370 U	360 U	350 U	
FLUORANTHENE	340 U	340 U	370 U	360 U	350 U	
FLUORENE	340 U	340 U	370 U	360 U	350 U	
INDENO(1,2,3-CD)PYRENE	340 U	340 U	370 U	360 U	350 U	
NAPHTHALENE	340 U	340 U	370 U	360 U	350 U	
PHENANTHRENE	340 U	340 U	370 U	360 U	350 U	
PHENOL	340 U	340 U	370 U	360 U	350 U	
PYRENE	340 U	340 U	370 U	360 U	350 U	
PCBs (µg/kg)						
AROCLOR-1016	34 U	34 U	36 U	36 U	35 U	
AROCLOR-1254	34 U	34 U	36 U	36 U	35 U	
METALS (mg/kg)						
ALUMINUM	*3530 J	*4040 J	*4290 J	*4380 J	2320 J	3420
ANTIMONY	3.1 UJ	2.8 UJ	*2.8 J	2.4 UJ	3.2 UJ	ND (2.0)
ARSENIC	2.3	2.9	4.3	4	1.9 J	8.1
BARIUM	73.2 J	87.1 J	90.8 J	86.8 J	10.6 J	128
BERYLLIUM	0.18 U	0.16 U	0.2 U	*0.23 J	*0.12	ND (1.0)
CADMIUM	0.39 U	0.35 U	0.28 U	0.31 U	0.33 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P10-01	003-SB-DP1-06	003-SB-P11-01	003-SB-DP1-07	003-SB-P12-01	BACKGROUND (1)
DEPTH (feet):	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	0.0 - 4.0'	
SAMPLE DATE:	09/05/97	09/05/97	09/08/97	09/08/97	08/10/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P10	P10	P11	P11	P12	
FIELD DUPLICATE OF:		003-SB-P10-01		003-SB-P11-01		
METALS (mg/kg)						
CALCIUM	957 J	992 J	1200 J	1900 J	8830 J	56400
CHROMIUM	6	6.8	6.5	7.9	7.9 J	9.3
COBALT	*4.5	*5.7	*5.9	*6	*5.3	ND (10.1)
COPPER	2.4 U	3.6 U	3.1 J	*8.1 J	*9.5	5.7
CYANIDE	0.26 U	0.26 U	0.27 UJ	0.27 UJ	0.26 U	ND (2.5)
IRON	9050 J	10100 J	*13600 J	*13900 J	4130 J	11000
LEAD	2.6 J	2.8 J	2.7	2.6	3.4 J	4.8
MAGNESIUM	1130 J	1250 J	1270 J	1450 J	3810 J	8580
MANGANESE	826 J	*1070 J	*1300 J	*1170 J	66.2 J	833
MERCURY	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	ND (0.1)
NICKEL	8.5	10.1	9.8	12.7	9.9	18.4
POTASSIUM	292	*345	268	273	318 J	342
SELENIUM	0.19 UJ	0.19 UJ	0.2 UJ	0.2 U	0.16 UJ	0.63
SODIUM	*37.8	*36.7	*50.1 J	*55 J	*114 J	ND (101)
THALLIUM	0.19 U	0.19 U	0.2 U	0.2 U	0.16 UR	ND (0.61)
VANADIUM	10.6	12	14 J	14.9 J	8.3	20.6
ZINC	13 J	14.9 J	15.4 J	16.4 J	12.9 J	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-01-0001	DUP-01	SB-02-0001	SB-02-0204	DUP-02	BACKGROUND (1)
DEPTH (feet):	0.0 - 1.0'	0.0 - 1.0'	0.0 - 1.0'	2.0 - 4.0'	2.0 - 4.0'	
SAMPLE DATE:	04/10/95	04/10/95	04/11/95	04/11/95	04/11/95	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	SB-01/TW-01	SB-01/TW-01	SB-02	SB-02	SB-02	
FIELD DUPLICATE OF:		SB-01-0001			SB-02-0204	
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	12 U	12 U	11 U	11 U		
1,1-DICHLOROETHANE	12 U	12 U	11 U	11 U		
1,2-DICHLOROETHENE (TOTAL)	8	12 U	11 U	11 U		
2-BUTANONE	12 U	12 U	11 U	11 U		
2-HEXANONE	12 U	12 U	11 U	11 U		
4-METHYL-2-PENTANONE	12 U	12 U	11 U	11 U		
ACETONE	24 U	110 U	31 U	26 U		
BROMOMETHANE	12 U	12 U	11 U	11 U		
CARBON DISULFIDE	12 U	12 U	11 U	11 U		
ETHYLBENZENE	12 U	12 U	11 U	11 U		
STYRENE	12 U	12 U	11 U	11 U		
TETRACHLOROETHENE	12 U	12 U	11 U	90		
TOLUENE	1	12 U	11 U	11 U		
TRICHLOROETHENE	640	12	130	71		
XYLENES, TOTAL	12 U	12 U	11 U	4		
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	350 U	340 U	340 U	330 U	340 U	
ACENAPHTHENE	350 U	340 U	340 U	330 U	340 U	
ACENAPHTHYLENE	350 U	340 U	340 U	330 U	340 U	
ANTHRACENE	350 U	340 U	340 U	330 U	340 U	
BENZO(A)ANTHRACENE	350 U	340 U	340 U	330 U	340 U	
BENZO(A)PYRENE	350 U	340 U	340 U	330 U	340 U	
BENZO(B)FLUORANTHENE	350 U	340 U	340 U	330 U	340 U	
BENZO(G,H,I)PERYLENE	350 U	340 U	340 U	330 U	340 U	
BENZO(K)FLUORANTHENE	350 U	340 U	340 U	330 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-01-0001	DUP-01	SB-02-0001	SB-02-0204	DUP-02	BACKGROUND (1)
DEPTH (feet):	0.0 - 1.0'	0.0 - 1.0'	0.0 - 1.0'	2.0 - 4.0'	2.0 - 4.0'	
SAMPLE DATE:	04/10/95	04/10/95	04/11/95	04/11/95	04/11/95	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	SB-01/TW-01	SB-01/TW-01	SB-02	SB-02	SB-02	
FIELD DUPLICATE OF:		SB-01-0001			SB-02-0204	
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	160	700	56	920	1200	
BUTYLBENZYL PHTHALATE	350 U	340 U	340 U	330 U	340 U	
CARBAZOLE	350 U	340 U	340 U	330 U	340 U	
CHRYSENE	350 U	340 U	340 U	330 U	340 U	
DI-N-BUTYL PHTHALATE	350 U	340 U	340 U	330 U	340 U	
DI-N-OCTYL PHTHALATE	350 U	340 U	340 U	330 U	340 U	
DIBENZO(A,H)ANTHRACENE	350 U	340 U	340 U	330 U	340 U	
DIBENZOFURAN	350 U	340 U	340 U	330 U	340 U	
FLUORANTHENE	350 U	340 U	340 U	330 U	340 U	
FLUORENE	350 U	340 U	340 U	330 U	340 U	
INDENO(1,2,3-CD)PYRENE	350 U	340 U	340 U	330 U	340 U	
NAPHTHALENE	350 U	340 U	340 U	330 U	340 U	
PHENANTHRENE	350 U	340 U	340 U	330 U	340 U	
PHENOL	350 U	340 U	340 U	330 U	340 U	
PYRENE	350 U	340 U	340 U	52	50	
PCBs (µg/kg)						
AROCLOR-1016	35 U	34 U	34 U	170 U	170 U	
AROCLOR-1254	35 U	34 U	34 U	170 U	170 U	
METALS (mg/kg)						
ALUMINUM	*4820	*3660	3310	525	498	3420
ANTIMONY	8.8 U	8.9 U	8 U	8.6 U	9.4 U	ND (2.0)
ARSENIC	2.1	4.1	2.1	0.42	0.32 U	8.1
BARIUM	32.6	37	28.1	19.5	13.8	128
BERYLLIUM	0.18 U	*0.29	*0.19	0.17 U	0.16 U	ND (1.0)
CADMIUM	0.53 U	0.53 U	1.8 U	1 U	0.79 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-01-0001	DUP-01	SB-02-0001	SB-02-0204	DUP-02	BACKGROUND (1)
DEPTH (feet):	0.0 - 1.0'	0.0 - 1.0'	0.0 - 1.0'	2.0 - 4.0'	2.0 - 4.0'	
SAMPLE DATE:	04/10/95	04/10/95	04/11/95	04/11/95	04/11/95	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	SB-01/TW-01	SB-01/TW-01	SB-02	SB-02	SB-02	
FIELD DUPLICATE OF:		SB-01-0001			SB-02-0204	
METALS (mg/kg)						
CALCIUM	14100	17400	12100	882	768	56400
CHROMIUM	*17.9	*19.5	*20	*72.3	*73.6	9.3
COBALT	*5.4	*3.7	*4	1.5 U	1.5 U	ND (10.1)
COPPER	*13	*14.6	*14.9	*24.9	*17.9	5.7
CYANIDE	0.99 U	0.94 U	0.89 U	*79	*90.4	ND (2.5)
IRON	10400	*13400	8990	2990	2430	11000
LEAD	*6	*6.1	*12.1	*215	*175	4.8
MAGNESIUM	4700	5800	5080	211	153	8580
MANGANESE	307	364	403	61.3	31.2	833
MERCURY	0.04 U	0.04 U	0.04 U	0.05 U	0.04 U	ND (0.1)
NICKEL	*19.6	*19.7	*27.4	7.9 U	4.6 U	18.4
POTASSIUM	*550	*417	*380	147	157	342
SELENIUM	0.71 U	0.71 U	0.64 U	0.69 U	0.64 U	0.63
SODIUM	*333	*316	*142	*103	*86	ND (101)
THALLIUM	0.88 U	0.89 U	0.8 U	0.86 U	0.81 U	ND (0.61)
VANADIUM	15.2	17.6	12	2	2.3	20.6
ZINC	21.4	19	*24.9	8.5 U	8.9 U	22.4
GENERAL CHEMISTRY						
PH	11.51	11.42	10.93	6.85	6.89	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

CTO 0003

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-03-0001	SB-04-0001	SB-05-0001	SB-06-0002		BACKGROUND (1)
DEPTH (feet):	0.0 - 1.0'	0.0 - 1.0'	0.0 - 1.0'	0.0 - 2.0'		
SAMPLE DATE:	04/05/95	04/06/95	04/06/95	04/04/95	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING		
LOCATION:	SB-03	SB-04/TW-02	SB-05	SB-06/TW-03		
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	11 U	11 U	11 U		
1,1-DICHLOROETHANE	11 U	11 U	11 U	11 U		
1,2-DICHLOROETHENE (TOTAL)	11 U	11 U	11 U	11 U		
2-BUTANONE	5	11 U	11 U	11 U		
2-HEXANONE	11 U	11 U	11 U	11 U		
4-METHYL-2-PENTANONE	11 U	11 U	11 U	11 U		
ACETONE	15 U	38 U	14 U	280		
BROMOMETHANE	11 U	11 U	11 U	11 U		
CARBON DISULFIDE	11 U	11 U	11 U	11 U		
ETHYLBENZENE	11 U	11 U	11 U	11 U		
STYRENE	9	11 U	11 U	4		
TETRACHLOROETHENE	11 U	11 U	11 U	11 U		
TOLUENE	11 U	11 U	11 U	11 U		
TRICHLOROETHENE	14	16	9	7		
XYLENES, TOTAL	11 U	11 U	11 U	11 U		
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	350 U	350 U	360 U	340 U		
ACENAPHTHENE	350 U	350 U	360 U	340 U		
ACENAPHTHYLENE	350 U	350 U	360 U	340 U		
ANTHRACENE	350 U			340 U		
BENZO(A)ANTHRACENE	350 U			340 U		
BENZO(A)PYRENE	350 U			340 U		
BENZO(B)FLUORANTHENE	350 U			340 U		
BENZO(G,H,I)PERYLENE	350 U			340 U		
BENZO(K)FLUORANTHENE	350 U			340 U		

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-03-0001	SB-04-0001	SB-05-0001	SB-06-0002		BACKGROUND (1)
DEPTH (feet):	0.0 - 1.0'	0.0 - 1.0'	0.0 - 1.0'	0.0 - 2.0'		
SAMPLE DATE:	04/05/95	04/06/95	04/06/95	04/04/95	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING		
LOCATION:	SB-03	SB-04/TW-02	SB-05	SB-06/TW-03		
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	350 U			340 U		
BUTYLBENZYL PHTHALATE	350 U			340 U		
CARBAZOLE	350 U			340 U		
CHRYSENE	350 U			340 U		
DI-N-BUTYL PHTHALATE	350 U			340 U		
DI-N-OCTYL PHTHALATE	350 U			340 U		
DIBENZO(A,H)ANTHRACENE	350 U			340 U		
DIBENZOFURAN	350 U			340 U		
FLUORANTHENE	350 U			340 U		
FLUORENE	350 U			340 U		
INDENO(1,2,3-CD)PYRENE	350 U			340 U		
NAPHTHALENE	350 U	350 U	360 U	340 U		
PHENANTHRENE	350 U			340 U		
PHENOL	350 U	350 U	360 U	340 U		
PYRENE	350 U			340 U		
METALS (mg/kg)						
ALUMINUM	2590	*3490	*3700	2790		3420
ANTIMONY	8.8 U	9.4 U	8.8 U	8.9 U		ND (2.0)
ARSENIC	5.8	3.4	2.5	4.5		8.1
BARIUM	*201	67.3	37.5	21.9		128
BERYLLIUM	*0.21	*0.23	*0.26	*0.25		ND (1.0)
CADMIUM	2.6 U	0.57 U	0.53 U	0.54 U		ND (1.0)
CALCIUM	4260	6400	9790	19100		56400
CHROMIUM	*13.4	*10.2	*15.9	*27.9		9.3
COBALT	*6.9	*5.3	*4.9	*7.2		ND (10.1)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL - 0-4 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-03-0001	SB-04-0001	SB-05-0001	SB-06-0002		BACKGROUND (1)
DEPTH (feet):	0.0 - 1.0'	0.0 - 1.0'	0.0 - 1.0'	0.0 - 2.0'		
SAMPLE DATE:	04/05/95	04/06/95	04/06/95	04/04/95	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING		
LOCATION:	SB-03	SB-04/TW-02	SB-05	SB-06/TW-03		
FIELD DUPLICATE OF:						
METALS (mg/kg)						
COPPER	*13.9	*14.7	*21.4	*9.6		5.7
CYANIDE	*1.1	1.1 U	1.1 U	1 U		ND (2.5)
IRON	*14600	*11700	10400	8570		11000
LEAD	*7.6	*9	*32.6	2.6		4.8
MAGNESIUM	1880	2920	4410	6630		8580
MANGANESE	*2490	638	442	246		833
MERCURY	0.05 U	0.04 U	0.05 U	0.05 U		ND (0.1)
NICKEL	14.7	12.4 U	13.6 U	12.9 U		18.4
POTASSIUM	268	*382	*413	285		342
SELENIUM	0.71 U	0.75 U	0.71 U	0.71 U		0.63
SODIUM	*259	*180	*145	*128		ND (101)
THALLIUM	0.88 U	0.94 U	0.88 U	0.89 U		ND (0.61)
VANADIUM	10.1	13.7	15.9	11.3		20.6
ZINC	*26.4	19.4	*22.9	15.2		22.4
GENERAL CHEMISTRY						
PH	9.47	9.22	8.79	9.54		

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-003-02	003-SB-004-03	003-SB-006-03	003-SB-007-02	003-SB-007-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	07/13/97	07/22/97	07/08/97	08/21/97	08/21/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC03	AOC04	AOC06	AOC07	AOC07	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	11 U	10 U	
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	11 U	10 U	
1,1-DICHLOROETHANE	10 U	10 U	10 U	11 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	10 U	11 U	10 U	
2-BUTANONE	4 J	4 J	10 UJ	11 U	10 U	
2-HEXANONE	10 UJ	10 U	10 UJ	11 U	10 U	
4-METHYL-2-PENTANONE	1 J	2 J	10 UJ	11 U	10 U	
ACETONE	29 J	40 U	8 J	62 J	10 UJ	
BENZENE	10 U	10 U	10 U	1 J	10 U	
BROMOMETHANE	10 U	10 U	10 U	11 U	10 U	
CARBON DISULFIDE	10 U	10 U	10 U	11 U	10 U	
ETHYLBENZENE	10 U	10 U	10 U	11 U	10 U	
STYRENE	10 U	10 U	10 U	11 U	10 U	
TETRACHLOROETHENE	10 U	10 U	10 U	11 U	10 U	
TOLUENE	10 U	1 J	10 U	2 J	10 U	
TRICHLOROETHENE	10 U	10 U	10 U	11 U	10 U	
XYLENES, TOTAL	10 U	1 J	10 U	1 J	10 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	340 U	340 U	360 U		
4-CHLORO-3-METHYLPHENOL	340 U	340 U	340 U	360 U		
ACENAPHTHENE	340 U	340 U	340 U	360 U		
ACENAPHTHYLENE	340 U	340 U	340 U	360 U		
ANTHRACENE	340 U	340 U	12 J	360 U		
BENZO(A)ANTHRACENE	340 U	340 U	39 J	360 U		
BENZO(A)PYRENE	340 U	340 U	33 J	360 U		

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-003-02	003-SB-004-03	003-SB-006-03	003-SB-007-02	003-SB-007-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	07/13/97	07/22/97	07/08/97	08/21/97	08/21/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC03	AOC04	AOC06	AOC07	AOC07	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	340 U	340 U	34 J	360 U		
BENZO(G,H,I)PERYLENE	340 U	340 U	18 J	360 U		
BENZO(K)FLUORANTHENE	340 U	340 U	30 J	360 U		
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	340 U	340 U	19 J		
BUTYLBENZYL PHTHALATE	340 U	340 U	110 J	360 U		
CARBAZOLE	340 U	340 U	340 U	360 U		
CHRYSENE	340 U	340 U	41 J	360 U		
DI-N-BUTYL PHTHALATE	340 U	340 U	340 U	360 U		
DI-N-OCTYL PHTHALATE	340 U	340 U	340 U	360 U		
DIBENZO(A,H)ANTHRACENE	340 U	340 U	340 U	360 U		
DIBENZOFURAN	340 U	340 U	340 U	360 U		
FLUORANTHENE	340 U	340 U	88 J	360 U		
FLUORENE	340 U	340 U	340 U	360 U		
INDENO(1,2,3-CD)PYRENE	340 U	340 U	20 J	360 U		
NAPHTHALENE	340 U	340 U	340 U	360 U		
PENTACHLOROPHENOL	340 U	840 U	340 U	900 U		
PHENANTHRENE	340 U	340 U	45 J	360 U		
PHENOL	340 U	340 U	340 U	360 U		
PYRENE	340 U	340 U	67 J	360 U		
METALS (mg/kg)						
ALUMINUM	1930 J	1450 J	2370 J	*4050 J		3420
ARSENIC	0.8 U	1.6	0.88 U	2.2		8.1
BARIUM	14.1 J	6.5 J	19.3 J	42.8 J		128
BERYLLIUM	*0.06	*0.07	*0.07	*0.22		ND (1.0)
CADMIUM	0.37 U	0.36 U	0.35 U	0.37 U		ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-003-02	003-SB-004-03	003-SB-006-03	003-SB-007-02	003-SB-007-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	07/13/97	07/22/97	07/08/97	08/21/97	08/21/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC03	AOC04	AOC06	AOC07	AOC07	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	5780 J	13800 J	18700 J	3440 J		56400
CHROMIUM	6.2	5.2	9.2	8.5		9.3
COBALT	3.1 U	*2.8 J	*4.3 J	*6.5 J		ND (10.1)
COPPER	1.1	1.6 U	2.4	*6.6		5.7
CYANIDE	0.26 U	0.25 U	0.26 U	0.27 U		ND (2.5)
IRON	5800 J	3520 J	5900 J	10200 J		11000
LEAD	1.9	1.2 J	2	*7		4.8
MAGNESIUM	2620 J	3850 J	6990 J	2220 J		8580
MANGANESE	82.5 J	53.3 J	220 J	405. J		833
MERCURY	0.08 U	0.05 U	*0.18 J	*0.19 J		ND (0.1)
NICKEL	3.6	5	7.9	12.4		18.4
POTASSIUM	156 J	154 J	237 J	339 J		342
SELENIUM	0.19 U	0.4 J	0.17 U	0.18 UJ		0.63
SODIUM	*52.4	41.8 U	*73	51.3 U		ND (101)
VANADIUM	9.8	6.7 J	10	15.7 J		20.6
ZINC	9.1 J	8.6 U	13.3 J	*23.2 J		22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON		2200 J	1100 J			15157.38

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-008-02	003-SB-013-02	003-SB-015-03	003-SB-016-03	003-SB-017-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	07/21/97	07/14/97	09/22/97	07/26/97	07/25/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC08/AOC09	AOC13/AOC14	AOC15	AOC16	AOC17	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	10 U	100 U	10 U	10 U	
1,1,2-TRICHLOROETHANE	10 U	10 U	100 U	10 U	10 U	
1,1-DICHLOROETHANE	10 U	10 U	100 U	10 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	100 U	10 U	10 U	
2-BUTANONE	10 UJ	1 J	100 U	6 J	2 J	
2-HEXANONE	10 U	10 UJ	100 U	10 U	10 U	
4-METHYL-2-PENTANONE	10 U	10 UJ	24 J	1 J	1 J	
ACETONE	10 U	19 J	430	33 U	13 U	
BENZENE	10 U	10 U	100 U	10 U	10 U	
BROMOMETHANE	10 U	10 U	100 U	1 J	10 U	
CARBON DISULFIDE	10 U	10 U	100 U	10 U	10 U	
ETHYLBENZENE	10 U	10 U	100 U	10 U	10 U	
STYRENE	10 U	10 U	100 U	10 U	10 U	
TETRACHLOROETHENE	10 U	10 U	100 U	10 UJ	1 J	
TOLUENE	10 U	10 U	100 U	10 U	10 U	
TRICHLOROETHENE	10 U	10 U	100 U	10 U	10 U	
XYLENES, TOTAL	10 U	10 U	100 U	10 U	10 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	340 U	340 U	340 U	350 U	
4-CHLORO-3-METHYLPHENOL	340 U	340 U	340 U	340 U	350 U	
ACENAPHTHENE	340 U	340 U	340 U	340 U	350 U	
ACENAPHTHYLENE	340 U	340 U	340 U	340 U	350 U	
ANTHRACENE	340 U	340 U	340 U	340 U	350 U	
BENZO(A)ANTHRACENE	340 U	18 J	340 U	340 U	350 U	
BENZO(A)PYRENE	340 U	11 J	340 U	340 U	350 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-008-02	003-SB-013-02	003-SB-015-03	003-SB-016-03	003-SB-017-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	07/21/97	07/14/97	09/22/97	07/26/97	07/25/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC08/AOC09	AOC13/AOC14	AOC15	AOC16	AOC17	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	340 U	14 J	340 U	340 U	350 U	
BENZO(G,H,I)PERYLENE	340 U	340 U	340 U	340 U	350 U	
BENZO(K)FLUORANTHENE	340 U	15 J	340 U	340 U	350 U	
BIS(2-ETHYLHEXYL)PHTHALATE	370 U	340 U	340 U	340 U	350 U	
BUTYLBENZYL PHTHALATE	340 U	340 U	340 U	340 U	350 U	
CARBAZOLE	340 U	340 U	340 U	340 U	350 UJ	
CHRYSENE	340 U	19 J	340 U	340 U	350 U	
DI-N-BUTYL PHTHALATE	340 U	340 U	340 U	340 U	350 U	
DI-N-OCTYL PHTHALATE	340 U	340 U	340 U	340 U	350 U	
DIBENZO(A,H)ANTHRACENE	340 U	340 U	340 U	340 U	350 U	
DIBENZOFURAN	340 U	340 U	340 U	340 U	350 U	
FLUORANTHENE	340 U	43 J	340 U	340 U	12 J	
FLUORENE	340 U	340 U	340 U	340 U	350 U	
INDENO(1,2,3-CD)PYRENE	340 U	340 U	340 U	340 U	350 U	
NAPHTHALENE	340 U	340 U	340 U	340 U	350 U	
PENTACHLOROPHENOL	850 U	340 U	840 U	850 U	870 U	
PHENANTHRENE	340 U	28 J	340 U	340 U	350 U	
PHENOL	340 U	340 U	340 U	340 U	350 U	
PYRENE	340 U	46 J	340 U	340 U	11 J	
METALS (mg/kg)						
ALUMINUM	2500 J	2300 J	1500	1970 J	2790 J	3420
ARSENIC	0.67	0.66 U	1.7 J	0.99 J	1.8 J	8.1
BARIUM	8.7 J	17.9 J	8.2	10.1 J	9.8 J	128
BERYLLIUM	*0.17	*0.1	*0.07	*0.17 J	0.12 U	ND (1.0)
CADMIUM	0.31 U	0.32 U	0.35 U	0.38 U	0.3 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-008-02	003-SB-013-02	003-SB-015-03	003-SB-016-03	003-SB-017-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	07/21/97	07/14/97	09/22/97	07/26/97	07/25/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC08/AOC09	AOC13/AOC14	AOC15	AOC16	AOC17	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	3270 J	12600 J	28700	29000 J	25400 J	56400
CHROMIUM	7.8	7.5	5.8 J	7.3	*11.6	9.3
COBALT	*4 J	*5.5 J	*5.6	*4.6	*6	ND (10.1)
COPPER	*12.7 J	4	1.6	2.3 U	*5.8 J	5.7
CYANIDE	0.25 U	0.26 U	0.25 U	0.26 U	0.26 U	ND (2.5)
IRON	7020 J	5120 J	5180 J	5340 J	6690 J	11000
LEAD	1.3 U	2.8	2.9 J	1.4 J	4.4 J	4.8
MAGNESIUM	2100 J	4240 J	*8630 J	*9670 J	7710 J	8580
MANGANESE	62.1 J	180 J	278 J	698 J	462 J	833
MERCURY	0.05 U	*0.32 J	0.04 U	0.05 U	0.04 U	ND (0.1)
NICKEL	9.3	8.8	9.9	7.8 J	11.6 J	18.4
POTASSIUM	186 J	234 J	191	215 J	234 J	342
SELENIUM	0.16 UJ	0.17 U	0.17 UJ	0.18 UJ	0.18 UJ	0.63
SODIUM	*138 J	*41.9	*58.4 J	*71.2 J	*62.4 J	ND (101)
VANADIUM	*26.1 J	8.8	10.5	8.2 J	13.7 J	20.6
ZINC	12.5 U	13.7 J	11.6 J	12.6 J	14.2 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON			1000 J	1400 J		15157.38

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-018-02	003-SB-023-03	003-SB-026-03	003-SB-027-02	003-SB-027-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	07/26/97	08/09/97	09/20/97	08/22/97	08/22/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC18	AOC23	AOC26	AOC27	AOC27	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	10 U	100 U	51 U	51 U	
1,1,2-TRICHLOROETHANE	10 U	10 U	100 U	51 U	51 U	
1,1-DICHLOROETHANE	10 U	10 U	100 U	51 U	51 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	100 U	26 J	3 J	
2-BUTANONE	5 J	4 J	41 J	86	51 U	
2-HEXANONE	10 U	10 U	100 U	51 U	51 U	
4-METHYL-2-PENTANONE	1 J	1 J	60 J	92	26 J	
ACETONE	32 U	27	320	350	61	
BENZENE	10 U	10 U	100 U	51 U	51 U	
BROMOMETHANE	1 J	10 U	100 U	51 U	51 U	
CARBON DISULFIDE	10 U	10 U	8 J	51 U	51 U	
ETHYLBENZENE	10 U	10 U	100 U	4 J	51 U	
STYRENE	10 U	10 U	100 U	51 U	51 U	
TETRACHLOROETHENE	10 UJ	10 U	8 J	51 U	51 U	
TOLUENE	1 J	1 J	100 U	8 J	51 U	
TRICHLOROETHENE	2 J	1 J	100 U	51 U	51 U	
XYLENES, TOTAL	10 U	1 J	100 U	10 J	51 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	340 U	34 J	340 U	340 U	
4-CHLORO-3-METHYLPHENOL	340 U	340 U	340 U	340 U	340 U	
ACENAPHTHENE	340 U	340 U	340 U	340 U	340 U	
ACENAPHTHYLENE	340 U	340 U	340 U	340 U	340 U	
ANTHRACENE	340 U	340 U	340 U	340 U	340 U	
BENZO(A)ANTHRACENE	340 U	340 U	340 U	340 U	340 U	
BENZO(A)PYRENE	340 U	340 U	340 U	340 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-018-02	003-SB-023-03	003-SB-026-03	003-SB-027-02	003-SB-027-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	07/26/97	08/09/97	09/20/97	08/22/97	08/22/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC18	AOC23	AOC26	AOC27	AOC27	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	340 U	340 U	340 U	340 U	340 U	
BENZO(G,H,I)PERYLENE	340 U	340 U	340 U	340 U	340 U	
BENZO(K)FLUORANTHENE	340 U	340 U	340 U	340 U	340 U	
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	340 U	340 U	16 J	25 J	
BUTYLBENZYL PHTHALATE	340 U	340 U	340 U	340 U	340 U	
CARBAZOLE	340 U	340 U	340 U	340 U	340 U	
CHRYSENE	340 U	340 U	13 J	340 U	340 U	
DI-N-BUTYL PHTHALATE	340 U	340 U	340 U	340 U	340 U	
DI-N-OCTYL PHTHALATE	340 U	340 U	340 U	340 U	340 U	
DIBENZO(A,H)ANTHRACENE	340 U	340 U	340 U	340 U	340 U	
DIBENZOFURAN	340 U	340 U	340 U	340 U	340 U	
FLUORANTHENE	340 U	340 U	20 J	340 U	340 U	
FLUORENE	340 U	340 U	340 U	340 U	340 U	
INDENO(1,2,3-CD)PYRENE	340 U	340 U	340 U	340 U	340 U	
NAPHTHALENE	340 U	340 U	110 J	340 U	340 U	
PENTACHLOROPHENOL	850 U	340 U	850 U	840 U	840 U	
PHENANTHRENE	340 U	340 U	39 J	340 U	340 U	
PHENOL	340 U	340 U	340 U	340 U	340 U	
PYRENE	340 U	340 U	17 J	340 U	340 U	
METALS (mg/kg)						
ALUMINUM	3060	1990 J	2280	2340 J	2380 J	3420
ARSENIC	1.1 J	0.68 J	4.6 J	0.73	0.69	8.1
BARIUM	21 J	6.3 J	11.5	8.4 J	8.2 J	128
BERYLLIUM	0.13 U	*0.14	*0.11	*0.14	*0.13	ND (1.0)
CADMIUM	0.36 U	0.28 U	0.37 U	0.35 U	0.33 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-018-02	003-SB-023-03	003-SB-026-03	003-SB-027-02	003-SB-027-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	07/26/97	08/09/97	09/20/97	08/22/97	08/22/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC18	AOC23	AOC26	AOC27	AOC27	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	30000 J	2630 J	3880	23700 J	21300 J	56400
CHROMIUM	*10.2	5.7 J	6.7 J	*9.4	*12.1	9.3
COBALT	*4.4 J	*2.3	*3.5	*6.6 J	*6.3 J	ND (10.1)
COPPER	*6.4	5	2.8	*10	*6.2	5.7
CYANIDE	0.26 U	0.25 U	0.26 U	0.25 U	0.25 U	ND (2.5)
IRON	6270 J	5040 J	6050 J	5590 J	5700 J	11000
LEAD	2.8	0.88 J	*9.5 J	2.4	2.4	4.8
MAGNESIUM	*9980 J	1340 J	2330 J	6840 J	7310 J	8580
MANGANESE	185 J	61.6 J	37.8 J	96.2 J	111 J	833
MERCURY	0.04 U	0.04 U	0.04 U	*0.31 J	*0.23 J	ND (0.1)
NICKEL	9.6 J	5.5	5.3	12.7	12.1	18.4
POTASSIUM	311 J	216 J	202	242 J	246 J	342
SELENIUM	0.16 UR	0.17 UJ	0.13 UJ	0.17 UJ	0.17 UJ	0.63
SODIUM	*140 J	74.1 U	*75.2 J	*88.6 J	*74.5 J	ND (101)
VANADIUM	10.1	13.9	14.9	14.1 J	11.4 J	20.6
ZINC	17.4 J	9.4 J	11.8 J	13.7 J	14.8 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON				1700 J	2000 J	15157.38

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-028-02	003-SB-029-02	003-SB-030-02	003-SB-030-03	003-SB-032-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	09/16/97	09/15/97	08/23/97	08/23/97	08/25/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC28	AOC29	AOC30	AOC30	AOC32	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	100 U	51 U	10 U	190 U	
1,1,2-TRICHLOROETHANE	100 U	100 U	51 U	10 U	190 U	
1,1-DICHLOROETHANE	100 U	100 U	51 U	10 U	11 J	
1,2-DICHLOROETHENE (TOTAL)	100 U	100 U	51 U	10 U	15000	
2-BUTANONE	100 U	87 J	18 J	10 U	190 U	
2-HEXANONE	100 U	100 U	51 U	10 U	190 U	
4-METHYL-2-PENTANONE	150	26 J	24 J	6 J	190 U	
ACETONE	160 U	440	130	43	1700	
BENZENE	100 U	100 U	51 U	10 U	24 J	
BROMOMETHANE	100 U	100 U	51 U	10 U	190 U	
CARBON DISULFIDE	100 U	100 U	51 U	10 U	11 J	
ETHYLBENZENE	100 U	100 U	51 U	10 U	720	
STYRENE	100 U	100 U	51 U	10 U	190 U	
TETRACHLOROETHENE	100 U	100 U	51 U	10 U	390	
TOLUENE	100 U	100 U	51 U	1 J	1000	
TRICHLOROETHENE	100 U	100 U	51 U	10 U	22 J	
XYLENES, TOTAL	100 U	23 J	51 U	10 U	7300	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	13 J	340 U	340 U		720 J	
4-CHLORO-3-METHYLPHENOL	340 U	340 U	340 U		11000	
ACENAPHTHENE	340 U	340 U	340 U		6200 U	
ACENAPHTHYLENE	340 U	340 U	340 U		6200 U	
ANTHRACENE	340 U	340 U	340 U		510 J	
BENZO(A)ANTHRACENE	340 U	340 U	340 U		6200 U	
BENZO(A)PYRENE	340 U	340 U	340 U		6200 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-028-02	003-SB-029-02	003-SB-030-02	003-SB-030-03	003-SB-032-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	09/16/97	09/15/97	08/23/97	08/23/97	08/25/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC28	AOC29	AOC30	AOC30	AOC32	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	340 U	340 U	340 U		6200 U	
BENZO(G,H,I)PERYLENE	340 U	340 U	340 U		6200 U	
BENZO(K)FLUORANTHENE	340 U	340 U	340 U		6200 U	
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	340 U	150 J		1600 J	
BUTYLBENZYL PHTHALATE	340 U	340 U	340 U		3600 J	
CARBAZOLE	340 U	340 U	340 U		6200 U	
CHRYSENE	340 U	340 U	340 U		6200 U	
DI-N-BUTYL PHTHALATE	340 U	340 U	340 U		6200 U	
DI-N-OCTYL PHTHALATE	340 U	340 U	84 J		6200 U	
DIBENZO(A,H)ANTHRACENE	340 U	340 U	340 U		6200 U	
DIBENZOFURAN	340 U	340 U	340 U		6200 U	
FLUORANTHENE	340 U	340 U	340 U		270 J	
FLUORENE	340 U	340 U	340 U		6200 U	
INDENO(1,2,3-CD)PYRENE	340 U	340 U	340 U		6200 U	
NAPHTHALENE	340 U	340 U	340 U		2300 J	
PENTACHLOROPHENOL	840 U	860 U	840 U		15000 U	
PHENANTHRENE	23 J	340 U	340 U		490 J	
PHENOL	340 U	340 U	340 U		6200 U	
PYRENE	340 U	340 U	340 U		410 J	
METALS (mg/kg)						
ALUMINUM	2980 J	1790 J	2400 J		*4400 J	3420
ARSENIC	0.9 J	0.64	1.2		*13.6	8.1
BARIUM	18.4 J	7 J	14.5 J		70.4 J	128
BERYLLIUM	0.21 U	0.13 U	*0.15		*0.28	ND (1.0)
CADMIUM	0.33 U	0.33 U	0.37 U		0.63 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-028-02	003-SB-029-02	003-SB-030-02	003-SB-030-03	003-SB-032-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	09/16/97	09/15/97	08/23/97	08/23/97	08/25/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC28	AOC29	AOC30	AOC30	AOC32	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	24700 J	1450 J	7610 J		10700 J	56400
CHROMIUM	8.2	3.7	*10.3		7.5	9.3
COBALT	*3.8	*2.3	*3.9 J		4.4 U	ND (10.1)
COPPER	*19.1 J	5 J	*6.9		*15.3	5.7
CYANIDE	0.25 UJ	0.26 UJ	0.25 U		0.46 U	ND (2.5)
IRON	9590 J	3400 J	5570 J		*23300 J	11000
LEAD	3.2	1.2	1.6		*10.8	4.8
MAGNESIUM	7690 J	1190 J	3230 J		1330 J	8580
MANGANESE	211 J	35.2 J	119 J		179 J	833
MERCURY	0.04 U	0.04 U	0.04 U		*0.06	ND (0.1)
NICKEL	8.9	4.9	8.5		5.6	18.4
POTASSIUM	254	216	315 J		*777 J	342
SELENIUM	0.18 U	0.17 U	0.19 UJ		0.34 UJ	0.63
SODIUM	*153 J	*73.7 J	*129 J		*267 J	ND (101)
VANADIUM	13.2 J	8.9 J	14.4 J		*35.3 J	20.6
ZINC	*207 J	9.2 J	12.2 J		*28.7 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	1300 J		750 J			15157.38

CTO 0003

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
'ank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-033-03	003-SB-034-03	003-SB-035-02	003-SB-036-02	003-SB-036-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	09/07/97	07/29/97	07/28/97	08/12/97	08/12/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC33	AOC34	AOC35	AOC36	AOC36	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	10 U	2 J	10 U	10 U	
1,1,2-TRICHLOROETHANE	100 U	10 U	10 U	10 U	10 U	
1,1-DICHLOROETHANE	100 U	10 U	10 U	10 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	100 U	10 U	10 U	10 U	10 U	
2-BUTANONE	100 U	18	4 J	6 J	8 J	
2-HEXANONE	100 U	1 J	10 U	2 J	2 J	
4-METHYL-2-PENTANONE	100 U	4 J	1 J	8 J	11	
ACETONE	100 U	60 U	35 U	18	27	
BENZENE	100 U	10 U	10 U	10 U	10 U	
BROMOMETHANE	100 U	10 U	10 U	10 U	10 U	
CARBON DISULFIDE	100 U	10 U	10 U	10 U	10 U	
ETHYLBENZENE	100 U	10 U	10 U	10 U	10 U	
STYRENE	100 U	10 U	1 J	10 U	10 U	
TETRACHLOROETHENE	100 U	10 U	2 J	10 U	10 U	
TOLUENE	100 U	2 J	2 J	1 J	1 J	
TRICHLOROETHENE	100 U	10 U	36	10 UJ	10 UJ	
XYLENES, TOTAL	100 U	1 J	1 J	1 J	1 J	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	350 U	350 U		340 U	
4-CHLORO-3-METHYLPHENOL	340 U	350 U	350 U		340 U	
ACENAPHTHENE	340 U	350 U	350 U		340 U	
ACENAPHTHYLENE	340 U	350 U	350 U		340 U	
ANTHRACENE	340 U	350 U	350 U		340 U	
BENZO(A)ANTHRACENE	340 U	350 U	350 U		340 U	
BENZO(A)PYRENE	340 U	350 U	350 U		340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-033-03	003-SB-034-03	003-SB-035-02	003-SB-036-02	003-SB-036-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	09/07/97	07/29/97	07/28/97	08/12/97	08/12/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC33	AOC34	AOC35	AOC36	AOC36	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	340 U	350 U	350 U		340 U	
BENZO(G,H,I)PERYLENE	340 U	350 U	350 U		340 U	
BENZO(K)FLUORANTHENE	340 U	350 U	350 U		340 U	
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	350 U	350 U		340 U	
BUTYLBENZYL PHTHALATE	340 U	350 U	350 U		340 U	
CARBAZOLE	340 U	350 U	350 U		340 U	
CHRYSENE	340 U	350 U	350 U		340 U	
DI-N-BUTYL PHTHALATE	340 U	350 U	350 U		340 U	
DI-N-OCTYL PHTHALATE	340 U	350 U	350 U		340 U	
DIBENZO(A,H)ANTHRACENE	340 U	350 U	350 U		340 U	
DIBENZOFURAN	340 U	350 U	350 U		340 U	
FLUORANTHENE	340 U	350 U	350 U		340 U	
FLUORENE	340 U	350 U	350 U		340 U	
INDENO(1,2,3-CD)PYRENE	340 U	350 U	350 U		340 U	
NAPHTHALENE	340 U	350 U	350 U		340 U	
PENTACHLOROPHENOL	860 U	870 U	870 U		850 U	
PHENANTHRENE	340 U	350 U	350 U		340 U	
PHENOL	340 U	350 U	350 U		340 U	
PYRENE	340 U	350 U	350 U		340 U	
METALS (mg/kg)						
ALUMINUM	1620 J	1800	*7090		1870	3420
ARSENIC	0.62	0.65 U	3.8 J		1.3	8.1
BARIUM	6.3 J	6.9 J	67.6 J		6.8	128
BERYLLIUM	0.09 U	0.13 U	*0.44 J		*0.12	ND (1.0)
CADMIUM	0.36 U	0.34 U	0.4 U		0.34 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-033-03	003-SB-034-03	003-SB-035-02	003-SB-036-02	003-SB-036-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	8.0 - 12.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	09/07/97	07/29/97	07/28/97	08/12/97	08/12/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC33	AOC34	AOC35	AOC36	AOC36	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	3030 J	1600 J	34500 J		25600 J	56400
CHROMIUM	5	5.7	*16		8.6 J	9.3
COBALT	*2.8	*3 J	*6.4 J		*6.5	ND (10.1)
COPPER	4.3 U	4.9	*10.1		4.7	5.7
CYANIDE	0.26 U	0.26 U	0.26 U		0.25 U	ND (2.5)
IRON	3410 J	4840 J	*12000 J		4200 J	11000
LEAD	1.3 J	1.6	*6.4		2.6 J	4.8
MAGNESIUM	1530 J	1110 J	*12900 J		8210 J	8580
MANGANESE	47.2 J	48.4 J	476 J		101 J	833
MERCURY	0.04 U	0.04 U	0.04 U		0.04 U	ND (0.1)
NICKEL	5.5	5.4 J	16.7 J		16.9	18.4
POTASSIUM	179	218 J	*1350 J		220 J	342
SELENIUM	0.19 UJ	0.17 UR	0.17 UR		0.19 U	0.63
SODIUM	*68	*77.6 J	*141 J		64.1 U	ND (101)
VANADIUM	9.4	16.3	*28.4		10.1	20.6
ZINC	8.7 J	9.8 U	*39.6 J		13.4 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON			1000 J			15157.38

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
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TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-037-02	003-SB-037-03	003-SB-038-03	003-SB-039-03	003-SB-046-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/06/97	08/06/97	07/23/97	09/25/97	09/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC37	AOC37	AOC38	AOC39	AOC46	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	10 U	10 U	110 U	100 U	
1,1,2-TRICHLOROETHANE	11 U	10 U	10 U	110 U	100 U	
1,1-DICHLOROETHANE	11 U	10 U	10 U	110 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	11 U	10 U	10 U	110 U	100 U	
2-BUTANONE	11	41	15 J	110 U	100 U	
2-HEXANONE	11 U	4 J	1 J	110 U	100 U	
4-METHYL-2-PENTANONE	5 J	24	6 J	68 J	38 J	
ACETONE	28	93	66 U	390	450	
BENZENE	11 U	10 U	10 U	110 U	100 U	
BROMOMETHANE	11 U	10 U	10 U	110 U	100 U	
CARBON DISULFIDE	11 U	10 U	10 U	110 U	100 U	
ETHYLBENZENE	11 U	10 U	10 U	110 U	100 U	
STYRENE	11 U	10 U	10 U	110 U	100 U	
TETRACHLOROETHENE	11 U	10 U	10 U	110 U	100 U	
TOLUENE	1 J	1 J	1 J	19 J	100 U	
TRICHLOROETHENE	1 J	10 UJ	10 U	110 U	100 U	
XYLENES, TOTAL	1 J	1 J	1 J	10 J	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE		350 U	350 U	370 U	17000 U	
4-CHLORO-3-METHYLPHENOL		350 U	350 U	370 U	17000 U	
ACENAPHTHENE		350 U	350 U	370 U	17000 U	
ACENAPHTHYLENE		350 U	350 U	370 U	17000 U	
ANTHRACENE		350 U	350 U	370 U	17000 U	
BENZO(A)ANTHRACENE		350 U	350 U	370 U	17000 U	
BENZO(A)PYRENE		350 U	350 U	370 U	17000 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-037-02	003-SB-037-03	003-SB-038-03	003-SB-039-03	003-SB-046-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/06/97	08/06/97	07/23/97	09/25/97	09/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC37	AOC37	AOC38	AOC39	AOC46	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE		350 U	350 U	370 U	17000 U	
BENZO(G,H,I)PERYLENE		350 U	350 U	370 U	17000 U	
BENZO(K)FLUORANTHENE		350 U	350 U	370 U	17000 U	
BIS(2-ETHYLHEXYL)PHTHALATE		350 U	350 U	370 U	17000 U	
BUTYLBENZYL PHTHALATE		350 U	350 U	370 U	17000 U	
CARBAZOLE		350 UJ	350 U	370 U	17000 U	
CHRYSENE		350 U	350 U	370 U	17000 U	
DI-N-BUTYL PHTHALATE		350 U	350 U	370 U	17000 U	
DI-N-OCTYL PHTHALATE		350 U	350 U	370 U	17000 U	
DIBENZO(A,H)ANTHRACENE		350 U	350 U	370 U	17000 U	
DIBENZOFURAN		350 U	350 U	370 U	17000 U	
FLUORANTHENE		350 U	350 U	370 U	17000 U	
FLUORENE		350 U	350 U	370 U	17000 U	
INDENO(1,2,3-CD)PYRENE		350 U	350 U	370 U	17000 U	
NAPHTHALENE		350 U	350 U	370 U	17000 U	
PENTACHLOROPHENOL		870 U	870 U	930 U	43000 U	
PHENANTHRENE		350 U	350 U	370 U	17000 U	
PHENOL		350 U	350 U	370 U	17000 U	
PYRENE		350 U	350 U	370 U	17000 U	
METALS (mg/kg)						
ALUMINUM		2100	*3510 J	3380 J	2460	3420
ARSENIC		0.44	0.79	2.5	0.43 U	8.1
BARIUM		8.7 J	11 J	28.3 J	10	128
BERYLLIUM		0.16 U	*0.15	*0.2	*0.13	ND (1.0)
CADMIUM		0.35 U	0.33 U	*0.38	0.32 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-037-02	003-SB-037-03	003-SB-038-03	003-SB-039-03	003-SB-046-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/06/97	08/06/97	07/23/97	09/25/97	09/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC37	AOC37	AOC38	AOC39	AOC46	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM		6330 J	46500 J	23300 J	3470	56400
CHROMIUM		6 J	*10.6	*18.4 J	5.2 J	9.3
COBALT		2.5 U	*5.8 J	*5.2	*2.6	ND (10.1)
COPPER		3.5	5.5 J	*7.2	4.8	5.7
CYANIDE		0.26 U	0.26 U	0.28 U	0.26 U	ND (2.5)
IRON		6240 J	7710 J	7470 J	5080 J	11000
LEAD		1.9 J	1.3 U	3.9 J	1.5 J	4.8
MAGNESIUM		1790 J	*20000 J	6470 J	1660 J	8580
MANGANESE		65.1 J	364 J	396 J	58.9 J	833
MERCURY		0.04 U	0.04 U	0.05 U	0.04 U	ND (0.1)
NICKEL		5.6 J	11.3	11.9	6.7	18.4
POTASSIUM		266 J	305 J	310	301	342
SELENIUM		0.89 UR	0.18 UJ	0.21 U	0.14 UJ	0.63
SODIUM		*109 J	*137 J	*127 J	*473 J	ND (101)
VANADIUM		18.8	14 J	15.7 J	11.3	20.6
ZINC		11.1 J	15.8 J	19.1 J	10.7 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON					2100 J	15157.38

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-047-03	003-SB-050-02	003-SB-054-02	003-SB-055-02	003-SB-055-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	4.0 - 8.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	09/23/97	09/24/97	08/04/97	08/24/97	08/24/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC47	AOC50	AOC54	AOC55	AOC55	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	100 U	2 J	11 U	110 U	
1,1,2-TRICHLOROETHANE	100 U	100 U	12 U	11 U	110 U	
1,1-DICHLOROETHANE	100 U	100 U	1 J	11 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	100 U	100 U	12 U	11 U	110 U	
2-BUTANONE	100 U	100 U	4 J	11 U	110 U	
2-HEXANONE	100 U	100 U	1 J	11 U	110 U	
4-METHYL-2-PENTANONE	100 U	34 J	2 J	11 U	110 U	
ACETONE	400	37 J	26 U	12	110 U	
BENZENE	100 U	100 U	12 U	11 U	110 U	
BROMOMETHANE	100 U	100 U	12 U	11 U	110 U	
CARBON DISULFIDE	100 U	100 U	14	11 U	110 U	
ETHYLBENZENE	100 U	100 U	12 U	11 U	110 U	
STYRENE	100 U	100 U	12 U	11 U	110 U	
TETRACHLOROETHENE	100 U	100 U	12 U	11 U	110 U	
TOLUENE	100 U	100 U	2 J	1 J	110 U	
TRICHLOROETHENE	100 U	100 U	2 J	11 U	110 U	
XYLENES, TOTAL	100 U	100 U	1 J	11 U	110 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	350 U	340 U	31 J	380 U	350 U	
4-CHLORO-3-METHYLPHENOL	350 U	340 U	400 UJ	380 U	350 U	
ACENAPHTHENE	350 U	340 U	59 J	380 U	350 U	
ACENAPHTHYLENE	350 U	340 U	20 J	380 U	350 U	
ANTHRACENE	350 U	340 U	73 J	380 U	350 U	
BENZO(A)ANTHRACENE	350 U	340 U	280 J	380 U	350 U	
BENZO(A)PYRENE	350 U	340 U	190 J	380 U	350 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-047-03	003-SB-050-02	003-SB-054-02	003-SB-055-02	003-SB-055-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	4.0 - 8.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	09/23/97	09/24/97	08/04/97	08/24/97	08/24/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC47	AOC50	AOC54	AOC55	AOC55	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	350 U	340 U	230 J	380 U	350 U	
BENZO(G,H,I)PERYLENE	350 U	340 U	150 J	380 U	350 U	
BENZO(K)FLUORANTHENE	350 U	340 U	190 J	380 U	350 U	
BIS(2-ETHYLHEXYL)PHTHALATE	350 U	360 U	400 UJ	44 J	26 J	
BUTYLBENZYL PHTHALATE	350 U	340 U	400 UJ	380 U	350 U	
CARBAZOLE	350 U	340 U	67 J	380 U	350 U	
CHRYSENE	350 U	340 U	240 J	380 U	350 U	
DI-N-BUTYL PHTHALATE	350 U	340 U	15 J	380 U	350 U	
DI-N-OCTYL PHTHALATE	350 U	340 U	400 UJ	380 U	350 U	
DIBENZO(A,H)ANTHRACENE	350 U	340 U	50 J	380 U	350 U	
DIBENZOFURAN	350 U	340 U	41 J	380 U	350 U	
FLUORANTHENE	350 U	340 U	840 J	380 U	350 U	
FLUORENE	350 U	340 U	44 J	380 U	350 U	
INDENO(1,2,3-CD)PYRENE	350 U	340 U	120 J	380 U	350 U	
NAPHTHALENE	350 U	340 U	56 J	380 U	350 U	
PENTACHLOROPHENOL	870 U	860 U	50 J	950 U	890 U	
PHENANTHRENE	350 U	340 U	570 J	380 U	350 U	
PHENOL	350 U	340 U	400 UJ	380 U	350 U	
PYRENE	350 U	340 U	590 J	380 U	350 U	
METALS (mg/kg)						
ALUMINUM	1550	2770 J	*4880	*6170 J	2150 J	3420
ARSENIC	0.65 U	0.97 J	3 J	4.5	0.83	8.1
BARIUM	16.6	11.9 J	51.8 J	56.8 J	9.6 J	128
BERYLLIUM	*0.05	*0.1	0.3 U	*0.4	*0.15	ND (1.0)
CADMIUM	0.32 U	0.4 U	0.4 U	0.42 U	0.36 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-047-03	003-SB-050-02	003-SB-054-02	003-SB-055-02	003-SB-055-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	4.0 - 8.0'	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	
SAMPLE DATE:	09/23/97	09/24/97	08/04/97	08/24/97	08/24/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC47	AOC50	AOC54	AOC55	AOC55	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	791	3250 J	37400 J	35600 J	3380 J	56400
CHROMIUM	3.8 J	7.8 J	*15.2	*12.4	4.5	9.3
COBALT	*3.1	*2.9	*5.9 J	*5.8 J	*2.8 J	ND (10.1)
COPPER	0.69	1.8	*32.7	*10.4	4.3 J	5.7
CYANIDE	0.26 U	0.26 U	0.3 U	0.29 U	0.27 U	ND (2.5)
IRON	3490 J	4740 J	9170 J	*12400 J	5000	11000
LEAD	1.6 J	2.5 J	*70.2	*5.7	1.4	4.8
MAGNESIUM	950 J	2300 J	*9300 J	*12900 J	1580 J	8580
MANGANESE	182 J	52.3 J	329 J	*1180 J	57.9 J	833
MERCURY	0.04 U	0.04 U	0.05 U	*0.26	*0.3	ND (0.1)
NICKEL	5.5	7.1	14.1 J	12.9	6.7	18.4
POTASSIUM	166	188	*831 J	*1250 J	256 J	342
SELENIUM	0.14 UJ	0.2 U	0.18 UR	0.84 UJ	0.18 UJ	0.63
SODIUM	40.3 U	*92.9 J	*114 J	*157 J	*80.4 J	ND (101)
VANADIUM	5.4	10.4 J	19.3	*28.7 J	14.8 J	20.6
ZINC	8.7 U	13.5 J	*49.8 J	*39.4 J	10.7 U	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-058-02	003-SB-058-03	003-SB-063-03	003-SB-068-03	003-SB-070-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/19/97	08/19/97	08/05/97	09/21/97	09/03/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC58	AOC58	AOC63	AOC68	AOC70	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	100 U	100 U	
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	100 U	100 U	
1,1-DICHLOROETHANE	10 U	10 U	10 U	100 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	10 U	100 U	100 U	
2-BUTANONE	9 J	10 U	3 J	100 U	100 U	
2-HEXANONE	10 U	10 U	10 U	100 U	100 U	
4-METHYL-2-PENTANONE	11	4 J	10 U	30 J	32 J	
ACETONE	28	10 U	11 U	120	100 U	
BENZENE	10 U	10 U	10 U	100 U	100 U	
BROMOMETHANE	10 U	10 U	2 J	100 U	100 U	
CARBON DISULFIDE	10 U	10 U	10 U	100 U	100 U	
ETHYLBENZENE	10 U	10 U	10 U	100 U	100 U	
STYRENE	10 U	10 U	10 U	100 U	100 U	
TETRACHLOROETHENE	10 U	10 U	10 U	100 U	100 U	
TOLUENE	10 U	10 U	1 J	100 U	100 U	
TRICHLOROETHENE	3 J	4 J	10 U	100 U	100 U	
XYLENES, TOTAL	1 J	10 U	10 U	100 U	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE		340 U	350 U	350 U	340 U	
4-CHLORO-3-METHYLPHENOL		340 U	350 U	350 U	340 U	
ACENAPHTHENE		340 U	350 U	350 U	340 U	
ACENAPHTHYLENE		340 U	350 U	350 U	340 U	
ANTHRACENE		340 U	350 U	350 U	340 U	
BENZO(A)ANTHRACENE		340 U	350 U	350 U	340 U	
BENZO(A)PYRENE		340 U	350 U	350 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-058-02	003-SB-058-03	003-SB-063-03	003-SB-068-03	003-SB-070-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/19/97	08/19/97	08/05/97	09/21/97	09/03/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC58	AOC58	AOC63	AOC68	AOC70	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE		340 U	350 U	350 U	340 U	
BENZO(G,H,I)PERYLENE		340 U	350 U	350 U	340 U	
BENZO(K)FLUORANTHENE		340 U	350 U	350 U	340 U	
BIS(2-ETHYLHEXYL)PHTHALATE		340 U	350 U	350 U	340 U	
BUTYLBENZYL PHTHALATE		340 U	350 U	350 U	340 U	
CARBAZOLE		340 U	350 U	350 U	340 U	
CHRYSENE		340 U	350 U	350 U	340 U	
DI-N-BUTYL PHTHALATE		340 U	350 U	350 U	340 U	
DI-N-OCTYL PHTHALATE		340 U	350 U	350 U	340 U	
DIBENZO(A,H)ANTHRACENE		340 U	350 U	350 U	340 U	
DIBENZOFURAN		340 U	350 U	350 U	340 U	
FLUORANTHENE		340 U	350 U	350 U	340 U	
FLUORENE		340 U	350 U	350 U	340 U	
INDENO(1,2,3-CD)PYRENE		340 U	350 U	350 U	340 U	
NAPHTHALENE		340 U	350 U	350 U	340 U	
PENTACHLOROPHENOL		850 U	870 U	870 U	840 U	
PHENANTHRENE		340 U	350 U	350 U	340 U	
PHENOL		120 J	350 U	350 U	340 U	
PYRENE		340 U	350 U	350 U	340 U	
METALS (mg/kg)						
ALUMINUM		3000 J	2100	2400	1750 J	3420
ARSENIC		1.3	0.76	0.68 U	0.25	8.1
BARIUM		12 J	8.1 J	26.1	5.8 J	128
BERYLLIUM		0.21 U	0.19 U	*0.09	0.1 U	ND (1.0)
CADMIUM		0.33 U	0.38 U	0.29 U	0.34 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-058-02	003-SB-058-03	003-SB-063-03	003-SB-068-03	003-SB-070-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/19/97	08/19/97	08/05/97	09/21/97	09/03/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC58	AOC58	AOC63	AOC68	AOC70	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM		4960 J	3350 J	965	18100 J	56400
CHROMIUM		5.7 U	6 J	7.6 J	6.8	9.3
COBALT		*6.1 J	*3 J	*3.9	*4	ND (10.1)
COPPER		*8	4.7	0.76	*16.1 J	5.7
CYANIDE		0.26 U	0.26 U	0.26 U	0.25 U	ND (2.5)
IRON		6370 J	6070 J	5600 J	4330 J	11000
LEAD		2.5 J	1.8 J	1.6 J	1.6 J	4.8
MAGNESIUM		3330 J	1630 J	1480 J	6560 J	8580
MANGANESE		145 J	58 J	185 J	86.2 J	833
MERCURY		0.03 U	0.04 U	0.04 U	0.04 U	ND (0.1)
NICKEL		10.1	5.3 J	8.3	8.9	18.4
POTASSIUM		268	218 J	246	154	342
SELENIUM		0.15 UJ	0.92 UR	0.13 UJ	0.17 UJ	0.63
SODIUM		66.6 U	*96.3 J	*487 J	*51.7	ND (101)
VANADIUM		11.2 J	18	7.1	7.7	20.6
ZINC		18.3 J	10.6 J	11.9 J	12.3 J	22.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON			480 J	600 J	710 J	15157.38

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ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-071-03	003-SB-073-03	003-SB-074-03	003-SB-28D-01	003-SB-29D-01	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	5.0 - 10.0'	5.0 - 10.0'	
SAMPLE DATE:	09/18/97	07/24/97	07/27/97	12/03/97	12/05/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC71	AOC73	AOC74	MS-28D	MS-29D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	1 J	10 U	110 U	120 UJ	
1,1,2-TRICHLOROETHANE	110 U	11 U	10 U	110 U	120 U	
1,1-DICHLOROETHANE	110 U	11 U	10 U	110 U	120 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	1 J	10 U	110 U	120 U	
2-BUTANONE	110 U	5 J	10 J	100 J	210 J	
2-HEXANONE	110 U	11 U	10 U	110 U	120 U	
4-METHYL-2-PENTANONE	110 U	2 J	2 J	110	64 J	
ACETONE	110 U	46 U	66 U	230 J	960 J	
BENZENE	110 U	11 U	10 U	110 U	120 U	
BROMOMETHANE	110 U	11 U	10 U	110 U	120 U	
CARBON DISULFIDE	110 U	11 U	10 U	110 U	120 UJ	
ETHYLBENZENE	110 U	11 U	10 U	110 U	19 J	
STYRENE	110 U	11 U	10 U	110 U	54 J	
TETRACHLOROETHENE	110 U	1 J	10 UJ	110 U	120 U	
TOLUENE	8 U	1 J	1 J	12 J	14 J	
TRICHLOROETHENE	110 U	8 J	10 U	110 U	120 U	
XYLENES, TOTAL	110 U	1 J	1 J	15 J	71 J	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	350 U	360 U	340 U			
4-CHLORO-3-METHYLPHENOL	350 U	360 U	340 U			
ACENAPHTHENE	350 U	360 U	340 U			
ACENAPHTHYLENE	350 U	360 U	340 U			
ANTHRACENE	350 U	360 U	340 U			
BENZO(A)ANTHRACENE	350 U	360 U	340 U			
BENZO(A)PYRENE	350 U	360 U	340 U			

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-071-03	003-SB-073-03	003-SB-074-03	003-SB-28D-01	003-SB-29D-01	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	5.0 - 10.0'	5.0 - 10.0'	
SAMPLE DATE:	09/18/97	07/24/97	07/27/97	12/03/97	12/05/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC71	AOC73	AOC74	MS-28D	MS-29D	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	350 U	360 U	340 U			
BENZO(G,H,I)PERYLENE	350 U	360 U	340 U			
BENZO(K)FLUORANTHENE	350 U	360 U	340 U			
BIS(2-ETHYLHEXYL)PHTHALATE	350 U	360 U	340 U			
BUTYLBENZYL PHTHALATE	350 U	360 U	340 U			
CARBAZOLE	350 U	360 U	340 U			
CHRYSENE	350 U	360 U	340 U			
DI-N-BUTYL PHTHALATE	350 U	360 U	340 U			
DI-N-OCTYL PHTHALATE	350 U	360 U	340 U			
DIBENZO(A,H)ANTHRACENE	350 U	360 U	340 U			
DIBENZOFURAN	350 U	360 U	340 U			
FLUORANTHENE	350 U	360 U	340 U			
FLUORENE	350 U	360 U	340 U			
INDENO(1,2,3-CD)PYRENE	350 U	360 U	340 U			
NAPHTHALENE	350 U	360 U	340 U			
PENTACHLOROPHENOL	890 U	900 U	850 U			
PHENANTHRENE	350 U	360 U	340 U			
PHENOL	350 U	360 U	340 U			
PYRENE	350 U	360 U	340 U			
METALS (mg/kg)						
ALUMINUM	1960 J	2050 J	2230			3420
ARSENIC	1	2.2 J	1 U			8.1
BARIUM	6.8 J	8.3 J	9.3 J			128
BERYLLIUM	*0.09	0.12 U	0.13 U			ND (1.0)
CADMIUM	0.36 U	0.34 U	0.3 U			ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-071-03	003-SB-073-03	003-SB-074-03	003-SB-28D-01	003-SB-29D-01	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	5.0 - 10.0'	5.0 - 10.0'	
SAMPLE DATE:	09/18/97	07/24/97	07/27/97	12/03/97	12/05/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC71	AOC73	AOC74	MS-28D	MS-29D	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	4360 J	22100 J	21400 J			56400
CHROMIUM	4.6	7.9	*12.4			9.3
COBALT	*2.9	*5	*5 J			ND (10.1)
COPPER	4.4	3.8 U	3.5			5.7
CYANIDE	0.27 U	0.27 U	0.26 U			ND (2.5)
IRON	4920 J	6040 J	5390 J			11000
LEAD	1.4 J	1.8 J	1.4			4.8
MAGNESIUM	1620 J	*8700 J	6560 J			8580
MANGANESE	111 J	206 J	475 J			833
MERCURY	0.05 U	0.05 U	0.04 U			ND (0.1)
NICKEL	6	8.7 J	10.7 J			18.4
POTASSIUM	181	211 J	225 J			342
SELENIUM	0.16 UJ	0.18 UJ	0.17 UR			0.63
SODIUM	*77.3 J	*72 J	*85.4 J			ND (101)
VANADIUM	12.2	8.8 J	10.6			20.6
ZINC	10.3 J	13.1 U	12.1 J			22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-31D-01	003-SB-31D-02	003-SB-33D-01	003-SB-33D-02	003-SB-P01-02	BACKGROUND (1)
DEPTH (feet):	5.0 - 10.0'	10.0 - 15.0'	5.0 - 10.0'	10.0 - 15.0'	4.0 - 8.0'	
SAMPLE DATE:	11/13/97	11/13/97	11/18/97	11/18/97	08/07/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-31D	MS-31D	MS-33D	MS-33D	P01	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	100 U	100 U	100 U	100 U	
1,1,2-TRICHLOROETHANE	110 U	100 U	100 U	100 U	100 U	
1,1-DICHLOROETHANE	110 U	100 U	100 U	100 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	100 U	100 U	100 U	100 U	
2-BUTANONE	200	120	100	42 J	100 U	
2-HEXANONE	110 U	100 U	100 U	100 U	100 U	
4-METHYL-2-PENTANONE	110 J	96 J	40 J	24 J	100 U	
ACETONE	380 U	290 U	310 U	100 U	100 U	
BENZENE	110 U	100 U	100 U	100 U	100 U	
BROMOMETHANE	110 U	100 U	100 U	100 U	100 U	
CARBON DISULFIDE	110 U	100 U	100 U	100 U	100 U	
ETHYLBENZENE	110 U	100 U	100 U	100 U	100 U	
STYRENE	110 U	100 U	100 U	100 U	100 U	
TETRACHLOROETHENE	110 U	100 U	100 U	100 U	100 U	
TOLUENE	9 J	8 J	5 J	100 U	100 U	
TRICHLOROETHENE	110 U	100 U	100 U	100 U	100 UJ	
XYLENES, TOTAL	24 J	11 J	11 J	7 J	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE					340 U	
4-CHLORO-3-METHYLPHENOL					340 U	
ACENAPHTHENE					340 U	
ACENAPHTHYLENE					340 U	
ANTHRACENE					340 U	
BENZO(A)ANTHRACENE					340 U	
BENZO(A)PYRENE					340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-31D-01	003-SB-31D-02	003-SB-33D-01	003-SB-33D-02	003-SB-P01-02	BACKGROUND (1)
DEPTH (feet):	5.0 - 10.0'	10.0 - 15.0'	5.0 - 10.0'	10.0 - 15.0'	4.0 - 8.0'	
SAMPLE DATE:	11/13/97	11/13/97	11/18/97	11/18/97	08/07/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-31D	MS-31D	MS-33D	MS-33D	P01	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE					340 U	
BENZO(G,H,I)PERYLENE					340 U	
BENZO(K)FLUORANTHENE					340 U	
BIS(2-ETHYLHEXYL)PHTHALATE					340 U	
BUTYLBENZYL PHTHALATE					340 U	
CARBAZOLE					340 UJ	
CHRYSENE					340 U	
DI-N-BUTYL PHTHALATE					340 U	
DI-N-OCTYL PHTHALATE					340 U	
DIBENZO(A,H)ANTHRACENE					340 U	
DIBENZOFURAN					340 U	
FLUORANTHENE					340 U	
FLUORENE					340 U	
INDENO(1,2,3-CD)PYRENE					340 U	
NAPHTHALENE					340 U	
PENTACHLOROPHENOL					840 U	
PHENANTHRENE					340 U	
PHENOL					340 U	
PYRENE					340 U	
METALS (mg/kg)						
ALUMINUM					2910	3420
ARSENIC					1.6	8.1
BARIUM					11.4 J	128
BERYLLIUM					0.15 U	ND (1.0)
CADMIUM					0.31 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-31D-01	003-SB-31D-02	003-SB-33D-01	003-SB-33D-02	003-SB-P01-02	BACKGROUND (1)
DEPTH (feet):	5.0 - 10.0'	10.0 - 15.0'	5.0 - 10.0'	10.0 - 15.0'	4.0 - 8.0'	
SAMPLE DATE:	11/13/97	11/13/97	11/18/97	11/18/97	08/07/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-31D	MS-31D	MS-33D	MS-33D	P01	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM					19500 J	56400
CHROMIUM					*10 J	9.3
COBALT					*5.9 J	ND (10.1)
COPPER					*6.1	5.7
CYANIDE					0.25 U	ND (2.5)
IRON					6560 J	11000
LEAD					2.6 J	4.8
MAGNESIUM					*12100 J	8580
MANGANESE					82.9 J	833
MERCURY					0.04 U	ND (0.1)
NICKEL					10.5 J	18.4
POTASSIUM					299 J	342
SELENIUM					0.79 UR	0.63
SODIUM					*104 J	ND (101)
VANADIUM					18.8	20.6
ZINC					15 J	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P01-03-BR	003-SB-P02-02	003-SB-P02-03	003-SB-P03-03	003-SB-P04-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/07/97	08/18/97	08/18/97	07/12/97	09/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P01	P02	P02	P03	P04	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	100 U	
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U	100 U	
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	10 U	10 U	100 U	
2-BUTANONE	10 U	10 U	10 U	5 J	100 U	
2-HEXANONE	10 U	10 U	10 U	10 UJ	100 U	
4-METHYL-2-PENTANONE	10 U	10 U	9 J	1 J	43 J	
ACETONE	10 U	10 U	16	33 J	100 U	
BENZENE	10 U	10 U	10 U	10 U	100 U	
BROMOMETHANE	10 U	10 U	10 U	10 U	100 U	
CARBON DISULFIDE	10 U	10 U	10 U	10 U	100 U	
ETHYLBENZENE	10 U	10 U	10 U	10 U	100 U	
STYRENE	10 U	10 U	10 U	10 U	100 U	
TETRACHLOROETHENE	10 U	10 U	10 U	10 U	100 U	
TOLUENE	10 U	10 U	10 U	10 U	100 U	
TRICHLOROETHENE	10 UJ	10 U	6 J	10 U	100 U	
XYLENES, TOTAL	10 U	1 J	1 J	1 J	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE			340 U	340 U	340 U	
4-CHLORO-3-METHYLPHENOL			340 U	340 U	340 U	
ACENAPHTHENE			340 U	340 U	340 U	
ACENAPHTHYLENE			340 U	340 U	340 U	
ANTHRACENE			340 U	340 U	340 U	
BENZO(A)ANTHRACENE			340 U	340 U	340 U	
BENZO(A)PYRENE			340 U	340 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P01-03-BR	003-SB-P02-02	003-SB-P02-03	003-SB-P03-03	003-SB-P04-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/07/97	08/18/97	08/18/97	07/12/97	09/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P01	P02	P02	P03	P04	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE			340 U	340 U	340 U	
BENZO(G,H,I)PERYLENE			340 U	340 U	340 U	
BENZO(K)FLUORANTHENE			340 U	340 U	340 U	
BIS(2-ETHYLHEXYL)PHTHALATE			45 J	340 U	340 U	
BUTYLBENZYL PHTHALATE			340 U	340 U	340 U	
CARBAZOLE			340 U	340 U	340 U	
CHRYSENE			340 U	340 U	340 U	
DI-N-BUTYL PHTHALATE			340 U	340 U	340 U	
DI-N-OCTYL PHTHALATE			340 U	340 U	340 U	
DIBENZO(A,H)ANTHRACENE			340 U	340 U	340 U	
DIBENZOFURAN			340 U	340 U	340 U	
FLUORANTHENE			340 U	340 U	340 U	
FLUORENE			340 U	340 U	340 U	
INDENO(1,2,3-CD)PYRENE			340 U	340 U	340 U	
NAPHTHALENE			340 U	340 U	340 U	
PENTACHLOROPHENOL			850 U	340 U	850 U	
PHENANTHRENE			340 U	340 U	340 U	
PHENOL			340 U	340 U	340 U	
PYRENE			340 U	340 U	340 U	
METALS (mg/kg)						
ALUMINUM			2060 J	2010 J	2150 J	3420
ARSENIC			1.1	1.6 U	1	8.1
BARIUM			14.6 J	7.1 J	21.6 J	128
BERYLLIUM			0.13 U	*0.07	0.11 U	ND (1.0)
CADMIUM			0.33 U	0.27 U	0.37 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P01-03-BR	003-SB-P02-02	003-SB-P02-03	003-SB-P03-03	003-SB-P04-03	BACKGROUND (1)
DEPTH (feet):	8.0 - 12.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/07/97	08/18/97	08/18/97	07/12/97	09/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P01	P02	P02	P03	P04	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM			3470 J	19600 J	22400 J	56400
CHROMIUM			5.7 J	7.4	8.9	9.3
COBALT			*3.4 J	*5.1 J	*5.9	ND (10.1)
COPPER			3.3	2.4	3.9 U	5.7
CYANIDE			0.25 U	0.25 U	0.25 U	ND (2.5)
IRON			5040 J	4650 J	5670 J	11000
LEAD			2.5 J	1.3	1.3 J	4.8
MAGNESIUM			1540 J	5620 J	7480 J	8580
MANGANESE			96.4 J	285 J	*873 J	833
MERCURY			0.04 U	0.1 U	0.05 U	ND (0.1)
NICKEL			5.4	8.4	13.9	18.4
POTASSIUM			218	205 J	161	342
SELENIUM			0.16 UJ	0.18 U	0.19 U	0.63
SODIUM			48.1 U	*61.5	*78.4	ND (101)
VANADIUM			7.6 J	8.4	7.9	20.6
ZINC			12.1 J	10.4 J	13.1 J	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P05-02	003-SB-P06-02-BR	003-SB-P06-03	003-SB-P07-03	003-SB-P08-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	09/17/97	08/07/97	08/07/97	07/10/97	09/02/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P05	P06	P06	P07	P08	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	11 U	10 U	10 U	100 U	
1,1,2-TRICHLOROETHANE	100 U	11 U	10 U	10 U	100 U	
1,1-DICHLOROETHANE	100 U	11 U	10 U	10 U	100 U	
1,2-DICHLOROETHENE (TOTAL)	100 U	11 U	10 U	10 U	100 U	
2-BUTANONE	38 J	2 J	19	10 UJ	100 U	
2-HEXANONE	100 U	11 U	10 U	10 UJ	100 U	
4-METHYL-2-PENTANONE	43 J	11 U	8 J	10 UJ	18 J	
ACETONE	420	14	83	11 J	65 J	
BENZENE	100 U	11 U	10 U	10 U	100 U	
BROMOMETHANE	100 U	11 U	10 U	10 U	100 U	
CARBON DISULFIDE	5 J	11 U	10 U	10 U	100 U	
ETHYLBENZENE	100 U	11 U	10 U	10 U	100 U	
STYRENE	100 U	11 U	10 U	10 U	100 U	
TETRACHLOROETHENE	100 U	11 U	10 U	10 U	100 U	
TOLUENE	13 J	11 U	3 J	10 U	100 U	
TRICHLOROETHENE	100 U	1 J	1 J	10 U	100 U	
XYLENES, TOTAL	100 U	11 U	2 J	10 U	100 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U		340 U	340 U	340 U	
4-CHLORO-3-METHYLPHENOL	340 U		340 U	340 U	340 U	
ACENAPHTHENE	340 U		340 U	340 U	340 U	
ACENAPHTHYLENE	340 U		340 U	340 U	340 U	
ANTHRACENE	340 U		340 U	340 U	340 U	
BENZO(A)ANTHRACENE	340 U		340 U	340 U	340 U	
BENZO(A)PYRENE	340 U		340 U	340 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P05-02	003-SB-P06-02-BR	003-SB-P06-03	003-SB-P07-03	003-SB-P08-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	09/17/97	08/07/97	08/07/97	07/10/97	09/02/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P05	P06	P06	P07	P08	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	340 U		340 U	340 U	340 U	
BENZO(G,H,I)PERYLENE	340 U		340 U	340 U	340 U	
BENZO(K)FLUORANTHENE	340 U		340 U	340 U	340 U	
BIS(2-ETHYLHEXYL)PHTHALATE	340 U		340 U	340 U	340 U	
BUTYLBENZYL PHTHALATE	340 U		340 U	340 U	340 U	
CARBAZOLE	340 U		340 U	340 U	340 U	
CHRYSENE	340 U		340 U	340 U	340 U	
DI-N-BUTYL PHTHALATE	340 U		340 U	340 U	340 U	
DI-N-OCTYL PHTHALATE	340 U		340 U	340 U	340 U	
DIBENZO(A,H)ANTHRACENE	340 U		340 U	340 U	340 U	
DIBENZOFURAN	340 U		340 U	340 U	340 U	
FLUORANTHENE	340 U		340 U	340 U	340 U	
FLUORENE	340 U		340 U	340 U	340 U	
INDENO(1,2,3-CD)PYRENE	340 U		340 U	340 U	340 U	
NAPHTHALENE	340 U		340 U	340 U	340 U	
PENTACHLOROPHENOL	850 U		860 U	340 U	850 U	
PHENANTHRENE	340 U		340 U	340 U	340 U	
PHENOL	340 U		340 U	340 U	340 U	
PYRENE	340 U		340 U	340 U	340 U	
METALS (mg/kg)						
ALUMINUM	2290 J		2700	*4780 J	2200 J	3420
ARSENIC	1.3		1.5	1.1 U	0.77 J	8.1
BARIUM	5.4 J		10.6 J	19.5 J	8.7 J	128
BERYLLIUM	*0.13		0.19 U	*0.16	0.11 U	ND (1.0)
CADMIUM	0.33 U		0.34 U	0.29 U	0.38 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P05-02	003-SB-P06-02-BR	003-SB-P06-03	003-SB-P07-03	003-SB-P08-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	09/17/97	08/07/97	08/07/97	07/10/97	09/02/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P05	P06	P06	P07	P08	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	1140 J		4610 J	34900 J	21700 J	56400
CHROMIUM	6.1		8.4 J	*16.8	7.9	9.3
COBALT	*4.3		*5.9 J	*8.1 J	*4.6	ND (10.1)
COPPER	*7.5		5.3	*23	4.5 U	5.7
CYANIDE	0.25 U		0.26 U	0.26 U	0.26 U	ND (2.5)
IRON	4720 J		5180 J	*12400 J	5750 J	11000
LEAD	1.8 J		2.9 J	2.7	2 J	4.8
MAGNESIUM	1250 J		3360 J	*11800 J	7830 J	8580
MANGANESE	46.8 J		56.9 J	195 J	254 J	833
MERCURY	0.04 U		0.04 U	0.07 U	0.04 U	ND (0.1)
NICKEL	9.9		12.2 J	17.7	9.3	18.4
POTASSIUM	167		238 J	*642 J	190	342
SELENIUM	0.18 UJ		0.85 UR	0.15 U	0.18 U	0.63
SODIUM	*70.9 J		*74.8 J	*161	*86.9	ND (101)
VANADIUM	14		13.5	*24.1	10.3	20.6
ZINC	11.3 J		15 J	*25.9 J	15 J	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P09-02	003-SB-P09-03	003-SB-P10-03	003-SB-P11-03	003-SB-P12-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/23/97	08/23/97	09/05/97	09/08/97	08/10/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P09	P09	P10	P11	P12	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	100 U	10 U	100 U	100 U	10 U	
1,1,2-TRICHLOROETHANE	100 U	10 U	100 U	100 U	10 U	
1,1-DICHLOROETHANE	100 U	10 U	100 U	100 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	100 U	10 U	100 U	100 U	10 U	
2-BUTANONE	100 U	8 J	100 U	100 U	10 U	
2-HEXANONE	100 U	10 U	100 U	100 U	10 U	
4-METHYL-2-PENTANONE	69 J	8 J	36 J	84 J	10 U	
ACETONE	170	56	100 U	100 U	3 J	
BENZENE	100 U	10 U	100 U	100 U	10 U	
BROMOMETHANE	100 U	10 U	100 U	100 U	10 U	
CARBON DISULFIDE	100 U	10 U	100 U	100 U	10 U	
ETHYLBENZENE	100 U	10 U	100 U	100 U	10 U	
STYRENE	100 U	10 U	100 U	100 U	10 U	
TETRACHLOROETHENE	100 U	10 U	100 U	100 U	10 U	
TOLUENE	100 U	1 J	100 U	100 U	10 U	
TRICHLOROETHENE	100 U	10 U	100 U	100 U	10 UJ	
XYLENES, TOTAL	100 U	10 U	100 U	100 U	10 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	340 U	340 U	340 U	340 U	
4-CHLORO-3-METHYLPHENOL	340 U	340 U	340 U	340 U	340 U	
ACENAPHTHENE	340 U	340 U	340 U	340 U	340 U	
ACENAPHTHYLENE	340 U	340 U	340 U	340 U	340 U	
ANTHRACENE	340 U	340 U	340 U	340 U	340 U	
BENZO(A)ANTHRACENE	340 U	340 U	340 U	340 U	340 U	
BENZO(A)PYRENE	340 U	340 U	340 U	340 U	340 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P09-02	003-SB-P09-03	003-SB-P10-03	003-SB-P11-03	003-SB-P12-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/23/97	08/23/97	09/05/97	09/08/97	08/10/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P09	P09	P10	P11	P12	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	340 U	340 U	340 U	340 U	340 U	
BENZO(G,H,I)PERYLENE	340 U	340 U	340 U	340 U	340 U	
BENZO(K)FLUORANTHENE	340 U	340 U	340 U	340 U	340 U	
BIS(2-ETHYLHEXYL)PHTHALATE	29 J	25 J	340 U	340 U	340 U	
BUTYLBENZYL PHTHALATE	340 U	340 U	340 U	340 U	340 U	
CARBAZOLE	340 U	340 U	340 U	340 U	340 U	
CHRYSENE	340 U	340 U	340 U	340 U	340 U	
DI-N-BUTYL PHTHALATE	18 J	340 U	340 U	340 U	340 U	
DI-N-OCTYL PHTHALATE	340 U	340 U	340 U	340 U	340 U	
DIBENZO(A,H)ANTHRACENE	340 U	340 U	340 U	340 U	340 U	
DIBENZOFURAN	340 U	340 U	340 U	340 U	340 U	
FLUORANTHENE	340 U	340 U	340 U	340 U	340 U	
FLUORENE	340 U	340 U	340 U	340 U	340 U	
INDENO(1,2,3-CD)PYRENE	340 U	340 U	340 U	340 U	340 U	
NAPHTHALENE	340 U	340 U	340 U	340 U	340 U	
PENTACHLOROPHENOL	850 U	840 U	850 U	840 U	340 U	
PHENANTHRENE	340 U	340 U	340 U	340 U	340 U	
PHENOL	340 U	340 U	340 U	340 U	340 U	
PYRENE	340 U	340 U	340 U	340 U	340 U	
METALS (mg/kg)						
ALUMINUM	2650 J	2760 J	1530 J	2390 J	2550 J	3420
ARSENIC	2.5	6.3	0.6	0.6	3.9 J	8.1
BARIUM	12.3 J	9.6 J	6.8 J	7.7 J	12.1 J	128
BERYLLIUM	*0.15	*0.17	0.05 U	0.1 U	*0.13	ND (1.0)
CADMIUM	0.34 U	0.38 U	0.35 U	0.38 U	0.33 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P09-02	003-SB-P09-03	003-SB-P10-03	003-SB-P11-03	003-SB-P12-03	BACKGROUND (1)
DEPTH (feet):	4.0 - 8.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	8.0 - 12.0'	
SAMPLE DATE:	08/23/97	08/23/97	09/05/97	09/08/97	08/10/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P09	P09	P10	P11	P12	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	32400 J	35800 J	2870 J	1130 J	31800 J	56400
CHROMIUM	*9.7	7.9	7	8.2	*10.8 J	9.3
COBALT	*6.8 J	*11.4 J	*2.4	*3	*10.2	ND (10.1)
COPPER	3.6	*7	1.2 J	2.2 J	*6.1	5.7
CYANIDE	0.25 U	0.25 U	0.25 U	0.25 UJ	0.26 U	ND (2.5)
IRON	8980 J	9550 J	3680 J	6330 J	7200 J	11000
LEAD	2.5	2.3	1.5 J	1.6	2.2 J	4.8
MAGNESIUM	*12500 J	*10100 J	1440 J	1440 J	*10800 J	8580
MANGANESE	437 J	322 J	54.5 J	121 J	284 J	833
MERCURY	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	ND (0.1)
NICKEL	12.8	*24.7	4.9	7	*24.1	18.4
POTASSIUM	277 J	305 J	235	226	275 J	342
SELENIUM	0.19 UJ	0.17 UJ	0.17 U	0.19 U	0.24 U	0.63
SODIUM	*62.3 J	*134 J	*44	*44.2 J	*88.3 J	ND (101)
VANADIUM	12.5 J	11.6 J	5.3	9.3 J	12.7	20.6
ZINC	18.5 J	16.5 J	9.1 J	15.2 J	16.7 J	22.4

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER: DEPTH (feet): SAMPLE DATE: INVESTIGATION: LOCATION: FIELD DUPLICATE OF:	SB-01-0608 6.0 - 8.0' 04/10/95 EAST PLATING SB-01/TW-01	SB-02-0406 4.0 - 6.0' 04/11/95 EAST PLATING SB-02	SB-02-0608 6.0 - 8.0' 04/11/95 EAST PLATING SB-02	SB-03-1012 10.0 - 12.0' 04/05/95 EAST PLATING SB-03	SB-04-1012 10.0 - 12.0' 04/10/95 EAST PLATING SB-04/TW-02	BACKGROUND (1)
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	11 U	11 U	1500 U	11 U	
1,1,2-TRICHLOROETHANE	10 U	9	8	1500 U	11 U	
1,1-DICHLOROETHANE	10 U	11 U	11 U	1500 U	11 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	11 U	11 U	1500 U	11 U	
2-BUTANONE	10 U	3	4	1500 U	11 U	
2-HEXANONE	10 U	11 U	11 U	1500 U	11 U	
4-METHYL-2-PENTANONE	10 U	11 U	11 U	1500 U	11 U	
ACETONE	10 U	66 U	460	1500 U	41 U	
BENZENE	10 U	11 U	11 U	1500 U	11 U	
BROMOMETHANE	10 U	11 U	11 U	1500 U	11 U	
CARBON DISULFIDE	10 U	11 U	11 U	1500 U	11 U	
ETHYLBENZENE	10 U	7	8	1500 U	11 U	
STYRENE	10 U	11 U	11 U	1500 U	11 U	
TETRACHLOROETHENE	10 U	760	740	1500 U	11 U	
TOLUENE	10 U	8	6	1500 U	11 U	
TRICHLOROETHENE	14	770	690	1100	15	
XYLENES, TOTAL	10 U	48	54	1500 U	11 U	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	330 U	87		370 U	380 U	
4-CHLORO-3-METHYLPHENOL	330 U	700 U		370 U	380 U	
ACENAPHTHENE	330 U	700 U		370 U	380 U	
ACENAPHTHYLENE	330 U	700 U		370 U	380 U	
ANTHRACENE	330 U	700 U		370 U	380 U	
BENZO(A)ANTHRACENE	330 U	700 U		370 U	380 U	
BENZO(A)PYRENE	330 U	700 U		370 U	380 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-01-0608	SB-02-0406	SB-02-0608	SB-03-1012	SB-04-1012	BACKGROUND (1)
DEPTH (feet):	6.0 - 8.0'	4.0 - 6.0'	6.0 - 8.0'	10.0 - 12.0'	10.0 - 12.0'	
SAMPLE DATE:	04/10/95	04/11/95	04/11/95	04/05/95	04/10/95	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	SB-01/TW-01	SB-02	SB-02	SB-03	SB-04/TW-02	
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE	330 U	700 U		370 U	380 U	
BENZO(G,H,I)PERYLENE	330 U	700 U		370 U	380 U	
BENZO(K)FLUORANTHENE	330 U	700 U		370 U	380 U	
BIS(2-ETHYLHEXYL)PHTHALATE	61	4400		370 U	380 U	
BUTYLBENZYL PHTHALATE	330 U	700 U		370 U	380 U	
CARBAZOLE	330 U	700 U		370 U	380 U	
CHRYSENE	330 U	700 U		370 U	380 U	
DI-N-BUTYL PHTHALATE	330 U	140		370 U	380 U	
DI-N-OCTYL PHTHALATE	330 U	700 U		370 U	380 U	
DIBENZO(A,H)ANTHRACENE	330 U	700 U		370 U	380 U	
DIBENZOFURAN	330 U	78		370 U	380 U	
FLUORANTHENE	330 U	700 U		370 U	380 U	
FLUORENE	330 U	700 U		370 U	380 U	
INDENO(1,2,3-CD)PYRENE	330 U	700 U		370 U	380 U	
NAPHTHALENE	330 U	73		370 U	380 U	
PENTACHLOROPHENOL	790 U	1700 U		890 U	920 U	
PHENANTHRENE	330 U	180		370 U	380 U	
PHENOL	330 U	700 U		370 U	380 U	
PYRENE	330 U	100		370 U	380 U	
METALS (mg/kg)						
ALUMINUM	2550	2220		*5210	*5310	3420
ARSENIC	1.4	0.94		2.3	2.9	8.1
BARIUM	16.4	36.2		27.7	29.9	128
BERYLLIUM	0.16 U	0.19 U		*0.29	*0.22	ND (1.0)
CADMIUM	0.47 U	3.7 U		0.52 U	0.58 U	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-01-0608	SB-02-0406	SB-02-0608	SB-03-1012	SB-04-1012	BACKGROUND (1)
DEPTH (feet):	6.0 - 8.0'	4.0 - 6.0'	6.0 - 8.0'	10.0 - 12.0'	10.0 - 12.0'	
SAMPLE DATE:	04/10/95	04/11/95	04/11/95	04/05/95	04/10/95	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	SB-01/TW-01	SB-02	SB-02	SB-03	SB-04/TW-02	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	5780	7910		25200	24300	56400
CHROMIUM	8.6 U	*618		*11.4	*13.2	9.3
COBALT	*4.1	*2.2		*4.8	*5.1	ND (10.1)
COPPER	4.2	*54.5		*9.9	*10.3	5.7
CYANIDE	1 U	*140		1.2 U	1.1 U	ND (2.5)
IRON	7200	*14200		*11400	*11400	11000
LEAD	3.9	*231		3.5	4	4.8
MAGNESIUM	4060	3970		8540	*9510	8580
MANGANESE	122	103		297	302	833
MERCURY	0.04 U	0.04 U		0.05 U	0.05 U	ND (0.1)
NICKEL	7.4 U	15.3		11.8 U	13.8 U	18.4
POTASSIUM	*403	*466		*862	*1000	342
SELENIUM	0.62 U	0.78 U		0.69 U	0.77 U	0.63
SODIUM	*194	*280		*175	*177	ND (101)
VANADIUM	9.2	7.2		*25.2	*24.8	20.6
ZINC	13	*28.6		*24.2	*23.2	22.4
GENERAL CHEMISTRY						
PH	9.24	5.63		8.38	8.32	

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Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-05-1012	SB-06-0608	SB-07-0406			BACKGROUND (1)
DEPTH (feet):	10.0 - 12.0'	6.0 - 8.0'	4.0 - 6.0'			
SAMPLE DATE:	04/06/95	04/04/95	04/11/95	/ /	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING			
LOCATION:	SB-05	SB-06/TW-03	SB-07			
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	12 U	10 U	53 U			
1,1,2-TRICHLOROETHANE	12 U	10 U	53 U			
1,1-DICHLOROETHANE	12 U	10 U	53 U			
1,2-DICHLOROETHENE (TOTAL)	12 U	10 U	53 U			
2-BUTANONE	12 U	4	53 U			
2-HEXANONE	12 U	10 U	53 U			
4-METHYL-2-PENTANONE	12 U	10 U	53 U			
ACETONE	890	10 U	53 U			
BENZENE	12 U	10 U	53 U			
BROMOMETHANE	12 U	10 U	53 U			
CARBON DISULFIDE	12 U	10 U	53 U			
ETHYLBENZENE	12 U	10 U	53 U			
STYRENE	12 U	10 U	53 U			
TETRACHLOROETHENE	1	10 U	120			
TOLUENE	2	10 U	53 U			
TRICHLOROETHENE	1100	4	290			
XYLENES, TOTAL	12 U	10 U	53 U			
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	380 U	330 U	350 U			
4-CHLORO-3-METHYLPHENOL	380 U	330 U	350 U			
ACENAPHTHENE	380 U	330 U	350 U			
ACENAPHTHYLENE	380 U	330 U	350 U			
ANTHRACENE		330 U	350 U			
BENZO(A)ANTHRACENE		330 U	350 U			
BENZO(A)PYRENE		330 U	350 U			

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
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TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-05-1012	SB-06-0608	SB-07-0406			BACKGROUND (1)
DEPTH (feet):	10.0 - 12.0'	6.0 - 8.0'	4.0 - 6.0'			
SAMPLE DATE:	04/06/95	04/04/95	04/11/95	/ /	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING			
LOCATION:	SB-05	SB-06/TW-03	SB-07			
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(B)FLUORANTHENE		330 U	350 U			
BENZO(G,H,I)PERYLENE		330 U	350 U			
BENZO(K)FLUORANTHENE		330 U	350 U			
BIS(2-ETHYLHEXYL)PHTHALATE		330 U	1800			
BUTYLBENZYL PHTHALATE		330 U	350 U			
CARBAZOLE		330 U	350 U			
CHRYSENE		330 U	350 U			
DI-N-BUTYL PHTHALATE		330 U	87			
DI-N-OCTYL PHTHALATE		330 U	350 U			
DIBENZO(A,H)ANTHRACENE		330 U	350 U			
DIBENZOFURAN		330 U	350 U			
FLUORANTHENE		330 U	350 U			
FLUORENE		330 U	350 U			
INDENO(1,2,3-CD)PYRENE		330 U	350 U			
NAPHTHALENE	380 U	330 U	350 U			
PENTACHLOROPHENOL		810 U	850 U			
PHENANTHRENE		330 U	350 U			
PHENOL	380 U	330 U	350 U			
PYRENE		330 U	350 U			
METALS (mg/kg)						
ALUMINUM	*4210	2040	1090			3420
ARSENIC	2	0.94	0.5			8.1
BARIUM	25.5	6.8 U	30.7			128
BERYLLIUM	*0.31	*0.2	0.17 U			ND (1.0)
CADMIUM	0.57 U	0.52 U	3.1 U			ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
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*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - 4-12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-05-1012	SB-06-0608	SB-07-0406			BACKGROUND (1)
DEPTH (feet):	10.0 - 12.0'	6.0 - 8.0'	4.0 - 6.0'			
SAMPLE DATE:	04/06/95	04/04/95	04/11/95	/ /	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING			
LOCATION:	SB-05	SB-06/TW-03	SB-07			
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	30600	7280	1080			56400
CHROMIUM	9.8 U	4.4 U	*175			9.3
COBALT	*4.3	*3.1	*1.6			ND (10.1)
COPPER	*10	*6.4	*57.7			5.7
CYANIDE	1.1 U	1 U	*148			ND (2.5)
IRON	9960	4810	7620			11000
LEAD	3.4	1.2	*515			4.8
MAGNESIUM	*11500	1900	286			8580
MANGANESE	316	71.3	38.3			833
MERCURY	0.05 U	0.05 U	0.04 U			ND (0.1)
NICKEL	10.4 U	6.9 U	6.7 U			18.4
POTASSIUM	*748	209	210			342
SELENIUM	0.76 U	0.69 U	0.67 U			0.63
SODIUM	*162	67.2 U	*262			ND (101)
VANADIUM	*20.7	9.3	4.9			20.6
ZINC	21.7	9.9	21.8			22.4
GENERAL CHEMISTRY						
PH	8.64	8.62	5.88			

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-007-05-BR	003-SB-007-11-BR	003-SB-023-05-BR	003-SB-023-15-BR	003-SB-027-05-BR	BACKGROUND (1)
DEPTH (feet):	16.0 - 20.0'	40.0 - 44.0'	16.0 - 20.0'	56.0 - 60.0'	16.0 - 20.0'	
SAMPLE DATE:	08/21/97	08/21/97	08/09/97	08/09/97	08/22/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC07	AOC07	AOC23	AOC23	AOC27	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	11 U	10 U	12 U	10 U	
1,1-DICHLOROETHANE	10 U	11 U	10 U	1 J	10 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	11 U	10 U	7 J	10 U	
2-BUTANONE	10 U	6 J	4 J	12 U	10 U	
2-HEXANONE	10 U	11 U	10 UJ	12 UJ	10 U	
4-METHYL-2-PENTANONE	2 J	13	10 U	12 U	10 U	
ACETONE	10 UJ	28 J	20	6 J	15	
CARBON DISULFIDE	10 U	1 J	10 U	12 U	10 U	
CHLOROBENZENE	10 U	11 U	10 U	12 U	10 U	
CHLOROMETHANE	10 U	11 U	10 U	12 U	10 U	
ETHYLBENZENE	10 U	11 U	10 U	12 U	10 U	
STYRENE	10 U	11 U	10 U	12 U	10 U	
TETRACHLOROETHENE	10 U	11 U	10 U	12 U	10 U	
TOLUENE	10 U	11 U	1 J	12 U	1 J	
TRICHLOROETHENE	10 U	2 J	2 J	31 J	10 U	
XYLENES, TOTAL	10 U	11 U	1 J	12 U	10 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
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TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-027-06-BR	003-SB-030-04-BR	003-SB-036-05-BR	003-SB-DP1-22-BR	003-SB-036-07-BR	BACKGROUND (1)
DEPTH (feet):	20.0 - 24.0'	12.0 - 16.0'	16.0 - 20.0'	16.0 - 20.0'	24.0 - 28.0'	
SAMPLE DATE:	08/22/97	08/23/97	08/12/97	08/12/97	08/12/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC27	AOC30	AOC36	AOC36	AOC36	
FIELD DUPLICATE OF:				003-SB-036-05-BR		
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	100 U	11 U	11 U	29 U	
1,1-DICHLOROETHANE	11 U	100 U	11 U	11 U	29 U	
1,2-DICHLOROETHENE (TOTAL)	11 U	100 U	11 U	11 U	29 U	
2-BUTANONE	11 U	100 U	1 J	11 U	3 J	
2-HEXANONE	11 U	100 U	11 UJ	11 UJ	29 UJ	
4-METHYL-2-PENTANONE	11 U	100 U	11 U	11 U	29 U	
ACETONE	12	100 U	7 J	6 J	37	
CARBON DISULFIDE	11 U	100 U	11 U	11 U	2 J	
CHLOROBENZENE	11 U	100 U	11 U	11 U	29 U	
CHLOROMETHANE	11 U	100 U	11 U	11 U	29 U	
ETHYLBENZENE	11 U	100 U	11 U	11 U	29 U	
STYRENE	11 U	100 U	11 U	11 U	29 U	
TETRACHLOROETHENE	11 U	100 U	11 U	11 U	29 U	
TOLUENE	1 J	100 U	11 U	11 U	29 U	
TRICHLOROETHENE	11 U	100 U	11 UJ	11 UJ	29 UJ	
XYLENES, TOTAL	11 U	100 U	11 U	11 U	2 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-037-05-BR	003-SB-037-10-BR	003-SB-055-05-BR	003-SB-058-05-BR	003-SB-DP1-25-BR	BACKGROUND (1)
DEPTH (feet):	16.0 - 20.0'	36.0 - 40.0'	16.0 - 20.0'	16.0 - 20.0'	16.0 - 20.0'	
SAMPLE DATE:	08/06/97	08/06/97	08/24/97	08/19/97	08/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC37	AOC37	AOC55	AOC58	AOC58	
FIELD DUPLICATE OF:					003-SB-058-05-BR	
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	12 U	11 U	4 J	1 J	
1,1-DICHLOROETHANE	11 U	12 U	11 U	10 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	11 U	12 U	11 U	1 J	10 U	
2-BUTANONE	4 J	19	11 U	10 U	10 U	
2-HEXANONE	11 U	3 J	11 U	10 U	10 U	
4-METHYL-2-PENTANONE	2 J	15	11 U	10 U	10 U	
ACETONE	20	45	20	30 J	61 J	
CARBON DISULFIDE	11 U	12 U	11 U	10 U	10 U	
CHLOROBENZENE	11 U	12 U	11 U	10 U	10 U	
CHLOROMETHANE	11 UJ	12 U	11 U	10 U	10 U	
ETHYLBENZENE	11 U	12 U	11 U	10 U	10 U	
STYRENE	11 U	12 U	11 U	10 U	10 U	
TETRACHLOROETHENE	11 U	12 U	11 U	10 U	10 U	
TOLUENE	1 J	1 J	1 J	10 U	10 U	
TRICHLOROETHENE	1 J	12 UJ	11 U	6 J	3 J	
XYLENES, TOTAL	1 J	1 J	11 U	10 U	1 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-058-15-BR	003-SB-063-04-BR	003-SB-063-14-BR	003-SB-28D-03	003-SB-28D-04	BACKGROUND (1)
DEPTH (feet):	56.0 - 60.0'	12.0 - 16.0'	52.0 - 56.0'	25.0 - 30.0'	35.0 - 40.0'	
SAMPLE DATE:	08/21/97	08/05/97	08/06/97	12/03/97	12/03/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	AOC58	AOC63	AOC63	MS-28D	MS-28D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	10 U	30 U	110 U	110 U	
1,1-DICHLOROETHANE	11 U	10 U	30 U	110 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	11 U	10 U	30 U	110 U	110 U	
2-BUTANONE	11 U	10 U	30 U	110 U	140	
2-HEXANONE	11 U	10 U	30 U	110 U	110 U	
4-METHYL-2-PENTANONE	11 U	10 U	30 U	26 J	160	
ACETONE	82 J	14	33	110 U	350 J	
CARBON DISULFIDE	11 U	10 U	6 J	6 J	110 U	
CHLOROBENZENE	11 U	10 U	30 U	110 U	110 U	
CHLOROMETHANE	11 U	10 UJ	30 UJ	110 U	110 U	
ETHYLBENZENE	11 U	10 U	30 U	110 U	110 U	
STYRENE	11 U	10 U	30 U	110 U	110 U	
TETRACHLOROETHENE	11 U	10 U	30 U	110 U	110 U	
TOLUENE	11 U	1 J	3 J	8 J	17 J	
TRICHLOROETHENE	11 U	10 U	30 U	110 U	110 U	
XYLENES, TOTAL	11 U	10 U	30 U	110 U	22 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-28D-05	003-SB-28D-06	003-SB-28D-07	003-SB-28D-08	003-SB-28D-09	BACKGROUND (1)
DEPTH (feet):	45.0 - 50.0'	50.0 - 55.0'	60.0 - 65.0'	70.0 - 75.0'	80.0 - 85.0'	
SAMPLE DATE:	12/03/97	12/03/97	12/03/97	12/03/97	12/03/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-28D	MS-28D	MS-28D	MS-28D	MS-28D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	110 U	110 U	120 U	110 U	
1,1-DICHLOROETHANE	110 U	110 U	110 U	120 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	110 U	110 U	120 U	110 U	
2-BUTANONE	210	130	100 J	370	110 J	
2-HEXANONE	110 U	110 U	110 U	120 U	110 U	
4-METHYL-2-PENTANONE	190	140	88 J	120 U	64 J	
ACETONE	300 J	160 U	450 J	540 J	350 J	
CARBON DISULFIDE	10 J	110 U	110 U	120 U	110 U	
CHLOROBENZENE	110 U	110 U	110 U	120 U	110 U	
CHLOROMETHANE	110 U	110 U	110 U	120 U	110 U	
ETHYLBENZENE	110 U	110 U	110 U	120 U	110 U	
STYRENE	110 U	110 U	110 U	120 U	110 U	
TETRACHLOROETHENE	110 U	110 U	110 U	120 U	110 U	
TOLUENE	13 J	14 J	17 J	23 J	16 J	
TRICHLOROETHENE	10 J	110 U	110 U	19 J	12 J	
XYLENES, TOTAL	18 J	20 J	22 J	46 J	22 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-28D-10	003-SB-DP2-04	003-SB-28D-11	003-SB-29D-02	003-SB-29D-03	BACKGROUND (1)
DEPTH (feet):	95.0 - 100.0'	95.0 - 100.0'	105.0 - 110.0'	15.0 - 20.0'	25.0 - 30.0'	
SAMPLE DATE:	12/03/97	12/03/97	12/03/97	12/05/97	12/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-28D	MS-28D	MS-28D	MS-29D	MS-29D	
FIELD DUPLICATE OF:		003-SB-28D-10				
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	120 U	120 U	110 U	110 UJ	120 UJ	
1,1-DICHLOROETHANE	120 U	120 U	110 U	110 U	120 U	
1,2-DICHLOROETHENE (TOTAL)	120 U	120 U	110 U	110 U	120 U	
2-BUTANONE	150	71 J	280	95 J	150 J	
2-HEXANONE	120 U	120 U	110 U	110 U	120 U	
4-METHYL-2-PENTANONE	190	100 J	150	72 J	58 J	
ACETONE	240 J	150 U	620 J	650 J	640 J	
CARBON DISULFIDE	120 U	120 U	110 U	110 UJ	120 UJ	
CHLOROBENZENE	120 U	120 U	110 U	110 U	120 U	
CHLOROMETHANE	120 U	120 U	110 U	110 U	120 U	
ETHYLBENZENE	120 U	120 U	9 J	110 U	19 J	
STYRENE	120 U	120 U	110 U	17 J	55 J	
TETRACHLOROETHENE	120 U	120 U	110 U	110 U	120 U	
TOLUENE	12 J	8 J	24 J	110 U	12 J	
TRICHLOROETHENE	120 U	120 U	110 U	110 U	120 U	
XYLENES, TOTAL	19 J	29 J	53 J	22 J	80 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-29D-04	003-SB-29D-05	003-SB-29D-06	003-SB-DP2-05	003-SB-29D-07	BACKGROUND (1)
DEPTH (feet):	30.0 - 35.0'	40.0 - 45.0'	55.0 - 60.0'	55.0 - 60.0'	65.0 - 70.0'	
SAMPLE DATE:	12/06/97	12/06/97	12/06/97	12/06/97	12/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-29D	MS-29D	MS-29D	MS-29D	MS-29D	
FIELD DUPLICATE OF:				003-SB-29D-06		
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	120 UJ	120 UJ	120 UJ	110 UJ	120 UJ	
1,1-DICHLOROETHANE	120 U	120 U	120 U	110 U	120 U	
1,2-DICHLOROETHENE (TOTAL)	120 U	120 U	120 U	110 U	120 U	
2-BUTANONE	88 J	88 J	150 J	91 J	140 J	
2-HEXANONE	120 U	120 U	120 U	110 U	120 U	
4-METHYL-2-PENTANONE	47 J	39 J	61 J	39 J	74 J	
ACETONE	380 J	380 J	670 J	450 J	620 J	
CARBON DISULFIDE	120 UJ	120 UJ	120 UJ	110 UJ	120 UJ	
CHLOROBENZENE	120 U	120 U	120 UJ	110 U	120 U	
CHLOROMETHANE	120 U	120 U	120 U	110 U	120 U	
ETHYLBENZENE	12 J	10 J	34 J	110 U	14 J	
STYRENE	31 J	33 J	72 J	10 J	32 J	
TETRACHLOROETHENE	120 U	120 U	120 U	110 U	120 U	
TOLUENE	7 J	8 J	19 J	110 U	8 J	
TRICHLOROETHENE	120 U	120 U	67 J	110 U	42 J	
XYLENES, TOTAL	42 J	42 J	120	20 J	58 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-29D-08	003-SB-29D-09	003-SB-29D-10	003-SB-29D-11	003-SB-29D-12	BACKGROUND (1)
DEPTH (feet):	75.0 - 80.0'	80.0 - 85.0'	95.0 - 100.0'	100.0 - 105.0'	115.0 - 120.0'	
SAMPLE DATE:	12/06/97	12/06/97	12/06/97	12/06/97	12/06/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-29D	MS-29D	MS-29D	MS-29D	MS-29D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 UJ	110 UJ	120 UJ	120 UJ	110 UJ	
1,1-DICHLOROETHANE	110 U	110 U	120 U	120 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	110 U	120 U	120 U	110 U	
2-BUTANONE	120 J	78 J	170 J	93 J	190 J	
2-HEXANONE	110 U	110 U	120 U	120 U	110 U	
4-METHYL-2-PENTANONE	46 J	36 J	55 J	140	81 J	
ACETONE	360 J	460 J	530 J	260 U	710 J	
CARBON DISULFIDE	110 UJ	110 UJ	7 J	11 J	110 UJ	
CHLOROBENZENE	110 U	110 U	120 U	120 U	110 U	
CHLOROMETHANE	110 U	110 U	120 U	120 U	110 U	
ETHYLBENZENE	9 J	18 J	16 J	120 U	110 U	
STYRENE	25 J	46 J	47 J	120 U	21 J	
TETRACHLOROETHENE	110 U	110 U	120 U	120 U	110 U	
TOLUENE	110 U	10 J	9 J	120 U	6 J	
TRICHLOROETHENE	8 J	13 J	120 U	120 U	110 U	
XYLENES, TOTAL	35 J	67 J	59 J	120 U	41 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-29D-13	003-SB-29D-14	003-SB-30D-02	003-SB-30D-03	003-SB-30D-04	BACKGROUND (1)
DEPTH (feet):	125.0 - 130.0'	130.0 - 135.0'	15.0 - 20.0'	20.0 - 25.0'	35.0 - 40.0'	
SAMPLE DATE:	12/06/97	12/06/97	10/23/97	10/23/97	10/23/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-29D	MS-29D	MS-30D	MS-30D	MS-30D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 UJ	110 UJ	100 U	120 U	120 U	
1,1-DICHLOROETHANE	110 U	110 U	100 U	120 U	120 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	110 U	100 U	120 U	120 U	
2-BUTANONE	110 J	110 UJ	130	180	120 U	
2-HEXANONE	110 U	110 U	100 UJ	120 UJ	120 UJ	
4-METHYL-2-PENTANONE	48 J	41 J	46 J	81 J	56 J	
ACETONE	560 J	440 J	450 J	360 J	120 U	
CARBON DISULFIDE	110 UJ	110 UJ	100 U	120 U	120 U	
CHLOROBENZENE	110 U	110 U	100 U	120 U	120 U	
CHLOROMETHANE	110 U	110 U	100 U	120 U	120 U	
ETHYLBENZENE	15 J	110 U	100 U	120 U	120 U	
STYRENE	34 J	110 U	100 U	120 U	120 U	
TETRACHLOROETHENE	110 U	110 U	100 U	120 U	120 U	
TOLUENE	8 J	110 U	100 U	120 U	120 U	
TRICHLOROETHENE	110 U	110 U	100 U	120 U	120 U	
XYLENES, TOTAL	56 J	110 U	12 J	10 J	120 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-30D-05	003-SB-30D-06	003-SB-30D-07	003-SB-30D-08	003-SB-30D-09	BACKGROUND (1)
DEPTH (feet):	45.0 - 50.0'	50.0 - 55.0'	65.0 - 70.0'	70.0 - 75.0'	80.0 - 85.0'	
SAMPLE DATE:	10/24/97	10/24/97	10/24/97	10/24/97	10/24/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-30D	MS-30D	MS-30D	MS-30D	MS-30D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	120 U	120 U	110 U	110 U	110 U	
1,1-DICHLOROETHANE	120 U	120 U	110 U	110 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	120 U	120 U	110 U	110 U	110 U	
2-BUTANONE	130	150	100 J	81 J	110 U	
2-HEXANONE	120 UJ	120 UJ	110 UJ	110 UJ	110 UJ	
4-METHYL-2-PENTANONE	64 J	72 J	48 J	56 J	40 J	
ACETONE	230 U	260 U	160 U	140 U	110 U	
CARBON DISULFIDE	120 U	120 U	110 U	110 U	110 U	
CHLOROBENZENE	120 U	120 U	110 U	110 U	110 U	
CHLOROMETHANE	120 U	120 U	110 U	110 U	110 U	
ETHYLBENZENE	120 U	120 U	110 U	110 U	110 U	
STYRENE	120 U	120 U	110 U	110 U	110 U	
TETRACHLOROETHENE	120 U	120 U	110 U	110 U	110 U	
TOLUENE	120 U	120 U	110 U	110 U	110 U	
TRICHLOROETHENE	120 U	120 U	110 U	110 U	110 U	
XYLENES, TOTAL	120 U	10 J	110 U	110 U	110 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-30D-10	003-SB-31D-03	003-SB-31D-04	003-SB-31D-05	003-SB-DP2-01	BACKGROUND (1)
DEPTH (feet):	90.0 - 95.0'	20.0 - 25.0'	30.0 - 35.0'	40.0 - 45.0'	40.0 - 45.0'	
SAMPLE DATE:	10/24/97	11/13/97	11/13/97	11/13/97	11/13/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-30D	MS-31D	MS-31D	MS-31D	MS-31D	
FIELD DUPLICATE OF:					003-SB-31D-05	
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	110 U	110 U	120 U	110 U	
1,1-DICHLOROETHANE	110 U	110 U	110 U	120 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	7 J	110 U	20 J	6 J	
2-BUTANONE	110	110 U	110 U	120 U	120	
2-HEXANONE	110 UJ	110 U	110 U	120 U	110 U	
4-METHYL-2-PENTANONE	120	110 U	110 U	120 U	76 J	
ACETONE	160 U	200 U	380 U	150 U	400 U	
CARBON DISULFIDE	110 U	110 U	110 U	120 U	110 U	
CHLOROBENZENE	110 U	110 U	110 U	120 U	110 U	
CHLOROMETHANE	110 U	110 U	110 U	120 U	110 U	
ETHYLBENZENE	110 U	110 U	110 U	120 U	110 U	
STYRENE	110 U	110 U	110 U	120 U	110 U	
TETRACHLOROETHENE	110 U	110 U	110 U	120 U	110 U	
TOLUENE	110 U	6 J	7 J	120 U	6 J	
TRICHLOROETHENE	110 U	110 U	110 U	120 U	110 U	
XYLENES, TOTAL	110 U	9 J	11 J	7 J	10 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-31D-06	003-SB-31D-07	003-SB-31D-08	003-SB-31D-09	003-SB-DP2-02	BACKGROUND (1)
DEPTH (feet):	55.0 - 60.0'	65.0 - 70.0'	70.0 - 75.0'	80.0 - 85.0'	80.0 - 85.0'	
SAMPLE DATE:	11/13/97	11/13/97	11/13/97	11/13/97	11/13/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-31D	MS-31D	MS-31D	MS-31D	MS-31D	
FIELD DUPLICATE OF:					003-SB-31D-09	
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	120 U	120 U	120 U	110 U	
1,1-DICHLOROETHANE	110 U	120 U	120 U	120 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	120 U	120 U	120 U	110 U	
2-BUTANONE	81 J	66 J	69 J	120 U	58 J	
2-HEXANONE	110 U	120 U	120 U	120 U	110 U	
4-METHYL-2-PENTANONE	110 U	26 J	120 U	120 U	23 J	
ACETONE	280 U	340 U	290 U	190 U	220 U	
CARBON DISULFIDE	110 U	120 U	120 U	120 U	110 U	
CHLOROBENZENE	110 U	120 U	120 U	120 U	110 U	
CHLOROMETHANE	110 U	120 U	120 U	120 U	110 U	
ETHYLBENZENE	110 U	120 U	120 U	120 U	110 U	
STYRENE	110 U	120 U	120 U	120 U	110 U	
TETRACHLOROETHENE	110 U	120 U	120 U	120 U	110 U	
TOLUENE	110 U	7 J	7 J	120 U	110 U	
TRICHLOROETHENE	110 U	120 U	120 U	120 U	110 U	
XYLENES, TOTAL	7 J	12 J	10 J	120 U	110 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-31D-10	003-SB-31D-11	003-SB-31D-12	003-SB-31D-13	003-SB-32D-02	BACKGROUND (1)
DEPTH (feet):	95.0 - 100.0'	105.0 - 110.0'	110.0 - 115.0'	120.0 - 125.0'	15.0 - 20.0'	
SAMPLE DATE:	11/14/97	11/14/97	11/14/97	11/14/97	12/08/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-31D	MS-31D	MS-31D	MS-31D	MS-32D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	110 U	110 U	110 U	110 U	
1,1-DICHLOROETHANE	110 U	110 U	110 U	110 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	110 U	110 U	110 U	110 U	
2-BUTANONE	110 U	110 U	46 J	110 U	280	
2-HEXANONE	110 U	110 U	110 U	110 U	110 U	
4-METHYL-2-PENTANONE	110 U	110 U	110 U	110 U	140	
ACETONE	110 U	380 U	190 U	120 U	520 J	
CARBON DISULFIDE	110 U	6 J	18 J	110 U	110 U	
CHLOROBENZENE	110 U	110 U	110 U	110 U	110 U	
CHLOROMETHANE	110 U	110 U	110 U	110 U	110 U	
ETHYLBENZENE	110 U	110 U	110 U	110 U	110 U	
STYRENE	110 U	110 U	110 U	110 U	110 U	
TETRACHLOROETHENE	110 U	110 U	110 U	110 U	110 U	
TOLUENE	110 U	7 J	110 U	6 J	110 U	
TRICHLOROETHENE	110 U	110 U	110 U	110 U	110 U	
XYLENES, TOTAL	110 U	10 J	6 J	9 J	110 U	

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(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-DP2-06	003-SB-32D-03	003-SB-32D-04	003-SB-32D-05	003-SB-DP2-07	BACKGROUND (1)
DEPTH (feet):	15.0 - 20.0'	25.0 - 30.0'	30.0 - 35.0'	45.0 - 50.0'	45.0 - 50.0'	
SAMPLE DATE:	12/08/97	12/08/97	12/08/97	12/08/97	12/08/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-32D	MS-32D	MS-32D	MS-32D	MS-32D	
FIELD DUPLICATE OF:	003-SB-32D-02				003-SB-32D-05	
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	110 U	110 U	110 U	110 U	
1,1-DICHLOROETHANE	110 U	110 U	110 U	110 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	110 U	6 J	61 J	120	
2-BUTANONE	200	190	180	100 J	150	
2-HEXANONE	110 U	110 U	110 U	110 U	110 U	
4-METHYL-2-PENTANONE	100 J	210	260	130	90 J	
ACETONE	330	430 J	460 J	310 U	410	
CARBON DISULFIDE	110 U	110 U	110 U	110 U	110 U	
CHLOROBENZENE	110 U	110 U	110 U	110 UJ	110 U	
CHLOROMETHANE	110 U	110 U	110 U	110 U	110 U	
ETHYLBENZENE	110 U	110 U	110 U	110 U	110 U	
STYRENE	110 U	110 U	110 U	110 U	110 U	
TETRACHLOROETHENE	110 U	110 U	110 U	110 U	110 U	
TOLUENE	110 U	110 U	110 U	110 UJ	110 U	
TRICHLOROETHENE	110 U	110 U	6 J	74 J	160	
XYLENES, TOTAL	110 U	8 J	9 J	110 U	110 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-32D-06	003-SB-32D-07	003-SB-32D-08	003-SB-32D-09	003-SB-32D-10	BACKGROUND (1)
DEPTH (feet):	50.0 - 55.0'	60.0 - 65.0'	75.0 - 80.0'	80.0 - 85.0'	90.0 - 95.0'	
SAMPLE DATE:	12/08/97	12/08/97	12/08/97	12/08/97	12/08/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-32D	MS-32D	MS-32D	MS-32D	MS-32D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	110 U	120 U	120 U	110 U	
1,1-DICHLOROETHANE	110 U	110 U	120 U	120 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	40 J	110 U	290	120 U	38 J	
2-BUTANONE	230	250	260	250	110 U	
2-HEXANONE	110 U	110 U	120 U	120 U	110 U	
4-METHYL-2-PENTANONE	150	150	140	120	110 U	
ACETONE	960 J	1000 J	630 J	320 U	110 U	
CARBON DISULFIDE	110 U	6 J	120 U	120 U	110 U	
CHLOROBENZENE	110 U	110 U	120 U	120 U	110 U	
CHLOROMETHANE	110 U	110 U	120 U	120 U	110 U	
ETHYLBENZENE	11 J	110 U	120 U	120 U	110 U	
STYRENE	22 J	110 U	120 U	120 U	110 U	
TETRACHLOROETHENE	110 U	110 U	120 U	120 U	110 U	
TOLUENE	9 J	110 U	120 U	120 U	110 U	
TRICHLOROETHENE	89 J	110 U	2000	190	400	
XYLENES, TOTAL	49 J	10 J	8 J	120 U	110 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
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*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-32D-11	003-SB-32D-12	003-SB-DP2-08	003-SB-32D-13	003-SB-33D-03	BACKGROUND (1)
DEPTH (feet):	100.0 - 105.0'	110.0 - 115.0'	110.0 - 115.0'	120.0 - 125.0'	20.0 - 25.0'	
SAMPLE DATE:	12/08/97	12/08/97	12/08/97	12/08/97	11/18/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-32D	MS-32D	MS-32D	MS-32D	MS-33D	
FIELD DUPLICATE OF:			003-SB-32D-12			
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	110 U	110 U	110 U	120 U	110 U	
1,1-DICHLOROETHANE	110 U	110 U	110 U	120 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	110 U	110 U	110 U	120 U	110 U	
2-BUTANONE	190	150	190	140	84 J	
2-HEXANONE	110 U	110 U	110 U	120 U	110 U	
4-METHYL-2-PENTANONE	87 J	170	83 J	150	42 J	
ACETONE	550	360	200	310	200 U	
CARBON DISULFIDE	110 U	110 U	110 U	120 U	110 U	
CHLOROBENZENE	110 U	110 U	110 UJ	120 U	110 U	
CHLOROMETHANE	110 U	110 U	110 U	120 U	110 U	
ETHYLBENZENE	110 U	110 U	110 U	120 U	110 U	
STYRENE	110 U	110 U	110 U	120 U	110 U	
TETRACHLOROETHENE	110 U	110 U	110 U	120 U	110 U	
TOLUENE	110 U	110 U	110 UJ	120 U	110 U	
TRICHLOROETHENE	27 J	10 J	21 J	120 U	110 U	
XYLENES, TOTAL	110 U	110 U	110 U	120 U	8 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-33D-04	003-SB-33D-05	003-SB-33D-06	003-SB-DP2-03	003-SB-33D-07	BACKGROUND (1)
DEPTH (feet):	30.0 - 35.0'	45.0 - 50.0'	55.0 - 60.0'	55.0 - 60.0'	65.0 - 70.0'	
SAMPLE DATE:	11/18/97	11/18/97	11/19/97	11/19/97	11/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-33D	MS-33D	MS-33D	MS-33D	MS-33D	
FIELD DUPLICATE OF:				003-SB-33D-06		
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	120 U	120 U	110 U	120 U	120 U	
1,1-DICHLOROETHANE	120 U	120 U	110 U	120 U	120 U	
1,2-DICHLOROETHENE (TOTAL)	15 J	120 U	110 U	34 J	98 J	
2-BUTANONE	86 J	120	110 U	120 U	42 J	
2-HEXANONE	120 U	120 U	110 U	120 U	120 U	
4-METHYL-2-PENTANONE	120 U	47 J	110 U	74 J	32 J	
ACETONE	420 U	390 U	530 U	220 U	180 U	
CARBON DISULFIDE	120 U	120 U	110 U	120 U	120 U	
CHLOROBENZENE	120 U	120 U	110 U	120 U	120 U	
CHLOROMETHANE	120 U	120 U	110 U	120 U	120 U	
ETHYLBENZENE	120 U	120 U	110 U	120 U	120 U	
STYRENE	120 U	120 U	110 U	120 U	120 U	
TETRACHLOROETHENE	120 U	120 U	110 U	120 U	120 U	
TOLUENE	10 J	7 J	10 J	120 U	120 U	
TRICHLOROETHENE	66 J	190	510	1400	510	
XYLENES, TOTAL	17 J	14 J	17 J	8 J	7 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
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*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-33D-08	003-SB-33D-09	003-SB-33D-10	003-SB-33D-11	003-SB-33D-12	BACKGROUND (1)
DEPTH (feet):	70.0 - 75.0'	80.0 - 85.0'	90.0 - 95.0'	105.0 - 110.0'	110.0 - 115.0'	
SAMPLE DATE:	11/19/97	11/19/97	11/19/97	11/19/97	11/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	MS-33D	MS-33D	MS-33D	MS-33D	MS-33D	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	120 U	110 U	120 U	110 U	110 U	
1,1-DICHLOROETHANE	120 U	110 U	120 U	110 U	110 U	
1,2-DICHLOROETHENE (TOTAL)	15 J	110 U	120 U	110 U	110 U	
2-BUTANONE	110 J	31 J	120 U	120	110 U	
2-HEXANONE	120 U	110 U	120 U	16 J	110 U	
4-METHYL-2-PENTANONE	120 U	39 J	47 J	47 J	110 U	
ACETONE	260 U	140 U	230 U	270 U	110 U	
CARBON DISULFIDE	120 U	110 U	120 U	110 U	110 U	
CHLOROBENZENE	120 U	110 U	120 U	110 U	110 U	
CHLOROMETHANE	120 U	110 U	120 U	110 U	110 U	
ETHYLBENZENE	120 U	110 U	120 U	110 U	110 U	
STYRENE	120 U	110 U	120 U	110 U	110 U	
TETRACHLOROETHENE	120 U	110 U	120 U	110 U	110 U	
TOLUENE	6 J	6 J	9 J	6 J	9 J	
TRICHLOROETHENE	14000 J	100 J	10 J	110 U	110 U	
XYLENES, TOTAL	11 J	110 U	13 J	9 J	14 J	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
* - Indicates that the concentration displayed exceeds the background concentration.
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P01-05-BR	003-SB-P01-09-BR	003-SB-P02-05-BR	003-SB-DP1-23-BR	003-SB-P02-15-BR	BACKGROUND (1)
DEPTH (feet):	16.0 - 20.0'	32.0 - 36.0'	16.0 - 20.0'	16.0 - 20.0'	56.0 - 60.0'	
SAMPLE DATE:	08/08/97	08/08/97	08/18/97	08/18/97	08/19/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P01	P01	P02	P02	P02	
FIELD DUPLICATE OF:				003-SB-P02-05-BR		
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	12 U	10 U	10 U	29 U	
1,1-DICHLOROETHANE	11 U	12 U	10 U	10 U	29 U	
1,2-DICHLOROETHENE (TOTAL)	11 U	12 U	10 U	10 U	29 U	
2-BUTANONE	11 U	2 J	10 U	10 U	29 U	
2-HEXANONE	11 U	12 U	10 U	10 U	29 U	
4-METHYL-2-PENTANONE	11 U	5 J	10 U	10 U	12 J	
ACETONE	4 J	17	25 J	26 J	29 UJ	
CARBON DISULFIDE	11 U	12 U	10 U	10 U	29 U	
CHLOROBENZENE	11 U	12 U	10 U	10 U	29 U	
CHLOROMETHANE	11 U	12 U	10 U	10 U	29 U	
ETHYLBENZENE	11 U	12 U	10 U	10 U	29 U	
STYRENE	11 U	12 U	10 U	10 U	29 U	
TETRACHLOROETHENE	11 U	12 U	10 U	10 U	29 U	
TOLUENE	11 U	12 U	10 U	10 U	29 U	
TRICHLOROETHENE	11 UJ	12 UJ	10 U	10 U	5 J	
XYLENES, TOTAL	11 U	12 U	10 U	10 U	29 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P06-05-BR	003-SB-P06-07-BR	003-SB-P09-05-BR	003-SB-P09-09-BR	003-SB-P12-05-BR	BACKGROUND (1)
DEPTH (feet):	16.0 - 20.0'	24.0 - 28.0'	16.0 - 20.0'	32.0 - 36.0'	16.0 - 20.0'	
SAMPLE DATE:	08/07/97	08/07/97	08/23/97	08/24/97	08/10/97	
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	
LOCATION:	P06	P06	P09	P09	P12	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	10 U	11 U	10 U	11 U	29 U	
1,1-DICHLOROETHANE	10 U	11 U	10 U	11 U	29 U	
1,2-DICHLOROETHENE (TOTAL)	10 U	6 J	10 U	11 U	29 U	
2-BUTANONE	3 J	11	10 U	11 U	29 U	
2-HEXANONE	3 J	3 J	10 U	11 U	29 UJ	
4-METHYL-2-PENTANONE	10 U	7 J	10 U	10 J	29 U	
ACETONE	16	21	12	18	29 U	
CARBON DISULFIDE	10 U	2 J	10 U	11 U	29 U	
CHLOROBENZENE	1 J	11 U	10 U	11 U	29 U	
CHLOROMETHANE	10 U	11 U	10 U	11 U	29 U	
ETHYLBENZENE	10 U	11 U	10 U	11 U	29 U	
STYRENE	10 U	11 U	10 U	11 U	29 U	
TETRACHLOROETHENE	10 U	11 U	10 U	11 U	29 U	
TOLUENE	10 U	11 U	10 U	1 J	29 U	
TRICHLOROETHENE	10 UJ	11 UJ	10 U	10 J	29 UJ	
XYLENES, TOTAL	10 U	11 U	10 U	11 U	29 U	

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
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Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P12-11-BR	SB-01-1416	SB-03-1214	SB-04-1214	SB-05-1315	BACKGROUND (1)
DEPTH (feet):	40.0 - 44.0'	14.0 - 16.0'	12.0 - 14.0'	12.0 - 14.0'	13.0 - 15.0'	
SAMPLE DATE:	08/11/97	04/10/95	04/05/95	04/10/95	04/06/95	
INVESTIGATION:	OU3	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	P12	SB-01/TW-01	SB-03	SB-04/TW-02	SB-05	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	1500 U	56 U	11 U	10 U	
1,1-DICHLOROETHANE	11 U	1500 U	56 U	11 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	1 J	1500 U	56 U	11 U	10 U	
2-BUTANONE	11 U	1500 U	56 U	11 U	10 U	
2-HEXANONE	11 UJ	1500 U	56 U	11 U	10 U	
4-METHYL-2-PENTANONE	11 U	1500 U	56 U	11 U	10 U	
ACETONE	7 J	1500 U	700	19 U	30 U	
CARBON DISULFIDE	11 U	1500 U	56 U	11 U	10 U	
CHLOROBENZENE	11 U	1500 U	56 U	11 U	10 U	
CHLOROMETHANE	11 U	1500 U	56 U	11 U	10 U	
ETHYLBENZENE	11 U	1500 U	56 U	11 U	10 U	
STYRENE	11 U	1500 U	56 U	11 U	10 U	
TETRACHLOROETHENE	1 J	2300	56 U	1	10 U	
TOLUENE	11 U	1500 U	56 U	11 U	10 U	
TRICHLOROETHENE	9 J	55000	160	66	13	
XYLENES, TOTAL	11 U	1500 U	56 U	11 U	10 U	
SEMIVOLATILES (µg/kg)						
4-METHYLPHENOL		370 U	360 U	370 U	350 U	
BIS(2-ETHYLHEXYL)PHTHALATE		47		66		
DI-N-BUTYL PHTHALATE		370 U		370 U		
METALS (mg/kg)						
ALUMINUM		*5450	2490	2440	2540	3420
ARSENIC		2.6	0.78	1.1	0.78	8.1
BARIUM		55.2	12	9.9 U	8.3 U	128
BERYLLIUM		*0.23	*0.22	0.17 U	*0.2	ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
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*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

CTO 0003

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-SB-P12-11-BR	SB-01-1416	SB-03-1214	SB-04-1214	SB-05-1315	BACKGROUND (1)
DEPTH (feet):	40.0 - 44.0'	14.0 - 16.0'	12.0 - 14.0'	12.0 - 14.0'	13.0 - 15.0'	
SAMPLE DATE:	08/11/97	04/10/95	04/05/95	04/10/95	04/06/95	
INVESTIGATION:	OU3	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	P12	SB-01/TW-01	SB-03	SB-04/TW-02	SB-05	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM		26300	4710	13900	4520	56400
CHROMIUM		*15.9	6.1 U	*12.7	5.9 U	9.3
COBALT		*5.1	*3.1	*5.1	*3.2	ND (10.1)
COPPER		*11.8	*6.8	*8.5	*7	5.7
CYANIDE		*2.9	1.1 U	1.1 U	1 U	ND (2.5)
IRON		*11100	6260	6920	6520	11000
LEAD		3.9	1.7	2.2	1.3	4.8
MAGNESIUM		*11400	2070	7660	2140	8580
MANGANESE		327	177	152	107	833
NICKEL		*20.5	6.7 U	14 U	8.3 U	18.4
POTASSIUM		*963	*347	276	240	342
SODIUM		*314	92.8 U	*84.2	95 U	ND (101)
VANADIUM		*23.4	14.1	12.5	12.4	20.6
ZINC		*26.1	11.6	11.9	12.1	22.4
GENERAL CHEMISTRY						
PH		7.55	8.21	8.36	8.62	

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Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-06-1214	SB-07-1416	SB-07-2830			BACKGROUND (1)
DEPTH (feet):	12.0 - 14.0'	14.0 - 16.0'	28.0 - 30.0'			
SAMPLE DATE:	04/04/95	04/11/95	04/11/95	/ /	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING			
LOCATION:	SB-06/TW-03	SB-07	SB-07			
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
1,1,1-TRICHLOROETHANE	11 U	7200 U	60 U			
1,1-DICHLOROETHANE	11 U	7200 U	60 U			
1,2-DICHLOROETHENE (TOTAL)	11 U	7200 U	60 U			
2-BUTANONE	3	7200 U	60 U			
2-HEXANONE	11 U	7200 U	60 U			
4-METHYL-2-PENTANONE	11 U	7200 U	60 U			
ACETONE	120	7200 U	60 U			
CARBON DISULFIDE	11 U	7200 U	60 U			
CHLOROBENZENE	11 U	7200 U	60 U			
CHLOROMETHANE	1	7200 U	60 U			
ETHYLBENZENE	11 U	7200 U	60 U			
STYRENE	11 U	7200 U	60 U			
TETRACHLOROETHENE	11 U	3800	250			
TOLUENE	11 U	7200 U	60 U			
TRICHLOROETHENE	8	100000	13000			
XYLENES, TOTAL	11 U	7200 U	60 U			
SEMIVOLATILES (µg/kg)						
4-METHYLPHENOL	350 U	320	380 U			
BIS(2-ETHYLHEXYL)PHTHALATE	350 U	210	45			
DI-N-BUTYL PHTHALATE	350 U	43	380 U			
METALS (mg/kg)						
ALUMINUM	1700	*3940	1940			3420
ARSENIC	0.46	2.8	0.84			8.1
BARIUM	6.6 U	47.4	8.6 U			128
BERYLLIUM	*0.17	*0.21	0.2 U			ND (1.0)

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
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Blank space indicates that the sample was not analyzed for this particular compound.

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TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL - >12 FEET
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	SB-06-1214	SB-07-1416	SB-07-2830			BACKGROUND (1)
DEPTH (feet):	12.0 - 14.0'	14.0 - 16.0'	28.0 - 30.0'			
SAMPLE DATE:	04/04/95	04/11/95	04/11/95	/ /	/ /	
INVESTIGATION:	EAST PLATING	EAST PLATING	EAST PLATING			
LOCATION:	SB-06/TW-03	SB-07	SB-07			
FIELD DUPLICATE OF:						
METALS (mg/kg)						
CALCIUM	3490	31900	4880			56400
CHROMIUM	4.8 U	10.2 U	5.6 U			9.3
COBALT	*2.2	*5.4	*2.4			ND (10.1)
COPPER	4.8	9.2 U	6.1 U			5.7
CYANIDE	1.1 U	1.1 U	1.1 U			ND (2.5)
IRON	3920	9270	5120			11000
LEAD	1.1	*5.2	1.6			4.8
MAGNESIUM	1480	*11200	1850			8580
MANGANESE	79.7	406	91.5			833
NICKEL	5.5 U	13 U	7 U			18.4
POTASSIUM	198	*1130	251			342
SODIUM	70.6 U	*337	*81.8			ND (101)
VANADIUM	9.4	15.2	12			20.6
ZINC	7.8 U	*29.5	7.9 U			22.4
GENERAL CHEMISTRY						
PH	8.53	8.66	8.32			

CTO 0003

(1) Background values presented are the 95 percent upper confidence limit (UCL) based on the background soil data set.
ND indicates that the UCL was less than the detection limit. The detection limit is shown in parentheses.
*** - Indicates that the concentration displayed exceeds the background concentration.**
Blank space indicates that the sample was not analyzed for this particular compound.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-003-01	003-TW-004-01	003-TW-006-01	003-TW-007-01	003-TW-008-01	003-TW-013-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/14/97	07/22/97	07/09/97	08/21/97	07/21/97	07/14/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC03	AOC04	AOC06	AOC07	AOC08/AOC09	AOC13/AOC14
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	2.9	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	0.6 J	1 U	3.5	1 U	1 U	33
1,1-DICHLOROETHENE	0.5 J	1.2	1 U	1 U	0.3 J	2
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	0.4 J
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	12	47	46	0.2 J	0.3 J	490
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	4.3	1 U	1 U	1 U	16	1 U
TOLUENE	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	0.3 J	6.5	2	1 U	1 U	17
TRICHLOROETHENE	200	81	94	15 J	8.9	1200
VINYL CHLORIDE	0.3 U	0.3	0.3 U	0.3 U	0.3 U	0.3
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE	11 U	10 U	10 U	10 U	10 U	10 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-003-01	003-TW-004-01	003-TW-006-01	003-TW-007-01	003-TW-008-01	003-TW-013-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/14/97	07/22/97	07/09/97	08/21/97	07/21/97	07/14/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC03	AOC04	AOC06	AOC07	AOC08/AOC09	AOC13/AOC14
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
4-METHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
BUTYLBENZYL PHTHALATE	11 U	1 J	1 J	10 U	6 J	10 U
DI-N-BUTYL PHTHALATE	11 U	10 U	1 J	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
NAPHTHALENE	11 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
PHENOL	11 U	10 U	10 U	10 U	10 U	10 U
METALS (µg/L)						
ALUMINUM	35 U	120 U	94.8 U	64.9 U	26.7 U	185 U
ARSENIC	2.5 U	1 U	2.1 U	1 U	1 U	3.4 U
BARIUM	55 J	37.1 J	70.1 J	12.7 J	40 J	39.2 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3	0.3 U
CALCIUM	170000 J	265000 J	139000 J	154000 J	106000 J	144000 J
CHROMIUM	15.1	17.7	8.7	13.2	15.1	17.5
COBALT	4.6 U	5 U	11.1 U	5.7 U	2 U	8.8 U
COPPER	3 U	3	3 U	3 U	3.2	3 U
CYANIDE	5 U	5 UJ	5 U	5 U	5 UJ	5 U
IRON	5350 J	4670 J	5310 J	1550 J	1170 J	4840 J
LEAD	1 UJ	1 UJ	1 U	1 U	1 UJ	1 U
MAGNESIUM	42900 J	81900 J	27500 J	29500 J	25500 J	24000 J
MANGANESE	686	1080 J	1170	812 J	102 J	1430

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-003-01	003-TW-004-01	003-TW-006-01	003-TW-007-01	003-TW-008-01	003-TW-013-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/14/97	07/22/97	07/09/97	08/21/97	07/21/97	07/14/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC03	AOC04	AOC06	AOC07	AOC08/AOC09	AOC13/AOC14
FIELD DUPLICATE OF:						
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.26	0.2 U	0.2 U
NICKEL	5.1	10.4 J	21.4	15	7.6	12.3
POTASSIUM	2900	6090 J	5080	2990 J	2510 J	4130
SELENIUM	1 UJ	1 UJ	1 UJ	1.9 J	51.8	5 UJ
SODIUM	7610 J	13900 J	22400 J	9290	10900 J	8990 J
THALLIUM	1 UJ	1 UJ	1 U	1 UJ	1 UJ	1 UJ
VANADIUM	2 U	3.6 U	2 U	2 U	4 U	2 U
ZINC	12.9 U	26.8 U	55.4 J	9.2 U	26 U	21.8 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-015-01	003-TW-016-01	003-TW-017-01	003-TW-018-01	003-TW-023-01	003-TW-026-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/22/97	07/26/97	07/25/97	07/26/97	08/09/97	09/20/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC15	AOC16	AOC17	AOC18	AOC23	AOC26
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	6	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	0.3 J	1 U
1,1-DICHLOROETHANE	1 U	34	110	3.2	0.8 J	2.6
1,1-DICHLOROETHENE	1 U	4.2	6.7	0.3 J	4.1	0.7 J
1,2-DICHLOROETHANE	1 U	0.4 J	0.9 J	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	0.2 J	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	0.3 J	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	1 U	600	1500	330	3.8	8.8
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	46
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	60
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	37
TETRACHLOROETHENE	1 U	3.8	0.7 J	0.5 J	0.3 J	13
TOLUENE	1 U	1 U	1 U	1 U	1 U	3.5 U
TRANS-1,2-DICHLOROETHENE	1 U	35	36	37	1 J	0.3 J
TRICHLOROETHENE	2.3	1000	2000	33	110	44
VINYL CHLORIDE	0.3 U	0.3 U	0.3 U	0.3	0.3 U	0.4
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE	11 U	10 U	10 U	10 U	10 U	2 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-015-01	003-TW-016-01	003-TW-017-01	003-TW-018-01	003-TW-023-01	003-TW-026-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/22/97	07/26/97	07/25/97	07/26/97	08/09/97	09/20/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC15	AOC16	AOC17	AOC18	AOC23	AOC26
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
4-METHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	11 U	10 U	10 U	10 U	1 J	10 U
BUTYLBENZYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
NAPHTHALENE	11 U	10 U	10 U	10 U	10 U	120
PENTACHLOROPHENOL	11 U	10 U	10 U	25 U	26 U	3 J
PHENOL	6 J	10 U	10 U	10 U	10 U	10 U
METALS (µg/L)						
ALUMINUM	26 U	1060 J	80.4 U	662 J	191	61.9
ARSENIC	1 U	1 J	1 U	2.7 U	1 U	4.9
BARIUM	14.7	67.1 J	76 J	64.3 J	61	59.1 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3	0.3 U
CALCIUM	73400	202000 J	188000 J	185000 J	114000	146000
CHROMIUM	6 U	32.2	11.6	25.1	18.2 U	8.6
COBALT	5 U	10.8	9	11.8 U	2 U	5 U
COPPER	3 U	5.9	3 U	8	3 U	3.8
CYANIDE	5 U	5 U	5 U	5 U	5 U	5 U
IRON	866 J	16300 J	4430 J	12100 J	2980 J	13300 J
LEAD	1 U	4.1	3	3.2	1 U	1 U
MAGNESIUM	17900	44500 J	31300 J	41500 J	27100 J	42800
MANGANESE	125 J	1150 J	1620 J	3200 J	794 J	865 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-015-01	003-TW-016-01	003-TW-017-01	003-TW-018-01	003-TW-023-01	003-TW-026-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/22/97	07/26/97	07/25/97	07/26/97	08/09/97	09/20/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC15	AOC16	AOC17	AOC18	AOC23	AOC26
FIELD DUPLICATE OF:						
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	5.1 U	45.8 J	24.8 J	33.3 J	4 U	5 U
POTASSIUM	2530	4700 J	4440 J	4510 J	3530	3850
SELENIUM	44.8 J	5 UJ	1 UJ	1 UJ	20 J	1 UR
SODIUM	9370 J	9220 J	12000 J	6260 J	8020 J	12800 J
THALLIUM	1 UJ	1 U	1 U	1 UJ	1 U	1 U
VANADIUM	2 U	6.9 U	2 U	4	2.1	2 U
ZINC	8.6 U	122 J	13.6 U	77.8 J	33.5 J	11.3 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-027-01	003-TW-028-01	003-TW-029-01	003-TW-030-01	003-TW-DP1-03	003-TW-032-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/22/97	09/16/97	09/15/97	08/23/97	08/23/97	08/26/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC27	AOC28	AOC29	AOC30	AOC30	AOC32
FIELD DUPLICATE OF:					003-TW-030-01	
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U	1 U	13	12	11	0.5 J
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	3	0.3 J	0.4 J	0.4 J	1.9
1,1-DICHLOROETHENE	1 U	4.9	8.2	6.1	5.4	1 U
1,2-DICHLOROETHANE	1 U	0.3 J	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	1 U	44	1 U	1 U	1 U	300
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	0.2 J
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	0.8 J
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	0.7 J
TETRACHLOROETHENE	1 U	1 U	2.8	1 U	1 U	20
TOLUENE	1 U	1 U	1 U	1 U	1 U	0.4 J
TRANS-1,2-DICHLOROETHENE	0.3 J	110	1 U	1 U	1 U	10
TRICHLOROETHENE	46	260	8.2	3.8	3.9	51
VINYL CHLORIDE	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE	11 U	10 U	10 U	10 U	10 U	10 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-027-01	003-TW-028-01	003-TW-029-01	003-TW-030-01	003-TW-DP1-03	003-TW-032-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/22/97	09/16/97	09/15/97	08/23/97	08/23/97	08/26/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC27	AOC28	AOC29	AOC30	AOC30	AOC32
FIELD DUPLICATE OF:					003-TW-030-01	
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	11 U	10 U	10 U	10 U	10 U	9 J
4-METHYLPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
BUTYLBENZYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	1 J
DI-N-BUTYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	1 J
NAPHTHALENE	11 U	10 U	10 U	10 U	10 U	1 J
PENTACHLOROPHENOL	11 U	10 U	10 U	10 U	10 U	10 U
PHENOL	11 U	10 U	10 U	10 U	10 U	10 U
METALS (µg/L)						
ALUMINUM	18 U	26 U	26 U	82.1 U	43.1 U	671 J
ARSENIC	1 U	2.1 J	1 U	1 U	1 U	1 U
BARIUM	42.3 J	37.8 J	57.3 J	27.9 J	28 J	38.8 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	76300 J	118000 J	67800 J	50500 J	50500 J	135000 J
CHROMIUM	6 U	6 U	8.1	7	7.1	15.4
COBALT	2 U	5 U	5 U	2 U	2 U	12.2 U
COPPER	6.2	3 U	7.3 U	3 U	3 U	3 U
CYANIDE	5 U	5 U	5 U	5 U	5 U	5 U
IRON	1390 J	2190 J	552 J	800 J	751 J	7520 J
LEAD	1 UJ	1 U	1 U	1 UJ	1 UJ	1.2 J
MAGNESIUM	16000 J	27000 J	15800 J	10500 J	10500 J	24900 J
MANGANESE	55 J	797 J	32.4 J	24.6 J	23.4 J	1540 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-027-01	003-TW-028-01	003-TW-029-01	003-TW-030-01	003-TW-DP1-03	003-TW-032-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/22/97	09/16/97	09/15/97	08/23/97	08/23/97	08/26/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC27	AOC28	AOC29	AOC30	AOC30	AOC32
FIELD DUPLICATE OF:					003-TW-030-01	
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	4 U	5 U	5 U	4 U	4 U	17.4
POTASSIUM	2650 J	3030	3070	2170 J	2240 J	3650 J
SELENIUM	23 J	5 UR	29.2 J	8.7 J	12.2 J	1.4 U
SODIUM	10300	8050 J	44600 J	38300	38700 J	17900
THALLIUM	1 UJ	1.7 U	1 U	1 UJ	1 UJ	2.7 U
VANADIUM	2 U	2.3 U	2 U	2 U	2 U	3.8 U
ZINC	9.3 U	4.7 U	4 U	8.6 U	8.9 U	17.1 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-033-01	003-TW-034-01	003-TW-035-01	003-TW-036-01	003-TW-037-01	003-TW-038-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/08/97	07/29/97	07/28/97	08/12/97	08/06/97	07/23/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC33	AOC34	AOC35	AOC36	AOC37	AOC38
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	690	0.2 J	1 U	1 U	6.8	1 U
1,1,2-TRICHLOROETHANE	1 J	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	14	1 U	1 U	1 U	1.9	1.2
1,1-DICHLOROETHENE	380	1 U	1 U	1 U	0.2 J	0.6 J
1,2-DICHLOROETHANE	8.2	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	25 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	25 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	5 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	5 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	5 U	3.6	1 U	1 U	8.3	44
ETHYLBENZENE	5 U	1 U	1 U	1 U	1 U	1 U
M+P-XYLENES	5 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	10 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	5 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	5 U	1 U	1 U	0.4 J	1.9	1 U
TOLUENE	5 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	5 U	0.3 J	1 U	1 U	0.3 J	0.2 J
TRICHLOROETHENE	12	110	20	1 U	88	55
VINYL CHLORIDE	1.5 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	10 U	10 U	10 U	10 U	11 U	10 U
2-METHYLNAPHTHALENE	10 U	10 U	10 U	10 U	11 U	10 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-033-01	003-TW-034-01	003-TW-035-01	003-TW-036-01	003-TW-037-01	003-TW-038-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/08/97	07/29/97	07/28/97	08/12/97	08/06/97	07/23/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC33	AOC34	AOC35	AOC36	AOC37	AOC38
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U	10 U	10 U	11 U	10 U
4-METHYLPHENOL	10 U	10 U	10 U	10 U	11 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U	10 U	1 J	11 U	10 U
BUTYLBENZYL PHTHALATE	10 U	10 U	10 U	10 U	11 U	10 U
DI-N-BUTYL PHTHALATE	10 U	10 U	10 U	10 U	11 U	10 U
DI-N-OCTYL PHTHALATE	10 U	10 U	10 U	10 U	11 U	10 U
DIETHYL PHTHALATE	10 U	10 U	10 U	10 U	11 U	10 U
NAPHTHALENE	10 U	10 U	10 U	10 U	11 U	10 U
PENTACHLOROPHENOL	10 U	25 U	25 U	10 U	11 U	10 U
PHENOL	10 U	10 U	10 U	10 U	11 U	10 U
METALS (µg/L)						
ALUMINUM	26 U	190 J	147 J	6110	93.5	18 U
ARSENIC	1 U	1 U	1.1 U	7.4 J	1 U	1
BARIUM	55.9 J	125 J	67.9 J	152	107 J	84.4 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.7	0.3 U	0.3 U
CALCIUM	87000 J	156000 J	81700 J	93600	187000 J	180000 J
CHROMIUM	8	17.9	15	79.9 J	17.3 U	8.5
COBALT	5 U	2 U	2 U	57.3	2.4 U	13.2 J
COPPER	3 U	3 U	3 U	40.1	3 U	3 U
CYANIDE	5 U	5 U	5 U	5 U	5 UR	5 UJ
IRON	515 J	2510 J	2430 J	25900 J	2520 J	4670 J
LEAD	1 U	1 U	1 U	17.7 J	1 U	1.2 U
MAGNESIUM	20200 J	35200 J	15200 J	29100 J	40100 J	48400 J
MANGANESE	19.5 J	20.7 J	34.9 J	1690 J	196 J	1360 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-033-01	003-TW-034-01	003-TW-035-01	003-TW-036-01	003-TW-037-01	003-TW-038-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/08/97	07/29/97	07/28/97	08/12/97	08/06/97	07/23/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC33	AOC34	AOC35	AOC36	AOC37	AOC38
FIELD DUPLICATE OF:						
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	5 U	4 U	4 U	87.9	4.3 U	6.4
POTASSIUM	4310	3800 J	3860 J	6110	3890 J	3620 J
SELENIUM	65 J	52 J	19.6 J	142 J	72.4 J	5 UJ
SODIUM	34600 J	27400 J	44100 J	101000 J	14100 J	11300 J
THALLIUM	1 UJ	1 UJ	1 UJ	1 UJ	1.8 J	1 UJ
VANADIUM	2 U	2.9	2 U	40.5	2 U	2 U
ZINC	4.4 U	20.5 U	28.9 U	121 J	8.4 U	36.8 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-039-01	003-TW-046-01	003-TW-047-01	003-TW-DP1-05	003-TW-050-01	003-TW-054-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/25/97	09/19/97	09/23/97	09/23/97	09/24/97	08/04/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC39	AOC46	AOC47	AOC47	AOC50	AOC54
FIELD DUPLICATE OF:				003-TW-047-01		
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	8.9	1.7	1 U	1 U	1 U	12
1,1,2-TRICHLOROETHANE	1 U	0.2 J	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	2.4	0.3 J	5	4.7	6.7	0.9 J
1,1-DICHLOROETHENE	0.5 J	0.5 J	2	2	2.6	1 U
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	0.7 J	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	0.2 J	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	140	1.6	430	440	230	1.4
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	0.6 J	0.2 J	1.1	1	0.3 J	2.1
TOLUENE	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	4	1 U	240	230	54	1 U
TRICHLOROETHENE	78	25	230	240	110	70
VINYL CHLORIDE	0.3 U	0.3 U	0.3 U	0.3	0.3 U	0.3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	10 U	11 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE	10 U	11 U	10 U	10 U	10 U	10 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-039-01	003-TW-046-01	003-TW-047-01	003-TW-DP1-05	003-TW-050-01	003-TW-054-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/25/97	09/19/97	09/23/97	09/23/97	09/24/97	08/04/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC39	AOC46	AOC47	AOC47	AOC50	AOC54
FIELD DUPLICATE OF:				003-TW-047-01		
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	10 U	11 U	10 U	10 U	10 U	10 U
4-METHYLPHENOL	10 U	11 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	11 U	10 U	10 U	10 U	10 U
BUTYLBENZYL PHTHALATE	10 U	11 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	10 U	11 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	10 U	11 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	10 U	11 U	10 U	10 U	10 U	10 U
NAPHTHALENE	10 U	11 U	10 U	10 U	10 U	10 U
PENTACHLOROPHENOL	10 U	11 U	1 J	10 U	10 U	25 U
PHENOL	10 U	11 U	10 U	10 U	10 U	10 U
METALS (µg/L)						
ALUMINUM	1060 J	26 U	26 U	26 U	678 J	257 J
ARSENIC	2	1 U	2.2 U	1 U	1	1 U
BARIUM	49.6 J	45.1 J	112	110	61.9 J	98 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	184000 J	66000	202000	203000	194000 J	149000 J
CHROMIUM	20.6	7.1	14.4	13.7	28.8	16
COBALT	12.8	5 U	5 U	5 U	5 U	2 U
COPPER	6.8	3 U	3 U	3 U	3.4	3.1
CYANIDE	5 U	5 U	5 U	5 U	5 U	5 U
IRON	4630 J	1050 J	2070 J	2100 J	6180 J	3860 J
LEAD	3	1 U	1 U	1 U	1 U	1 U
MAGNESIUM	53100 J	15400	49500	49100	36100 J	29400 J
MANGANESE	1280	212 J	679 J	680 J	930	158 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-039-01	003-TW-046-01	003-TW-047-01	003-TW-DP1-05	003-TW-050-01	003-TW-054-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/25/97	09/19/97	09/23/97	09/23/97	09/24/97	08/04/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC39	AOC46	AOC47	AOC47	AOC50	AOC54
FIELD DUPLICATE OF:				003-TW-047-01		
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	27.3	5 U	9.4 U	8.4 U	6.6	4 U
POTASSIUM	4890	3570	3670	3630	4010	4040 J
SELENIUM	1 UJ	35.3 J	1 UJ	1 UJ	1 UJ	9.5 J
SODIUM	11500 J	51900 J	107000 J	106000 J	15300 J	38300 J
THALLIUM	1.4 U	1 UJ	1 UJ	1 UJ	1.6 U	1 UJ
VANADIUM	8.3 U	2 U	2 U	2 U	5.2 U	3.3
ZINC	21.3 U	6.3 U	13.1 U	12.7 U	32 U	36.9 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-055-01	003-TW-058-01	003-TW-063-01	003-TW-068-01	003-TW-070-01	003-TW-071-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/24/97	08/20/97	08/05/97	09/21/97	09/04/97	09/18/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC55	AOC58	AOC63	AOC68	AOC70	AOC71
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	3.4	11	0.6 J	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	0.9 J	1.1	1 U	3	13	1 U
1,1-DICHLOROETHENE	0.4 J	0.7 J	1 U	1.4	2.2	1 U
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 U	5 UR	0.2 J	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	1 U	1 U	1 U	0.2 J	1 U	1 U
CIS-1,2-DICHLOROETHENE	9.7	0.7 J	1 U	290	1000	1 U
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	2.5	1 U	1 U	1	1 U	1 U
TOLUENE	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	1 U	0.4 J	1 U	130	33	1 U
TRICHLOROETHENE	68	71	0.6 J	540	860	1 U
VINYL CHLORIDE	0.3 U	0.3 U	0.3 U	0.3 J	1.1	0.3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	11 U	11 U	11 U	10 U	10 U	11 U
2-METHYLNAPHTHALENE	11 U	11 U	11 U	10 U	10 U	11 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-055-01	003-TW-058-01	003-TW-063-01	003-TW-068-01	003-TW-070-01	003-TW-071-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/24/97	08/20/97	08/05/97	09/21/97	09/04/97	09/18/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC55	AOC58	AOC63	AOC68	AOC70	AOC71
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	11 U	11 U	11 U	10 U	10 U	11 U
4-METHYLPHENOL	11 U	11 U	11 U	10 U	10 U	11 U
BIS(2-ETHYLHEXYL)PHTHALATE	11 U	11 U	11 U	10 U	10 U	11 U
BUTYLBENZYL PHTHALATE	11 U	11 U	11 U	10 U	10 U	11 U
DI-N-BUTYL PHTHALATE	11 U	11 U	11 U	10 U	10 U	11 U
DI-N-OCTYL PHTHALATE	11 U	11 U	11 U	10 U	1 J	11 U
DIETHYL PHTHALATE	11 U	11 U	11 U	10 U	10 U	11 U
NAPHTHALENE	11 U	11 U	11 U	10 U	10 U	11 U
PENTACHLOROPHENOL	11 U	11 U	11 U	10 U	10 U	11 U
PHENOL	11 U	11 U	11 U	10 U	10 U	5 J
METALS (µg/L)						
ALUMINUM	27.5 U	538 J	18 U	124	196 U	26 U
ARSENIC	1 U	1 U	1 U	1.6	1 U	1 U
BARIUM	110 J	26.5 J	35.8 J	67.2 J	85.2 J	67.8 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	140000 J	76900 J	112000 J	195000	226000 J	142000
CHROMIUM	10	16 U	8.5 U	16.9	25.7	7.3
COBALT	2.5 U	2 U	2.9 U	5 U	7.5	5 U
COPPER	3 U	3 U	3 U	3 U	3 U	3 U
CYANIDE	5 U	5 U	5 UR	5 U	5 U	5 U
IRON	1470 J	5480 J	1210 J	3160 J	6000 J	1850 J
LEAD	1 UJ	1 U	1 U	1 U	1.4	1 U
MAGNESIUM	22900 J	20300 J	23400 J	45700	46200 J	35700
MANGANESE	278 J	551 J	61 J	441 J	1430 J	1090 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-055-01	003-TW-058-01	003-TW-063-01	003-TW-068-01	003-TW-070-01	003-TW-071-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/24/97	08/20/97	08/05/97	09/21/97	09/04/97	09/18/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC55	AOC58	AOC63	AOC68	AOC70	AOC71
FIELD DUPLICATE OF:						
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	8.4	4 U	4 U	5 U	9.5	5 U
POTASSIUM	4610 J	3550	2220 J	2350	3560	2920
SELENIUM	78.6 J	74 J	11.9 U	1 UR	1 UJ	1 UR
SODIUM	49000 J	19300 J	13700 J	44500 J	9170 J	8270 J
THALLIUM	1 UJ	1 U	1 U	1 UJ	1 U	1 U
VANADIUM	2 U	4.2 U	2.9	2 U	2.3	2 U
ZINC	8.2 U	15.9 U	5.7 U	12.7 U	21.2 U	8 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-073-01	003-TW-DP1-01	003-TW-074-01	003-MS-28D-01	003-MS-28I-01	003-MS-28S-01
DEPTH:	Shallow	Shallow	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	07/24/97	07/24/97	07/27/97	02/17/98	02/11/98	02/11/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC73	AOC73	AOC74	MS-28D	MS-28I	MS-28S
FIELD DUPLICATE OF:		003-TW-073-01				
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	0.5 J	0.5 J	22	0.9 J	8.4	1 U
1,1-DICHLOROETHENE	0.3 J	0.5 J	3.1	0.3 J	1.9	1.9
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	1 U	1 U	1 U	0.2 J	1 U	1 U
CIS-1,2-DICHLOROETHENE	86	85	330	11	140	120
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	1 U	1 U	0.6 J	5.9	1 U	1 U
TOLUENE	1 U	1 U	1 U	0.2 J	1 U	0.5 J
TRANS-1,2-DICHLOROETHENE	3.6	3.3	19	0.5 J	2.7	31
TRICHLOROETHENE	120	120	860	61	150	150
VINYL CHLORIDE	0.3 U	0.3 U	0.2 J	0.3 U	0.8	0.3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	10 U	10 U	10 U	5 U	5 U	5 U
2-METHYLNAPHTHALENE	10 U	10 U	10 U	5 U	5 U	5 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-073-01	003-TW-DP1-01	003-TW-074-01	003-MS-28D-01	003-MS-28I-01	003-MS-28S-01
DEPTH:	Shallow	Shallow	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	07/24/97	07/24/97	07/27/97	02/17/98	02/11/98	02/11/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC73	AOC73	AOC74	MS-28D	MS-28I	MS-28S
FIELD DUPLICATE OF:		003-TW-073-01				
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U	10 U	5 U	5 U	5 U
4-METHYLPHENOL	10 U	10 U	10 U	5 U	5 U	5 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U	10 U	5 U	5 U	5 U
BUTYLBENZYL PHTHALATE	10 UJ	10 U	10 U	5 U	5 U	5 U
DI-N-BUTYL PHTHALATE	10 U	10 U	10 U	1 J	5 U	5 U
DI-N-OCTYL PHTHALATE	10 U	10 U	10 U	5 U	5 U	5 U
DIETHYL PHTHALATE	10 U	10 U	10 U	5 U	5 U	5 U
NAPHTHALENE	10 U	10 U	10 U	5 U	5 U	5 U
PENTACHLOROPHENOL	10 U	10 U	25 U	10 U	10 U	10 U
PHENOL	10 U	10 U	10 U	5 U	5 U	5 U
METALS (µg/L)						
ALUMINUM	750 J	920 J	139 J	28 U	28 U	28 U
ARSENIC	3.6	3	1.8 U	1 U	1 U	1 U
BARIUM	100 J	104 J	59 J	45.1 J	7.3 J	46.3 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	193000 J	199000 J	126000 J	129000 J	56600 J	176000 J
CHROMIUM	16.8	20.7	13.1	7.4 U	4.5 U	12.5
COBALT	10.7	13	10.8 U	3.9 U	3.9 U	3.9 U
COPPER	6.6	6.3	3 U	3.9 U	5.7	3.9 U
CYANIDE	5 U	5 U	5 U	5 U	5 U	5 U
IRON	5870 J	6610 J	4680 J	2700 J	11000 J	2260 J
LEAD	6.6	7.9	1 U	0.8 UJ	0.8 UJ	0.8 UJ
MAGNESIUM	43200 J	44300 J	20700 J	50200 J	32000 J	33000 J
MANGANESE	1820 J	1890 J	1010 J	415	251	1240

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-073-01	003-TW-DP1-01	003-TW-074-01	003-MS-28D-01	003-MS-28I-01	003-MS-28S-01
DEPTH:	Shallow	Shallow	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	07/24/97	07/24/97	07/27/97	02/17/98	02/11/98	02/11/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC73	AOC73	AOC74	MS-28D	MS-28I	MS-28S
FIELD DUPLICATE OF:		003-TW-073-01				
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	29.4 J	27.6 J	24.8 J	4.3 U	4.3 U	4.3 U
POTASSIUM	4340 J	4410 J	4100 J	2560	4260	2990
SELENIUM	5 UJ	5 UJ	1 UJ	1 UJ	1 UJ	1 UJ.
SODIUM	16800 J	17100 J	11100 J	14600 J	15100 J	11500 J
THALLIUM	1.2 U	1 U	1.3 U	1.8 U	1.8 U	1.8 U
VANADIUM	9.6 U	9 U	2.2	2.9 U	2.9 U	2.9 U
ZINC	35.8 J	33.7 U	31.7 U	27.7 J	123 J	13.5
MISCELLANEOUS PARAMETERS (mg/L)						
TOTAL SUSPENDED SOLIDS				9	25	8
GENERAL CHEMISTRY						
PH				7.33	7.22	6.79

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-29D-01	003-MS-29I-01	003-MS-29S-01	003-MS-30D-01	003-MS-30I-01	003-MS-30S-01
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	02/16/98	02/16/98	02/16/98	03/03/98	02/24/98	02/24/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-29D	MS-29I	MS-29S	MS-30D	MS-30I	MS-30S
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	0.3 J
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	3.7	0.2 J	1 U	17	1 U
1,1-DICHLOROETHENE	1 U	1.9	1 U	1 U	0.9 J	1 U
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1.7	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	1 U	1 U	0.3 J	1 U	0.3 J	0.5 J
CIS-1,2-DICHLOROETHENE	2.7	46	54	1.6	5	1 U
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	0.3 J	3.8	1 U	5	6.3	1 U
TOLUENE	1 U	1 U	0.4 J	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	0.5 J	0.7 J	6	1 U	1 U	1 U
TRICHLOROETHENE	1.8	720	18	13	150	3.9
VINYL CHLORIDE	0.3 U	0.3 U	0.3 U	0.3 U	0.4	0.3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U
2-METHYLNAPHTHALENE	5 U	5 U	5 U	5 U	5 U	5 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-29D-01	003-MS-29I-01	003-MS-29S-01	003-MS-30D-01	003-MS-30I-01	003-MS-30S-01
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	02/16/98	02/16/98	02/16/98	03/03/98	02/24/98	02/24/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-29D	MS-29I	MS-29S	MS-30D	MS-30I	MS-30S
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U
BIS(2-ETHYLHEXYL)PHTHALATE	5 U	5 U	5 U	2 U	3 U	1 U
BUTYLBENZYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U
DI-N-BUTYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	1 U
DI-N-OCTYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U
DIETHYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U
NAPHTHALENE	5 U	5 U	5 U	5 U	5 U	5 U
PENTACHLOROPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
PHENOL	5 U	5 U	5 U	5 U	5 U	5 U
METALS (µg/L)						
ALUMINUM	36.3	28 U	28 U	28 U	29.6 U	28 U
ARSENIC	1 U	1.4	1 U	1 U	1 U	1 U
BARIUM	64.5 J	45.5 J	39.2 J	40.6 J	66.3 J	29.5 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3
CALCIUM	120000 J	168000 J	169000 J	202000	159000 J	101000 J
CHROMIUM	6.5	11.9	13.6	16.2	13.4	11.2
COBALT	3.9 U	3.9 U	3.9 U	6.9 U	3.9 U	3.9 U
COPPER	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
CYANIDE	5 U	5 U	5 U	5 U	5 U	5 U
IRON	465 J	6890 J	614 J	2630 J	2830 J	111 U
LEAD	0.8 UJ	0.8 UJ	0.8 UJ	0.8 U	0.8 U	1.3
MAGNESIUM	45300 J	43600 J	42200 J	63800	48000 J	22900 J
MANGANESE	342	641	907	566	829 J	4.7 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-29D-01	003-MS-29I-01	003-MS-29S-01	003-MS-30D-01	003-MS-30I-01	003-MS-30S-01
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	02/16/98	02/16/98	02/16/98	03/03/98	02/24/98	02/24/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-29D	MS-29I	MS-29S	MS-30D	MS-30I	MS-30S
FIELD DUPLICATE OF:						
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2	0.21
NICKEL	4.3 U	4.3 U	11.1	4.3 U	4.3 U	4.3 U
POTASSIUM	2600	2890	5130	2860	3140	2280
SELENIUM	1 UJ	1 UJ	1 UJ	1 UJ	2.6 U	9.8 U
SODIUM	28300 J	5690 J	25800 J	11600	17100 J	13100 J
THALLIUM	1.8 U	1.8 U	2.2	9 UJ	1.8 U	1.8 U
VANADIUM	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U
ZINC	20.3 J	229 J	18.5 J	8.8 U	89.3 J	18.2 U
MISCELLANEOUS PARAMETERS (mg/L)						
TOTAL SUSPENDED SOLIDS	2 U	16	3	9	6	2 U
GENERAL CHEMISTRY						
PH	7.26	7.1	6.95	7.37	7.25	7.64

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-31D-01	003-MS-31I-01	003-MS-31S-01	003-MS-32D-01	003-MS-32I-01	003-MS-DP2-02
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Intermediate
SAMPLE DATE:	02/26/98	02/18/98	02/17/98	03/02/98	03/02/98	03/02/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-31D	MS-31I	MS-31S	MS-32D	MS-32I	MS-32I
FIELD DUPLICATE OF:						003-MS-32I-01
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U	1 U	0.3 J	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	2.4	1.1	1 U	7.2	1 U
1,1-DICHLOROETHENE	1 U	1 U	1.6	1 U	13	10
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	0.6 J	1 U	1 U	1 U	0.4 J	1 U
CIS-1,2-DICHLOROETHENE	1.2	1 U	200	4.1	560	550
ETHYLBENZENE	1 U	1 U	1 U	1 U	0.2 J	1 U
M+P-XYLENES	1 U	1 U	1 U	1 U	0.2 J	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1 U
TOLUENE	1 U	1 U	1 U	1 U	0.6 J	0.6 J
TRANS-1,2-DICHLOROETHENE	1 U	1 U	13	1.6	1300	1400
TRICHLOROETHENE	0.7 J	1 U	82	3.4	14000	15000
VINYL CHLORIDE	0.3 U	0.3 U	0.3 U	0.3 U	7.8	6.5
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U
2-METHYLNAPHTHALENE	5 U	5 U	5 U	5 U	5 U	5 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-31D-01	003-MS-31I-01	003-MS-31S-01	003-MS-32D-01	003-MS-32I-01	003-MS-DP2-02
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Intermediate
SAMPLE DATE:	02/26/98	02/18/98	02/17/98	03/02/98	03/02/98	03/02/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-31D	MS-31I	MS-31S	MS-32D	MS-32I	MS-32I
FIELD DUPLICATE OF:						003-MS-32I-01
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U
BIS(2-ETHYLHEXYL)PHTHALATE	1 U	6 U	5 U	2 U	1 U	1 U
BUTYLBENZYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U
DI-N-BUTYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U
DI-N-OCTYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U
DIETHYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U
NAPHTHALENE	5 U	5 U	5 U	5 U	5 U	5 U
PENTACHLOROPHENOL	10 U	10 U	11 U	11 U	10 U	10 U
PHENOL	5 U	5 U	5 U	5 U	5 U	5 U
METALS (µg/L)						
ALUMINUM	36.3 U	28 U	28 U	28 U	28 U	28 U
ARSENIC	1 U	2.1	2.7	1 U	8	9.4
BARIUM	53.6 J	31.6 J	87.2 J	59.8 J	88.1 J	89.7 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	138000 J	375000 J	215000 J	114000	211000	218000
CHROMIUM	12	26.7	15.6	4.5 U	11.7	19.7
COBALT	3.9 U	3.9 U	5.9	3.9 U	3.9 U	3.9 U
COPPER	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
CYANIDE	5 U	5 U	5 U	9	5 U	7
IRON	2830 J	6970 J	2560 J	2060 J	9010 J	9280 J
LEAD	0.8 U	0.8 UJ	0.8 UJ	0.8 U	0.8 U	0.8 U
MAGNESIUM	55300 J	110000 J	57100 J	43000	62000	63400
MANGANESE	331 J	1760	1600	341	850	872

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-31D-01	003-MS-31I-01	003-MS-31S-01	003-MS-32D-01	003-MS-32I-01	003-MS-DP2-02
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Intermediate
SAMPLE DATE:	02/26/98	02/18/98	02/17/98	03/02/98	03/02/98	03/02/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-31D	MS-31I	MS-31S	MS-32D	MS-32I	MS-32I
FIELD DUPLICATE OF:						003-MS-32I-01
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	4.3 U	4.3 U	35	4.3 U	4.3 U	4.3 U
POTASSIUM	3200	3860	4790	2290	2630	2710
SELENIUM	1 UJ	5 UJ	1 UJ	1 UJ	5 UJ	5 UJ
SODIUM	29400 J	8690 J	12200 J	29000	17700	18000
THALLIUM	1.8 U	1.8 U	1.8 U	45 UJ	1.8 UJ	9 UJ
VANADIUM	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	3.1
ZINC	27.7 U	20.4 J	16.7 J	19.6 U	8.2 U	7.6
MISCELLANEOUS PARAMETERS (mg/L)						
TOTAL SUSPENDED SOLIDS	5	12	6	5	20	17
GENERAL CHEMISTRY						
PH	7.41	7.05	6.78	7.41	7.16	

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-32S-01	003-MS-33D-01	003-MS-33I-01	003-MS-DP2-01	003-MS-33S-01	003-TW-P01-01
DEPTH:	Shallow	Deep	Intermediate	Intermediate	Shallow	Shallow
SAMPLE DATE:	02/27/98	02/26/98	02/25/98	02/25/98	02/25/98	08/08/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-32S	MS-33D	MS-33I	MS-33I	MS-33S	P01
FIELD DUPLICATE OF:				003-MS-33I-01		
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	5	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	1.9	1 U	5.1	1	0.2 J	1 U
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	0.3 J	0.4 J	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	1 U	0.3 J	1.2	1	0.4 J	1 U
CIS-1,2-DICHLOROETHENE	170	2.5	580	570	2.3	1 U
ETHYLBENZENE	1 U	1 U	0.3 J	0.3 J	1 U	1 U
M+P-XYLENES	1 U	1 U	0.7 J	0.6 J	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	0.3 J	1 J	1 U	1 U
TETRACHLOROETHENE	2.1	22	6.8	6.3	1 U	0.7 J
TOLUENE	1 U	1 U	1.6	1.5	1 U	1 U
TRANS-1,2-DICHLOROETHENE	110	0.3 J	1100	1100	7.2	1 U
TRICHLOROETHENE	370	7.5	59000	54000	87	1.6
VINYL CHLORIDE	0.4	0.3 U	9.1	9.5	0.3 U	0.3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	5 U	5 U	5 U	5 U	5 U	10 U
2-METHYLNAPHTHALENE	5 U	5 U	5 U	5 U	5 U	10 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-32S-01	003-MS-33D-01	003-MS-33I-01	003-MS-DP2-01	003-MS-33S-01	003-TW-P01-01
DEPTH:	Shallow	Deep	Intermediate	Intermediate	Shallow	Shallow
SAMPLE DATE:	02/27/98	02/26/98	02/25/98	02/25/98	02/25/98	08/08/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-32S	MS-33D	MS-33I	MS-33I	MS-33S	P01
FIELD DUPLICATE OF:				003-MS-33I-01		
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	10 U
4-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	1 U	3 U	2 U	1 U	1 U	1 J
BUTYLBENZYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	10 U
DI-N-BUTYL PHTHALATE	5 U	5 U	1 U	5 U	5 U	10 U
DI-N-OCTYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	10 U
DIETHYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	10 U
NAPHTHALENE	5 U	5 U	5 U	5 U	5 U	10 U
PENTACHLOROPHENOL	10 U	10 U	10 U	10 U	10 U	25 U
PHENOL	5 U	5 U	5 U	1 J	5 U	10 U
METALS (µg/L)						
ALUMINUM	28 U	37.5 U	567 J	712 J	28 U	207
ARSENIC	6 J	1 U	1.1 U	1.6 U	1.3 U	1 U
BARIUM	52.8 J	27.9 J	80.1 J	82.7 J	60.1	30.9
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.4
CALCIUM	200000 J	138000 J	182000 J	189000 J	85500 J	71200
CHROMIUM	9.5	11.3	18.8	16.1	7.2	19.1 J
COBALT	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	2 U
COPPER	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3 U
CYANIDE	6.7	6	5 U	8.6	5.9	5 U
IRON	4580 J	2280 J	7940 J	8260 J	767 J	2080 J
LEAD	0.8	1.7	0.8 U	0.8 U	0.8 U	1 U
MAGNESIUM	49900 J	55500 J	66400 J	69000 J	18900 J	14900 J
MANGANESE	882 J	167 J	655 J	677 J	210 J	71.6 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-32S-01	003-MS-33D-01	003-MS-33I-01	003-MS-DP2-01	003-MS-33S-01	003-TW-P01-01
DEPTH:	Shallow	Deep	Intermediate	Intermediate	Shallow	Shallow
SAMPLE DATE:	02/27/98	02/26/98	02/25/98	02/25/98	02/25/98	08/08/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-32S	MS-33D	MS-33I	MS-33I	MS-33S	P01
FIELD DUPLICATE OF:				003-MS-33I-01		
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.57	0.2 U	0.2 U
NICKEL	4.3 U	4.3 U	5.2	4.3 U	4.3 U	4 U
POTASSIUM	3800	2980	3850	3840	3220	2010
SELENIUM	1 UJ	1 UJ	1 UJ	1 UJ	12.5 U	4.6 U
SODIUM	37900 J	24600 J	127000 J	132000 J	12600 J	5080 J
THALLIUM	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1 U
VANADIUM	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2 U
ZINC	17.7 U	32.5 U	21.2 U	62.1 U	16.6 U	19.3 U
MISCELLANEOUS PARAMETERS (mg/L)						
TOTAL SUSPENDED SOLIDS	10	3	35	37	2 U	
GENERAL CHEMISTRY						
PH	6.96	7.36	7.32		7.53	

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P02-01	003-TW-P03-01	003-TW-P04-01	003-TW-P05-01	003-TW-P06-01	003-TW-DP1-02
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/19/97	07/12/97	09/06/97	09/17/97	08/07/97	08/07/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P02	P03	P04	P05	P06	P06
FIELD DUPLICATE OF:						003-TW-P06-01
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	0.3 J	1 U	20 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	20 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	1 U	8.4 J	1 U	1.2	1.2
1,1-DICHLOROETHENE	1.4	1 U	20 U	1 U	0.7 J	0.7 J
1,2-DICHLOROETHANE	1 U	1 U	20 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	100 UR	5 UR	5 UR	5 UR
ACETONE	5 UR	5 UR	100 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	20 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	20 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	20 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	20 U	1 U	1 U	1 U
CHLOROMETHANE	1 U	0.3 J	20 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	80	3.9	510	1 U	270	260
ETHYLBENZENE	1 U	1 U	820	1 U	1 U	1 U
M+P-XYLENES	1 U	1 U	780	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	40 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	750	1 U	1 U	1 U
TETRACHLOROETHENE	1 U	1 U	20 U	1.8	1 U	1 U
TOLUENE	1 U	1 U	34	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	30	1 U	20 U	1 U	11	11
TRICHLOROETHENE	320	10	20 U	1.2	4.9	4.3
VINYL CHLORIDE	0.3 U	0.3 U	6 U	0.3 U	0.3 U	0.3 J
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	10 U	10 U	3 J	10 U	10 U	11 U
2-METHYLNAPHTHALENE	10 U	10 U	11 U	10 U	10 U	11 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P02-01	003-TW-P03-01	003-TW-P04-01	003-TW-P05-01	003-TW-P06-01	003-TW-DP1-02
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/19/97	07/12/97	09/06/97	09/17/97	08/07/97	08/07/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P02	P03	P04	P05	P06	P06
FIELD DUPLICATE OF:						003-TW-P06-01
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U	11 U	10 U	10 U	11 U
4-METHYLPHENOL	10 U	10 U	11 U	10 U	10 U	11 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U	11 U	10 U	10 U	11 U
BUTYLBENZYL PHTHALATE	1 J	1 J	11 U	10 U	10 U	11 U
DI-N-BUTYL PHTHALATE	1 J	10 U	11 U	10 U	10 U	11 U
DI-N-OCTYL PHTHALATE	10 U	10 U	11 U	10 U	10 U	11 U
DIETHYL PHTHALATE	10 U	10 U	11 U	10 U	10 U	11 U
NAPHTHALENE	10 U	10 U	11 U	10 U	10 U	11 U
PENTACHLOROPHENOL	10 U	10 U	11 U	10 U	10 U	11 U
PHENOL	10 U	10 U	11 U	10 U	10 U	11 U
METALS (µg/L)						
ALUMINUM	503 J	404 J	26 U	26 U	18 U	18 U
ARSENIC	1 U	1 U	2.1 J	1 U	3.2 U	2.8 U
BARIUM	56.9 J	92.2 J	43.1 J	23 J	115 J	112 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3	0.3 U	0.3 U
CALCIUM	175000 J	184000 J	140000 J	94100	220000 J	214000 J
CHROMIUM	26.2 U	23.3	6.4	6.6	16.8 U	17.6 U
COBALT	4.8 U	7.6 U	5 U	5 U	3.1 U	2.3 U
COPPER	3 U	3 U	3 U	3 U	3 U	3 U
CYANIDE	5 U	5 U	5 U	5 U	5 UR	5 UR
IRON	8970 J	4460 J	5070 J	1080 J	4350 J	4170 J
LEAD	1 U	1 U	1 U	1 U	1 U	1.2 U
MAGNESIUM	36300 J	40500 J	45400 J	22900	40000 J	38600 J
MANGANESE	488 J	1850	453 J	28 J	2260 J	2190 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P02-01	003-TW-P03-01	003-TW-P04-01	003-TW-P05-01	003-TW-P06-01	003-TW-DP1-02
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/19/97	07/12/97	09/06/97	09/17/97	08/07/97	08/07/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P02	P03	P04	P05	P06	P06
FIELD DUPLICATE OF:						003-TW-P06-01
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	11	24.5	5 U	5 U	8.9 U	9.8 U
POTASSIUM	4680	4580	3790	1660	5610 J	5370 J
SELENIUM	9.6 J	1 UJ	1 UJ	52.7 J	1 UJ	1 UJ
SODIUM	10800 J	16000 J	8750 J	10300 J	16500 J	15900 J
THALLIUM	1 U	1 UJ	1 UJ	1 U	1.1 J	1 U
VANADIUM	3 U	3.6	2 U	2 U	2.3	2 U
ZINC	27.2 J	26.7 J	5.9 U	6.2 U	12.9 U	12.3 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P07-01	003-TW-P08-01	003-TW-P09-01	003-TW-P10-01	003-TW-DP1-04	003-TW-P11-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/12/97	09/03/97	08/24/97	09/05/97	09/05/97	09/09/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P07	P08	P09	P10	P10	P11
FIELD DUPLICATE OF:					003-TW-P10-01	
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	16	0.4 J	1 U	1000 U	1 U	10 U
1,1,2-TRICHLOROETHANE	0.5 J	1 U	1 U	1000 U	1 U	10 U
1,1-DICHLOROETHANE	6.2	5.5	22	1000 U	11	8.3 J
1,1-DICHLOROETHENE	5.2	1.4	13	1000 U	19	4.6 J
1,2-DICHLOROETHANE	0.3 J	1 U	1 U	1000 U	1 U	10 U
2-BUTANONE	5 UR	5 UR	5 UR	5000 UR	5 UR	50 UR
ACETONE	5 UR	5 UR	5 UR	5000 UR	5 UR	50 UR
BENZENE	1 U	1 U	1 U	1000 U	1 U	10 U
CARBON DISULFIDE	1 U	1 U	1 U	1000 U	1 U	10 U
CHLOROETHANE	1 U	1 U	1 U	1000 U	1 U	10 U
CHLOROFORM	1 U	1 U	1 U	1000 U	1 U	10 U
CHLOROMETHANE	1 U	1 U	1 U	1000 U	1 U	10 U
CIS-1,2-DICHLOROETHENE	61	220	99	730 J	760	56
ETHYLBENZENE	1 U	1 U	1 U	1000 U	0.3 J	10 U
M+P-XYLENES	1 U	1 U	1 U	1000 U	0.5 J	10 U
METHYLENE CHLORIDE	2 U	2 U	2 U	640 J	5 U	20 U
O-XYLENE	1 U	1 U	1 U	1000 U	0.3 J	10 U
TETRACHLOROETHENE	1	1 U	6.9	1000 U	1 U	7.8 J
TOLUENE	1 U	1 U	1 U	240 J	0.8 J	10 U
TRANS-1,2-DICHLOROETHENE	77	3	4.1	1900	1800	3.7 J
TRICHLOROETHENE	510	100	880	39000	36000	930
VINYL CHLORIDE	0.2 J	0.3 U	40	300 U	16	3 U
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	10 U	10 U	10 U	10 U	11 U	11 U
2-METHYLNAPHTHALENE	10 U	10 U	10 U	10 U	11 U	11 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P07-01	003-TW-P08-01	003-TW-P09-01	003-TW-P10-01	003-TW-DP1-04	003-TW-P11-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/12/97	09/03/97	08/24/97	09/05/97	09/05/97	09/09/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P07	P08	P09	P10	P10	P11
FIELD DUPLICATE OF:					003-TW-P10-01	
SEMIVOLATILES (µg/L)						
2-METHYLPHENOL	3 U	3 U	3 U	3 U	3 U	3 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U	10 U	10 U	11 U	11 U
4-METHYLPHENOL	10 U	10 U	10 U	10 U	11 U	11 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U	10 U	10 U	11 U	11 U
BUTYLBENZYL PHTHALATE	1 J	10 U	10 U	10 U	11 U	11 U
DI-N-BUTYL PHTHALATE	10 U	1 J	10 U	10 U	11 U	11 U
DI-N-OCTYL PHTHALATE	10 U	10 U	10 U	10 U	11 U	11 U
DIETHYL PHTHALATE	10 U	10 U	10 U	10 U	11 U	11 U
NAPHTHALENE	10 U	10 U	10 U	10 U	11 U	11 U
PENTACHLOROPHENOL	10 U	10 U	10 U	10 U	11 U	11 U
PHENOL	10 U	10 U	10 U	10 U	11 U	11 U
METALS (µg/L)						
ALUMINUM	664 J	650 J	108 U	108 U	57 U	26 U
ARSENIC	2.2 U	1.8	1 U	7.4	6.8	5.8
BARIUM	31.7 J	51.4 J	73.3 J	67 J	67.3 J	70.1 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	123000 J	188000 J	178000 J	141000 J	142000 J	128000 J
CHROMIUM	9.6	31	13.5	8.5	6.9	12.4
COBALT	4 U	9.9	2.3 U	5 U	5 U	5 U
COPPER	4.4	3.4	3 U	3 U	3 U	5.9 U
CYANIDE	5 U	5 U	5 U	17	17.5	5 U
IRON	3290 J	10200 J	2340 U	7150 J	7120 J	1390 J
LEAD	1 U	1 U	1 UJ	1.2	1 U	1 U
MAGNESIUM	30400 J	45100 J	32300 J	38600 J	39300 J	58200 J
MANGANESE	1540	2160 J	532 J	659 J	662 J	2770 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P07-01	003-TW-P08-01	003-TW-P09-01	003-TW-P10-01	003-TW-DP1-04	003-TW-P11-01
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/12/97	09/03/97	08/24/97	09/05/97	09/05/97	09/09/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P07	P08	P09	P10	P10	P11
FIELD DUPLICATE OF:					003-TW-P10-01	
METALS (µg/L)						
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	8.7	29.7	6.4	5 U	5 U	9.7
POTASSIUM	3990	4610	3570 J	2710	2730	3690
SELENIUM	27.7 J	1 UJ	20.8 J	1 UJ	1 UJ	5 UR
SODIUM	12200 J	11600 J	54900	18800 J	19100 J	13500 J
THALLIUM	1 U	1 U	2.4 U	1 UJ	1 UJ	1 U
VANADIUM	4.5	2 U	2.8 U	2 U	2 U	2 U
ZINC	25 J	63.8 J	9.7 U	4.3 U	9.8 U	6.3 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P12-01	GW-01	GW-02	DUP-03	GW-03	
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	
SAMPLE DATE:	08/10/97	04/17/95	04/17/95	04/17/95	04/07/95	/ /
INVESTIGATION:	OU3	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	P12	SB-01/TW-01	SB-04/TW-02	SB-04/TW-02	SB-06/TW-03	
FIELD DUPLICATE OF:				GW-02		
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	0.6 J	1000 U	9	100 U	9	
1,1,2-TRICHLOROETHANE	1 U	1000 U	10 U	100 U	10 U	
1,1-DICHLOROETHANE	1.8	1000 U	22	16	9	
1,1-DICHLOROETHENE	1.4	1000 U	10 U	100 U	10 U	
1,2-DICHLOROETHANE	1 U	1000 U	10 U	100 U	10 U	
1,2-DICHLOROETHENE (TOTAL)		12000	180	160	100	
2-BUTANONE	5 UR	1000 U	10 U	270	10 U	
ACETONE	5 UR	1000 U	17 U	100 U	10 U	
BENZENE	1 U	1000 U	10 U	100 U	10 U	
CARBON DISULFIDE	1 U	1000 U	10 U	31	10 U	
CHLOROETHANE	1 U	1000 U	10 U	100 U	10 U	
CHLOROFORM	1 U	1000 U	10 U	100 U	10 U	
CHLOROMETHANE	1 U	1000 U	10 U	100 U	10 U	
CIS-1,2-DICHLOROETHENE	4.8					
ETHYLBENZENE	1 U	1000 U	10 U	100 U	10 U	
M+P-XYLENES	1 U					
METHYLENE CHLORIDE	2 U	1000 U	10 U	100 U	10 U	
O-XYLENE	1 U					
TETRACHLOROETHENE	3.8	160	5	100 U	10 U	
TOLUENE	1 U	1000 U	10 U	100 U	10 U	
TRANS-1,2-DICHLOROETHENE	0.5 J					
TRICHLOROETHENE	210	140000	1200	1200	1700	
VINYL CHLORIDE	0.3 U	1000 U	10 U	100 U	10 U	
SEMIVOLATILES (µg/L)						
2,4-DIMETHYLPHENOL	11 U	5	10 U	10 U	10 U	

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P12-01	GW-01	GW-02	DUP-03	GW-03	
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	
SAMPLE DATE:	08/10/97	04/17/95	04/17/95	04/17/95	04/07/95	/ /
INVESTIGATION:	OU3	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	P12	SB-01/TW-01	SB-04/TW-02	SB-04/TW-02	SB-06/TW-03	
FIELD DUPLICATE OF:				GW-02		
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	11 U	10 U	10 U	10 U	10 U	
2-METHYLPHENOL	3 U	2	10 U	10 U	10 U	
4-CHLORO-3-METHYLPHENOL	11 U	10 U	10 U	10 U	10 U	
4-METHYLPHENOL	11 U	11	10 U	10 U	10 U	
BIS(2-ETHYLHEXYL)PHTHALATE	1 J	10 U	10 U	10 U	10 U	
BUTYLBENZYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	
DI-N-BUTYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	
DI-N-OCTYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	
DIETHYL PHTHALATE	11 U	10 U	10 U	10 U	10 U	
NAPHTHALENE	11 U	10 U	10 U	10 U	10 U	
PENTACHLOROPHENOL	11 U	25 U	25 U	25 U	25 U	
PHENOL	11 U	10	10 U	10 U	10 U	
METALS (µg/L)						
ALUMINUM	25.3	19400	8500	6280	8450	
ARSENIC	10.1 J	11	4.2	3.8	3.9	
BARIUM	138	380	154	142	137	
BERYLLIUM	0.3	1 U	1 U	1 U	1 U	
CALCIUM	162000	132000	215000	187000	144000	
CHROMIUM	12.8 U	286	24.4 U	25.1 U	28.9 U	
COBALT	2 U	23.8	12.2	10.6	12.7	
COPPER	3 U	172	28.7 U	24.9 U	43.1 J	
CYANIDE	5 U	291	10 U	10 U	10 U	
IRON	18100 J	27000	14100	10400	15300	
LEAD	1 U	10	2.3	2.3	5.1 J	
MAGNESIUM	34000 J	47900	65700	57000	42100	

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-4
SUMMARY OF POSITIVE DETECTIONS IN UNFILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P12-01	GW-01	GW-02	DUP-03	GW-03	
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	
SAMPLE DATE:	08/10/97	04/17/95	04/17/95	04/17/95	04/07/95	/ /
INVESTIGATION:	OU3	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	P12	SB-01/TW-01	SB-04/TW-02	SB-04/TW-02	SB-06/TW-03	
FIELD DUPLICATE OF:				GW-02		
METALS (µg/L)						
MANGANESE	475 J	993	1520	1250	862	
MERCURY	0.2 U	0.14 U	0.14 U	0.13 U	0.1 U	
NICKEL	4 U	63.6 U	24.9 U	24.3 U	38.9 U	
POTASSIUM	3540	9430	6610	5470	6430	
SELENIUM	5 UR	4 U	4 U	4 U	33.3	
SODIUM	13100 J	89100	10100	8950	9960	
THALLIUM	1 U	5 U	5 U	5 U	5 U	
VANADIUM	2 U	53.9	30.4	22.6	33.7	
ZINC	9.6 U	159	36.8 U	26.1 U	31.8 U	
GENERAL CHEMISTRY						
PH		7.53	6.95	6.95	7.34	

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-003-F1	003-TW-004-F1	003-TW-006-F1	003-TW-007-F1	003-TW-008-F1	003-TW-013-F1
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/14/97	07/22/97	07/09/97	08/21/97	07/21/97	07/15/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC03	AOC04	AOC06	AOC07	AOC08/AOC09	AOC13/AOC14
FIELD DUPLICATE OF:						
METALS (µg/L)						
ALUMINUM	18 U	18 U	18 U	18 U	18 U	18 U
ARSENIC	1.5 U	1 U	1 U	1 U	1 U	2.1 U
BARIUM	53.8 J	35.4 J	91.5 J	11.9 U	39.8 J	35.7 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	169000 J	265000 J	130000 J	156000 J	106000 J	135000 J
CHROMIUM	10.3	13.4	6 U	10	6.3	10.2
COBALT	2 U	5.7 U	7.1 U	4.5 U	2 U	7.1 U
COPPER	3 U	3 U	3 U	3 U	3 U	3 U
IRON	5070 J	5160 J	12300 J	1070 J	1110 J	1750 J
LEAD	1 UJ	1 U	1 UJ	1 UJ	1 U	1 UJ
MAGNESIUM	42800 J	81200 J	26000 J	29200 J	25600 J	22100 J
MANGANESE	675 J	1090 J	1520 J	807 J	117 J	1300 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	6.4	8.8 J	30.9	12.3	4 U	8
POTASSIUM	2800	5930	4920	2850 J	2580	3950
SELENIUM	1 UJ	1 UJ	1 UJ	1 UJ	47 J	5 UJ
SODIUM	7850 J	13800 J	22800 J	9100	11100 J	8630 J
THALLIUM	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 U
VANADIUM	2 U	2.3 U	2 U	2 U	2.5 U	2 J
ZINC	18.6 U	24.9 U	43.9 J	7.5 U	23.3 U	7.5 J

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-015-F1	003-TW-016-F1	003-TW-017-F1	003-TW-018-F1	003-TW-023-F1	003-TW-026-F1
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/22/97	07/26/97	07/25/97	07/26/97	08/09/97	09/20/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC15	AOC16	AOC17	AOC18	AOC23	AOC26
FIELD DUPLICATE OF:						
METALS (µg/L)						
ALUMINUM	26 U	18 U	18 U	18 U	18 U	26 U
ARSENIC	1 U	1 U	1 U	1 U	1 U	3.5
BARIUM	14.7	55.7 J	78.6 J	55.2 J	56	59.1 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.4	0.3 U
CALCIUM	74400	196000 J	193000 J	171000 J	107000	148000
CHROMIUM	6 U	13	12	10.2	11.6 U	6 U
COBALT	5 U	7	7.2	9	2 U	5 U
COPPER	3 U	3 U	3 U	3 U	3 U	3 U
IRON	1350 J	2690 J	4270 J	3070 J	1560 J	13400 J
LEAD	1 U	1 U	1.1	1 U	1 U	1 U
MAGNESIUM	18100	42600 J	31600 J	37700 J	25700 J	43900
MANGANESE	131 J	1080 J	1610 J	2920 J	739 J	872 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	5 U	33.7 J	20.6 U	24.6	4 U	5 U
POTASSIUM	2480	4590	4400	4370	3350	4080
SELENIUM	49 J	1 UJ	1 UJ	1 U	21 J	1 UJ
SODIUM	9550 J	9350 J	11800 J	6240 J	7710 J	13400 J
THALLIUM	1 UJ	1 U	1 U	1 U	1 UJ	1 U
VANADIUM	2 U	2.2 U	2 U	2 U	2 U	2 U
ZINC	7.7 U	20.4 U	12.9 U	18.4 U	6.1 U	10.7 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-027-F1	003-TW-028-F1	003-TW-029-F1	003-TW-030-F1	003-TW-DP1-F3	003-TW-032-F1
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/22/97	09/16/97	09/15/97	08/23/97	08/23/97	08/26/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC27	AOC28	AOC29	AOC30	AOC30	AOC32
FIELD DUPLICATE OF:					003-TW-030-F1	
METALS (µg/L)						
ALUMINUM	18 U	26 U	26 U	18 U	18 U	18 U
ARSENIC	1 U	1.7 J	1 U	1 U	1 U	1 U
BARIUM	43 J	35.8 J	56.6 J	27.9 J	28.8 J	35 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3
CALCIUM	78700 J	112000 J	68300 J	52000 J	51600 J	137000 J
CHROMIUM	7.2	11.8	8.1	7.2	7.2	13.8
COBALT	2 U	5 U	5 U	2 U	2 U	13.8 U
COPPER	3 U	5.2 U	6.7 U	3 U	3 U	3 U
IRON	1320 J	2080 J	448 J	528 J	524 J	1950 J
LEAD	1 UJ	1 U	1 U	1 UJ	1 U	1 U
MAGNESIUM	16400 J	25800 J	15700 J	10700 J	10700 J	25000 J
MANGANESE	53.8 J	751 J	31.6 J	20.4 J	23 J	1520 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	4 U	5 U	5 U	4 U	4 U	14.6
POTASSIUM	2620 J	2910	3140	2280 J	2230 J	3670 J
SELENIUM	31 J	1 UR	15.8 J	22.5 J	14.7 J	1 UJ
SODIUM	10500	7760 J	44100 J	38300	39800	18800
THALLIUM	1.9 J	1.8 U	2.6 U	1.4 J	1 UJ	1 UJ
VANADIUM	2 U	2.7 U	2 U	2 U	2 U	2 U
ZINC	8 U	4.5 U	4.1 U	7.3 U	9 U	6.1 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-033-F1	003-TW-034-F1	003-TW-035-F1	003-TW-036-F1	003-TW-037-F1	003-TW-038-F1
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/08/97	07/29/97	07/28/97	08/12/97	08/06/97	07/23/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC33	AOC34	AOC35	AOC36	AOC37	AOC38
FIELD DUPLICATE OF:						
METALS (µg/L)						
ALUMINUM	26 U	18 U	18 U	18 U	18 U	18 U
ARSENIC	1 U	22.9 J	1 U	2.9	1 U	1 U
BARIUM	55.4 J	127 J	65.6 J	32.4	112	85.2 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3	0.3
CALCIUM	87100 J	163000 J	81600 J	48100	216000	180000 J
CHROMIUM	13.2	12.6	6.3	6 U	19 U	10.1
COBALT	5 U	2 U	2 U	5.3	4.5	13.1 J
COPPER	3.2 U	3 U	3 U	3 U	3 U	3 U
IRON	846 J	1850 J	753 J	391 J	3940 J	4610 J
LEAD	1 U	1 U	1 U	1 U	1 U	1 U
MAGNESIUM	20900 J	37000 J	15100 J	10100 J	39200 J	48800 J
MANGANESE	26.6 J	25.8 J	26.1 J	76.1 J	2200 J	1490 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	5 U	4 U	4 U	4.1	6.3	9.1
POTASSIUM	4270	3930 J	3750 J	4940	5350	3740
SELENIUM	67.4 J	49.9 J	16.1 J	131 J	116 J	5 UJ
SODIUM	34800 J	28900 J	43500 J	109000 J	16100 J	11600 J
THALLIUM	1.8 U	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
VANADIUM	2 U	2.4	2 U	3.1	2.5	3.4 U
ZINC	4 U	9.8 U	6.8 U	8 U	8.9 U	21.7 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-039-F1	003-TW-046-F1	003-TW-047-F1	003-TW-DP1-F5	003-TW-050-F1	003-TW-054-F1
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	09/25/97	09/19/97	09/23/97	09/23/97	09/24/97	08/04/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC39	AOC46	AOC47	AOC47	AOC50	AOC54
FIELD DUPLICATE OF:				003-TW-047-F1		
METALS (µg/L)						
ALUMINUM	26 U	26 U	26 U	26 U	26 U	18 U
ARSENIC	1 J	1 U	1 U	1 U	1 U	1 U
BARIUM	36.6 J	44.4 J	113	110	56 J	96.1 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	175000 J	63600	202000	201000	190000 J	149000 J
CHROMIUM	11.6	6 U	13.4	13.1	8.8	9.9
COBALT	6.5	5 U	5 U	5 U	5 U	2 U
COPPER	3.3	3 U	3 U	3 U	3 U	3 U
IRON	987 J	391 J	1840 J	1850 J	2560 J	2090 J
LEAD	1 U	1 U	1 U	1 U	1 UJ	1 U
MAGNESIUM	49600 J	15200	50100	48500	34300 J	29600 J
MANGANESE	851	188 J	678 J	678 J	920	152 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	13.8	5 U	8.4 U	11.7 U	5 U	4.5
POTASSIUM	4620	3690	3640	3650	3980	4120 J
SELENIUM	1 UJ	31 J	1 UJ	1 UJ	1 UJ	5 UJ
SODIUM	11300 J	53500 J	110000 J	105000 J	15300 J	38800 J
THALLIUM	1 UJ	1 U	1 UJ	1 UJ	1 UJ	1 UJ
VANADIUM	2 U	2 U	2 U	2 U	2.2 U	2 U
ZINC	11.6 U	9.3 U	10.1 U	9.2 U	14.5 U	14.1 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-055-F1	003-TW-058-F1	003-TW-063-F1	003-TW-068-F1	003-TW-070-F1	003-TW-071-F1
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/24/97	08/20/97	08/05/97	09/21/97	09/04/97	09/18/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC55	AOC58	AOC63	AOC68	AOC70	AOC71
FIELD DUPLICATE OF:						
METALS (µg/L)						
ALUMINUM	18 U	18 U	18 U	26 U	26 U	26 U
ARSENIC	1 U	1 U	1 U	2.5	1 U	1 U
BARIUM	110 J	24.9 J	35	63.9 J	84.3 J	66.1 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	139000 J	77000 J	112000	204000	226000 J	134000
CHROMIUM	11.1	10.5 U	15.7 U	10.7	12.1	6.2
COBALT	2.1 U	2 U	2.4	5 U	6.6	5 U
COPPER	3 U	3 U	3 U	3 U	3 U	3 U
IRON	1760 J	844 J	1300 J	2180 J	4570 J	1870 J
LEAD	1 U	1 U	1 U	1 U	1 U	1 U
MAGNESIUM	23200 J	20400 J	23600 J	48800	46100 J	34900
MANGANESE	284 J	532 J	62.4 J	369 J	1440 J	1000 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	8.6	4 U	4 U	5 U	10.2	5 U
POTASSIUM	4590 J	3480	2150	2410	3580	2860
SELENIUM	78.8 J	78.4	22.8 J	1 UJ	1 UJ	1 UJ
SODIUM	50100	19800 J	13800 J	52100 J	9300 J	8030 J
THALLIUM	3.6 U	1 U	1 U	1 UJ	1 UJ	1 U
VANADIUM	2 U	2 U	2.5	2 U	2 U	2 U
ZINC	8.7 U	7 U	6.1 U	12.6 U	8.8 U	10.5 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-073-F1	003-TW-DP1-F1	003-TW-074-F1	003-MS-28D-F1	003-MS-28I-F1	003-MS-28S-F1
DEPTH:	Shallow	Shallow	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	07/24/97	07/24/97	07/27/97	02/17/98	02/11/98	02/11/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	AOC73	AOC73	AOC74	MS-28D	MS-28I	MS-28S
FIELD DUPLICATE OF:		003-TW-073-F1				
METALS (µg/L)						
ALUMINUM	18 U	18 U	18 U	28 U	28 U	28 U
ARSENIC	1.4	1 U	1 U	1 U	1 U	1 U
BARIUM	87.7 J	88.9 J	56.4 J	43.6 J	4.7 U	47.7 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	185000 J	186000 J	124000 J	128000 J	48300 J	179000 J
CHROMIUM	13.1	13.8	6.3	10.8	4.5 U	12.1
COBALT	8.2	8.5	6.2	3.9 U	3.9 U	3.9 U
COPPER	3 U	3 U	3 U	3.9 U	3.9 U	3.9 U
IRON	3610 J	2770 J	1640 J	1290 J	4690 J	2280 J
LEAD	1.2	1 U	1 U	0.8 UJ	0.8 UJ	0.8 UJ
MAGNESIUM	40200 J	40300 J	20000 J	49400 J	30600 J	33900 J
MANGANESE	1590 J	1550 J	927 J	407	212	1280
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.44	0.2 U
NICKEL	23.8 J	22.1 U	19.1	4.3 U	4.3 U	4.6
POTASSIUM	4250	4260	4080 J	2510	4280	2990
SELENIUM	1 UJ	1 UJ	1.3 U	1 UJ	1 UJ	1 UJ
SODIUM	17300 J	17400 J	11200 J	14500 J	14900 J	11900 J
THALLIUM	1 U	1 U	1 UJ	1.8 U	1.8 U	1.8 U
VANADIUM	2.5 U	2.3 U	2 U	2.9 U	2.9 U	2.9 U
ZINC	24.8 U	24.6 U	8.8 U	13.8 U	28.7 J	16.8 J

Blank space indicates that the sample was not analyzed for this particular parameter.

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TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-29D-F1	003-MS-29I-F1	003-MS-29S-F1	003-MS-30D-F1	003-MS-30I-F1	003-MS-30S-F1
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Shallow
SAMPLE DATE:	02/16/98	02/16/98	02/16/98	03/03/98	02/24/98	02/24/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-29D	MS-29I	MS-29S	MS-30D	MS-30I	MS-30S
FIELD DUPLICATE OF:						
METALS (µg/L)						
ALUMINUM	28 U	28 U	28 U	28 U	28 U	28 U
ARSENIC	1 U	1.1	1 U	1 U	1 U	1 U
BARIUM	63.9 J	45.4 J	37.9 J	42.4 J	64.2 J	28.9 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3
CALCIUM	118000 J	171000 J	166000 J	210000	156000 J	98600 J
CHROMIUM	9.1	17.7	11.4	18.2	9.4	11.8
COBALT	3.9 U	3.9 U	3.9 U	7.6 U	3.9 U	3.9 U
COPPER	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	4.1
IRON	171 J	5030 J	575 J	2510 J	1380 J	56.7 U
LEAD	0.8 UJ	0.8 UJ	0.8 UJ	0.8 U	0.8 U	0.8 U
MAGNESIUM	45400 J	44900 J	41600 J	66300	47300 J	22500
MANGANESE	339	648	892	588	814 J	3.8
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	4.3 U	4.3 U	11.2	4.3 U	4.3 U	4.3 U
POTASSIUM	2580	2860	5100	2990	3010	2320
SELENIUM	1 UJ	1 UJ	1 UJ	5 UJ	1 UJ	5.7 U
SODIUM	28200 J	5790 J	25500 J	12100	16900 J	12900 J
THALLIUM	1.8 U	1.8 U	1.8 U	9 UJ	1.8 U	1.8 U
VANADIUM	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U
ZINC	17.7 J	87.8 J	16.4 J	5.4 U	13.3 U	22.8 U

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Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-31D-F1	003-MS-31I-F1	003-MS-31S-F1	003-MS-32D-F1	003-MS-32I-F1	003-MS-DP2-F2
DEPTH:	Deep	Intermediate	Shallow	Deep	Intermediate	Intermediate
SAMPLE DATE:	02/26/98	02/18/98	02/17/98	03/02/98	03/02/98	03/02/98
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-31D	MS-31I	MS-31S	MS-32D	MS-32I	MS-32I
FIELD DUPLICATE OF:						003-MS-32I-F1
METALS (µg/L)						
ALUMINUM	28 U	28 U	28 U	28 U	28 U	28 U
ARSENIC	1 U	3	2.6	1 U	8.6	8.9
BARIUM	52.3 J	30.3 J	86.5 J	59.7 J	87 J	90 J
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	136000 J	371000 J	214000 J	117000	212000	219000
CHROMIUM	8.1	22	20.1	6.8	15.2	16.3
COBALT	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
COPPER	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
IRON	1520 J	5770 J	2410 J	763 J	8700 J	8990 J
LEAD	0.8 U	0.8 UJ	0.8 UJ	0.8 U	0.8 U	0.8 U
MAGNESIUM	54700 J	109000 J	56800 J	43900	61500	63700
MANGANESE	317 J	1740	1580	345	849	878
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	4.3 U	4.3 U	32.2	4.3 U	4.3 U	4.3 U
POTASSIUM	3130	3790	4810	2310	2620	2780
SELENIUM	1 UJ	5 UJ	1 UJ	1 UJ	5.1 J	5 UJ
SODIUM	29100 J	8600 J	12200 J	29600	17400	18000
THALLIUM	1.8 U	1.8 U	1.8 U	45 UJ	1.8 UJ	9 UJ
VANADIUM	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U
ZINC	15.6 U	13.5 U	21.4 J	5.4 U	4.9 U	4.4 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-MS-32S-F1	003-MS-33D-F1	003-MS-33I-F1	003-MS-DP2-F1	003-MS-33S-F1	003-TW-P01-F1
DEPTH:	Shallow	Deep	Intermediate	Intermediate	Shallow	Shallow
SAMPLE DATE:	02/27/98	02/26/98	02/25/98	02/25/98	02/25/98	08/08/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	MS-32S	MS-33D	MS-33I	MS-33I	MS-33S	P01
FIELD DUPLICATE OF:				003-MS-33I-F1		
METALS (µg/L)						
ALUMINUM	28 U	28 U	28 U	28 U	48 U	18 U
ARSENIC	6.5 J	1 U	1.3 U	1 U	1 U	1 U
BARIUM	54.4 J	26.8 J	77.3	77.3	61.5	29.8
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3	0.3 U
CALCIUM	206000 J	135000 J	185000 J	185000 J	88300 J	74400
CHROMIUM	15.3	9.7	19.3	9.7	5.9	11.8 U
COBALT	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	2 U
COPPER	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3 U
IRON	4660 J	818 J	6230 J	6220 J	757 J	721 J
LEAD	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	1 U
MAGNESIUM	51000 J	54900 J	67300 J	67900 J	19600 J	15700 J
MANGANESE	906 J	157 J	643 J	643 J	218 J	69 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2	0.2 U	0.2 U
NICKEL	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4 U
POTASSIUM	3950	3050	3730	3580	3400	2170
SELENIUM	1.3 U	2.3 U	1 UJ	5 UJ	11.8 U	6.3 U
SODIUM	39200 J	24300 J	128000 J	129000 J	13100 J	5460 J
THALLIUM	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1 U
VANADIUM	2.9 U	2.9 U	3.4	2.9 U	2.9 U	2 U
ZINC	18.8 U	19.1 U	15.9 U	17.3 U	17.7 U	7.2 U

Blank space indicates that the sample was not analyzed for this particular parameter.

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TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P02-F1	003-TW-P03-F1	003-TW-P04-F1	003-TW-P05-F1	003-TW-P06-F1	003-TW-DP1-F2
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	08/19/97	07/12/97	09/06/97	09/17/97	08/07/97	08/07/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P02	P03	P04	P05	P06	P06
FIELD DUPLICATE OF:						003-TW-P06-F1
METALS (µg/L)						
ALUMINUM	18 U	18 U	26 U	26 U	18 U	18 U
ARSENIC	1 U	1.5 J	1.6	1 U	4.1	4.3
BARIUM	51.8 J	84.1	42.5 J	23.5 J	117	108
BERYLLIUM	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	174000 J	172000 J	145000 J	97000	221000	192000
CHROMIUM	14.4 U	12.9	7.5	8	17 U	22.4 U
COBALT	2.2	5.7 U	5 U	5 U	5.4	2.4
COPPER	3 U	3 U	3 U	3 U	3 U	3 U
IRON	2950 J	3060 J	4380 J	1070 J	4070 J	2030 J
LEAD	1 U	1 UJ	1 U	1 U	1 U	1 U
MAGNESIUM	36400 J	37300 J	47000 J	23600	40600 J	40200 J
MANGANESE	443 J	1630 J	449 J	27.3 J	2270 J	194 J
MERCURY	0.2 U	0.36 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	5.8	20.5	5 U	5 U	4.8	4 U
POTASSIUM	4570	4370	3940	1700	5630	3910
SELENIUM	10.3	5 UJ	1 UJ	53.9 J	1 UJ	1 UJ
SODIUM	10900 J	15600 J	9010 J	10600 J	16800 J	14300 J
THALLIUM	1.5 U	1 UJ	1 U	1 U	1	1 UJ
VANADIUM	2 U	3.2 U	2 U	2 U	2 U	4
ZINC	4.8 U	16.7 U	5.7 U	7.1 U	8.7 U	7.4 U

CTO 0003

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P07-F1	003-TW-P08-F1	003-TW-P09-F1	003-TW-P10-F1	003-TW-DP1-F4	003-TW-P11-F1
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
SAMPLE DATE:	07/11/97	09/03/97	08/24/97	09/05/97	09/05/97	09/09/97
INVESTIGATION:	OU3	OU3	OU3	OU3	OU3	OU3
LOCATION:	P07	P08	P09	P10	P10	P11
FIELD DUPLICATE OF:					003-TW-P10-F1	
METALS (µg/L)						
ALUMINUM	18 U	26 U	18 U	26 U	26 U	26 U
ARSENIC	1 U	1.6	1 U	6.9	8	5.2 J
BARIUM	27.8 J	45.8 J	75 J	65.3 J	66.2 J	71.4 J
BERYLLIUM	0.3	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
CALCIUM	121000 J	182000 J	185000 J	137000 J	141000 J	131000 J
CHROMIUM	6.7	13.8	15.8	7.2	6.3	13.9
COBALT	2 U	8.3	2 U	5 U	5 U	5 U
COPPER	3 U	3 U	3.8	3 U	3 U	3 U
IRON	1360 J	2240 J	2230 J	6620 J	6860 J	1230 J
LEAD	1 UJ	1 U	1 U	1 U	1 U	1 U
MAGNESIUM	29300 J	43500 J	33100 J	38100 J	38900 J	57900 J
MANGANESE	1480 J	2070 J	533 J	634 J	657 J	2820 J
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	4.1	24.5	8.2	5 U	5 U	7.1
POTASSIUM	3600	4600	3620 J	2650	2700	3820
SELENIUM	39.2 J	1 UJ	16.9 J	1 UJ	1 UJ	5 UR
SODIUM	11600 J	11900 J	55800	18800 J	18900 J	13900 J
THALLIUM	1 U	1 UJ	1 UJ	1 UJ	1 UJ	1.8 U
VANADIUM	4.2 U	2 U	2	2 U	2 U	3.1 U
ZINC	14.5 U	10.8 U	11.4 U	5.5 U	4.5 U	5.3 U

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-5
SUMMARY OF POSITIVE DETECTIONS IN FILTERED GROUNDWATER
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER:	003-TW-P12-F1	GW-01-F	GW-02-F	DUP-03-F	GW-03-F	
DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	
SAMPLE DATE:	08/10/97	04/17/95	04/17/95	04/17/95	04/07/95	/ /
INVESTIGATION:	OU3	EAST PLATING	EAST PLATING	EAST PLATING	EAST PLATING	
LOCATION:	P12	SB-01/TW-01	SB-04/TW-02	SB-04/TW-02	SB-06/TW-03	
FIELD DUPLICATE OF:				GW-02-F		
METALS (µg/L)						
ALUMINUM	18 U	46.5 U	370	44 U	35 U	
ARSENIC	7.2	4.9	2 U	2 U	2 U	
BARIUM	138	147	100	89.9	47.1 U	
BERYLLIUM	0.3 U	1 U	1 U	1 U	1 U	
CALCIUM	163000	91500	182000	194000	153000	
CHROMIUM	11.7 U	5 U	5 U	5 U	5 U	
COBALT	2.2	12.2	9 U	9 U	9 U	
COPPER	3 U	23.6	18.8	21.1	6 U	
IRON	17700 J	50.5 U	348	44.7 U	41.1 U	
LEAD	1 U	2 U	2 U	2 U	2 U	
MAGNESIUM	34000 J	30200	55500	58500	42600	
MANGANESE	472 J	201	890	947	199	
MERCURY	0.2 U	0.14 U	0.14 U	0.13 U	0.13 U	
NICKEL	4 U	20.9 U	15.4 U	9 U	9 U	
POTASSIUM	3580	5730	4610	4640	5480	
SELENIUM	5 UR	4 U	4 U	4 U	36.7	
SODIUM	13000 J	90800	9010	9640	11500	
THALLIUM	1 UJ	5 U	5 U	5 U	5 U	
VANADIUM	2 U	5 U	5 U	5 U	5 U	
ZINC	6.7 U	5 U	5 U	5 U	5 U	

Blank space indicates that the sample was not analyzed for this particular parameter.

TABLE 4-6

SCREENING CRITERIA
NIROP FRIDLEY, MINNESOTA

Parameter	State Reference Value (1) mg/kg	Health Risk Limit (1) ug/L	EPA Drinking Water Standard (2)		EPA Drinking Water Health Advisories (2)	
			MCL ug/L	MCLG ug/L	Value ug/L	Receptor
Volatile Organic Compounds						
1,1,1-Trichloroethane	854 sat	600	200	200	200	Lifetime, Adult
1,1,2-Trichloroethane	11 c	3	5	3	3	Lifetime, Adult
1,1-Dichloroethane	50 c	70	NA	NA	NA	NA
1,1-Dichloroethene	0.7	6	7	7	7	Lifetime, Adult
1,2-Dichloroethane	5 c	4	5	0	700	Longer-term, Child
trans-1,2-Dichloroethene	425 n	100	100	100	100	Lifetime, Adult
cis-1,2-Dichloroethene	2200 n	70	70	70	70	Lifetime, Adult
1,2-Dichloroethene (Total)	380 n	NA	NA	NA	NA	NA
2-Butanone	4300 n	4000	NA	NA	NA	NA
2-Hexanone	420 n	300	NA	NA	NA	NA
Acetone	16000 n	700	NA	NA	NA	NA
Benzene	4 n	10	5	0	200	Ten-day,Child
Bromomethane	3.5 n	10	NA	NA	NA	NA
Carbon Disulfide	255 n	700	NA	NA	NA	NA
Chlorobenzene	32 n	100	NA	NA	NA	NA
Chloroethane	1484 sat	NA	NA	NA	NA	NA
Chloroform	4 c	60	0.1/.08	0	100	Ten-day,Child
Chloromethane	21 c	NA	NA	NA	3	Lifetime, Adult
Ethylbenzene	190 sat	700	700	700	700	Lifetime, Adult
Methylene Chloride	150 c	50	5	0	2	DWEL, Adult
Styrene	350 c	NA	100	100	100	Lifetime, Adult
Tetrachloroethene	320 n	7	5	0	500	DWEL, Adult
Toluene	420 n	1000	1000	1000	1000	Lifetime, Adult
Trichloroethene	55 c	30	5	0	300	DWEL, Adult
Vinyl Chloride	0.3 c	0.2	2	0	10	Longer-term, Child
Xylenes, Total	268 sat	10000	10000 (3)	10000(3)	10000 (3)	Lifetime, Adult

TABLE 4-6

SCREENING CRITERIA
NIROP FRIDLEY, MINNESOTA

Parameter	State Reference Value (1) mg/kg	Health Risk Limit (1) ug/L	EPA Drinking Water Standard (2)		EPA Drinking Water Health Advisories (2)	
			MCL ug/L	MCLG ug/L	Value ug/L	Receptor
Semivolatile Organic Compounds						
2,4-Dimethylphenol	4000 n	100	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA
4-Chloro-3-Methylphenol	NA	NA	NA	NA	NA	NA
4-Methyl-2-Pentanone	420 n	300	NA	NA	NA	NA
Acenaphthene	90 sat	400	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA	NA
Anthracene	5 sat	2000	NA	NA	NA	NA
Benzo(a)anthracene	35 c	0.05 (6)	NA	NA	NA	NA
Benzo(a)pyrene	3.5 c	0.05 (6)	NA	NA	NA	NA
Benzo(b)fluoranthene	35 c	0.05 (6)	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	350 c	0.05 (6)	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	2100 c	100	NA	NA	NA	NA
Butylbenzyl phthalate	37000 n	100	NA	NA	7000	DWEL, Adult
Carbazole	NA	NA	NA	NA	NA	NA
Chrysene	3500 c	0.05 (6)	NA	NA	NA	NA
di-n-Butyl Phthalate	18400 n	700	NA	NA	4000	DWEL, Adult
di-n-Octyl Phthalate	3700 n	NA	NA	NA	NA	NA
Diethyl Phthalate	NA	6000	NA	NA	5000	DWEL, Adult
Dibenzo(a,h)anthracene	3.5 c	0.05 (6)	NA	NA	NA	NA
Dibenzofuran	120 sat	NA	NA	NA	NA	NA
Fluoranthene	6400 n	300	NA	NA	NA	NA
Fluorene	3564 sat	300	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	35 c	0.05 (6)	NA	NA	NA	NA
Naphthalene	5.5 n	300	NA	NA	NA	NA
Pentachlorophenol	150 c	3	1	0	300	Ten-day,Child

TABLE 4-6

SCREENING CRITERIA
NIROP FRIDLEY, MINNESOTA

Parameter	State Reference Value (1) mg/kg	Health Risk Limit (1) ug/L	EPA Drinking Water Standard (2)		EPA Drinking Water Health Advisories (2)	
			MCL ug/L	MCLG ug/L	Value ug/L	Receptor
Phenanthrene	NA	NA	NA	NA	NA	NA
Phenol	34000 n	4000	NA	NA	4000	DWEL, Adult
Pyrene	5300 n	200	NA	NA	NA	NA
Polychlorinated biphenyls						
Aroclor-1016	3.5 n (7)	0.04 (7)	0.5	0	NA	NA
Aroclor-1254	3.5 n (7)	0.04 (7)	0.5	0	NA	NA
Metals						
Aluminum	100000 max	NA	50 To 200 (4)	NA	NA	NA
Antimony	100 n	6	6	6	NA	NA
Arsenic	22 c	NA	50	NA	NA	NA
Barium	12500 n	2000	2000	2000	2000	Lifetime, Adult
Beryllium	7 c	0.08	4	4	200	DWEL, Adult
Cadmium	150 n	4	5	5	5	Lifetime, Adult
Calcium	NA	NA	NA	NA	NA	NA
Chromium	100000 max	100 (5)	100 (5)	100 (5)	100 (5)	Lifetime, Adult
Cobalt	13000 n	30 (8)	NA	NA	NA	NA
Copper	9000 n	1000 (8)	1000 (4)	1300	NA	NA
Hexavalent Chromium	155 n	100	NA	NA	NA	NA
Cyanide	5000 n	100	200	200	200	Lifetime, Adult
Iron	NA	NA	300 (4)	NA	NA	NA
Lead	700	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA
Manganese	3200 n	100	50 (4)	NA	NA	NA
Mercury	2 n	NA	2	2	2	Lifetime, Adult
Nickel	3000 n	100	100	100	100	Lifetime, Adult
Potassium	NA	NA	NA	NA	NA	NA
Selenium	1250 n	30	50	50	NA	NA

TABLE 4-6

SCREENING CRITERIA
NIROP FRIDLEY, MINNESOTA

Parameter	State Reference Value (1) mg/kg	Health Risk Limit (1) ug/L	EPA Drinking Water Standard (2)		EPA Drinking Water Health Advisories (2)	
			MCL ug/L	MCLG ug/L	Value ug/L	Receptor
Sodium	NA	NA	NA	NA	NA	NA
Thallium	21 n	0.6	2	0.5	2.3	DWEL, Adult
Vanadium	1300 n	50	NA	NA	NA	NA
Zinc	70000 n	2000	5000 (4)	NA	2000	Lifetime, Adult

Notes:

1 - MPCA, 1997.
2 - U.S. EPA Drinking Water Regulations and Health Advisories, Office of Water, October 1996.
3 - Total xylenes.
4 - Secondary MCL.
5 - Total chromium.
6 - Total PAHs.
7 - Total PCBs.
8 - No health risk limit available, value presented in MPCA Health Based Value (HBV).
MCL - Maximum contaminant level
MCLG - Maximum contaminant level goal
DWEL - Drinking Water Equivalent Level.
c - carcinogenic
n - noncarcinogenic
sat - saturation concentration
max - maximum ceiling limit
NA - Not available.

TABLE 4-7
COMPARISON OF REPORTED DETECTION LIMITS TO STATE REFERENCE VALUES
SOIL SAMPLES 0 - 12 FEET
NIROP FRIDLEY, MINNESOTA

Chemical	Units	Range of Non-Detects	State Reference Value (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	MG/KG	0.01 - 1.5	854	No	0/133
1,1,2,2-TETRACHLOROETHANE	MG/KG	0.01 - 1.5	8.5	No	0/141
1,1,2-TRICHLOROETHANE	MG/KG	0.01 - 1.5	11	No	0/139
1,1-DICHLOROETHANE	MG/KG	0.01 - 1.5	50	No	0/137
1,1-DICHLOROETHENE	MG/KG	0.01 - 1.5	0.7	Yes	1/141
1,2-DICHLOROETHANE	MG/KG	0.01 - 1.5	5	No	0/141
1,2-DICHLOROETHENE (TOTAL)	MG/KG	0.01 - 1.5	380	No	0/132
1,2-DICHLOROPROPANE	MG/KG	0.01 - 1.5	15	No	0/141
2-BUTANONE	MG/KG	0.01 - 1.5	4300	No	0/70
2-HEXANONE	MG/KG	0.01 - 1.5	NV	No	0/132
4-METHYL-2-PENTANONE	MG/KG	0.01 - 1.5	420	No	0/60
ACETONE	MG/KG	0.01 - 1.5	16000	No	0/70
BENZENE	MG/KG	0.01 - 1.5	4	No	0/139
BROMODICHLOROMETHANE	MG/KG	0.01 - 1.5	5	No	0/141
BROMOFORM	MG/KG	0.01 - 1.5	3200	No	0/141
BROMOMETHANE	MG/KG	0.01 - 1.5	3.5	No	0/137
CARBON DISULFIDE	MG/KG	0.01 - 1.5	255	No	0/129
CARBON TETRACHLORIDE	MG/KG	0.01 - 1.5	0.8	Yes	1/141
CHLOROBENZENE	MG/KG	0.01 - 1.5	32	No	0/141
CHLOROETHANE	MG/KG	0.01 - 1.5	1484	No	0/141
CHLOROFORM	MG/KG	0.01 - 1.5	4	No	0/141
CHLOROMETHANE	MG/KG	0.01 - 1.5	21	No	0/141
CIS-1,2-DICHLOROETHENE	MG/KG	0.01	2200	No	0/10
CIS-1,3-DICHLOROPROPENE	MG/KG	0.01 - 1.5	NV	No	0/141
DIBROMOCHLOROMETHANE	MG/KG	0.01 - 1.5	315	No	0/141
ETHYLBENZENE	MG/KG	0.01 - 1.5	190	No	0/132
METHYLENE CHLORIDE	MG/KG	0.01 - 1.5	150	No	0/141
STYRENE	MG/KG	0.01 - 1.5	350	No	0/136
TETRACHLOROETHENE	MG/KG	0.01 - 1.5	320	No	0/121
TOLUENE	MG/KG	0.01 - 1.5	420	No	0/87
TRANS-1,2-DICHLOROETHENE	MG/KG	0.01	425	No	0/10
TRANS-1,3-DICHLOROPROPENE	MG/KG	0.01 - 1.5	NV	No	0/141
TRICHLOROETHENE	MG/KG	0.01 - 0.12	55	No	0/94
VINYL CHLORIDE	MG/KG	0.01 - 1.5	0.3	Yes	1/141
XYLENES, TOTAL	MG/KG	0.01 - 1.5	268	No	0/92
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	MG/KG	0.33 - 17	1120	No	0/125
1,2-DICHLOROBENZENE	MG/KG	0.33 - 17	590	No	0/125
1,3-DICHLOROBENZENE	MG/KG	0.33 - 17	575	No	0/125
1,4-DICHLOROBENZENE	MG/KG	0.33 - 17	50	No	0/125
2,2'-OXYBIS(1-CHLOROPROPANE)	MG/KG	0.33 - 0.7	NV	No	0/16
2,4,5-TRICHLOROPHENOL	MG/KG	0.79 - 43	12000	No	0/125
2,4,6-TRICHLOROPHENOL	MG/KG	0.33 - 17	1730	No	0/125
2,4-DICHLOROPHENOL	MG/KG	0.33 - 17	370	No	0/125
2,4-DIMETHYLPHENOL	MG/KG	0.33 - 17	4000	No	0/125
2,4-DINITROPHENOL	MG/KG	0.34 - 43	NV	No	0/122
2,4-DINITROTOLUENE	MG/KG	0.33 - 17	380	No	0/122
2,6-DINITROTOLUENE	MG/KG	0.33 - 17	175	No	0/125

TABLE 4-7
COMPARISON OF REPORTED DETECTION LIMITS TO STATE REFERENCE VALUES
SOIL SAMPLES 0 - 12 FEET
NIROP FRIDLEY, MINNESOTA

Chemical	Units	Range of Non-Detects	State Reference Value (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
2-CHLORONAPHTHALENE	MG/KG	0.33 - 17	NV	No	0/125
2-CHLOROPHENOL	MG/KG	0.33 - 17	NV	No	0/125
2-METHYLNAPHTHALENE	MG/KG	0.33 - 17	NV	No	0/116
2-METHYLPHENOL	MG/KG	0.33 - 17	5800	No	0/125
2-NITROANILINE	MG/KG	0.79 - 43	NV	No	0/125
2-NITROPHENOL	MG/KG	0.33 - 17	NV	No	0/125
3,3'-DICHLOROBENZIDINE	MG/KG	0.33 - 17	57	No	0/122
3-NITROANILINE	MG/KG	0.79 - 43	NV	No	0/125
4,6-DINITRO-2-METHYLPHENOL	MG/KG	0.79 - 43	NV	No	0/122
4-BROMOPHENYL PHENYL ETHER	MG/KG	0.33 - 17	NV	No	0/122
4-CHLORO-3-METHYLPHENOL	MG/KG	0.33 - 17	NV	No	0/124
4-CHLOROANILINE	MG/KG	0.33 - 17	NV	No	0/125
4-CHLOROPHENYL PHENYL ETHER	MG/KG	0.33 - 17	NV	No	0/122
4-METHYLPHENOL	MG/KG	0.33 - 17	580	No	0/125
4-NITROANILINE	MG/KG	0.79 - 43	NV	No	0/122
4-NITROPHENOL	MG/KG	0.35 - 43	NV	No	0/122
ACENAPHTHENE	MG/KG	0.33 - 17	90	No	0/116
ACENAPHTHYLENE	MG/KG	0.33 - 17	NV	No	0/122
ANTHRACENE	MG/KG	0.33 - 17	5	Yes	1/110
BENZO(A)ANTHRACENE	MG/KG	0.33 - 17	35	No	0/105
BENZO(A)PYRENE	MG/KG	0.33 - 17	3.5	Yes	2/106
BENZO(B)FLUORANTHENE	MG/KG	0.33 - 17	35	No	0/106
BENZO(G,H,I)PERYLENE	MG/KG	0.33 - 17	NV	No	0/107
BENZO(K)FLUORANTHENE	MG/KG	0.33 - 17	350	No	0/105
BIS(2-CHLOROETHOXY)METHANE	MG/KG	0.33 - 17	NV	No	0/125
BIS(2-CHLOROETHYL)ETHER	MG/KG	0.33 - 17	0.8	Yes	3/125
BIS(2-CHLOROISOPROPYL) ETHER	MG/KG	0.33 - 17	NV	No	0/109
BIS(2-ETHYLHEXYL)PHTHALATE	MG/KG	0.04 - 19	2100	No	0/95
BUTYLBENZYL PHTHALATE	MG/KG	0.33 - 17	37000	No	0/119
CARBAZOLE	MG/KG	0.33 - 17	NV	No	0/114
CHRYSENE	MG/KG	0.33 - 17	3500	No	0/103
DI-N-BUTYL PHTHALATE	MG/KG	0.33 - 17	18400	No	0/115
DI-N-OCTYL PHTHALATE	MG/KG	0.33 - 17	3700	No	0/119
DIBENZO(A,H)ANTHRACENE	MG/KG	0.33 - 17	3.5	Yes	2/112
DIBENZOFURAN	MG/KG	0.33 - 17	120	No	0/117
DIETHYL PHTHALATE	MG/KG	0.33 - 17	NV	No	0/122
DIMETHYL PHTHALATE	MG/KG	0.33 - 17	NV	No	0/125
FLUORANTHENE	MG/KG	0.33 - 17	6400	No	0/98
FLUORENE	MG/KG	0.33 - 17	3564	No	0/113
HEXACHLOROBENZENE	MG/KG	0.33 - 17	NV	No	0/122
HEXACHLOROBUTADIENE	MG/KG	0.33 - 17	NV	No	0/125
HEXACHLOROCYCLOPENTADIENE	MG/KG	0.33 - 17	NV	No	0/125
HEXACHLOROETHANE	MG/KG	0.33 - 17	NV	No	0/125
INDENO(1,2,3-CD)PYRENE	MG/KG	0.33 - 17	35	No	0/108
ISOPHORONE	MG/KG	0.33 - 17	NV	No	0/125
N-NITROSO-DI-N-PROPYLAMINE	MG/KG	0.33 - 17	4	Yes	2/125
N-NITROSODIPHENYLAMINE	MG/KG	0.33 - 17	5200	No	0/122
NAPHTHALENE	MG/KG	0.33 - 17	5.5	Yes	1/119
NITROBENZENE	MG/KG	0.33 - 17	NV	No	0/125

TABLE 4-7
COMPARISON OF REPORTED DETECTION LIMITS TO STATE REFERENCE VALUES
SOIL SAMPLES 0 - 12 FEET
NIROP FRIDLEY, MINNESOTA

Chemical	Units	Range of Non-Detects	State Reference Value (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
PENTACHLOROPHENOL	MG/KG	0.34 - 43	150	No	0/121
PHENANTHRENE	MG/KG	0.33 - 17	NV	No	0/103
PHENOL	MG/KG	0.33 - 17	34000	No	0/122
PYRENE	MG/KG	0.33 - 17	5300	No	0/95
PYRIDINE	MG/KG	0.33 - 17	NV	No	0/109
PCBs					
AROCLOR-1016	MG/KG	0.03 - 0.17	3.5	No	0/117
AROCLOR-1221	MG/KG	0.07 - 0.35	3.5	No	0/118
AROCLOR-1232	MG/KG	0.03 - 0.17	3.5	No	0/118
AROCLOR-1242	MG/KG	0.03 - 0.17	3.5	No	0/118
AROCLOR-1248	MG/KG	0.03 - 0.17	3.5	No	0/118
AROCLOR-1254	MG/KG	0.03 - 0.17	3.5	No	0/115
AROCLOR-1260	MG/KG	0.03 - 0.17	3.5	No	0/118
Inorganics					
ALUMINUM	MG/KG	NA	100000	No	0/0
ANTIMONY	MG/KG	2.2 - 9.7	100	No	0/105
ARSENIC	MG/KG	0.29 - 1.6	22	No	0/15
BARIUM	MG/KG	6.8	12500	No	0/1
BERYLLIUM	MG/KG	0.05 - 0.42	7	No	0/50
CADMIUM	MG/KG	0.27 - 3.7	150	No	0/120
CALCIUM	MG/KG	NA	NV	No	0/0
CHROMIUM	MG/KG	4.4 - 9.8	100000	No	0/4
COBALT	MG/KG	1.5 - 4.4	13000	No	0/8
COPPER	MG/KG	1.6 - 4.8	9000	No	0/12
CYANIDE	MG/KG	0.25 - 1.2	5000	No	0/120
IRON	MG/KG	NA	NV	No	0/0
LEAD	MG/KG	1.3	700	No	0/2
MAGNESIUM	MG/KG	NA	NV	No	0/0
MANGANESE	MG/KG	NA	3200	No	0/0
MERCURY	MG/KG	0.03 - 0.1	2	No	0/108
NICKEL	MG/KG	4.6 - 13.8	3000	No	0/11
POTASSIUM	MG/KG	169	NV	No	0/1
SELENIUM	MG/KG	0.13 - 0.88	1250	No	0/103
SILVER	MG/KG	0.4 - 0.97	1250	No	0/125
SODIUM	MG/KG	40.3 - 74.1	NV	No	0/10
THALLIUM	MG/KG	0.13 - 0.97	21	No	0/117
VANADIUM	MG/KG	NA	1300	No	0/0
ZINC	MG/KG	8.5 - 14.8	70000	No	0/12

Notes:
(1) - MPCA State Reference Value for industrial exposures.
(2) - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No State Reference Value available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-8

COMPARISON OF REPORTED DETECTION LIMITS TO STATE REFERENCE VALUES
SOIL SAMPLES > 12 FEET
NIROP FRIDLEY, MINNESOTA

Chemical	Units	Range of Non-Detects	State Reference Value (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	MG/KG	0.01 - 7.2	854	No	0/106
1,1,2,2-TETRACHLOROETHANE	MG/KG	0.01 - 7.2	8.5	No	0/108
1,1,2-TRICHLOROETHANE	MG/KG	0.01 - 7.2	11	No	0/108
1,1-DICHLOROETHANE	MG/KG	0.01 - 7.2	50	No	0/107
1,1-DICHLOROETHENE	MG/KG	0.01 - 7.2	0.7	Yes	2/108
1,2-DICHLOROETHANE	MG/KG	0.01 - 7.2	5	Yes	1/108
1,2-DICHLOROETHENE (TOTAL)	MG/KG	0.01 - 7.2	380	No	0/91
1,2-DICHLOROPROPANE	MG/KG	0.01 - 7.2	15	No	0/108
2-BUTANONE	MG/KG	0.01 - 7.2	4300	No	0/42
2-HEXANONE	MG/KG	0.01 - 7.2	NV	No	0/104
4-METHYL-2-PENTANONE	MG/KG	0.01 - 7.2	420	No	0/44
ACETONE	MG/KG	0.01 - 7.2	16000	No	0/47
BENZENE	MG/KG	0.01 - 7.2	4	Yes	1/108
BROMODICHLOROMETHANE	MG/KG	0.01 - 7.2	5	Yes	1/108
BROMOFORM	MG/KG	0.01 - 7.2	3200	No	0/108
BROMOMETHANE	MG/KG	0.01 - 7.2	3.5	Yes	1/108
CARBON DISULFIDE	MG/KG	0.01 - 7.2	255	No	0/97
CARBON TETRACHLORIDE	MG/KG	0.01 - 7.2	0.8	Yes	2/108
CHLOROBENZENE	MG/KG	0.01 - 7.2	32	No	0/107
CHLOROETHANE	MG/KG	0.01 - 7.2	1484	No	0/108
CHLOROFORM	MG/KG	0.01 - 7.2	4	Yes	1/108
CHLOROMETHANE	MG/KG	0.01 - 7.2	21	No	0/107
CIS-1,3-DICHLOROPROPENE	MG/KG	0.01 - 7.2	NV	No	0/108
DIBROMOCHLOROMETHANE	MG/KG	0.01 - 7.2	315	No	0/108
ETHYLBENZENE	MG/KG	0.01 - 7.2	190	No	0/97
METHYLENE CHLORIDE	MG/KG	0.01 - 7.2	150	No	0/108
STYRENE	MG/KG	0.01 - 7.2	350	No	0/95
TETRACHLOROETHENE	MG/KG	0.01 - 0.12	320	No	0/103
TOLUENE	MG/KG	0.01 - 7.2	420	No	0/64
TRANS-1,3-DICHLOROPROPENE	MG/KG	0.01 - 7.2	NV	No	0/108
TRICHLOROETHENE	MG/KG	0.01 - 0.12	55	No	0/67
VINYL CHLORIDE	MG/KG	0.01 - 7.2	0.3	Yes	2/108
XYLENES, TOTAL	MG/KG	0.01 - 7.2	268	No	0/54
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	MG/KG	0.35 - 0.38	1120	No	0/7
1,2-DICHLOROBENZENE	MG/KG	0.35 - 0.38	590	No	0/7
1,3-DICHLOROBENZENE	MG/KG	0.35 - 0.38	575	No	0/7
1,4-DICHLOROBENZENE	MG/KG	0.35 - 0.38	50	No	0/7
2,2'-OXYBIS(1-CHLOROPROPANE)	MG/KG	0.35 - 0.38	NV	No	0/7
2,4,5-TRICHLOROPHENOL	MG/KG	0.85 - 0.93	12000	No	0/7
2,4,6-TRICHLOROPHENOL	MG/KG	0.35 - 0.38	1730	No	0/7
2,4-DICHLOROPHENOL	MG/KG	0.35 - 0.38	370	No	0/7
2,4-DIMETHYLPHENOL	MG/KG	0.35 - 0.38	4000	No	0/7
2,4-DINITROPHENOL	MG/KG	0.85 - 0.93	NV	No	0/5
2,4-DINITROTOLUENE	MG/KG	0.35 - 0.38	380	No	0/5
2,6-DINITROTOLUENE	MG/KG	0.35 - 0.38	175	No	0/7
2-CHLORONAPHTHALENE	MG/KG	0.35 - 0.38	NV	No	0/7

TABLE 4-8

COMPARISON OF REPORTED DETECTION LIMITS TO STATE REFERENCE VALUES
SOIL SAMPLES > 12 FEET
NIROP FRIDLEY, MINNESOTA

Chemical	Units	Range of Non-Detects	State Reference Value (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
2-CHLOROPHENOL	MG/KG	0.35 - 0.38	NV	No	0/7
2-METHYLNAPHTHALENE	MG/KG	0.35 - 0.38	NV	No	0/7
2-METHYLPHENOL	MG/KG	0.35 - 0.38	5800	No	0/7
2-NITROANILINE	MG/KG	0.85 - 0.93	NV	No	0/7
2-NITROPHENOL	MG/KG	0.35 - 0.38	NV	No	0/7
3,3'-DICHLOROBENZIDINE	MG/KG	0.35 - 0.38	57	No	0/5
3-NITROANILINE	MG/KG	0.85 - 0.93	NV	No	0/7
4,6-DINITRO-2-METHYLPHENOL	MG/KG	0.85 - 0.93	NV	No	0/5
4-BROMOPHENYL PHENYL ETHER	MG/KG	0.35 - 0.38	NV	No	0/5
4-CHLORO-3-METHYLPHENOL	MG/KG	0.35 - 0.38	NV	No	0/7
4-CHLOROANILINE	MG/KG	0.35 - 0.38	NV	No	0/7
4-CHLOROPHENYL PHENYL ETHER	MG/KG	0.35 - 0.38	NV	No	0/5
4-METHYLPHENOL	MG/KG	0.35 - 0.38	580	No	0/6
4-NITROANILINE	MG/KG	0.85 - 0.93	NV	No	0/5
4-NITROPHENOL	MG/KG	0.85 - 0.93	NV	No	0/5
ACENAPHTHENE	MG/KG	0.35 - 0.38	90	No	0/7
ACENAPHTHYLENE	MG/KG	0.35 - 0.38	NV	No	0/7
ANTHRACENE	MG/KG	0.35 - 0.38	5	No	0/5
BENZO(A)ANTHRACENE	MG/KG	0.35 - 0.38	35	No	0/5
BENZO(A)PYRENE	MG/KG	0.35 - 0.38	3.5	No	0/5
BENZO(B)FLUORANTHENE	MG/KG	0.35 - 0.38	35	No	0/5
BENZO(G,H,I)PERYLENE	MG/KG	0.35 - 0.38	NV	No	0/5
BENZO(K)FLUORANTHENE	MG/KG	0.35 - 0.38	350	No	0/5
BIS(2-CHLOROETHOXY)METHANE	MG/KG	0.35 - 0.38	NV	No	0/7
BIS(2-CHLOROETHYL)ETHER	MG/KG	0.35 - 0.38	0.8	No	0/7
BIS(2-ETHYLHEXYL)PHTHALATE	MG/KG	0.35	2100	No	0/1
BUTYLBENZYL PHTHALATE	MG/KG	0.35 - 0.38	37000	No	0/5
CARBAZOLE	MG/KG	0.35 - 0.38	NV	No	0/5
CHRYSENE	MG/KG	0.35 - 0.38	3500	No	0/5
DI-N-BUTYL PHTHALATE	MG/KG	0.35 - 0.38	18400	No	0/4
DI-N-OCTYL PHTHALATE	MG/KG	0.35 - 0.38	3700	No	0/5
DIBENZO(A,H)ANTHRACENE	MG/KG	0.35 - 0.38	3.5	No	0/5
DIBENZOFURAN	MG/KG	0.35 - 0.38	120	No	0/5
DIETHYL PHTHALATE	MG/KG	0.35 - 0.38	NV	No	0/5
DIMETHYL PHTHALATE	MG/KG	0.35 - 0.38	NV	No	0/7
FLUORANTHENE	MG/KG	0.35 - 0.38	6400	No	0/5
FLUORENE	MG/KG	0.35 - 0.38	3564	No	0/5
HEXACHLOROBENZENE	MG/KG	0.35 - 0.38	NV	No	0/5
HEXACHLOROBUTADIENE	MG/KG	0.35 - 0.38	NV	No	0/7
HEXACHLOROCYCLOPENTADIENE	MG/KG	0.35 - 0.38	NV	No	0/7
HEXACHLOROETHANE	MG/KG	0.35 - 0.38	NV	No	0/7
INDENO(1,2,3-CD)PYRENE	MG/KG	0.35 - 0.38	35	No	0/5
ISOPHORONE	MG/KG	0.35 - 0.38	NV	No	0/7
N-NITROSO-DI-N-PROPYLAMINE	MG/KG	0.35 - 0.38	4	No	0/7
N-NITROSODIPHENYLAMINE	MG/KG	0.35 - 0.38	5200	No	0/5
NAPHTHALENE	MG/KG	0.35 - 0.38	5.5	No	0/7
NITROBENZENE	MG/KG	0.35 - 0.38	NV	No	0/7
PENTACHLOROPHENOL	MG/KG	0.85 - 0.93	150	No	0/5

TABLE 4-8

COMPARISON OF REPORTED DETECTION LIMITS TO STATE REFERENCE VALUES
SOIL SAMPLES > 12 FEET
NIROP FRIDLEY, MINNESOTA

Chemical	Units	Range of Non-Detects	State Reference Value (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
PHENANTHRENE	MG/KG	0.35 - 0.38	NV	No	0/5
PHENOL	MG/KG	0.35 - 0.38	34000	No	0/7
PYRENE	MG/KG	0.35 - 0.38	5300	No	0/5
PCBs					
AROCLOR-1016	MG/KG	0.04 - 0.07	3.5	No	0/4
AROCLOR-1221	MG/KG	0.07 - 0.15	3.5	No	0/4
AROCLOR-1232	MG/KG	0.04 - 0.07	3.5	No	0/4
AROCLOR-1242	MG/KG	0.04 - 0.07	3.5	No	0/4
AROCLOR-1248	MG/KG	0.04 - 0.07	3.5	No	0/4
AROCLOR-1254	MG/KG	0.04 - 0.07	3.5	No	0/4
AROCLOR-1260	MG/KG	0.04 - 0.07	3.5	No	0/4
Inorganics					
ALUMINUM	MG/KG	NA	100000	No	0/0
ANTIMONY	MG/KG	8.4 - 10.1	100	No	0/7
ARSENIC	MG/KG	NA	22	No	0/0
BARIUM	MG/KG	6.6 - 9.9	12500	No	0/4
BERYLLIUM	MG/KG	0.17 - 0.2	7	No	0/2
CADMIUM	MG/KG	0.5 - 0.7	150	No	0/7
CALCIUM	MG/KG	NA	NV	No	0/0
CHROMIUM	MG/KG	4.8 - 10.2	100000	No	0/5
COBALT	MG/KG	NA	13000	No	0/0
COPPER	MG/KG	6.1 - 9.2	9000	No	0/2
CYANIDE	MG/KG	1 - 1.1	5000	No	0/6
IRON	MG/KG	NA	NV	No	0/0
LEAD	MG/KG	NA	700	No	0/0
MAGNESIUM	MG/KG	NA	NV	No	0/0
MANGANESE	MG/KG	NA	3200	No	0/0
MERCURY	MG/KG	0.04 - 0.06	2	No	0/7
NICKEL	MG/KG	5.5 - 14	3000	No	0/6
POTASSIUM	MG/KG	NA	NV	No	0/0
SELENIUM	MG/KG	0.67 - 0.81	1250	No	0/7
SILVER	MG/KG	0.84 - 1	1250	No	0/7
SODIUM	MG/KG	70.6 - 95	NV	No	0/3
THALLIUM	MG/KG	0.84 - 1	21	No	0/7
VANADIUM	MG/KG	NA	1300	No	0/0
ZINC	MG/KG	7.8 - 7.9	70000	No	0/2

Notes:
1 - MPCA State Reference Value for industrial exposures.
2 - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No State Reference Value available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-9

COMPARISON OF REPORTED DETECTON LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	UG/L	1 - 1000	600	Yes	2/40
1,1,2,2-TETRACHLOROETHANE	UG/L	1 - 1000	2	Yes	8/63
1,1,2-TRICHLOROETHANE	UG/L	1 - 1000	3	Yes	7/59
1,1-DICHLOROETHANE	UG/L	1 - 1000	70	Yes	2/19
1,1-DICHLOROETHENE	UG/L	1 - 1000	6	Yes	6/22
1,2-DICHLOROETHANE	UG/L	1 - 1000	4	Yes	7/57
1,2-DICHLOROETHENE (TOTAL)	UG/L	NA	NV	No	0/0
1,2-DICHLOROPROPANE	UG/L	1 - 1000	5	Yes	7/63
2-BUTANONE	UG/L	10 - 1000	4000	No	0/3
2-HEXANONE	UG/L	5 - 1000	NV	No	0/17
4-METHYL-2-PENTANONE	UG/L	5 - 5000	300	Yes	2/63
ACETONE	UG/L	5 - 1000	700	Yes	1/5
BENZENE	UG/L	1 - 1000	10	Yes	4/62
BROMODICHLOROMETHANE	UG/L	1 - 1000	6	Yes	7/63
BROMOFORM	UG/L	1 - 1000	40	Yes	3/63
BROMOMETHANE	UG/L	1 - 1000	10	Yes	4/63
CARBON DISULFIDE	UG/L	1 - 1000	700	Yes	2/62
CARBON TETRACHLORIDE	UG/L	1 - 1000	3	Yes	8/63
CHLOROBENZENE	UG/L	1 - 1000	100	Yes	2/63
CHLOROETHANE	UG/L	1 - 1000	NV	No	0/63
CHLOROFORM	UG/L	1 - 1000	60	Yes	3/62
CHLOROMETHANE	UG/L	1 - 1000	3	Yes	8/56
CIS-1,2-DICHLOROETHENE	UG/L	1 - 5	70	No	0/13
CIS-1,3-DICHLOROPROPENE	UG/L	1 - 1000	NV	No	0/63
DIBROMOCHLOROMETHANE	UG/L	1 - 1000	10	Yes	4/63
ETHYLBENZENE	UG/L	1 - 1000	700	Yes	2/59
M+P-XYLENES	UG/L	1 - 1000	10000	No	0/55
METHYLENE CHLORIDE	UG/L	2 - 1000	50	Yes	2/62
O-XYLENE	UG/L	1 - 1000	10000	No	0/55
STYRENE	UG/L	1 - 1000	100	Yes	2/63
TETRACHLOROETHENE	UG/L	1 - 1000	7	Yes	4/34
TOLUENE	UG/L	1 - 1000	1000	No	0/57
TRANS-1,2-DICHLOROETHENE	UG/L	1 - 20	100	No	0/19
TRANS-1,3-DICHLOROPROPENE	UG/L	1 - 1000	NV	No	0/63
TRICHLOROETHENE	UG/L	1 - 20	30	No	0/3
VINYL CHLORIDE	UG/L	0.3 - 1000	0.2	Yes	50/50
XYLENES, TOTAL	UG/L	10 - 1000	NV	No	0/4
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	UG/L	5 - 11	70	No	0/63
1,2-DICHLOROBENZENE	UG/L	5 - 11	600	No	0/63

TABLE 4-9

COMPARISON OF REPORTED DETECTON LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
1,3-DICHLOROBENZENE	UG/L	5 - 11	600	No	0/63
1,4-DICHLOROBENZENE	UG/L	5 - 11	10	Yes	14/63
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	1 - 10	300	No	0/10
2,4,5-TRICHLOROPHENOL	UG/L	20 - 27	70	No	0/63
2,4,6-TRICHLOROPHENOL	UG/L	5 - 11	30	No	0/63
2,4-DICHLOROPHENOL	UG/L	5 - 11	20	No	0/63
2,4-DIMETHYLPHENOL	UG/L	5 - 11	100	No	0/61
2,4-DINITROPHENOL	UG/L	10 - 26	10	Yes	31/63
2,4-DINITROTOLUENE	UG/L	2 - 10	0.5	Yes	63/63
2,6-DINITROTOLUENE	UG/L	2 - 10	0.5	Yes	63/63
2-CHLORONAPHTHALENE	UG/L	5 - 11	NV	No	0/63
2-CHLOROPHENOL	UG/L	5 - 11	30	No	0/63
2-METHYLNAPHTHALENE	UG/L	5 - 11	NV	No	0/62
2-METHYLPHENOL	UG/L	3 - 10	30	No	0/62
2-NITROANILINE	UG/L	20 - 27	NV	No	0/63
2-NITROPHENOL	UG/L	5 - 11	200	No	0/63
3,3'-DICHLOROBENZIDINE	UG/L	5 - 11	0.8	Yes	63/63
3-NITROANILINE	UG/L	20 - 27	NV	No	0/63
4,6-DINITRO-2-METHYLPHENOL	UG/L	20 - 27	NV	No	0/63
4-BROMOPHENYL PHENYL ETHER	UG/L	5 - 11	NV	No	0/63
4-CHLORO-3-METHYLPHENOL	UG/L	5 - 11	NV	No	0/62
4-CHLOROANILINE	UG/L	5 - 11	NV	No	0/63
4-CHLOROPHENYL PHENYL ETHER	UG/L	5 - 11	NV	No	0/63
4-METHYLPHENOL	UG/L	5 - 11	3	Yes	62/62
4-NITROANILINE	UG/L	20 - 27	NV	No	0/63
4-NITROPHENOL	UG/L	20 - 27	NV	No	0/63
ACENAPHTHENE	UG/L	5 - 11	400	No	0/63
ACENAPHTHYLENE	UG/L	5 - 11	NV	No	0/63
ANTHRACENE	UG/L	5 - 11	2000	No	0/63
BENZO(A)ANTHRACENE	UG/L	1 - 10	0.05	Yes	63/63
BENZO(A)PYRENE	UG/L	1 - 10	0.05	Yes	63/63
BENZO(B)FLUORANTHENE	UG/L	1 - 10	0.05	Yes	63/63
BENZO(G,H,I)PERYLENE	UG/L	5 - 11	NV	No	0/63
BENZO(K)FLUORANTHENE	UG/L	5 - 10	0.05	Yes	63/63
BIS(2-CHLOROETHOXY)METHANE	UG/L	5 - 11	NV	No	0/63
BIS(2-CHLOROETHYL)ETHER	UG/L	1 - 10	NV	No	0/63
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 - 11	NV	No	0/53
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	1 - 11	20	No	0/59
BUTYLBENZYL PHTHALATE	UG/L	5 - 11	100	No	0/56
CARBAZOLE	UG/L	5 - 11	NV	No	0/63
CHRYSENE	UG/L	5 - 11	0.05	Yes	63/63

TABLE 4-9

COMPARISON OF REPORTED DETECTON LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
DI-N-BUTYL PHTHALATE	UG/L	1 - 11	NV	No	0/60
DI-N-OCTYL PHTHALATE	UG/L	5 - 11	NV	No	0/62
DIBENZO(A,H)ANTHRACENE	UG/L	1 - 10	0.05	Yes	63/63
DIBENZOFURAN	UG/L	5 - 11	NV	No	0/63
DIETHYL PHTHALATE	UG/L	5 - 11	6000	No	0/62
DIMETHYL PHTHALATE	UG/L	5 - 11	70000	No	0/63
FLUORANTHENE	UG/L	5 - 11	300	No	0/63
FLUORENE	UG/L	5 - 11	300	No	0/63
HEXACHLOROBENZENE	UG/L	1 - 10	0.2	Yes	63/63
HEXACHLOROBUTADIENE	UG/L	1 - 10	1	Yes	4/63
HEXACHLOROCYCLOPENTADIENE	UG/L	5 - 11	50	No	0/63
HEXACHLOROETHANE	UG/L	2 - 10	1	Yes	63/63
INDENO(1,2,3-CD)PYRENE	UG/L	1 - 10	0.05	Yes	63/63
ISOPHORONE	UG/L	5 - 11	100	No	0/63
N-NITROSO-DI-N-PROPYLAMINE	UG/L	5 - 11	NV	No	0/63
N-NITROSODIPHENYLAMINE	UG/L	5 - 11	70	No	0/63
NAPHTHALENE	UG/L	5 - 11	300	No	0/61
NITROBENZENE	UG/L	5 - 11	NV	No	0/63
PENTACHLOROPHENOL	UG/L	10 - 26	3	Yes	61/61
PHENANTHRENE	UG/L	5 - 11	NV	No	0/63
PHENOL	UG/L	5 - 11	4000	No	0/60
PYRENE	UG/L	5 - 11	200	No	0/63
PYRIDINE	UG/L	10 - 11	NV	No	0/53
PCBs					
AROCLOR-1016	UG/L	0.2 - 1	0.04	Yes	62/62
AROCLOR-1221	UG/L	0.4 - 2	0.04	Yes	62/62
AROCLOR-1232	UG/L	0.2 - 1	0.04	Yes	62/62
AROCLOR-1242	UG/L	0.2 - 1	0.04	Yes	62/62
AROCLOR-1248	UG/L	0.2 - 1	0.04	Yes	62/62
AROCLOR-1254	UG/L	0.2 - 1	0.04	Yes	62/62
AROCLOR-1260	UG/L	0.2 - 1	0.04	Yes	62/62
Inorganics					
ALUMINUM	UG/L	18 - 196	50	Yes	10/36
ANTIMONY	UG/L	14 - 50	6	Yes	63/63
ARSENIC	UG/L	1 - 3.4	50	No	0/41
BARIUM	UG/L	NA	2000	No	0/0
BERYLLIUM	UG/L	0.3 - 1	0.08	Yes	56/56
CADMIUM	UG/L	1.9 - 5.6	4	Yes	1/63
CALCIUM	UG/L	NA	NV	No	0/0
CHROMIUM	UG/L	6 - 28.9	100	No	0/14
COBALT	UG/L	2 - 12.2	30	No	0/49

TABLE 4-9

COMPARISON OF REPORTED DETECTON LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
COPPER	UG/L	3 - 28.7	1000	No	0/47
CYANIDE	UG/L	5 - 10	100	No	0/54
IRON	UG/L	111 - 2340	300	Yes	1/2
LEAD	UG/L	0.8 - 1.2	NV	No	0/47
MAGNESIUM	UG/L	NA	NV	No	0/0
MANGANESE	UG/L	4.7	1000	No	0/1
MERCURY	UG/L	0.1 - 0.2	2	No	0/61
NICKEL	UG/L	4 - 63.6	100	No	0/36
POTASSIUM	UG/L	NA	NV	No	0/0
SELENIUM	UG/L	1 - 12.5	30	No	0/35
SILVER	UG/L	3 - 5	30	No	0/63
SODIUM	UG/L	NA	NV	No	0/0
THALLIUM	UG/L	1 - 5	0.6	Yes	60/60
VANADIUM	UG/L	2 - 9.6	50	No	0/48
ZINC	UG/L	4 - 36.8	2000	No	0/46

Notes:
1 - MPCA Health Risk Limit or Health Risk Value.
2 - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No criteria available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-10

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	UG/L	1 - 1000	200	Yes	2/40
1,1,2,2-TETRACHLOROETHANE	UG/L	1 - 1000	NV	No	0/63
1,1,2-TRICHLOROETHANE	UG/L	1 - 1000	5	Yes	7/59
1,1-DICHLOROETHANE	UG/L	1 - 1000	NV	No	0/19
1,1-DICHLOROETHENE	UG/L	1 - 1000	7	Yes	6/22
1,2-DICHLOROETHANE	UG/L	1 - 1000	5	Yes	7/57
1,2-DICHLOROETHENE (TOTAL)	UG/L	NA	70	No	0/0
1,2-DICHLOROPROPANE	UG/L	1 - 1000	5	Yes	7/63
2-BUTANONE	UG/L	10 - 1000	NV	No	0/3
2-HEXANONE	UG/L	5 - 1000	NV	No	0/17
4-METHYL-2-PENTANONE	UG/L	5 - 5000	NV	No	0/63
ACETONE	UG/L	5 - 1000	NV	No	0/5
BENZENE	UG/L	1 - 1000	5	Yes	7/62
BROMODICHLOROMETHANE	UG/L	1 - 1000	80	Yes	3/63
BROMOFORM	UG/L	1 - 1000	80	Yes	3/63
BROMOMETHANE	UG/L	1 - 1000	NV	No	0/63
CARBON DISULFIDE	UG/L	1 - 1000	NV	No	0/62
CARBON TETRACHLORIDE	UG/L	1 - 1000	5	Yes	7/63
CHLOROBENZENE	UG/L	1 - 1000	100	Yes	2/63
CHLOROETHANE	UG/L	1 - 1000	NV	No	0/63
CHLOROFORM	UG/L	1 - 1000	80	Yes	3/62
CHLOROMETHANE	UG/L	1 - 1000	NV	No	0/56
CIS-1,2-DICHLOROETHENE	UG/L	1 - 5	70	No	0/13
CIS-1,3-DICHLOROPROPENE	UG/L	1 - 1000	NV	No	0/63
DIBROMOCHLOROMETHANE	UG/L	1 - 1000	NV	No	0/63
ETHYLBENZENE	UG/L	1 - 1000	700	Yes	2/59
M+P-XYLENES	UG/L	1 - 1000	10000	No	0/55
METHYLENE CHLORIDE	UG/L	2 - 1000	5	Yes	7/62
O-XYLENE	UG/L	1 - 1000	10000	No	0/55
STYRENE	UG/L	1 - 1000	100	Yes	2/63
TETRACHLOROETHENE	UG/L	1 - 1000	5	Yes	4/34
TOLUENE	UG/L	1 - 1000	1000	No	0/57
TRANS-1,2-DICHLOROETHENE	UG/L	1 - 20	100	No	0/19
TRANS-1,3-DICHLOROPROPENE	UG/L	1 - 1000	NV	No	0/63
TRICHLOROETHENE	UG/L	1 - 20	5	Yes	1/3
VINYL CHLORIDE	UG/L	0.3 - 1000	2	Yes	7/50
XYLENES, TOTAL	UG/L	10 - 1000	10000	No	0/4
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	UG/L	5 - 11	70	No	0/63
1,2-DICHLOROBENZENE	UG/L	5 - 11	600	No	0/63
1,3-DICHLOROBENZENE	UG/L	5 - 11	NV	No	0/63

TABLE 4-10

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
1,4-DICHLOROBENZENE	UG/L	5 - 11	75	No	0/63
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	1 - 10	NV	No	0/10
2,4,5-TRICHLOROPHENOL	UG/L	20 - 27	NV	No	0/63
2,4,6-TRICHLOROPHENOL	UG/L	5 - 11	NV	No	0/63
2,4-DICHLOROPHENOL	UG/L	5 - 11	NV	No	0/63
2,4-DIMETHYLPHENOL	UG/L	5 - 11	NV	No	0/61
2,4-DINITROPHENOL	UG/L	10 - 26	NV	No	0/63
2,4-DINITROTOLUENE	UG/L	2 - 10	NV	No	0/63
2,6-DINITROTOLUENE	UG/L	2 - 10	NV	No	0/63
2-CHLORONAPHTHALENE	UG/L	5 - 11	NV	No	0/63
2-CHLOROPHENOL	UG/L	5 - 11	NV	No	0/63
2-METHYLNAPHTHALENE	UG/L	5 - 11	NV	No	0/62
2-METHYLPHENOL	UG/L	3 - 10	NV	No	0/62
2-NITROANILINE	UG/L	20 - 27	NV	No	0/63
2-NITROPHENOL	UG/L	5 - 11	NV	No	0/63
3,3'-DICHLOROBENZIDINE	UG/L	5 - 11	NV	No	0/63
3-NITROANILINE	UG/L	20 - 27	NV	No	0/63
4,6-DINITRO-2-METHYLPHENOL	UG/L	20 - 27	NV	No	0/63
4-BROMOPHENYL PHENYL ETHER	UG/L	5 - 11	NV	No	0/63
4-CHLORO-3-METHYLPHENOL	UG/L	5 - 11	NV	No	0/62
4-CHLOROANILINE	UG/L	5 - 11	NV	No	0/63
4-CHLOROPHENYL PHENYL ETHER	UG/L	5 - 11	NV	No	0/63
4-METHYLPHENOL	UG/L	5 - 11	NV	No	0/62
4-NITROANILINE	UG/L	20 - 27	NV	No	0/63
4-NITROPHENOL	UG/L	20 - 27	NV	No	0/63
ACENAPHTHENE	UG/L	5 - 11	NV	No	0/63
ACENAPHTHYLENE	UG/L	5 - 11	NV	No	0/63
ANTHRACENE	UG/L	5 - 11	NV	No	0/63
BENZO(A)ANTHRACENE	UG/L	1 - 10	NV	No	0/63
BENZO(A)PYRENE	UG/L	1 - 10	0.2	Yes	63/63
BENZO(B)FLUORANTHENE	UG/L	1 - 10	NV	No	0/63
BENZO(G,H,I)PERYLENE	UG/L	5 - 11	NV	No	0/63
BENZO(K)FLUORANTHENE	UG/L	5 - 10	NV	No	0/63
BIS(2-CHLOROETHOXY)METHANE	UG/L	5 - 11	NV	No	0/63
BIS(2-CHLOROETHYL)ETHER	UG/L	1 - 10	NV	No	0/63
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 - 11	NV	No	0/53
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	1 - 11	6	Yes	53/59
BUTYLBENZYL PHTHALATE	UG/L	5 - 11	NV	No	0/56
CARBAZOLE	UG/L	5 - 11	NV	No	0/63
CHRYSENE	UG/L	5 - 11	NV	No	0/63
DI-N-BUTYL PHTHALATE	UG/L	1 - 11	NV	No	0/60
DI-N-OCTYL PHTHALATE	UG/L	5 - 11	NV	No	0/62

TABLE 4-10

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
DIBENZO(A,H)ANTHRACENE	UG/L	1 - 10	NV	No	0/63
DIBENZOFURAN	UG/L	5 - 11	NV	No	0/63
DIETHYL PHTHALATE	UG/L	5 - 11	NV	No	0/62
DIMETHYL PHTHALATE	UG/L	5 - 11	NV	No	0/63
FLUORANTHENE	UG/L	5 - 11	NV	No	0/63
FLUORENE	UG/L	5 - 11	NV	No	0/63
HEXACHLOROBENZENE	UG/L	1 - 10	1	Yes	4/63
HEXACHLOROBUTADIENE	UG/L	1 - 10	NV	No	0/63
HEXACHLOROCYCLOPENTADIENE	UG/L	5 - 11	50	No	0/63
HEXACHLOROETHANE	UG/L	2 - 10	NV	No	0/63
INDENO(1,2,3-CD)PYRENE	UG/L	1 - 10	NV	No	0/63
ISOPHORONE	UG/L	5 - 11	NV	No	0/63
N-NITROSO-DI-N-PROPYLAMINE	UG/L	5 - 11	NV	No	0/63
N-NITROSODIPHENYLAMINE	UG/L	5 - 11	NV	No	0/63
NAPHTHALENE	UG/L	5 - 11	NV	No	0/61
NITROBENZENE	UG/L	5 - 11	NV	No	0/63
PENTACHLOROPHENOL	UG/L	10 - 26	1	Yes	61/61
PHENANTHRENE	UG/L	5 - 11	NV	No	0/63
PHENOL	UG/L	5 - 11	NV	No	0/60
PYRENE	UG/L	5 - 11	NV	No	0/63
PYRIDINE	UG/L	10 - 11	NV	No	0/53
PCBs					
AROCLOR-1016	UG/L	0.2 - 1	0.5	Yes	27/62
AROCLOR-1221	UG/L	0.4 - 2	0.5	Yes	56/62
AROCLOR-1232	UG/L	0.2 - 1	0.5	Yes	27/62
AROCLOR-1242	UG/L	0.2 - 1	0.5	Yes	27/62
AROCLOR-1248	UG/L	0.2 - 1	0.5	Yes	27/62
AROCLOR-1254	UG/L	0.2 - 1	0.5	Yes	27/62
AROCLOR-1260	UG/L	0.2 - 1	0.5	Yes	27/62
Inorganics					
ALUMINUM	UG/L	18 - 196	50	Yes	10/36
ANTIMONY	UG/L	14 - 50	6	Yes	63/63
ARSENIC	UG/L	1 - 3.4	50	No	0/41
BARIUM	UG/L	NA	2000	No	0/0
BERYLLIUM	UG/L	0.3 - 1	4	No	0/56
CADMIUM	UG/L	1.9 - 5.6	5	Yes	1/63
CALCIUM	UG/L	NA	NV	No	0/0
CHROMIUM	UG/L	6 - 28.9	100	No	0/14
COBALT	UG/L	2 - 12.2	NV	No	0/49
COPPER	UG/L	3 - 28.7	1300	No	0/47
CYANIDE	UG/L	5 - 10	200	No	0/54
IRON	UG/L	111 - 2340	300	Yes	1/2

TABLE 4-10

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - SHALLOW WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
LEAD	UG/L	0.8 - 1.2	15	No	0/47
MAGNESIUM	UG/L	NA	NV	No	0/0
MANGANESE	UG/L	4.7	50	No	0/1
MERCURY	UG/L	0.1 - 0.2	2	No	0/61
NICKEL	UG/L	4 - 63.6	100	No	0/36
POTASSIUM	UG/L	NA	NV	No	0/0
SELENIUM	UG/L	1 - 12.5	50	No	0/35
SILVER	UG/L	3 - 5	100	No	0/63
SODIUM	UG/L	NA	NV	No	0/0
THALLIUM	UG/L	1 - 5	2	Yes	6/60
VANADIUM	UG/L	2 - 9.6	NV	No	0/48
ZINC	UG/L	4 - 36.8	5000	No	0/46

Notes:
1 - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No criteria available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-11

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	UG/L	1	600	No	0/8
1,1,2,2-TETRACHLOROETHANE	UG/L	1	2	No	0/8
1,1,2-TRICHLOROETHANE	UG/L	1	3	No	0/8
1,1-DICHLOROETHANE	UG/L	1	70	No	0/3
1,1-DICHLOROETHENE	UG/L	1	6	No	0/1
1,2-DICHLOROETHANE	UG/L	1	4	No	0/7
1,2-DICHLOROPROPANE	UG/L	1	5	No	0/8
2-BUTANONE	UG/L	NA	4000	No	0/0
2-HEXANONE	UG/L	NA	NV	No	0/0
4-METHYL-2-PENTANONE	UG/L	5	300	No	0/8
ACETONE	UG/L	NA	700	No	0/0
BENZENE	UG/L	1	10	No	0/8
BROMODICHLOROMETHANE	UG/L	1	6	No	0/8
BROMOFORM	UG/L	1	40	No	0/8
BROMOMETHANE	UG/L	1	10	No	0/8
CARBON DISULFIDE	UG/L	1	700	No	0/8
CARBON TETRACHLORIDE	UG/L	1	3	No	0/8
CHLOROBENZENE	UG/L	1	100	No	0/8
CHLOROETHANE	UG/L	1	NV	No	0/6
CHLOROFORM	UG/L	1	60	No	0/8
CHLOROMETHANE	UG/L	1	3	No	0/4
CIS-1,2-DICHLOROETHENE	UG/L	1	70	No	0/1
CIS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/8
DIBROMOCHLOROMETHANE	UG/L	1	10	No	0/8
ETHYLBENZENE	UG/L	1	700	No	0/5
M+P-XYLENES	UG/L	1	NV	No	0/5
METHYLENE CHLORIDE	UG/L	2	50	No	0/8
O-XYLENE	UG/L	1	NV	No	0/6
STYRENE	UG/L	1	100	No	0/8
TETRACHLOROETHENE	UG/L	1	7	No	0/4
TOLUENE	UG/L	1	1000	No	0/4
TRANS-1,2-DICHLOROETHENE	UG/L	1	100	No	0/2
TRANS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/8
TRICHLOROETHENE	UG/L	1	30	No	0/1
VINYL CHLORIDE	UG/L	0.3	0.2	Yes	2/2
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	UG/L	5	70	No	0/8
1,2-DICHLOROBENZENE	UG/L	5	600	No	0/8
1,3-DICHLOROBENZENE	UG/L	5	600	No	0/8
1,4-DICHLOROBENZENE	UG/L	5	10	No	0/8

TABLE 4-11

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	1	300	No	0/8
2,4,5-TRICHLOROPHENOL	UG/L	20 - 21	70	No	0/8
2,4,6-TRICHLOROPHENOL	UG/L	5	30	No	0/8
2,4-DICHLOROPHENOL	UG/L	5	20	No	0/8
2,4-DIMETHYLPHENOL	UG/L	5	100	No	0/8
2,4-DINITROPHENOL	UG/L	20 - 21	10	Yes	8/8
2,4-DINITROTOLUENE	UG/L	5	0.5	Yes	8/8
2,6-DINITROTOLUENE	UG/L	2	0.5	Yes	8/8
2-CHLORONAPHTHALENE	UG/L	5	NV	No	0/8
2-CHLOROPHENOL	UG/L	5	30	No	0/8
2-METHYLNAPHTHALENE	UG/L	5	NV	No	0/8
2-METHYLPHENOL	UG/L	3	30	No	0/8
2-NITROANILINE	UG/L	20 - 21	NV	No	0/8
2-NITROPHENOL	UG/L	5	200	No	0/8
3,3'-DICHLOROBENZIDINE	UG/L	5	0.8	Yes	8/8
3-NITROANILINE	UG/L	20 - 21	NV	No	0/8
4,6-DINITRO-2-METHYLPHENOL	UG/L	20 - 21	NV	No	0/8
4-BROMOPHENYL PHENYL ETHER	UG/L	5	NV	No	0/8
4-CHLORO-3-METHYLPHENOL	UG/L	5	NV	No	0/8
4-CHLOROANILINE	UG/L	5	NV	No	0/8
4-CHLOROPHENYL PHENYL ETHER	UG/L	5	NV	No	0/8
4-METHYLPHENOL	UG/L	5	3	Yes	8/8
4-NITROANILINE	UG/L	20 - 21	NV	No	0/8
4-NITROPHENOL	UG/L	20 - 21	NV	No	0/8
ACENAPHTHENE	UG/L	5	400	No	0/8
ACENAPHTHYLENE	UG/L	5	NV	No	0/8
ANTHRACENE	UG/L	5	2000	No	0/8
BENZO(A)ANTHRACENE	UG/L	1	NV	No	0/8
BENZO(A)PYRENE	UG/L	1	NV	No	0/8
BENZO(B)FLUORANTHENE	UG/L	1	NV	No	0/8
BENZO(G,H,I)PERYLENE	UG/L	5	NV	No	0/8
BENZO(K)FLUORANTHENE	UG/L	5	NV	No	0/8
BIS(2-CHLOROETHOXY)METHANE	UG/L	5	NV	No	0/8
BIS(2-CHLOROETHYL)ETHER	UG/L	5	NV	No	0/8
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	1 - 6	NV	No	0/8
BUTYLBENZYL PHTHALATE	UG/L	5	100	No	0/8
CARBAZOLE	UG/L	5	NV	No	0/8
CHRYSENE	UG/L	5	NV	No	0/8
DI-N-BUTYL PHTHALATE	UG/L	1 - 5	NV	No	0/8
DI-N-OCTYL PHTHALATE	UG/L	5	NV	No	0/8
DIBENZO(A,H)ANTHRACENE	UG/L	1	NV	No	0/8

TABLE 4-11

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
DIBENZOFURAN	UG/L	5	NV	No	0/8
DIETHYL PHTHALATE	UG/L	5	6000	No	0/8
DIMETHYL PHTHALATE	UG/L	5	70000	No	0/8
FLUORANTHENE	UG/L	5	300	No	0/8
FLUORENE	UG/L	5	300	No	0/8
HEXACHLOROBENZENE	UG/L	1	0.2	Yes	8/8
HEXACHLOROBUTADIENE	UG/L	1	1	No	0/8
HEXACHLOROCYCLOPENTADIENE	UG/L	5	50	No	0/8
HEXACHLOROETHANE	UG/L	2	1	Yes	8/8
INDENO(1,2,3-CD)PYRENE	UG/L	1	NV	No	0/8
ISOPHORONE	UG/L	5	100	No	0/8
N-NITROSO-DI-N-PROPYLAMINE	UG/L	5	NV	No	0/8
N-NITROSODIPHENYLAMINE	UG/L	5	70	No	0/8
NAPHTHALENE	UG/L	5	300	No	0/8
NITROBENZENE	UG/L	5	NV	No	0/8
PENTACHLOROPHENOL	UG/L	10	3	Yes	8/8
PHENANTHRENE	UG/L	5	NV	No	0/8
PHENOL	UG/L	5	4000	No	0/7
PYRENE	UG/L	5	200	No	0/8
PCBs					
AROCLOR-1016	UG/L	0.2	NV	No	0/8
AROCLOR-1221	UG/L	0.4	NV	No	0/8
AROCLOR-1232	UG/L	0.2	NV	No	0/8
AROCLOR-1242	UG/L	0.2	NV	No	0/8
AROCLOR-1248	UG/L	0.2	NV	No	0/8
AROCLOR-1254	UG/L	0.2	NV	No	0/8
AROCLOR-1260	UG/L	0.2	NV	No	0/8
Inorganics					
ALUMINUM	UG/L	28 - 29.6	50	No	0/6
ANTIMONY	UG/L	14	6	Yes	8/8
ARSENIC	UG/L	1 - 1.6	50	No	0/4
BARIUM	UG/L	NA	2000	No	0/0
BERYLLIUM	UG/L	0.3	0.08	Yes	8/8
CADMIUM	UG/L	1.9	4	No	0/8
CALCIUM	UG/L	NA	NV	No	0/0
CHROMIUM	UG/L	4.5	NV	No	0/1
COBALT	UG/L	3.9	30	No	0/8
COPPER	UG/L	3.9	1000	No	0/7
CYANIDE	UG/L	5	100	No	0/6
IRON	UG/L	NA	300	No	0/0
LEAD	UG/L	0.8	NV	No	0/8

TABLE 4-11

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
MAGNESIUM	UG/L	NA	NV	No	0/0
MANGANESE	UG/L	NA	1000	No	0/0
MERCURY	UG/L	0.2	2	No	0/6
NICKEL	UG/L	4.3	100	No	0/7
POTASSIUM	UG/L	NA	NV	No	0/0
SELENIUM	UG/L	1 - 5	30	No	0/8
SILVER	UG/L	3.7	30	No	0/8
SODIUM	UG/L	NA	NV	No	0/0
THALLIUM	UG/L	1.8 - 9	0.6	Yes	8/8
VANADIUM	UG/L	2.9	50	No	0/7
ZINC	UG/L	8.2 - 62.1	2000	No	0/3

Notes:
1 - MPCA Health Risk Limit or Health Risk Value.
2 - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No criteria available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-12

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	UG/L	1	200	No	0/8
1,1,2,2-TETRACHLOROETHANE	UG/L	1	NV	No	0/8
1,1,2-TRICHLOROETHANE	UG/L	1	5	No	0/8
1,1-DICHLOROETHANE	UG/L	1	NV	No	0/3
1,1-DICHLOROETHENE	UG/L	1	7	No	0/1
1,2-DICHLOROETHANE	UG/L	1	5	No	0/7
1,2-DICHLOROPROPANE	UG/L	1	5	No	0/8
2-BUTANONE	UG/L	NA	NV	No	0/0
2-HEXANONE	UG/L	NA	NV	No	0/0
4-METHYL-2-PENTANONE	UG/L	5	NV	No	0/8
ACETONE	UG/L	NA	NV	No	0/0
BENZENE	UG/L	1	5	No	0/8
BROMODICHLOROMETHANE	UG/L	1	80	No	0/8
BROMOFORM	UG/L	1	80	No	0/8
BROMOMETHANE	UG/L	1	NV	No	0/8
CARBON DISULFIDE	UG/L	1	NV	No	0/8
CARBON TETRACHLORIDE	UG/L	1	5	No	0/8
CHLOROBENZENE	UG/L	1	100	No	0/8
CHLOROETHANE	UG/L	1	NV	No	0/6
CHLOROFORM	UG/L	1	80	No	0/8
CHLOROMETHANE	UG/L	1	NV	No	0/4
CIS-1,2-DICHLOROETHENE	UG/L	1	70	No	0/1
CIS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/8
DIBROMOCHLOROMETHANE	UG/L	1	NV	No	0/8
ETHYLBENZENE	UG/L	1	700	No	0/5
M+P-XYLENES	UG/L	1	10000	No	0/5
METHYLENE CHLORIDE	UG/L	2	5	No	0/8
O-XYLENE	UG/L	1	10000	No	0/6
STYRENE	UG/L	1	100	No	0/8
TETRACHLOROETHENE	UG/L	1	5	No	0/4
TOLUENE	UG/L	1	1000	No	0/4
TRANS-1,2-DICHLOROETHENE	UG/L	1	100	No	0/2
TRANS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/8
TRICHLOROETHENE	UG/L	1	5	No	0/1
VINYL CHLORIDE	UG/L	0.3	2	No	0/2
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	UG/L	5	70	No	0/8
1,2-DICHLOROBENZENE	UG/L	5	600	No	0/8
1,3-DICHLOROBENZENE	UG/L	5	NV	No	0/8
1,4-DICHLOROBENZENE	UG/L	5	75	No	0/8
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	1	NV	No	0/8

TABLE 4-12

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
2,4,5-TRICHLOROPHENOL	UG/L	20 - 21	NV	No	0/8
2,4,6-TRICHLOROPHENOL	UG/L	5	NV	No	0/8
2,4-DICHLOROPHENOL	UG/L	5	NV	No	0/8
2,4-DIMETHYLPHENOL	UG/L	5	NV	No	0/8
2,4-DINITROPHENOL	UG/L	20 - 21	NV	No	0/8
2,4-DINITROTOLUENE	UG/L	5	NV	No	0/8
2,6-DINITROTOLUENE	UG/L	2	NV	No	0/8
2-CHLORONAPHTHALENE	UG/L	5	NV	No	0/8
2-CHLOROPHENOL	UG/L	5	NV	No	0/8
2-METHYLNAPHTHALENE	UG/L	5	NV	No	0/8
2-METHYLPHENOL	UG/L	3	NV	No	0/8
2-NITROANILINE	UG/L	20 - 21	NV	No	0/8
2-NITROPHENOL	UG/L	5	NV	No	0/8
3,3'-DICHLOROBENZIDINE	UG/L	5	NV	No	0/8
3-NITROANILINE	UG/L	20 - 21	NV	No	0/8
4,6-DINITRO-2-METHYLPHENOL	UG/L	20 - 21	NV	No	0/8
4-BROMOPHENYL PHENYL ETHER	UG/L	5	NV	No	0/8
4-CHLORO-3-METHYLPHENOL	UG/L	5	NV	No	0/8
4-CHLOROANILINE	UG/L	5	NV	No	0/8
4-CHLOROPHENYL PHENYL ETHER	UG/L	5	NV	No	0/8
4-METHYLPHENOL	UG/L	5	NV	No	0/8
4-NITROANILINE	UG/L	20 - 21	NV	No	0/8
4-NITROPHENOL	UG/L	20 - 21	NV	No	0/8
ACENAPHTHENE	UG/L	5	NV	No	0/8
ACENAPHTHYLENE	UG/L	5	NV	No	0/8
ANTHRACENE	UG/L	5	NV	No	0/8
BENZO(A)ANTHRACENE	UG/L	1	NV	No	0/8
BENZO(A)PYRENE	UG/L	1	0.2	Yes	8/8
BENZO(B)FLUORANTHENE	UG/L	1	NV	No	0/8
BENZO(G,H,I)PERYLENE	UG/L	5	NV	No	0/8
BENZO(K)FLUORANTHENE	UG/L	5	NV	No	0/8
BIS(2-CHLOROETHOXY)METHANE	UG/L	5	NV	No	0/8
BIS(2-CHLOROETHYL)ETHER	UG/L	5	NV	No	0/8
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	1 - 6	6	No	0/8
BUTYLBENZYL PHTHALATE	UG/L	5	NV	No	0/8
CARBAZOLE	UG/L	5	NV	No	0/8
CHRYSENE	UG/L	5	NV	No	0/8
DI-N-BUTYL PHTHALATE	UG/L	1 - 5	NV	No	0/8
DI-N-OCTYL PHTHALATE	UG/L	5	NV	No	0/8
DIBENZO(A,H)ANTHRACENE	UG/L	1	NV	No	0/8
DIBENZOFURAN	UG/L	5	NV	No	0/8
DIETHYL PHTHALATE	UG/L	5	NV	No	0/8

TABLE 4-12

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
DIMETHYL PHTHALATE	UG/L	5	NV	No	0/8
FLUORANTHENE	UG/L	5	NV	No	0/8
FLUORENE	UG/L	5	NV	No	0/8
HEXACHLOROBENZENE	UG/L	1	1	No	0/8
HEXACHLOROBUTADIENE	UG/L	1	NV	No	0/8
HEXACHLOROCYCLOPENTADIENE	UG/L	5	50	No	0/8
HEXACHLOROETHANE	UG/L	2	NV	No	0/8
INDENO(1,2,3-CD)PYRENE	UG/L	1	NV	No	0/8
ISOPHORONE	UG/L	5	NV	No	0/8
N-NITROSO-DI-N-PROPYLAMINE	UG/L	5	NV	No	0/8
N-NITROSODIPHENYLAMINE	UG/L	5	NV	No	0/8
NAPHTHALENE	UG/L	5	NV	No	0/8
NITROBENZENE	UG/L	5	NV	No	0/8
PENTACHLOROPHENOL	UG/L	10	1	Yes	8/8
PHENANTHRENE	UG/L	5	NV	No	0/8
PHENOL	UG/L	5	NV	No	0/7
PYRENE	UG/L	5	NV	No	0/8
PCBs					
AROCLOR-1016	UG/L	0.2	0.5	No	0/8
AROCLOR-1221	UG/L	0.4	0.5	No	0/8
AROCLOR-1232	UG/L	0.2	0.5	No	0/8
AROCLOR-1242	UG/L	0.2	0.5	No	0/8
AROCLOR-1248	UG/L	0.2	0.5	No	0/8
AROCLOR-1254	UG/L	0.2	0.5	No	0/8
AROCLOR-1260	UG/L	0.2	0.5	No	0/8
Inorganics					
ALUMINUM	UG/L	28 - 29.6	50	No	0/6
ANTIMONY	UG/L	14	6	Yes	8/8
ARSENIC	UG/L	1 - 1.6	50	No	0/4
BARIUM	UG/L	NA	2000	No	0/0
BERYLLIUM	UG/L	0.3	4	No	0/8
CADMIUM	UG/L	1.9	5	No	0/8
CALCIUM	UG/L	NA	NV	No	0/0
CHROMIUM	UG/L	4.5	100	No	0/1
COBALT	UG/L	3.9	NV	No	0/8
COPPER	UG/L	3.9	1300	No	0/7
CYANIDE	UG/L	5	200	No	0/6
IRON	UG/L	NA	300	No	0/0
LEAD	UG/L	0.8	15	No	0/8
MAGNESIUM	UG/L	NA	NV	No	0/0
MANGANESE	UG/L	NA	50	No	0/0
MERCURY	UG/L	0.2	2	No	0/6

TABLE 4-12

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - INTERMEDIATE WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
NICKEL	UG/L	4.3	100	No	0/7
POTASSIUM	UG/L	NA	NV	No	0/0
SELENIUM	UG/L	1 - 5	50	No	0/8
SILVER	UG/L	3.7	100	No	0/8
SODIUM	UG/L	NA	NV	No	0/0
THALLIUM	UG/L	1.8 - 9	2	Yes	1/8
VANADIUM	UG/L	2.9	NV	No	0/7
ZINC	UG/L	8.2 - 62.1	5000	No	0/3

Notes:
1 - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No criteria available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-13

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	UG/L	1	600	No	0/6
1,1,2,2-TETRACHLOROETHANE	UG/L	1	2	No	0/6
1,1,2-TRICHLOROETHANE	UG/L	1	3	No	0/6
1,1-DICHLOROETHANE	UG/L	1	70	No	0/5
1,1-DICHLOROETHENE	UG/L	1	6	No	0/5
1,2-DICHLOROETHANE	UG/L	1	4	No	0/6
1,2-DICHLOROPROPANE	UG/L	1	5	No	0/6
2-BUTANONE	UG/L	NA	4000	No	0/0
2-HEXANONE	UG/L	NA	NV	No	0/0
4-METHYL-2-PENTANONE	UG/L	5	300	No	0/6
ACETONE	UG/L	NA	700	No	0/0
BENZENE	UG/L	1	10	No	0/6
BROMODICHLOROMETHANE	UG/L	1	6	No	0/6
BROMOFORM	UG/L	1	40	No	0/6
BROMOMETHANE	UG/L	1	10	No	0/6
CARBON DISULFIDE	UG/L	1	700	No	0/6
CARBON TETRACHLORIDE	UG/L	1	3	No	0/6
CHLOROBENZENE	UG/L	1	100	No	0/6
CHLOROETHANE	UG/L	1	NV	No	0/6
CHLOROFORM	UG/L	1	60	No	0/6
CHLOROMETHANE	UG/L	1	3	No	0/3
CIS-1,2-DICHLOROETHENE	UG/L	NA	70	No	0/0
CIS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/6
DIBROMOCHLOROMETHANE	UG/L	1	10	No	0/6
ETHYLBENZENE	UG/L	1	700	No	0/6
M+P-XYLENES	UG/L	1	10000	No	0/6
METHYLENE CHLORIDE	UG/L	2	50	No	0/6
O-XYLENE	UG/L	1	10000	No	0/6
STYRENE	UG/L	1	100	No	0/6
TETRACHLOROETHENE	UG/L	1	7	No	0/2
TOLUENE	UG/L	1	1000	No	0/5
TRANS-1,2-DICHLOROETHENE	UG/L	1	100	No	0/2
TRANS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/6
TRICHLOROETHENE	UG/L	NA	30	No	0/0
VINYL CHLORIDE	UG/L	0.3	0.2	Yes	6/6
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	UG/L	5	70	No	0/6
1,2-DICHLOROBENZENE	UG/L	5	600	No	0/6
1,3-DICHLOROBENZENE	UG/L	5	600	No	0/6

TABLE 4-13

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
1,4-DICHLOROBENZENE	UG/L	5	10	No	0/6
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	1	300	No	0/6
2,4,5-TRICHLOROPHENOL	UG/L	20 - 21	70	No	0/6
2,4,6-TRICHLOROPHENOL	UG/L	5	30	No	0/6
2,4-DICHLOROPHENOL	UG/L	5	20	No	0/6
2,4-DIMETHYLPHENOL	UG/L	5	100	No	0/6
2,4-DINITROPHENOL	UG/L	20 - 21	10	Yes	6/6
2,4-DINITROTOLUENE	UG/L	5	0.5	Yes	6/6
2,6-DINITROTOLUENE	UG/L	2	0.5	Yes	6/6
2-CHLORONAPHTHALENE	UG/L	5	NV	No	0/6
2-CHLOROPHENOL	UG/L	5	30	No	0/6
2-METHYLNAPHTHALENE	UG/L	5	NV	No	0/6
2-METHYLPHENOL	UG/L	3	30	No	0/6
2-NITROANILINE	UG/L	20 - 21	NV	No	0/6
2-NITROPHENOL	UG/L	5	200	No	0/6
3,3'-DICHLOROBENZIDINE	UG/L	5	0.8	Yes	6/6
3-NITROANILINE	UG/L	20 - 21	NV	No	0/6
4,6-DINITRO-2-METHYLPHENOL	UG/L	20 - 21	NV	No	0/6
4-BROMOPHENYL PHENYL ETHER	UG/L	5	NV	No	0/6
4-CHLORO-3-METHYLPHENOL	UG/L	5	NV	No	0/6
4-CHLOROANILINE	UG/L	5	NV	No	0/6
4-CHLOROPHENYL PHENYL ETHER	UG/L	5	NV	No	0/6
4-METHYLPHENOL	UG/L	5	3	Yes	6/6
4-NITROANILINE	UG/L	20 - 21	NV	No	0/6
4-NITROPHENOL	UG/L	20 - 21	NV	No	0/6
ACENAPHTHENE	UG/L	5	400	No	0/6
ACENAPHTHYLENE	UG/L	5	NV	No	0/6
ANTHRACENE	UG/L	5	2000	No	0/6
BENZO(A)ANTHRACENE	UG/L	1	0.05	Yes	6/6
BENZO(A)PYRENE	UG/L	1	0.05	Yes	6/6
BENZO(B)FLUORANTHENE	UG/L	1	0.05	Yes	6/6
BENZO(G,H,I)PERYLENE	UG/L	5	NV	No	0/6
BENZO(K)FLUORANTHENE	UG/L	5	0.05	Yes	6/6
BIS(2-CHLOROETHOXY)METHANE	UG/L	5	NV	No	0/6
BIS(2-CHLOROETHYL)ETHER	UG/L	5	NV	No	0/6
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	1 - 5	20	No	0/6
BUTYLBENZYL PHTHALATE	UG/L	5	100	No	0/6
CARBAZOLE	UG/L	5	NV	No	0/6
CHRYSENE	UG/L	5	0.05	Yes	6/6
DI-N-BUTYL PHTHALATE	UG/L	5	NV	No	0/5

TABLE 4-13

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
DI-N-OCTYL PHTHALATE	UG/L	5	NV	No	0/6
DIBENZO(A,H)ANTHRACENE	UG/L	1	0.05	Yes	6/6
DIBENZOFURAN	UG/L	5	NV	No	0/6
DIETHYL PHTHALATE	UG/L	5	6000	No	0/6
DIMETHYL PHTHALATE	UG/L	5	70000	No	0/6
FLUORANTHENE	UG/L	5	300	No	0/6
FLUORENE	UG/L	5	300	No	0/6
HEXACHLOROBENZENE	UG/L	1	0.2	Yes	6/6
HEXACHLOROBUTADIENE	UG/L	1	1	No	0/6
HEXACHLOROCYCLOPENTADIENE	UG/L	5	50	No	0/6
HEXACHLOROETHANE	UG/L	2	1	Yes	6/6
INDENO(1,2,3-CD)PYRENE	UG/L	1	0.05	Yes	6/6
ISOPHORONE	UG/L	5	100	No	0/6
N-NITROSO-DI-N-PROPYLAMINE	UG/L	5	NV	No	0/6
N-NITROSODIPHENYLAMINE	UG/L	5	70	No	0/6
NAPHTHALENE	UG/L	5	300	No	0/6
NITROBENZENE	UG/L	5	NV	No	0/6
PENTACHLOROPHENOL	UG/L	10 - 11	3	Yes	6/6
PHENANTHRENE	UG/L	5	NV	No	0/6
PHENOL	UG/L	5	4000	No	0/6
PYRENE	UG/L	5	200	No	0/6
PCBs					
AROCLOR-1016	UG/L	0.2	0.04	Yes	6/6
AROCLOR-1221	UG/L	0.4	0.04	Yes	6/6
AROCLOR-1232	UG/L	0.2	0.04	Yes	6/6
AROCLOR-1242	UG/L	0.2	0.04	Yes	6/6
AROCLOR-1248	UG/L	0.2	0.04	Yes	6/6
AROCLOR-1254	UG/L	0.2	0.04	Yes	6/6
AROCLOR-1260	UG/L	0.2	0.04	Yes	6/6
Inorganics					
ALUMINUM	UG/L	28 - 37.5	50	No	0/5
ANTIMONY	UG/L	14	6	Yes	6/6
ARSENIC	UG/L	1	50	No	0/6
BARIUM	UG/L	NA	2000	No	0/0
BERYLLIUM	UG/L	0.3	0.08	Yes	6/6
CADMIUM	UG/L	1.9	4	No	0/6
CALCIUM	UG/L	NA	NV	No	0/0
CHROMIUM	UG/L	4.5 - 7.4	100	No	0/2
COBALT	UG/L	3.9 - 6.9	30	No	0/6
COPPER	UG/L	3.9	1000	No	0/6

TABLE 4-13

COMPARISON OF REPORTED DETECTION LIMITS TO MPCA GROUNDWATER CRITERIA
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	MPCA Criteria (1)	Exceeded Detection Limit	Frequency of Exceedances (2)
CYANIDE	UG/L	5	100	No	0/4
IRON	UG/L	NA	300	No	0/0
LEAD	UG/L	0.8	NV	No	0/5
MAGNESIUM	UG/L	NA	NV	No	0/0
MANGANESE	UG/L	NA	1000	No	0/0
MERCURY	UG/L	0.2	2	No	0/6
NICKEL	UG/L	4.3	100	No	0/6
POTASSIUM	UG/L	NA	NV	No	0/0
SELENIUM	UG/L	1	30	No	0/6
SILVER	UG/L	3.7	30	No	0/6
SODIUM	UG/L	NA	NV	No	0/0
THALLIUM	UG/L	1.8 - 45	0.6	Yes	6/6
VANADIUM	UG/L	2.9	50	No	0/6
ZINC	UG/L	8.8 - 32.5	2000	No	0/4

Notes:
1 - MPCA Health Risk Limit or Health Risk Value.
2 - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No criteria available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-14

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
Volatile Organic Compounds					
1,1,1-TRICHLOROETHANE	UG/L	1	200	No	0/6
1,1,2,2-TETRACHLOROETHANE	UG/L	1	NV	No	0/6
1,1,2-TRICHLOROETHANE	UG/L	1	5	No	0/6
1,1-DICHLOROETHANE	UG/L	1	NV	No	0/5
1,1-DICHLOROETHENE	UG/L	1	7	No	0/5
1,2-DICHLOROETHANE	UG/L	1	5	No	0/6
1,2-DICHLOROPROPANE	UG/L	1	5	No	0/6
2-BUTANONE	UG/L	NA	NV	No	0/0
2-HEXANONE	UG/L	NA	NV	No	0/0
4-METHYL-2-PENTANONE	UG/L	5	NV	No	0/6
ACETONE	UG/L	NA	NV	No	0/0
BENZENE	UG/L	1	5	No	0/6
BROMODICHLOROMETHANE	UG/L	1	80	No	0/6
BROMOFORM	UG/L	1	80	No	0/6
BROMOMETHANE	UG/L	1	NV	No	0/6
CARBON DISULFIDE	UG/L	1	NV	No	0/6
CARBON TETRACHLORIDE	UG/L	1	5	No	0/6
CHLOROBENZENE	UG/L	1	100	No	0/6
CHLOROETHANE	UG/L	1	NV	No	0/6
CHLOROFORM	UG/L	1	80	No	0/6
CHLOROMETHANE	UG/L	1	NV	No	0/3
CIS-1,2-DICHLOROETHENE	UG/L	NA	70	No	0/0
CIS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/6
DIBROMOCHLOROMETHANE	UG/L	1	NV	No	0/6
ETHYLBENZENE	UG/L	1	700	No	0/6
M+P-XYLENES	UG/L	1	10000	No	0/6
METHYLENE CHLORIDE	UG/L	2	5	No	0/6
O-XYLENE	UG/L	1	10000	No	0/6
STYRENE	UG/L	1	100	No	0/6
TETRACHLOROETHENE	UG/L	1	5	No	0/2
TOLUENE	UG/L	1	1000	No	0/5
TRANS-1,2-DICHLOROETHENE	UG/L	1	100	No	0/2
TRANS-1,3-DICHLOROPROPENE	UG/L	1	NV	No	0/6
TRICHLOROETHENE	UG/L	NA	5	No	0/0
VINYL CHLORIDE	UG/L	0.3	2	No	0/6
Semivolatile Organic Compounds					
1,2,4-TRICHLOROBENZENE	UG/L	5	70	No	0/6
1,2-DICHLOROBENZENE	UG/L	5	600	No	0/6
1,3-DICHLOROBENZENE	UG/L	5	NV	No	0/6
1,4-DICHLOROBENZENE	UG/L	5	75	No	0/6

TABLE 4-14

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	1	NV	No	0/6
2,4,5-TRICHLOROPHENOL	UG/L	20 - 21	NV	No	0/6
2,4,6-TRICHLOROPHENOL	UG/L	5	NV	No	0/6
2,4-DICHLOROPHENOL	UG/L	5	NV	No	0/6
2,4-DIMETHYLPHENOL	UG/L	5	NV	No	0/6
2,4-DINITROPHENOL	UG/L	20 - 21	NV	No	0/6
2,4-DINITROTOLUENE	UG/L	5	NV	No	0/6
2,6-DINITROTOLUENE	UG/L	2	NV	No	0/6
2-CHLORONAPHTHALENE	UG/L	5	NV	No	0/6
2-CHLOROPHENOL	UG/L	5	NV	No	0/6
2-METHYLNAPHTHALENE	UG/L	5	NV	No	0/6
2-METHYLPHENOL	UG/L	3	NV	No	0/6
2-NITROANILINE	UG/L	20 - 21	NV	No	0/6
2-NITROPHENOL	UG/L	5	NV	No	0/6
3,3'-DICHLOROBENZIDINE	UG/L	5	NV	No	0/6
3-NITROANILINE	UG/L	20 - 21	NV	No	0/6
4,6-DINITRO-2-METHYLPHENOL	UG/L	20 - 21	NV	No	0/6
4-BROMOPHENYL PHENYL ETHER	UG/L	5	NV	No	0/6
4-CHLORO-3-METHYLPHENOL	UG/L	5	NV	No	0/6
4-CHLOROANILINE	UG/L	5	NV	No	0/6
4-CHLOROPHENYL PHENYL ETHER	UG/L	5	NV	No	0/6
4-METHYLPHENOL	UG/L	5	NV	No	0/6
4-NITROANILINE	UG/L	20 - 21	NV	No	0/6
4-NITROPHENOL	UG/L	20 - 21	NV	No	0/6
ACENAPHTHENE	UG/L	5	NV	No	0/6
ACENAPHTHYLENE	UG/L	5	NV	No	0/6
ANTHRACENE	UG/L	5	NV	No	0/6
BENZO(A)ANTHRACENE	UG/L	1	NV	No	0/6
BENZO(A)PYRENE	UG/L	1	0.2	Yes	6/6
BENZO(B)FLUORANTHENE	UG/L	1	NV	No	0/6
BENZO(G,H,I)PERYLENE	UG/L	5	NV	No	0/6
BENZO(K)FLUORANTHENE	UG/L	5	NV	No	0/6
BIS(2-CHLOROETHOXY)METHANE	UG/L	5	NV	No	0/6
BIS(2-CHLOROETHYL)ETHER	UG/L	5	NV	No	0/6
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	1 - 5	6	No	0/6
BUTYLBENZYL PHTHALATE	UG/L	5	NV	No	0/6
CARBAZOLE	UG/L	5	NV	No	0/6
CHRYSENE	UG/L	5	NV	No	0/6
DI-N-BUTYL PHTHALATE	UG/L	5	NV	No	0/5
DI-N-OCTYL PHTHALATE	UG/L	5	NV	No	0/6
DIBENZO(A,H)ANTHRACENE	UG/L	1	NV	No	0/6

TABLE 4-14

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
DIBENZOFURAN	UG/L	5	NV	No	0/6
DIETHYL PHTHALATE	UG/L	5	NV	No	0/6
DIMETHYL PHTHALATE	UG/L	5	NV	No	0/6
FLUORANTHENE	UG/L	5	NV	No	0/6
FLUORENE	UG/L	5	NV	No	0/6
HEXACHLOROBENZENE	UG/L	1	1	No	0/6
HEXACHLOROBUTADIENE	UG/L	1	NV	No	0/6
HEXACHLOROCYCLOPENTADIENE	UG/L	5	50	No	0/6
HEXACHLOROETHANE	UG/L	2	NV	No	0/6
INDENO(1,2,3-CD)PYRENE	UG/L	1	NV	No	0/6
ISOPHORONE	UG/L	5	NV	No	0/6
N-NITROSO-DI-N-PROPYLAMINE	UG/L	5	NV	No	0/6
N-NITROSODIPHENYLAMINE	UG/L	5	NV	No	0/6
NAPHTHALENE	UG/L	5	NV	No	0/6
NITROBENZENE	UG/L	5	NV	No	0/6
PENTACHLOROPHENOL	UG/L	10 - 11	1	Yes	6/6
PHENANTHRENE	UG/L	5	NV	No	0/6
PHENOL	UG/L	5	NV	No	0/6
PYRENE	UG/L	5	NV	No	0/6
PCBs					
AROCLOR-1016	UG/L	0.2	0.5	No	0/6
AROCLOR-1221	UG/L	0.4	0.5	No	0/6
AROCLOR-1232	UG/L	0.2	0.5	No	0/6
AROCLOR-1242	UG/L	0.2	0.5	No	0/6
AROCLOR-1248	UG/L	0.2	0.5	No	0/6
AROCLOR-1254	UG/L	0.2	0.5	No	0/6
AROCLOR-1260	UG/L	0.2	0.5	No	0/6
Inorganics					
ALUMINUM	UG/L	28 - 37.5	50	No	0/5
ANTIMONY	UG/L	14	6	Yes	6/6
ARSENIC	UG/L	1	50	No	0/6
BARIUM	UG/L	NA	2000	No	0/0
BERYLLIUM	UG/L	0.3	4	No	0/6
CADMIUM	UG/L	1.9	5	No	0/6
CALCIUM	UG/L	NA	NV	No	0/0
CHROMIUM	UG/L	4.5 - 7.4	100	No	0/2
COBALT	UG/L	3.9 - 6.9	NV	No	0/6
COPPER	UG/L	3.9	1300	No	0/6
CYANIDE	UG/L	5	200	No	0/4
IRON	UG/L	NA	300	No	0/0
LEAD	UG/L	0.8	15	No	0/5

TABLE 4-14

COMPARISON OF REPORTED DETECTION LIMITS TO EPA MCLs
GROUNDWATER - DEEP WELLS

Chemical	Units	Range of Non-Detects	EPA MCL	Exceeded Detection Limit	Frequency of Exceedances (1)
MAGNESIUM	UG/L	NA	NV	No	0/0
MANGANESE	UG/L	NA	50	No	0/0
MERCURY	UG/L	0.2	2	No	0/6
NICKEL	UG/L	4.3	100	No	0/6
POTASSIUM	UG/L	NA	NV	No	0/0
SELENIUM	UG/L	1	50	No	0/6
SILVER	UG/L	3.7	100	No	0/6
SODIUM	UG/L	NA	NV	No	0/0
THALLIUM	UG/L	1.8 - 45	2	Yes	2/6
VANADIUM	UG/L	2.9	NV	No	0/6
ZINC	UG/L	8.8 - 32.5	5000	No	0/4

Notes:
1 - number of exceedances/number of non-detects.
NA - Not applicable, chemical was detected in every sample.
NV - No criteria available.
Duplicates were treated as individual samples for this evaluation.

TABLE 4-15

SUMMARY OF SOIL ANALYTICAL RESULTS
NIROP FRIDLEY, MINNESOTA

Analyte	Surface Soil (<4 Feet)[1]			Subsurface Soil (4 to 12 Feet)[2]			Subsurface Soil (>12 Feet)[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
Volatile Organic Compounds (ug/kg)									
1,1,1-Trichloroethane	4/57	1-56	003-SB-058-01	3/73	1-2	003-SB-035-02/ 003-SB-054-02	1/97	4	003-SB-058-05-BR
1,1,2-Trichloroethane	0/57	ND[5]	ND	2/73	8-9	SB-02-0406	0/97	ND	ND
1,1-Dichloroethane	1/57	2-9	003-SB-058-01	2/73	1-11	003-SB-032-03	1/97	1	003-SB-023-15-BR
1,2-Dichloroethene (total)	4/57	3-15	003-SB-073-01	4/73	1-15000	003-SB-032-03	15/97	1-290	003-SB-32D-08
2-Butanone	32/57	1-190	003-SB-30D-01	37/73	1-210	003-SB-29D-01	61/97	1-370	003-SB-28D-08
2-Hexanone	3/57	1-26	003-SB-P11-01-D	6/73	1-4	003-SB-037-03	4/97	3-16	003-SB-33D-11
4-Methyl-2-pentanone	30/57	1-120	003-SB-30D-01	47/73	1-150	003-SB-028-02	59/97	2-260	003-SB-32D-04
Acetone	28/57	3-770	003-SB-32D-01	38/73	3-1700	003-SB-032-03	55/97	4-1000	003-SB-32D-07
Benzene	0/57	ND	ND	2/73	1-24	003-SB-032-03	0/97	ND	ND
Bromomethane	1/57	2	003-SB-054-01	3/73	1-2	003-SB-063-03	0/97	ND	ND
Carbon Disulfide	8/57	1-13	003-SB-029-01	4/73	5-14	003-SB-054-02	11/97	1-18	003-SB-31D-12
Chlorobenzene	0/57	ND	ND	0/73	ND	ND	1/97	1	003-SB-P06-05-BR
Chloromethane	0/57	ND	ND	0/73	ND	ND	1/97	1	SB-06-1214
Ethylbenzene	4/57	1-10	003-SB-32D-01	5/73	4-720	003-SB-032-03	11/97	9-34	003-SB-29D-06
Styrene	3/57	4-33	003-SB-32D-01	2/73	1-54	003-SB-29D-01	12/97	10-72	003-SB-29D-06
Tetrachloroethene	9/57	1-90	SB-02-0204	9/73	1-760	SB-02-0406	5/97	1-3800	SB-07-1416
Toluene	21/57	1-14	003-SB-039-01	31/73	1-1000	003-SB-032-03	43/97	1-24	003-SB-28D-11
Trichloroethene	24/57	1-640	SB-01-0001	20/73	1-1100	SB-03-1012/ SB-05-1012	37/97	1-100000	SB-07-1416
Xylenes, Total	19/57	1-45	003-SB-32D-01	30/73	1-7300	003-SB-032-03	50/97	1-120	003-SB-29D-06
Semivolatile Organic Compounds (ug/kg)									
2-Methylnaphthalene	4/55	12-1000	003-SB-028-01	5/58	13-720	003-SB-032-03	0/7	ND	ND
4-Chloro-3-methylphenol	0/55	ND	ND	1/58	11000	003-SB-032-03	0/7	ND	ND
4-Methylphenol	0/55	ND	ND	0/58	ND	ND	1/7	320	SB-07-1416
Acenaphthene	8/55	11-650	003-SB-028-01	1/58	59	003-SB-054-02	0/7	ND	ND
Acenaphthylene	2/55	19-760	003-SB-017-01	1/58	20	003-SB-054-02	0/7	ND	ND
Anthracene	9/53	20-640	003-SB-017-01	3/57	12-510	003-SB-032-03	0/5	ND	ND
Benzo(a)anthracene	14/53	11-3500	003-SB-P03-01	3/57	18-280	003-SB-054-02	0/5	ND	ND
Benzo(a)pyrene	13/53	15-1700	003-SB-017-01	3/57	11-190	003-SB-054-02	0/5	ND	ND
Benzo(b)fluoranthene	13/53	12-3600	003-SB-P03-01	3/57	14-230	003-SB-054-02	0/5	ND	ND
Benzo(g,h,i)perylene	13/53	12-820	003-SB-P03-01	2/57	18-150	003-SB-054-02	0/5	ND	ND
Benzo(k)fluoranthene	14/53	14-1300	003-SB-017-01	3/57	15-190	003-SB-054-02	0/5	ND	ND
Bis(2-Ethylhexyl)phthalate	10/53	17-1200	SB-02-0204-D	13/57	16-4400	SB-02-0406	4/5	45-210	SB-07-1416

TABLE 4-15

SUMMARY OF SOIL ANALYTICAL RESULTS
NIROP FRIDLEY, MINNESOTA

Analyte	Surface Soil (<4 Feet)[1]			Subsurface Soil (4 to 12 Feet)[2]			Subsurface Soil (>12 Feet)[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
Butylbenzyl Phthalate	1/53	16	003-SB-P06-01	2/57	110-3600	003-SB-032-03	0/5	ND	ND
Carbazole	7/53	16-530	003-SB-P03-01	1/57	67	003-SB-054-02	0/5	ND	ND
Chrysene	15/53	11-1700	003-SB-017-01	4/57	13-240	003-SB-054-02	0/5	ND	ND
Di-n-butyl phthalate	3/53	13-28	003-SB-017-01	4/57	15-140	SB-02-0406	1/5	43	SB-07-1416
Di-n-octyl phthalate	2/53	12-40	003-SB-073-01	1/57	84	003-SB-030-02	0/5	ND	ND
Dibenzo(a,h)anthracene	9/53	11-400	003-SB-017-01	1/57	50	003-SB-054-02	0/5	ND	ND
Dibenzofuran	3/53	11-250	003-SB-017-01	2/57	41-78	SB-02-0406	0/5	ND	ND
Fluoranthene	18/53	10-5600	003-SB-017-01	6/57	12-840	003-SB-054-02	0/5	ND	ND
Fluorene	8/53	15-760	003-SB-028-01	1/57	44	003-SB-054-02	0/5	ND	ND
Indeno(1,2,3-cd)pyrene	12/53	15-1100	003-SB-P03-01	2/57	20-120	003-SB-054-02	0/7	ND	ND
Naphthalene	2/55	55-78	003-SB-P03-01	4/58	56-2300	003-SB-032-03	0/5	ND	ND
Pentachlorophenol	0/53	ND	ND	1/57	50	003-SB-054-02	0/5	ND	ND
Phenanthrene	12/53	29-5000	003-SB-P03-01	7/57	23-570	003-SB-054-02	0/5	ND	ND
Phenol	2/55	45-54	003-SB-046-01-D	1/58	120	003-SB-058-03	0/7	ND	ND
Pyrene	19/53	12-4800	003-SB-P03-01	7/57	11-590	003-SB-054-02	0/5	ND	ND
Polychlorinated Biphenyls (ug/kg)									
Aroclor-1016	1/51	150	003-SB-030-01	0/55	ND	ND	0/4	ND	ND
Aroclor-1254	2/51	230-290	003-SB-050-01-D	0/55	ND	ND	0/4	ND	ND
Inorganics (mg/kg)									
Aluminum	55/55	498-7830	003-SB-037-01-D	58/58	1090-7090	003-SB-035-02	7/7	1700-5450	SB-01-1416
Antimony	5/49	2.8-3.4	003-SB-017-01	0/51	ND	ND	0/7	ND	ND
Arsenic	52/55	0.42-13.8	003-SB-071-01	48/58	0.25-13.6	003-SB-032-03	7/7	0.46-2.8	SB-07-1416
Barium	55/55	7.3-201	SB-03-0001	57/58	5.4-70.4	003-SB-032-03	3/7	12-55.2	SB-01-1416
Beryllium	34/55	0.07-0.7	003-SB-058-01	35/58	0.05-0.44	003-SB-035-02	5/7	0.17-0.23	SB-01-1416
Cadmium	3/55	0.46-0.75	003-SB-035-01	1/58	0.38	003-SB-039-03	0/7	ND	ND
Calcium	55/55	768-34100	003-SB-028-01	58/58	791-46500	003-SB-038-03	7/7	3490-31900	SB-07-1416
Chromium	55/55	3.6-91	003-SB-036-01	54/58	3.7-618	SB-02-0406	2/7	12.7-15.9	SB-01-1416
Cobalt	52/55	2.4-10.4	003-SB-058-01-D	55/58	1.6-11.4	003-SB-P09-03	7/7	2.2-5.4	SB-07-1416
Copper	50/55	0.8-1360	003-SB-035-01	52/58	0.69-57.7	SB-07-0406	5/7	4.8-11.8	SB-01-1416
Cyanide	2/55	1.1-90.4	SB-02-0204-D	2/58	140-148	SB-07-0406	1/7	2.9	SB-01-1416
Hexavalent Chromium	3/17	2-6	003-SB-035-01	0/18	ND	ND	NA[7]	NA	NA
Iron	55/55	2430-48400	003-SB-017-01	58/58	3400-23300	003-SB-032-03	7/7	3920-11100	SB-01-1416
Lead	55/55	1.6-733	003-SB-017-01	56/58	0.88-515	SB-07-0406	7/7	1.1-5.2	SB-07-1416
Magnesium	55/55	153-14100	003-SB-035-01	58/58	286-20000	003-SB-038-03	7/7	1480-11400	SB-01-1416
Manganese	55/55	31.2-2490	SB-03-0001	58/58	35.2-1180	003-SB-055-02	7/7	79.7-406	SB-07-1416

TABLE 4-15

SUMMARY OF SOIL ANALYTICAL RESULTS
NIROP FRIDLEY, MINNESOTA

Analyte	Surface Soil (<4 Feet)[1]			Subsurface Soil (4 to 12 Feet)[2]			Subsurface Soil (>12 Feet)[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
Mercury	9/55	0.05-0.19	003-SB-013-01	8/58	0.06-0.32	003-SB-013-02	0/7	ND	ND
Nickel	51/55	4.9-33.5	003-SB-035-01	52/58	3.6-24.7	003-SB-P09-03	1/7	20.5	SB-01-1416
Potassium	55/55	147-1130	003-SB-037-01	58/58	154-1350	003-SB-035-02	7/7	198-1130	SB-07-1416
Selenium	1/47	0.8-1.3	003-SB-058-01	1/49	0.4	003-SB-004-03	0/7	ND	ND
Sodium	54/55	36.7-364	003-SB-028-01	50/58	41.9-487	003-SB-068-03	4/7	81.8-337	SB-07-1416
Thallium	4/53	0.18-0.24	003-SB-047-01	0/56	ND	ND	0/7	ND	ND
Vanadium	55/55	2-35.6	003-SB-058-01-D	58/58	4.9-35.3	003-SB-032-03	7/7	9.4-23.4	SB-01-1416
Zinc	51/55	7.9-479	003-SB-035-01	52/58	8.7-207	003-SB-028-02	5/7	11.6-29.5	SB-07-1416
Miscellaneous (mg/kg)									
Total Organic Carbon	12/12	740-19000	003-SB-016-01	13/13	480-2200	003-SB-004-03	NA	NA	NA
pH	14/14	6.85-11.51	SB-01-0001	7/7	5.63-9.24	SB-01-0608	7/7	7.55-8.66	SB-07-1416

1 Includes samples:

003-SB-003-01	003-SB-023-01	003-SB-037-01-D	003-SB-063-01	003-SB-P04-01	SB-01-0001
003-SB-004-01	003-SB-026-01	003-SB-038-01	003-SB-068-01	003-SB-P05-01	SB-01-0001-D
003-SB-004-01-D	003-SB-027-01	003-SB-039-01	003-SB-070-01	003-SB-P06-01	SB-02-0001
003-SB-006-01	003-SB-028-01	003-SB-046-01	003-SB-071-01	003-SB-P07-01	SB-02-0204
003-SB-007-01	003-SB-029-01	003-SB-046-01-D	003-SB-073-01	003-SB-P08-01	SB-02-0204-D
003-SB-008-01	003-SB-030-01	003-SB-047-01	003-SB-074-01	003-SB-P09-01	SB-03-0001
003-SB-013-01	003-SB-032-01	003-SB-050-01	003-SB-074-01-D	003-SB-P09-01-D	SB-04-0001
003-SB-015-01	003-SB-033-01	003-SB-050-01-D	003-SB-30D-01	003-SB-P10-01	SB-05-0001
003-SB-015-01-D	003-SB-034-01	003-SB-054-01	003-SB-32D-01	003-SB-P10-01-D	SB-06-0002
003-SB-016-01	003-SB-035-01	003-SB-055-01	003-SB-P01-01	003-SB-P11-01	
003-SB-017-01	003-SB-036-01	003-SB-058-01	003-SB-P02-01	003-SB-P11-01-D	
003-SB-018-01	003-SB-037-01	003-SB-058-01-D	003-SB-P03-01	003-SB-P12-01	

2 Includes samples:

003-SB-003-02	003-SB-027-03	003-SB-039-03	003-SB-074-03	003-SB-P06-02-BR	SB-05-1012
003-SB-004-03	003-SB-028-02	003-SB-046-03	003-SB-28D-01	003-SB-P06-03	SB-06-0608
003-SB-006-03	003-SB-029-02	003-SB-047-03	003-SB-29D-01	003-SB-P07-03	SB-07-0406
003-SB-007-02	003-SB-030-02	003-SB-050-02	003-SB-31D-01	003-SB-P08-03	
003-SB-007-03	003-SB-030-03	003-SB-054-02	003-SB-31D-02	003-SB-P09-02	
003-SB-008-02	003-SB-032-03	003-SB-055-02	003-SB-33D-01	003-SB-P09-03	
003-SB-013-02	003-SB-033-03	003-SB-055-03	003-SB-33D-02	003-SB-P10-03	
003-SB-015-03	003-SB-034-03	003-SB-058-02	003-SB-P01-02	003-SB-P11-03	

TABLE 4-15

SUMMARY OF SOIL ANALYTICAL RESULTS
NIROP FRIDLEY, MINNESOTA

Analyte	Surface Soil (<4 Feet)[1]			Subsurface Soil (4 to 12 Feet)[2]			Subsurface Soil (>12 Feet)[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
2 Includes samples: (continued)									
003-SB-016-03	003-SB-035-02		003-SB-058-03		003-SB-P01-03-BR		003-SB-P12-03		
003-SB-017-03	003-SB-036-02		003-SB-063-03		003-SB-P02-02		SB-01-0608		
003-SB-018-02	003-SB-036-03		003-SB-068-03		003-SB-P02-03		SB-02-0406		
003-SB-023-03	003-SB-037-02		003-SB-070-03		003-SB-P03-03		SB-02-0608		
003-SB-026-03	003-SB-037-03		003-SB-071-03		003-SB-P04-03		SB-03-1012		
003-SB-027-02	003-SB-038-03		003-SB-073-03		003-SB-P05-02		SB-04-1012		
3 Includes samples:									
003-SB-007-05-BR	003-SB-28D-04		003-SB-29D-11		003-SB-31D-08		003-SB-32D-12		003-SB-P06-05-BR
003-SB-007-11-BR	003-SB-28D-05		003-SB-29D-12		003-SB-31D-09		003-SB-32D-12-D		003-SB-P06-07-BR
003-SB-023-05-BR	003-SB-28D-06		003-SB-29D-13		003-SB-31D-09-D		003-SB-32D-13		003-SB-P09-05-BR
003-SB-023-15-BR	003-SB-28D-07		003-SB-29D-14		003-SB-31D-10		003-SB-33D-03		003-SB-P09-09-BR
003-SB-027-05-BR	003-SB-28D-08		003-SB-30D-02		003-SB-31D-11		003-SB-33D-04		003-SB-P12-05-BR
003-SB-027-06-BR	003-SB-28D-09		003-SB-30D-03		003-SB-31D-12		003-SB-33D-05		003-SB-P12-11-BR
003-SB-030-04-BR	003-SB-28D-10		003-SB-30D-04		003-SB-31D-13		003-SB-33D-06		SB-01-1416
003-SB-036-05-BR	003-SB-28D-10-D		003-SB-30D-05		003-SB-32D-02		003-SB-33D-06-D		SB-03-1214
003-SB-036-05-BR-D	003-SB-28D-11		003-SB-30D-06		003-SB-32D-02-D		003-SB-33D-07		SB-04-1214
003-SB-036-07-BR	003-SB-29D-02		003-SB-30D-07		003-SB-32D-03		003-SB-33D-08		SB-05-1315
003-SB-037-05-BR	003-SB-29D-03		003-SB-30D-08		003-SB-32D-04		003-SB-33D-09		SB-06-1214
003-SB-037-10-BR	003-SB-29D-04		003-SB-30D-09		003-SB-32D-05		003-SB-33D-10		SB-07-1416
003-SB-055-05-BR	003-SB-29D-05		003-SB-30D-10		003-SB-32D-05-D		003-SB-33D-11		SB-07-2830
003-SB-058-05-BR	003-SB-29D-06		003-SB-31D-03		003-SB-32D-06		003-SB-33D-12		
003-SB-058-05-BR-D	003-SB-29D-06-D		003-SB-31D-04		003-SB-32D-07		003-SB-P01-05-BR		
003-SB-058-15-BR	003-SB-29D-07		003-SB-31D-05		003-SB-32D-08		003-SB-P01-09-BR		
003-SB-063-04-BR	003-SB-29D-08		003-SB-31D-05-D		003-SB-32D-09		003-SB-P02-05-BR		
003-SB-063-14-BR	003-SB-29D-09		003-SB-31D-06		003-SB-32D-10		003-SB-P02-05-BR-D		
003-SB-28D-03	003-SB-29D-10		003-SB-31D-07		003-SB-32D-11		003-SB-P02-15-BR		

4 Frequency of detection determined considering a duplicate pair as one sample.
5 Concentration range determined considering duplicate sample results as individual data points.
6 Not Detected.
7 Not Analyzed.

TABLE 4-16

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - UNFILTERED
NIROP FRIDLEY, MINNESOTA

Analyte	Shallow Wells[1]			Intermediate Wells[2]			Deep Wells[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
Volatile Organic Compounds (ug/L)									
1,1,1-Trichloroethane	22/57	0.2-690	003-TW-033-01	0/6	ND[6]	ND	0/6	ND	ND
1,1,2-Trichloroethane	4/57	0.2-1	003-TW-033-01	0/6	ND	ND	0/6	ND	ND
1,1-Dichloroethane	39/57	0.2-110	003-TW-017-01	5/6	2.4-17	003-MS-30I-01	1/6	0.9	003-MS-28D-01
1,1-Dichloroethene	37/57	0.2-380	003-TW-033-01	5/6	0.9-13	003-MS-32I-01	1/6	0.3	003-MS-28D-01
1,2-Dichloroethane	6/57	0.3-8.2	003-TW-033-01	1/6	1.7	003-MS-30I-01	0/6	ND	ND
1,2-Dichloroethene (total)	3/3	100-12000	GW-01	NA[7]	NA	NA	NA	NA	NA
2-Butanone	1/3	270	GW-02-D	R[8]	R	R	R	R	R
Acetone	1/5	0.2	003-TW-070-01	R	R	R	R	R	R
Benzene	1/57	0.2	003-TW-017-01	0/6	ND	ND	0/6	ND	ND
Carbon Disulfide	1/57	31	GW-02-D	0/6	ND	ND	0/6	ND	ND
Chloroform	1/57	0.7	003-TW-039-01	0/6	ND	ND	0/6	ND	ND
Chloromethane	7/57	0.2-0.5	003-MS-30S-01	3/6	0.3-1.2	003-MS-33I-01	3/6	0.2-0.6	003-MS-31D-01
cis-1,2-dichloroethene	42/54	0.2-1500	003-TW-017-01	5/6	5-580	003-MS-33I-01	6/6	1.2-11	003-MS-28D-01
Ethylbenzene	4/57	0.2-820	003-TW-P04-01	2/6	0.2-0.3	003-MS-33I-01/ 003-MS-33I-01-D	0/6	ND	ND
M+p-Xylenes	4/54	0.5-780	003-TW-P04-01	2/6	0.2-0.7	003-MS-33I-01	0/6	ND	ND
Methylene Chloride	1/57	640	003-TW-P10-01	0/6	ND	ND	0/6	ND	ND
o-Xylene	4/54	0.3-750	003-TW-P04-01	1/6	0.3-1	003-MS-33I-01-D	0/6	ND	ND
Tetrachloroethene	28/57	0.2-160	GW-01	3/6	3.8-6.8	003-MS-33I-01	4/6	0.3-22	003-MS-33D-01
Toluene	5/57	0.4-240	003-TW-P10-01	2/6	0.6-1.6	003-MS-33I-01	1/6	0.2	003-MS-28D-01
Trans-1,2-dichloroethene	36/54	0.2-1900	003-TW-P10-01	4/6	0.7-1400	003-MS-32I-01-D	4/6	0.3-1.6	003-MS-32D-01
Trichloroethene	54/57	0.6-140000	GW-01	5/6	150-59000	003-MS-33I-01	6/6	0.7-61	003-MS-28D-01
Vinyl Chloride	13/57	0.2-40	003-TW-P09-01	4/6	0.4-9.5	003-MS-33I-01-D	0/6	ND	ND
Semivolatile Organic Compounds (ug/L)									
2,4-Dimethylphenol	2/57	3-5	GW-01	0/6	ND	ND	0/6	ND	ND
2-Methylnaphthalene	1/57	2	003-TW-026-01	0/6	ND	ND	0/6	ND	ND
2-Methylphenol	1/57	2	GW-01	0/6	ND	ND	0/6	ND	ND
4-Chloro-3-methylphenol	1/57	9	003-TW-032-01	0/6	ND	ND	0/6	ND	ND
4-Methylphenol	1/57	11	GW-01	0/6	ND	ND	0/6	ND	ND

TABLE 4-16

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - UNFILTERED
NIROP FRIDLEY, MINNESOTA

Analyte	Shallow Wells[1]			Intermediate Wells[2]			Deep Wells[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
Bis(2-Ethylhexyl)phthalate	4/57	1	003-TW-023-01/ 003-TW-036-01/ 003-TW-P01-01/ 003-TW-P12-01	0/6	ND	ND	0/6	ND	ND
Butylbenzyl Phthalate	7/57	1-6	003-TW-008-01	0/6	ND	ND	0/6	ND	ND
Di-n-butyl phthalate	3/57	1	003-TW-006-01/ 003-TW-P02-01/ 003-TW-P08-01	0/6	ND	ND	1/6	1	003-MS-28D-01
Di-n-octyl phthalate	1/57	1	003-TW-070-01	0/6	ND	ND	0/6	ND	ND
Diethyl Phthalate	1/57	1	003-TW-032-01	0/6	ND	ND	0/6	ND	ND
Naphthalene	2/57	1-120	003-TW-026-01	0/6	ND	ND	0/6	ND	ND
Pentachlorophenol	2/57	1-3	003-TW-026-01	0/6	ND	ND	0/6	ND	ND
Phenol	3/57	5-10	GW-01	1/6	1	003-MS-33I-01-D	0/6	ND	ND
Inorganics (ug/L)									
Aluminum	25/57	25.3-19400	GW-01	1/6	567-712	003-MS-33I-01-D	1/6	36.3	003-MS-29D-01
Arsenic	19/57	1-11	GW-01	3/6	1.4-9.4	003-MS-32I-01-D	0/6	ND	ND
Barium	57/57	12.7-380	GW-01	6/6	7.3-89.7	003-MS-32I-01-D	6/6	27.9-64.5	003-MS-29D-01
Beryllium	7/57	0.3-0.7	003-TW-036-01	0/6	ND	ND	0/6	ND	ND
Calcium	57/57	50500-265000	003-TW-004-01	6/6	56600-375000	003-MS-31I-01	6/6	114000-202000	003-MS-30D-01
Chromium	45/57	6.4-286	GW-01	5/6	11.7-26.7	003-MS-31I-01	4/6	6.5-16.2	003-MS-30D-01
Cobalt	12/57	5.9-57.3	003-TW-036-01	0/6	ND	ND	0/6	ND	ND
Copper	15/57	3-172	GW-01	1/6	5.7	003-MS-28I-01	0/6	ND	ND
Cyanide	4/54	5.9-291	GW-01	2/6	7-8.6	003-MS-33I-01-D	2/6	6-9	003-MS-32D-01
Iron	55/57	515-27000	GW-01	6/6	2830-11000	003-MS-28I-01	6/6	465-2830	003-MS-31D-01
Lead	14/57	0.8-17.7	003-TW-036-01	0/6	ND	ND	1/6	1.7	003-MS-33D-01
Magnesium	57/57	10500-81900	003-TW-004-01	6/6	32000-110000	003-MS-31I-01	6/6	43000-63800	003-MS-30D-01
Manganese	56/57	19.5-3200	003-TW-018-01	6/6	251-1760	003-MS-31I-01	6/6	167-566	003-MS-30D-01
Mercury	2/57	0.21-0.26	003-TW-007-01	2/6	0.2-0.57	003-MS-33I-01-D	0/6	ND	ND
Nickel	26/57	5.1-87.9	003-TW-036-01	1/6	5.2	003-MS-33I-01	0/6	ND	ND
Potassium	57/57	1660-9430	GW-01	6/6	2630-4260	003-MS-28I-01	6/6	2290-3200	003-MS-31D-01
Selenium	21/51	1.9-142	003-TW-036-01	0/6	ND	ND	0/6	ND	ND
Sodium	57/57	5080-107000	003-TW-047-01	6/6	5690-132000	003-MS-33I-01-D	6/6	11600-29400	003-MS-31D-01

TABLE 4-16

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - UNFILTERED
NIROP FRIDLEY, MINNESOTA

Analyte	Shallow Wells[1]			Intermediate Wells[2]			Deep Wells[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
Thallium	3/57	1.1-2.2	003-MS-29S-01	0/6	ND	ND	0/6	ND	ND
Vanadium	14/57	2.1-53.9	GW-01	1/6	3.1	003-MS-32I-01-D	0/6	ND	ND
Zinc	17/57	13.5-159	GW-01	5/6	7.6-229	003-MS-29I-01	2/6	20.3-27.7	003-MS-28D-01

1 Includes samples:

003-MS-28S-01	003-TW-013-01	003-TW-030-01-D	003-TW-047-01-D	003-TW-074-01	003-TW-P10-01
003-MS-29S-01	003-TW-015-01	003-TW-032-01	003-TW-050-01	003-TW-P01-01	003-TW-P10-01-D
003-MS-30S-01	003-TW-016-01	003-TW-033-01	003-TW-054-01	003-TW-P02-01	003-TW-P11-01
003-MS-31S-01	003-TW-017-01	003-TW-034-01	003-TW-055-01	003-TW-P03-01	003-TW-P12-01
003-MS-32S-01	003-TW-018-01	003-TW-035-01	003-TW-058-01	003-TW-P04-01	GW-01
003-MS-33S-01	003-TW-023-01	003-TW-036-01	003-TW-063-01	003-TW-P05-01	GW-02
003-TW-003-01	003-TW-026-01	003-TW-037-01	003-TW-068-01	003-TW-P06-01	GW-02-D
003-TW-004-01	003-TW-027-01	003-TW-038-01	003-TW-070-01	003-TW-P06-01-D	GW-03
003-TW-006-01	003-TW-028-01	003-TW-039-01	003-TW-071-01	003-TW-P07-01	
003-TW-007-01	003-TW-029-01	003-TW-046-01	003-TW-073-01	003-TW-P08-01	
003-TW-008-01	003-TW-030-01	003-TW-047-01	003-TW-073-01-D	003-TW-P09-01	

2 Includes samples:

003-MS-28I-01	003-MS-30I-01	003-MS-32I-01	003-MS-33I-01
003-MS-29I-01	003-MS-31I-01	003-MS-32I-01-D	003-MS-33I-01-D

3 Includes samples:

003-MS-28D-01	003-MS-30D-01	003-MS-32D-01
003-MS-29D-01	003-MS-31D-01	003-MS-33D-01

4 Frequency of detection determined considering a duplicate pair as one sample.
5 Concentration range determined considering duplicate sample results as individual data points.
6 Not Detected.
7 Not Analyzed.
8 All results for this parameter in these samples were rejected during data validation.

TABLE 4-17

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - FILTERED
NIROP FRIDLEY, MINNESOTA

Analyte	Shallow Wells[1]			Intermediate Wells[2]			Deep Wells[3]		
	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection	Frequency of Detection[4]	Concentration Range[5]	Location of Maximum Detection
INORGANICS (UG/L)									
Aluminum	1/57	196-370	GW-02-F	0/6	ND[6]	ND	0/6	ND	ND
Arsenic	17/57	1-22.9	003-TW-034-F1	3/6	1.1-8.9	003-MS-32I-F1-D	0/6	ND	ND
Barium	55/57	14.7-147	GW-01-F	5/6	30.3-90	003-MS-32I-F1-D	6/6	26.8-63.9	003-MS-29D-F1
Beryllium	7/57	0.3-0.4	003-TW-023-F1	0/6	ND	ND	0/6	ND	ND
Calcium	57/57	48100-265000	003-TW-004-F1	6/6	48300-371000	003-MS-31I-F1	6/6	117000-210000	003-MS-30D-F1
Chromium	41/57	5.9-20.1	003-MS-31S-F1	5/6	9.4-22	003-MS-31I-F1	6/6	6.8-18.2	003-MS-30D-F1
Cobalt	16/57	2.2-13.1	003-TW-038-F1	0/6	ND	ND	0/6	ND	ND
Copper	5/57	3.3-23.6	GW-01-F	0/6	ND	ND	0/6	ND	ND
Iron	54/57	348-17700	003-TW-P12-F1	6/6	1380-8990	003-MS-32I-F1-D	6/6	171-2510	003-MS-30D-F1
Lead	2/57	1.1-1.2	003-TW-073-F1	0/6	ND	ND	0/6	ND	ND
Magnesium	57/57	10100-81200	003-TW-004-F1	6/6	30600-109000	003-MS-31I-F1	6/6	43900-66300	003-MS-30D-F1
Manganese	57/57	3.8-2920	003-TW-018-F1	6/6	212-1740	003-MS-31I-F1	6/6	157-588	003-MS-30D-F1
Mercury	0/57	ND	ND	2/6	0.2-0.44	003-MS-28I-F1	0/6	ND	ND
Nickel	27/57	4.1-33.7	003-TW-016-F1	0/6	ND	ND	0/6	ND	ND
Potassium	57/57	1700-5930	003-TW-004-F1	6/6	2620-4280	003-MS-28I-F1	6/6	2310-3130	003-MS-31D-F1
Selenium	20/54	10.3-131	003-TW-036-F1	1/6	5.1	003-MS-32I-F1	0/6	ND	ND
Sodium	57/57	5460-110000	003-TW-047-F1	6/6	5790-129000	003-MS-33I-F1-D	6/6	12100-29600	003-MS-32D-F1
Thallium	3/57	1-1.9	003-TW-027-F1	0/6	ND	ND	0/6	ND	ND
Vanadium	7/57	2-4	003-TW-P06-F1-D	1/6	3.4	003-MS-33I-F1	0/6	ND	ND
Zinc	5/57	7.5-43.9	003-TW-006-F1	2/6	28.7-87.8	003-MS-29I-F1	1/6	17.7	003-MS-29D-F1

1 Includes samples:

003-MS-28S-F1	003-TW-003-F1	003-TW-015-F1	003-TW-027-F1	003-TW-033-F1
003-MS-29S-F1	003-TW-004-F1	003-TW-016-F1	003-TW-028-F1	003-TW-034-F1
003-MS-30S-F1	003-TW-006-F1	003-TW-017-F1	003-TW-029-F1	003-TW-035-F1
003-MS-31S-F1	003-TW-007-F1	003-TW-018-F1	003-TW-030-F1	003-TW-036-F1
003-MS-32S-F1	003-TW-008-F1	003-TW-023-F1	003-TW-030-F1-D	003-TW-037-F1
003-MS-33S-F1	003-TW-013-F1	003-TW-026-F1	003-TW-032-F1	003-TW-038-F1

TABLE 4-17

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - FILTERED
NIROP FRIDLEY, MINNESOTA

1 Includes samples: (continued)

003-TW-039-F1	003-TW-058-F1	003-TW-074-F1	003-TW-P06-F1-D	003-TW-P12-F1
003-TW-046-F1	003-TW-063-F1	003-TW-P01-F1	003-TW-P07-F1	GW-01-F
003-TW-047-F1	003-TW-068-F1	003-TW-P02-F1	003-TW-P08-F1	GW-02-F
003-TW-047-F1-D	003-TW-070-F1	003-TW-P03-F1	003-TW-P09-F1	GW-02-F-D
003-TW-050-F1	003-TW-071-F1	003-TW-P04-F1	003-TW-P10-F1	GW-03-F
003-TW-054-F1	003-TW-073-F1	003-TW-P05-F1	003-TW-P10-F1-D	
003-TW-055-F1	003-TW-073-F1-D	003-TW-P06-F1	003-TW-P11-F1	

2 Includes samples:

003-MS-28I-F1	003-MS-32I-F1
003-MS-29I-F1	003-MS-32I-F1-D
003-MS-30I-F1	003-MS-33I-F1
003-MS-31I-F1	003-MS-33I-F1-D

3 Includes samples:

003-MS-28D-F1	003-MS-31D-F1
003-MS-29D-F1	003-MS-32D-F1
003-MS-30D-F1	003-MS-33D-F1

4 Frequency of detection determined considering a duplicate pair as one sample.
5 Concentration range determined considering duplicate sample results as individual data points.
6 Not Detected.

TABLE 4-18

EVALUATION OF AOC GROUPS
NIROP FRIDLEY, MINNESOTA

GROUP	OPERATIONS	ANTICIPATED CONTAMINANTS (FROM WORKPLAN)	AOC #	SAMPLE DEPTH	KEY MEASURED CONTAMINANT	COMMENT
1	1,1,1-TCA/TCE STORAGE	VOC	3	4-8 ft.	xylenes, 2 ug/kg	highest concentration of any chlorinated solvent or BTEX
2	DEGREASING	VOC, DRO/GRO	58	0-4 ft.	tce, 490 ug/kg	highest concentration of any chlor. solvent, BTEX, or SVOC -
						concentration at 4-8 ft. is only 3 ug/kg
2	DEGREASING	VOC, DRO/GRO	39	0-4 ft.	toluene, 14 ug/kg	also, xylenes at 7 ug/kg. No chlorinated solvents detected.
				8-12 ft.	toluene, 19 ug/kg	also, xylenes at 10 ug/kg. No chlorinated solvents detected.
2	DEGREASING	VOC, DRO/GRO	16	0-4 ft.	tce, 12 ug/kg	only chlorinated solvent greater than 10 ug/kg
3	HEAT TREAT	METALS, INORGANICS, PCBs	46			no PCBs detected, no metals out of normal range
4	MACHINING	VOC, DRO/GRO, PCBs	30	0-4 ft.	aroclor 1016, 150ug/kg	only PCB detect. No chlor solv, BTEX, or SVOC > 10 ug/kg
5	PAINTING	METALS, VOC	35	0-4 ft.	metals	chrome III/VI: 84/6 ug/kg, pb = 15 ug/kg, zn = 479 ug/kg
				8-12 ft.	tce, 36 ug/kg	only chlorinated solvent greater than 10 ug/kg
6	PEPSET STORAGE	VOC, SVOC	63	0-4 ft.	pce, 18 ug/kg	only chlorinated solvent greater than 10 ug/kg
7	PLATING	VOC, DRO/GRO, METALS	50	0-4 ft.	toluene, 12 ug/kg	only chlorinated solvent greater than 10 ug/kg

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FIGURE 4-1

SHEET - OF -

NAVFAC DRAWING NO.

CONSTR. CONTR. NO.

SPEC. NO.

STA. PROJ. NO.

EFD NO.

SCALE: AS SHOWN

CODE ID. NO. 80091

SIZE D

DEPARTMENT OF THE NAVY — **SOUTHERN DIVISION** — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL STATION — CHARLESTON, SOUTH CAROLINA

NIROP FRIDLEY — FRIDLEY, MINNESOTA

ORGANIC CHEMICALS DETECTED IN SURFACE SOIL - 0 TO 4 FEET

SEAL

Tetra Tech NUS, Inc.
FOSTER PLAZA
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

APPROVED: DATE

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D. PERRY	DRAWN	14-AUG-98
	REVIEW	
	CHIEF ARCH./ENGR.	
	PROJECT MANAGER	
	FIRE PROTECTION	
	QUALITY CONTROL	
	BRANCH MANAGER	
	DESIGN DIRECTOR	

SYM.	DESCRIPTION	DATE	APPROVED

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FIGURE 4-2

SHEET - OF -

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SPEC. NO.

STA. PROJ. NO.

EFD NO.

SCALE: AS SHOWN

CODE ID. NO. 80091

SIZE D

DEPARTMENT OF THE NAVY — **SOUTHERN DIVISION** — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL STATION — CHARLESTON, SOUTH CAROLINA

NIROP FRIDLEY — FRIDLEY, MINNESOTA

INORGANIC CHEMICALS DETECTED IN SURFACE SOIL - 0 TO 4 FEET

SEAL

Tetra Tech NUS, Inc.
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BRANCH MANAGER

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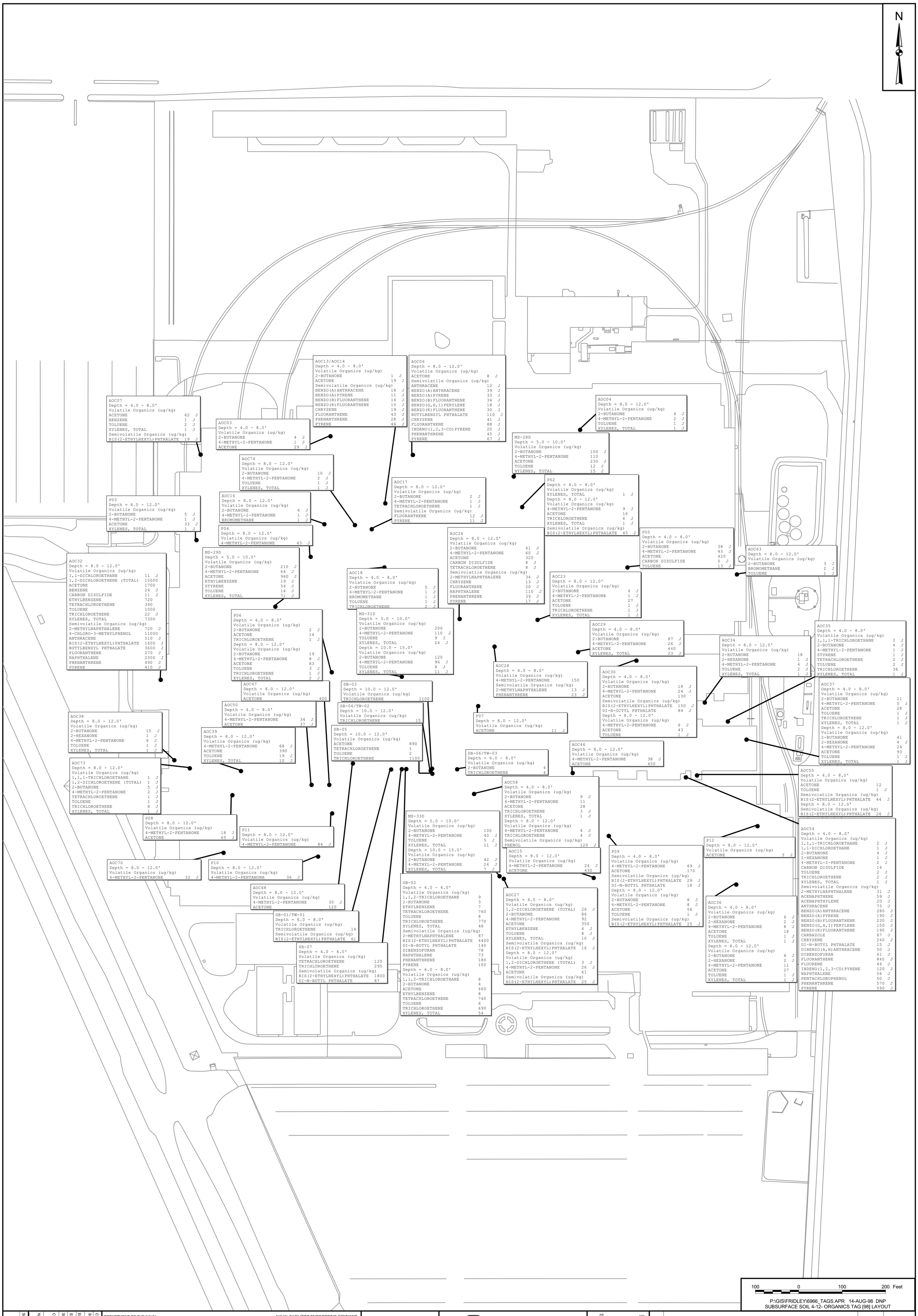

FIGURE 4-3

SHEET – OF –

NAVFAC DRAWING NO.

CONSTR. CONTR. NO.

SPEC. NO.

STA. PROJ. NO.

EFD NO.

SCALE: AS SHOWN

CODE ID. NO. 60091

SIZE D

DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

NAVAL FACILITIES ENGINEERING COMMAND

NAVAL STATION

CHARLESTON, SOUTH CAROLINA

NIROP FRIDLEY

FRIDLEY, MINNESOTA

ORGANIC CHEMICALS DETECTED IN SUBSURFACE SOIL - 4 TO 12 FEET

SEAL

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661 ANDERSEN DRIVE
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FIRE PROTECTION

QUALITY CONTROL

BRANCH MANAGER

DESIGN DIRECTOR

SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

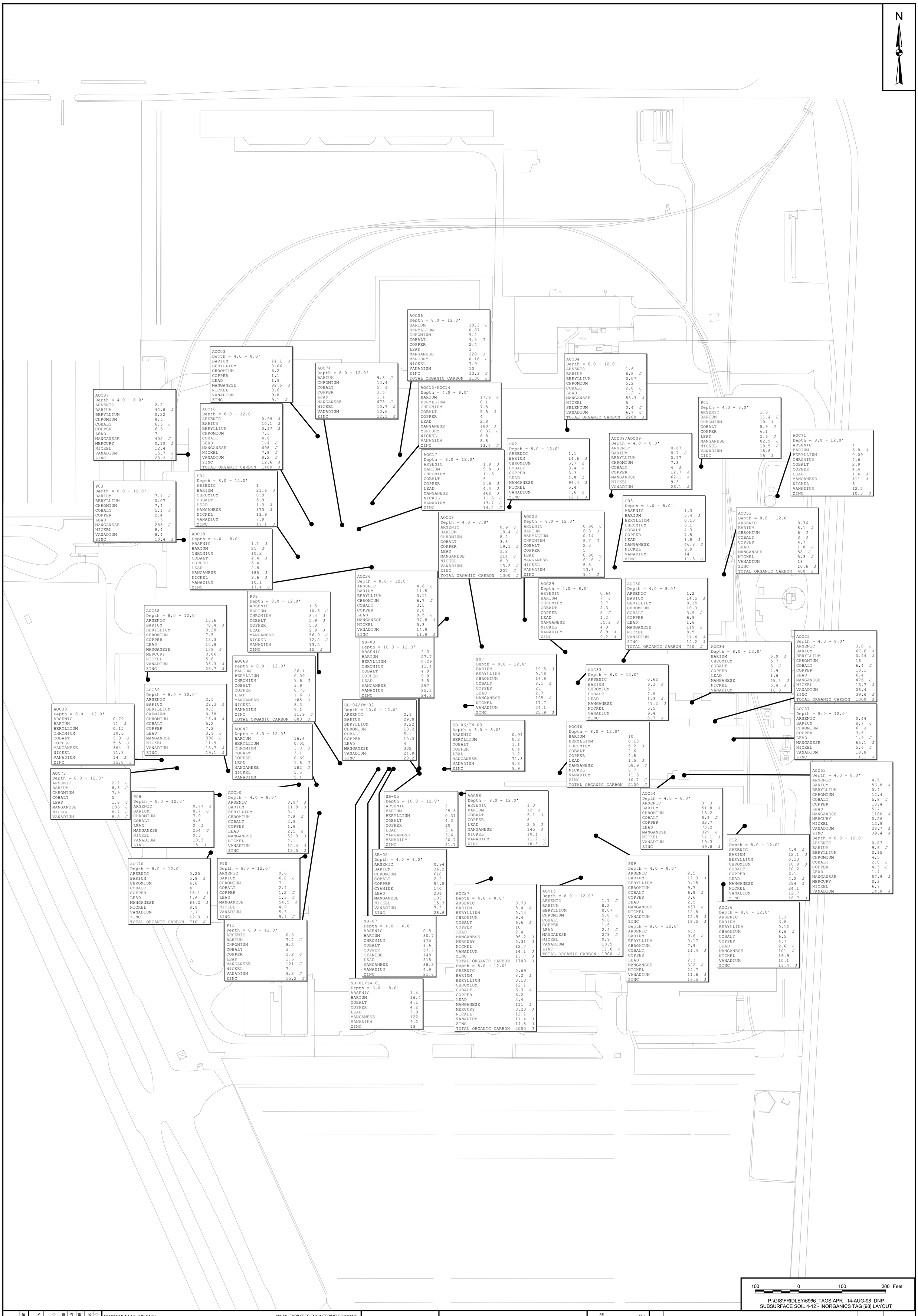

FIGURE 4-4

SHEET - OF -

NAVFAC DRAWING NO.

CONSTR. CONTR. NO.

SPEC. NO.

STA. PROJ. NO.

EFD NO.

SCALE: AS SHOWN

CODE ID. NO. 80091

SIZE D

DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

NAVAL FACILITIES ENGINEERING COMMAND

NAVAL STATION

CHARLESTON, SOUTH CAROLINA

NIROP FRIDLEY

FRIDLEY, MINNESOTA

INORGANIC CHEMICALS DETECTED IN SUBSURFACE SOIL - 4 TO 12 FEET

SEAL

Tetra Tech NUS, Inc.

FOSTER PLAZA
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

APPROVED: DATE

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APPROVED: DATE

FOR FED FOR COMMANDER NAVFAC

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DESIGN

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REVIEW

CHIEF ARCH./ENGR.

PROJECT MANAGER

FIRE PROTECTION

QUALITY CONTROL

BRANCH MANAGER

DESIGN DIRECTOR

SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

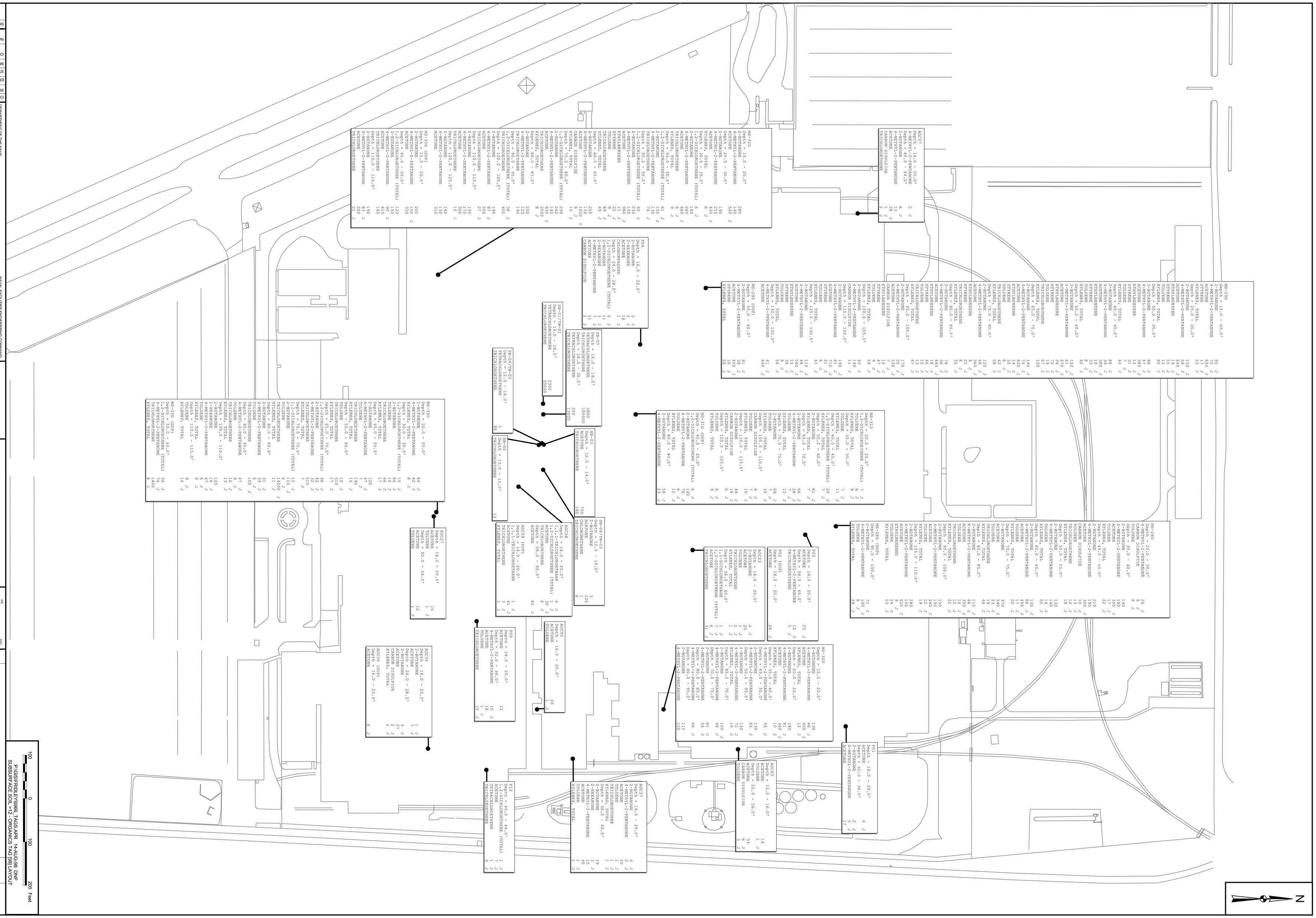


FIGURE 4-5

SHEET - OF -

NAVFAC DRAWING NO.

CONSTR. CONTR. NO.

SPEC. NO.

STA. PROJ. NO.

EFD NO.

SCALE: AS SHOWN

CODE ID. NO. 80091 SIZE D

DEPARTMENT OF THE NAVY

NAVAL STATION NIROP FRIDLEY

SOUTHERN DIVISION

NAVAL FACILITIES ENGINEERING COMMAND

CHARLESTON, SOUTH CAROLINA

FRIDLEY, MINNESOTA

ORGANIC CHEMICALS DETECTED IN SUBSURFACE SOIL - >12 FEET

Tetra Tech NUS, Inc.

60 INDUSTRIAL DRIVE
BIRMINGHAM, ALABAMA 35211

APPROVED

ACTIVITY - SATISFACTORY TO.

DATE

APPROVED

FOR DEPARTMENT/NAVFAC

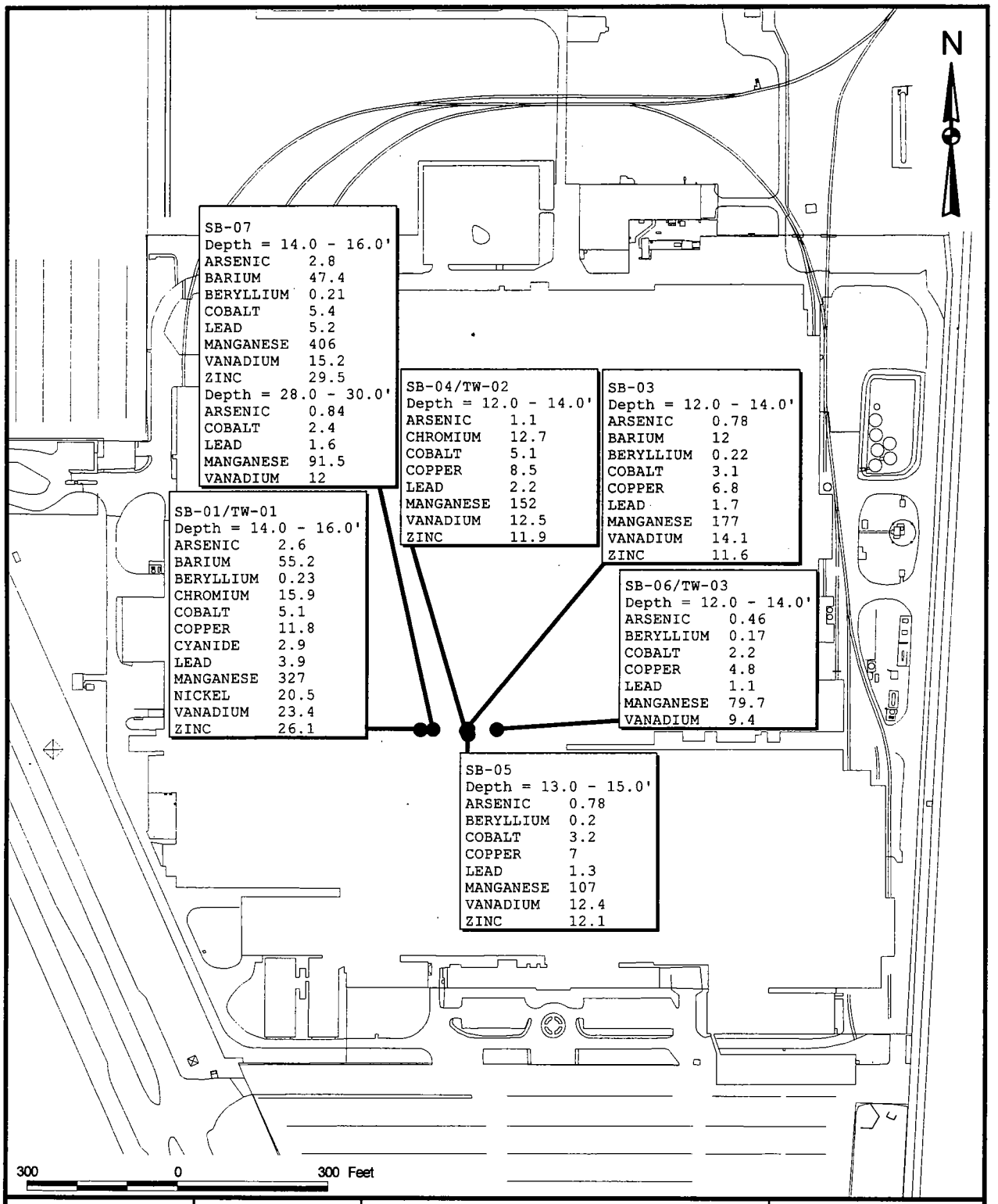
INC.

		DATE	DESIGN	EFD
			D.PERRY	
			DRAWN	J.HUGHES
			REVIEW	
			CHIEF ARCHITECT	
PROJECT MANAGER				
FIRE PROTECTION				
QUALITY CONTROL				
BRANCH MANAGER				
DEPARTMENT DIRECTOR				

SYM	DESCRIPTION	DATE	APPROVED
	REVISIONS		

100 0 100 200 Feet

P:\GISFRID\EV6966_TAGS.APR 14-AUG-08 DNP
SUBSURFACE SOIL >12 ORGANICS TAG [98] LAYOUT



DRAWN BY D. PERRY	DATE 17-AUG-98	INORGANIC CHEMICALS DETECTED IN SUBSURFACE SOIL - >12 FEET NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA	CONTRACT NUMBER —
CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY DATE 8/13/99
SCALE AS NOTED			DRAWING NO. FIGURE 4-6 REV 0

P:\GIS\FRIDLEY\6986_TAGS.APR 17-AUG-98 DNP SUBSURFACE SOIL >12 - INORGANICS TAG [98] AV LAYOUT

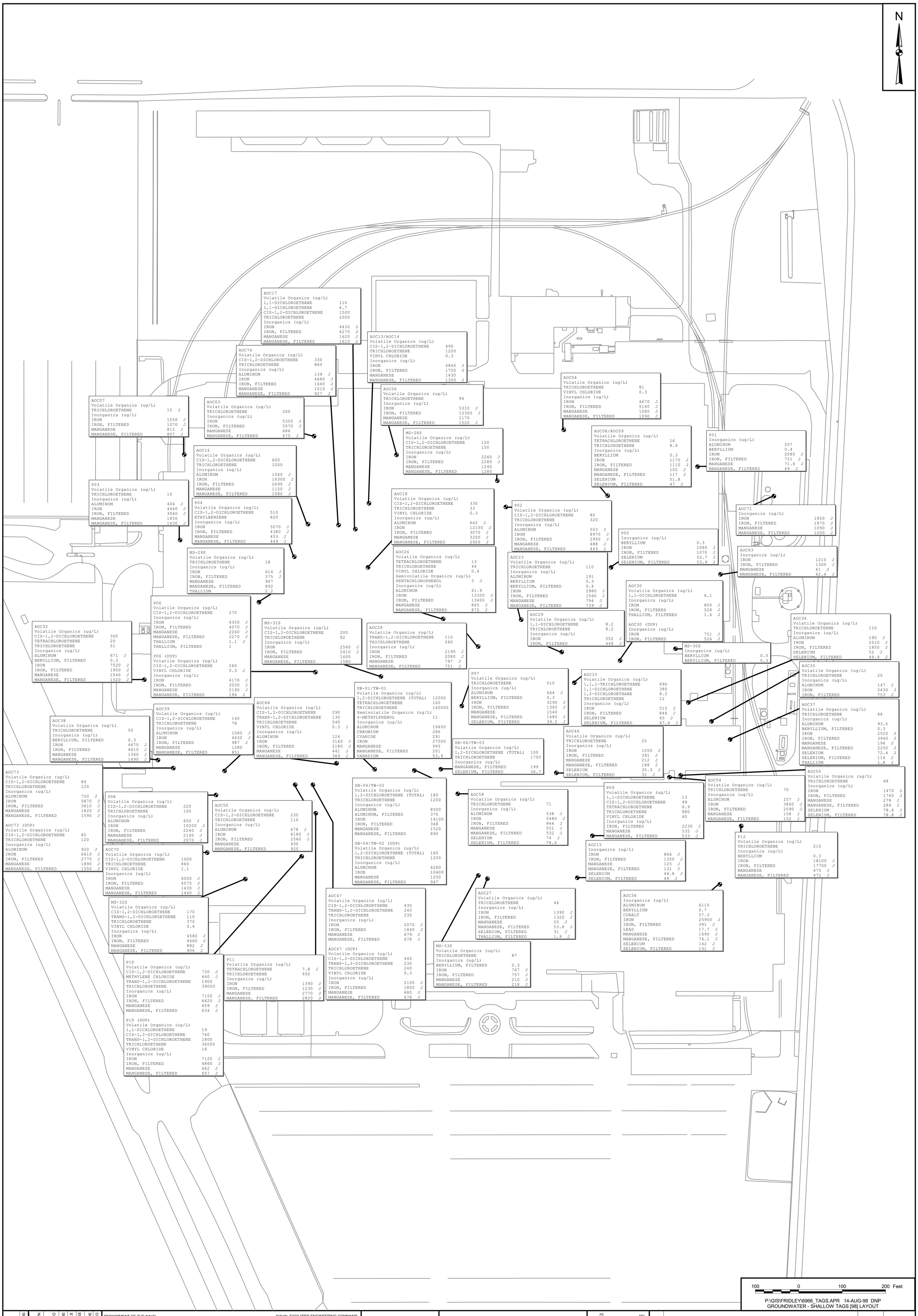


FIGURE 4-7

SHEET - OF -

NAVFAC DRAWING NO.

CONSTR. CONTR. NO.

SPEC. NO.

STA. PROJ. NO.

EFD NO.

SCALE: AS SHOWN

CODE ID. NO. 80091

SIZE D

DEPARTMENT OF THE NAVY **SOUTHERN DIVISION** NAVAL FACILITIES ENGINEERING COMMAND

NAVAL STATION CHARLESTON, SOUTH CAROLINA

NIROP FRIDLEY FRIDLEY, MINNESOTA

CHEMICALS EXCEEDING BENCHMARKS IN GROUNDWATER - SHALLOW WELLS

SEAL

Tetra Tech NUS, Inc.
FOSTER PLAZA
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

APPROVED: DATE

ACTIVITY - SATISFACTORY TO.

APPROVED: DATE

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PROJECT MANAGER

FIRE PROTECTION

QUALITY CONTROL

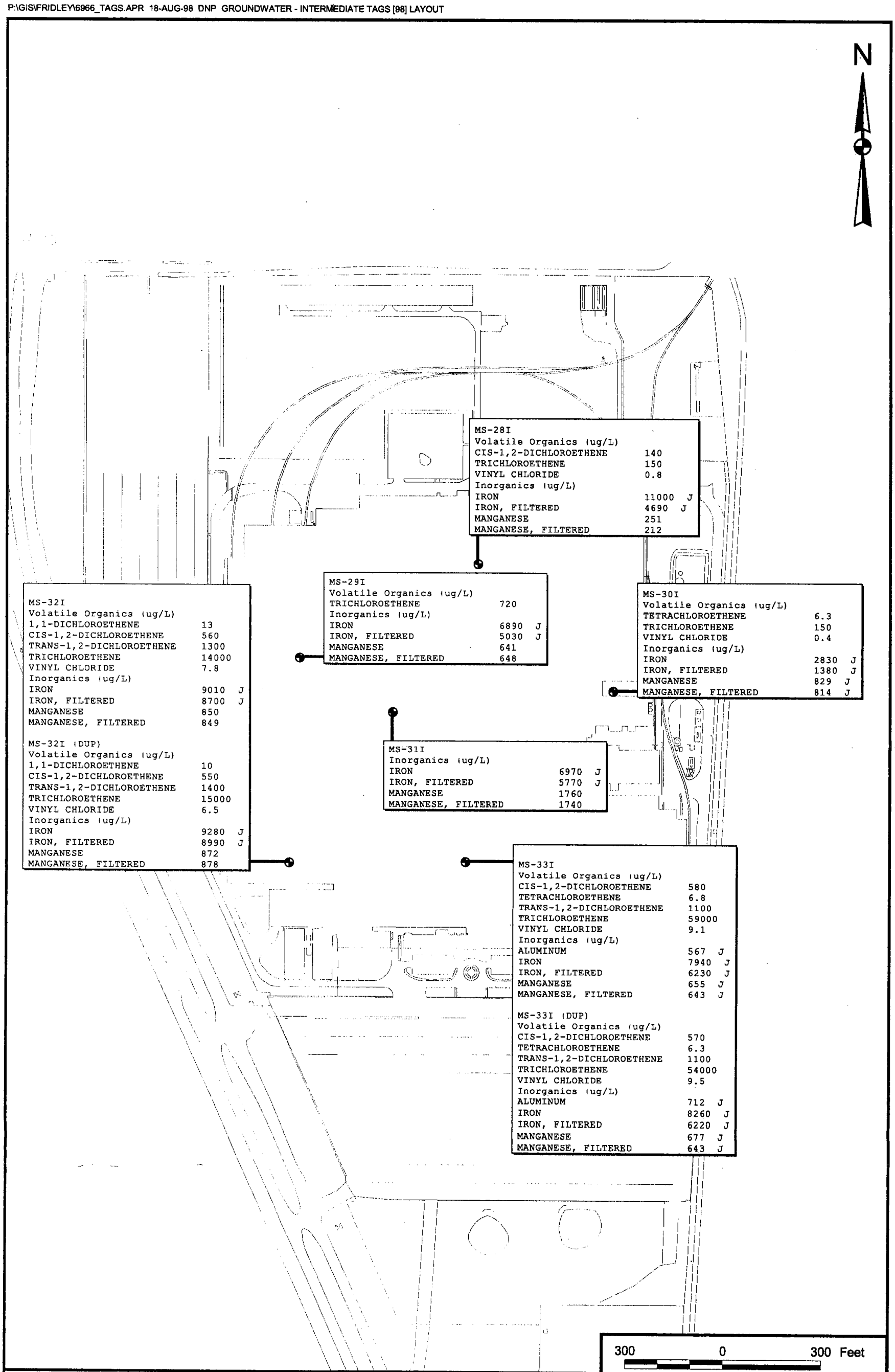
BRANCH MANAGER

DESIGN DIRECTOR

SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

P:\GIS\FRIDLEY\6966_TAGS.APR 18-AUG-98 DNP GROUNDWATER - INTERMEDIATE TAGS [98] LAYOUT



DRAWN BY D. PERRY	DATE 18-AUG-98	CHEMICALS EXCEEDING BENCHMARKS IN GROUNDWATER - INTERMEDIATE WELLS NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA	CONTRACT NUMBER
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE 8/12/99
SCALE AS NOTED			DRAWING NO. FIGURE 4-8 REV 0

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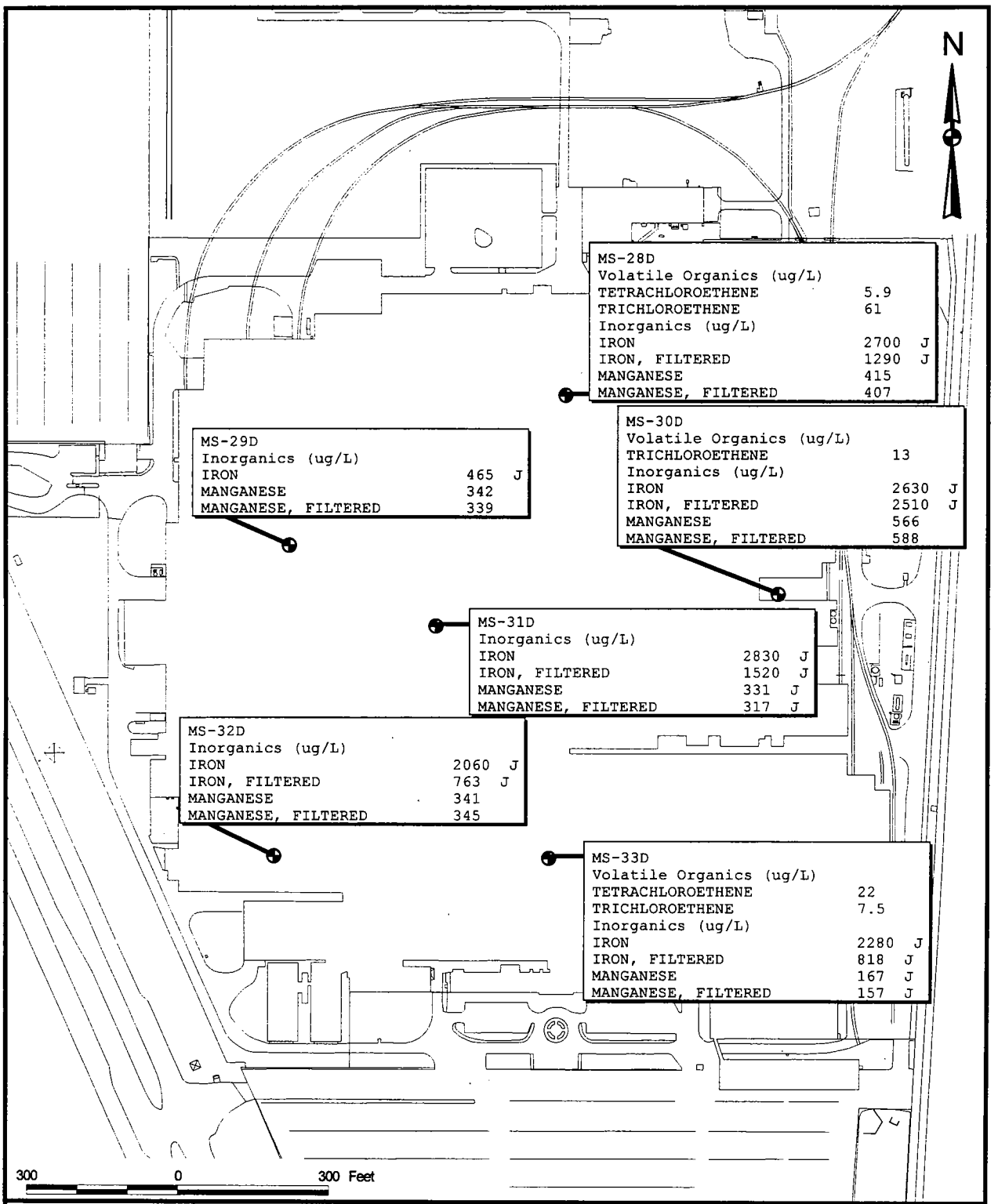
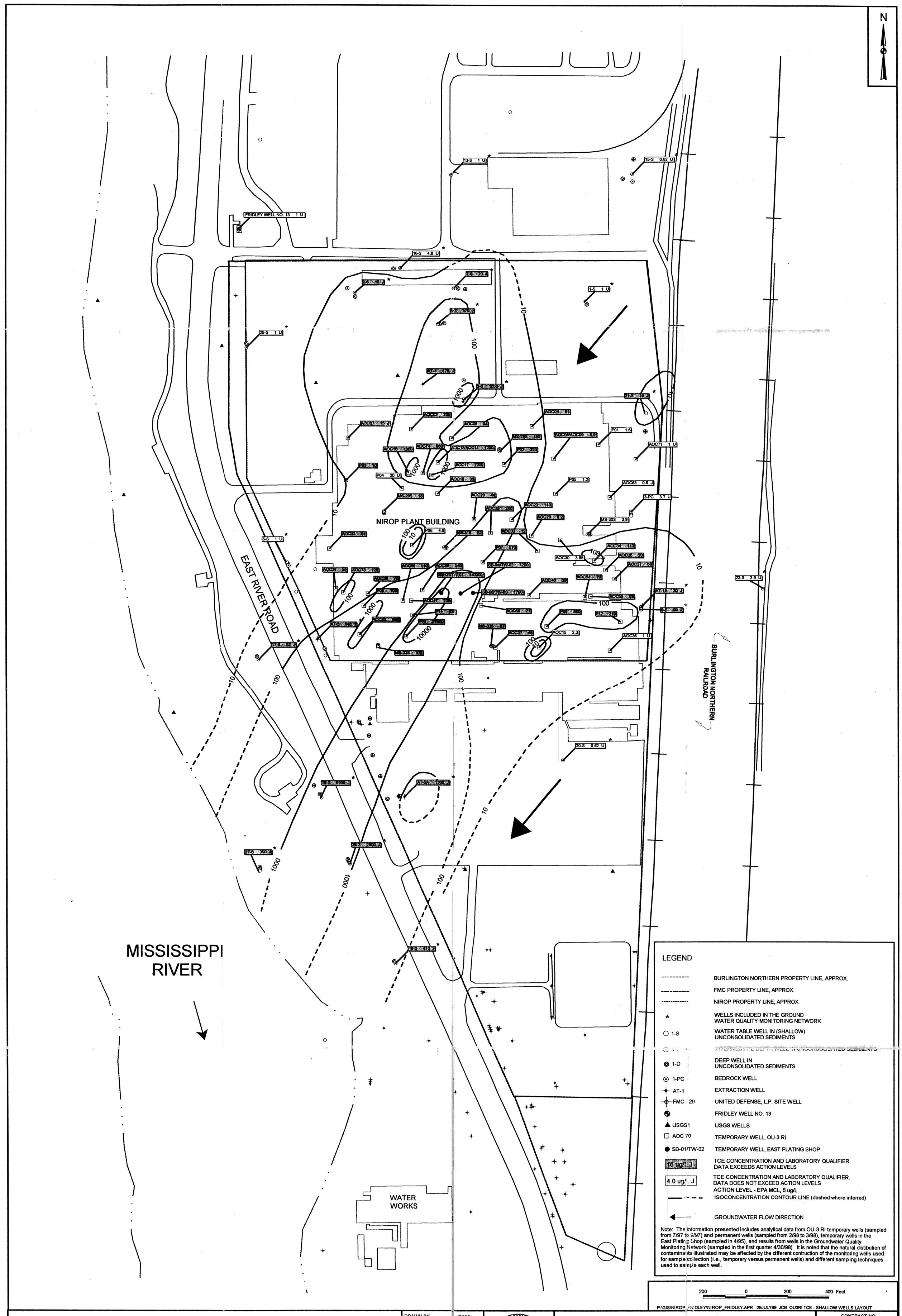


DRAWN BY D. PERRY	DATE 18-AUG-98	CHEMICALS EXCEEDING BENCHMARKS IN GROUNDWATER - DEEP WELLS NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA	CONTRACT NUMBER
CHECKED BY	DATE		APPROVED BY / DATE
COST/SCHEDULE-AREA			APPROVED BY / DATE 8/12/99
SCALE AS NOTED			DRAWING NO. FIGURE 4-9 / REV 0

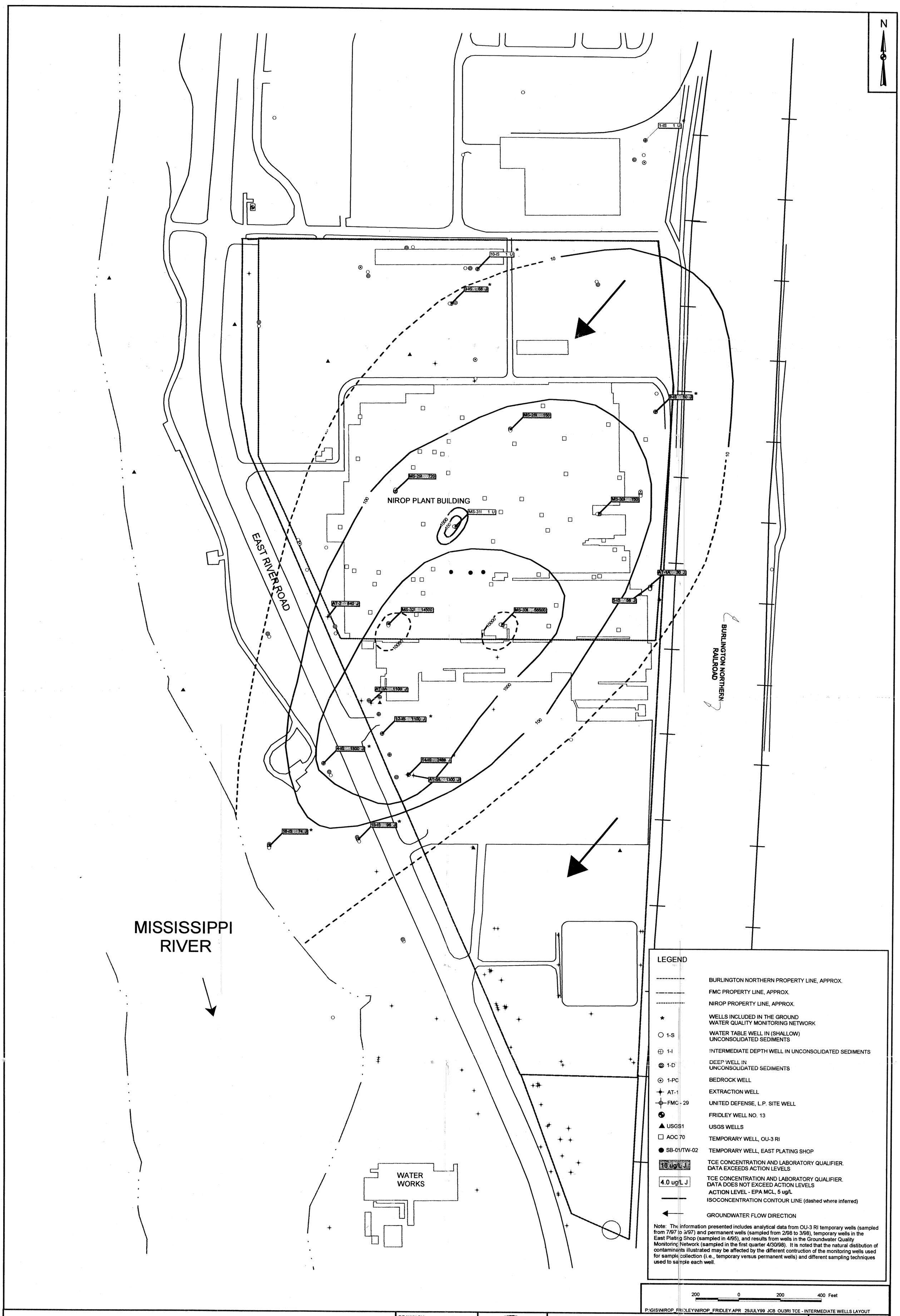
P:\GIS\FRIDLEY\6966_TAGS.APR 18-AUG-98 DNP GROUNDWATER - DEEP TAGS [96] LAYOUT



DRAWN BY J. BELLONE	DATE 29 JULY 99	
CHECKED BY K. HENN	DATE 9 AUG 99	
	DATE	
SCALE AS NOTED		

TRICHLOROETHENE (TCE) CONCENTRATIONS
SHALLOW MONITORING WELLS
OU - 3 REMEDIAL INVESTIGATION
NIROP FRIDLEY
FRIDLEY, MINNESOTA

CONTRACT NO. 57	
OWNER NO.	
APPROVED BY	DATE 8/12/99
DRAWING NO. 4-10	REV. 0



DRAWN BY	DATE
J. BELLONE	29 JULY 99
CHECKED BY	DATE
K. HENN	9 AUG 99
	DATE
SCALE	
AS NOTED	

TRICHLOROETHENE (TCE) CONCENTRATIONS
INTERMEDIATE MONITORING WELLS
OU - 3 REMEDIAL INVESTIGATION
NIROP FRIDLEY
FRIDLEY, MINNESOTA

CONTRACT NO.	
57	
OWNER NO.	
APPROVED BY	DATE
	8/13/99
DRAWING NO.	REV.
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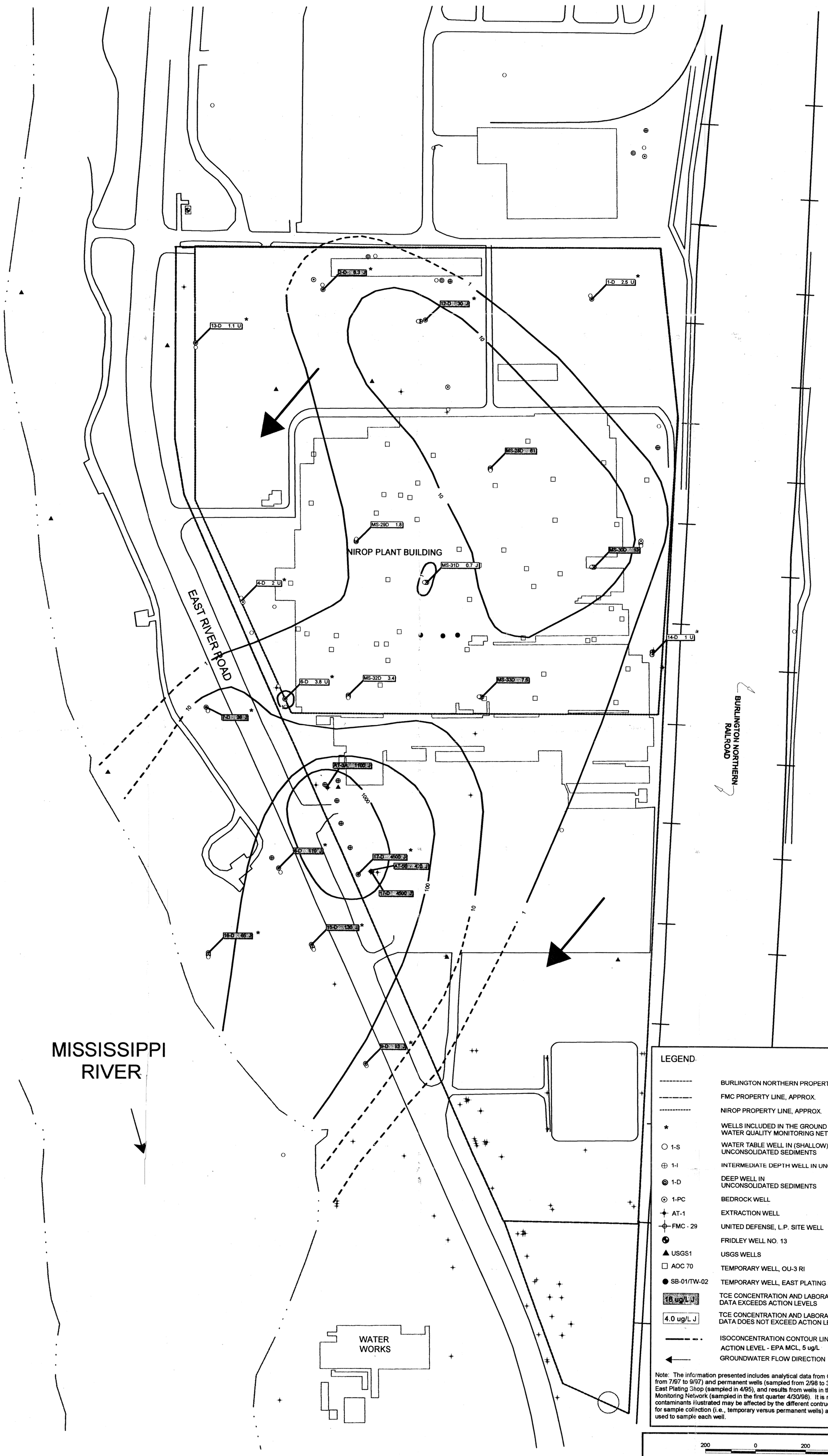
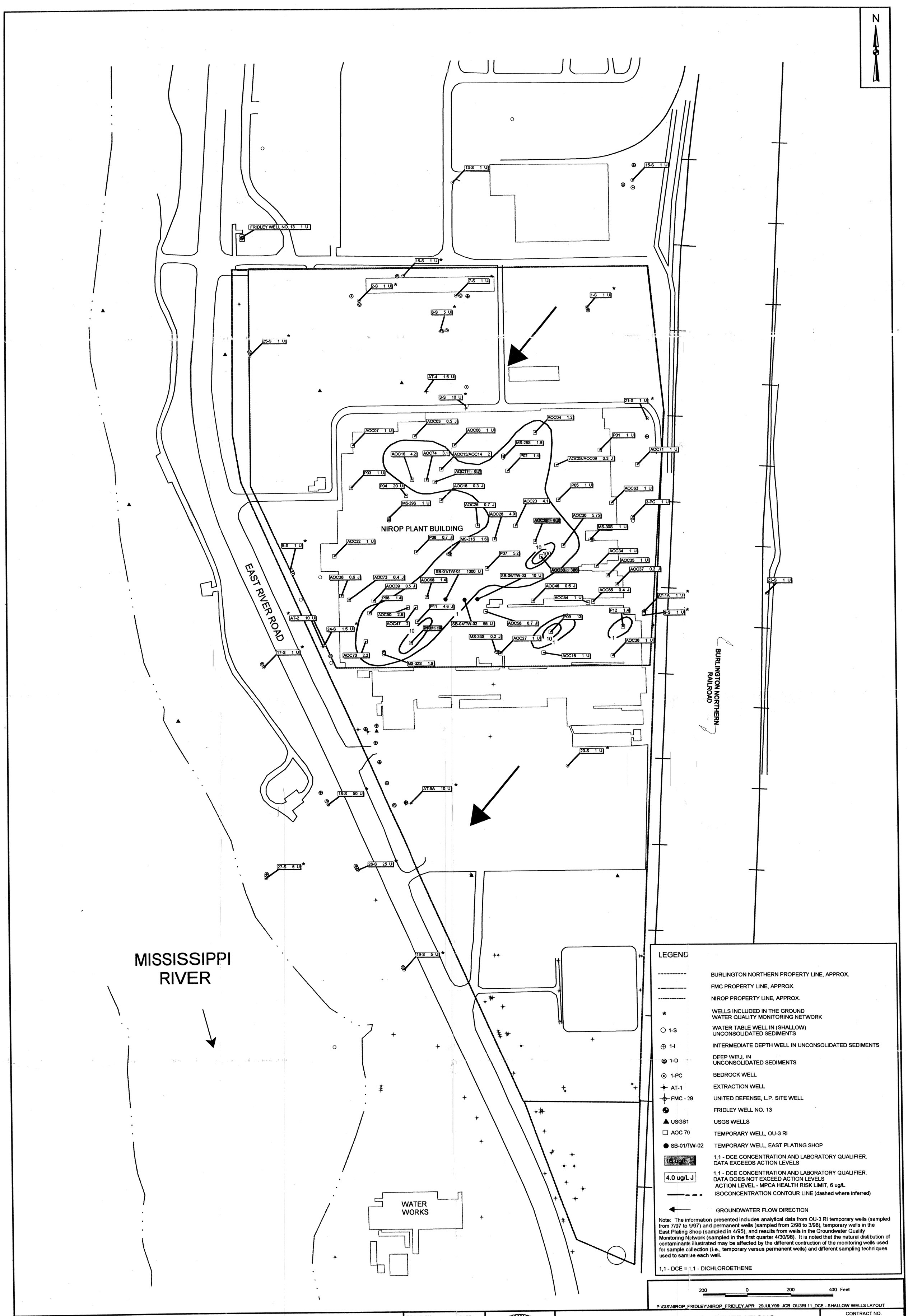


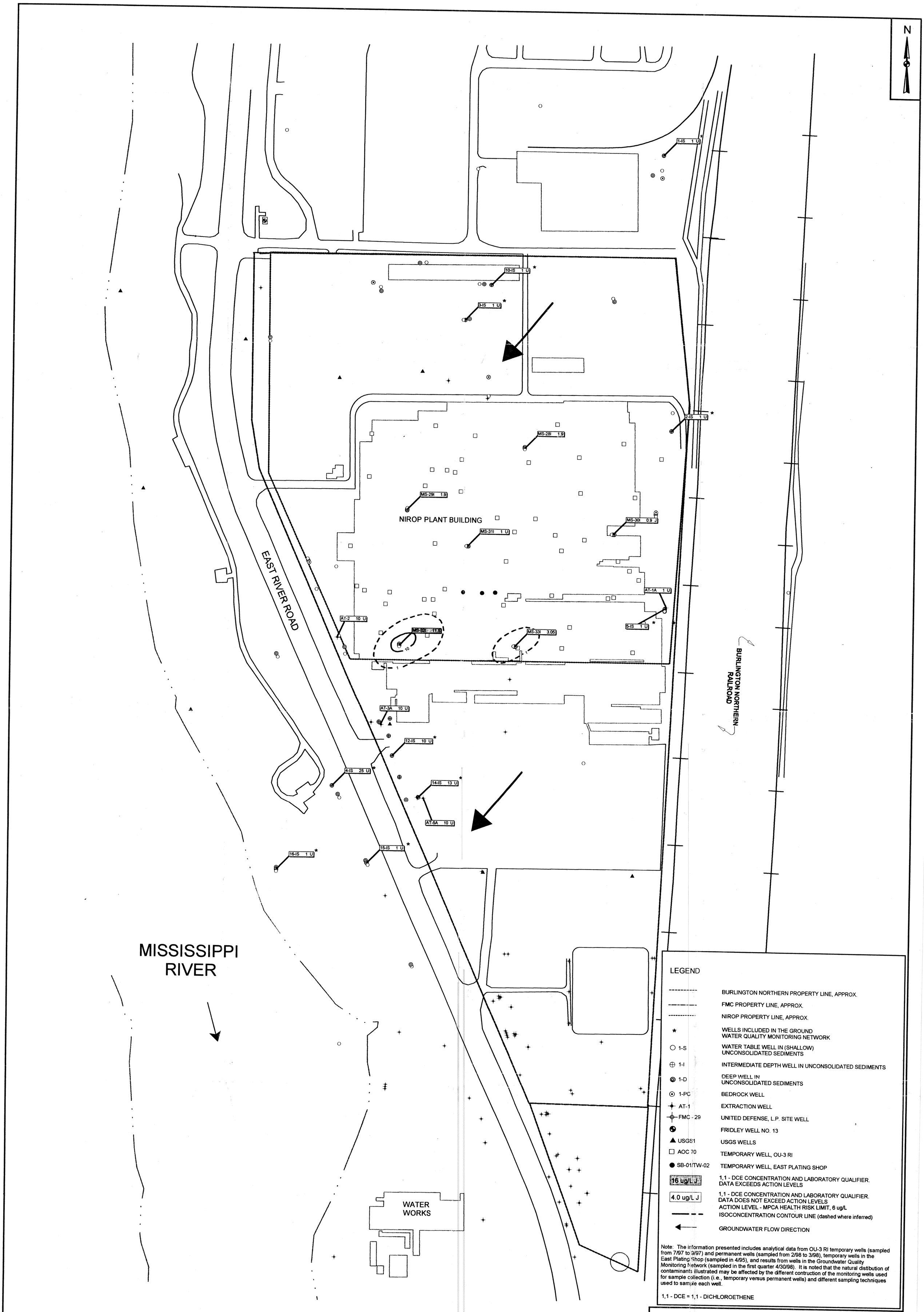
DRAWN BY J. BELLONE	DATE 29 JULY 99	TRICHLOROETHENE (TCE) CONCENTRATIONS DEEP MONITORING WELLS OU - 3 REMEDIAL INVESTIGATION NIROP FRIDLEY FRIDLEY, MINNESOTA
CHECKED BY K. HENN	DATE 9 AUG 99	CONTRACT NO. 57
	DATE	OWNER NO.
SCALE AS NOTED		APPROVED BY / DATE 8/12/99
		DRAWING NO. 4-12 / REV. 0



DRAWN BY J. BELLONE	DATE 29 JULY 99	
CHECKED BY K. HENN	DATE 9 AUG 99	
	DATE	
SCALE AS NOTED		

1,1 - DICHLOROETHENE CONCENTRATIONS
IN GROUNDWATER
SHALLOW MONITORING WELLS
OU - 3 REMEDIAL INVESTIGATION
NIROP FRIDLEY
FRIDLEY, MINNESOTA

CONTRACT NO. 57	
OWNER NO.	
APPROVED BY	DATE 8/10/99
DRAWING NO. 4-13	REV. 0

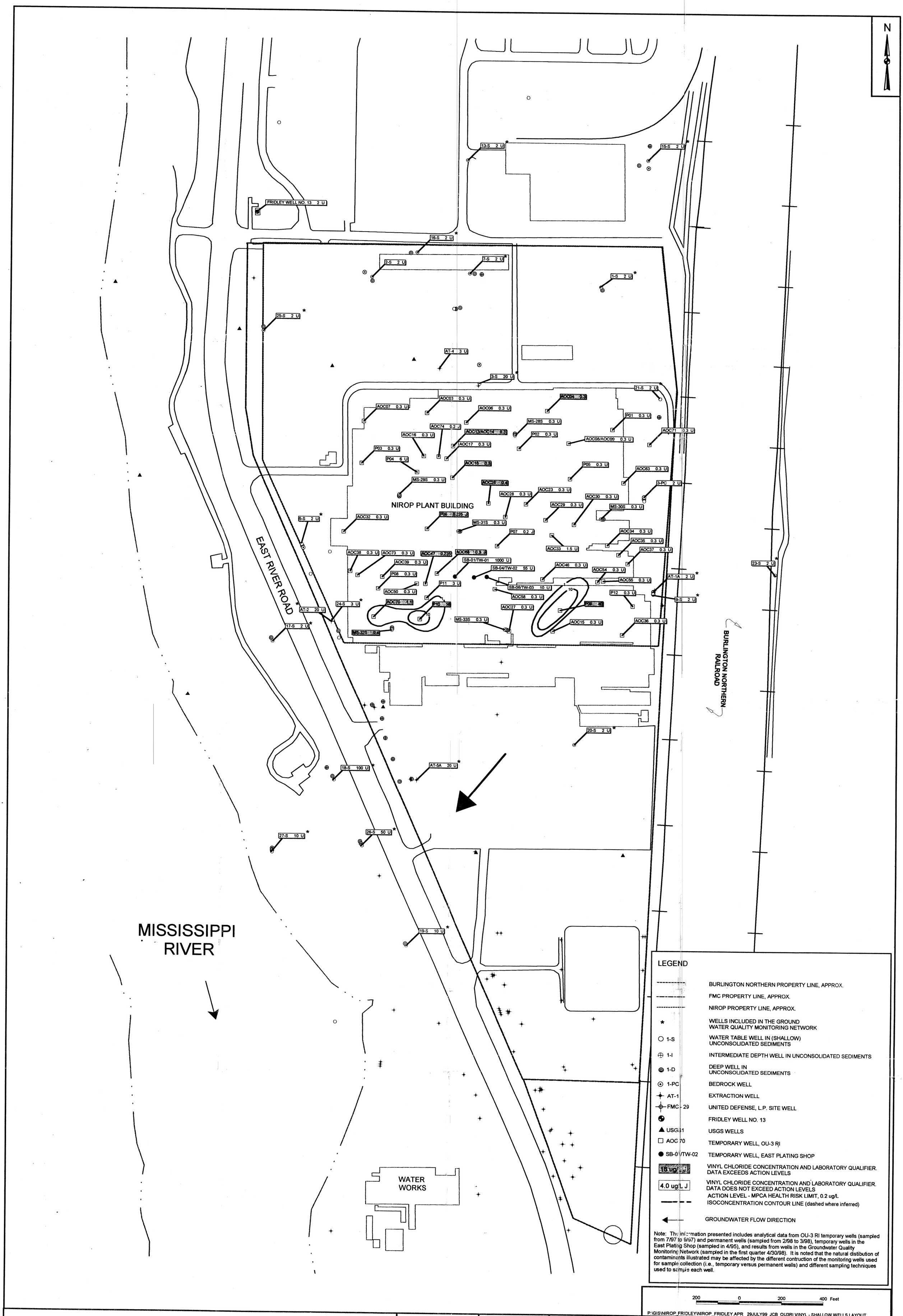


DRAWN BY J. BELLONE	DATE 29 JULY 99	
CHECKED BY K. HENN	DATE 9 AUG 99	
	DATE	
SCALE AS NOTED		

DEPARTMENT OF THE NAVY ★ SOUTHERN DIV FACILITIES ENGINEERING COMD

1,1 - DICHLOROETHENE CONCENTRATIONS
IN GROUNDWATER
INTERMEDIATE MONITORING WELLS
OU - 3 REMEDIAL INVESTIGATION
NIROP FRIDLEY
FRIDLEY, MINNESOTA

CONTRACT NO. 57	
OWNER NO.	
APPROVED BY	DATE 8/12/99
DRAWING NO. 4-14	REV. 0

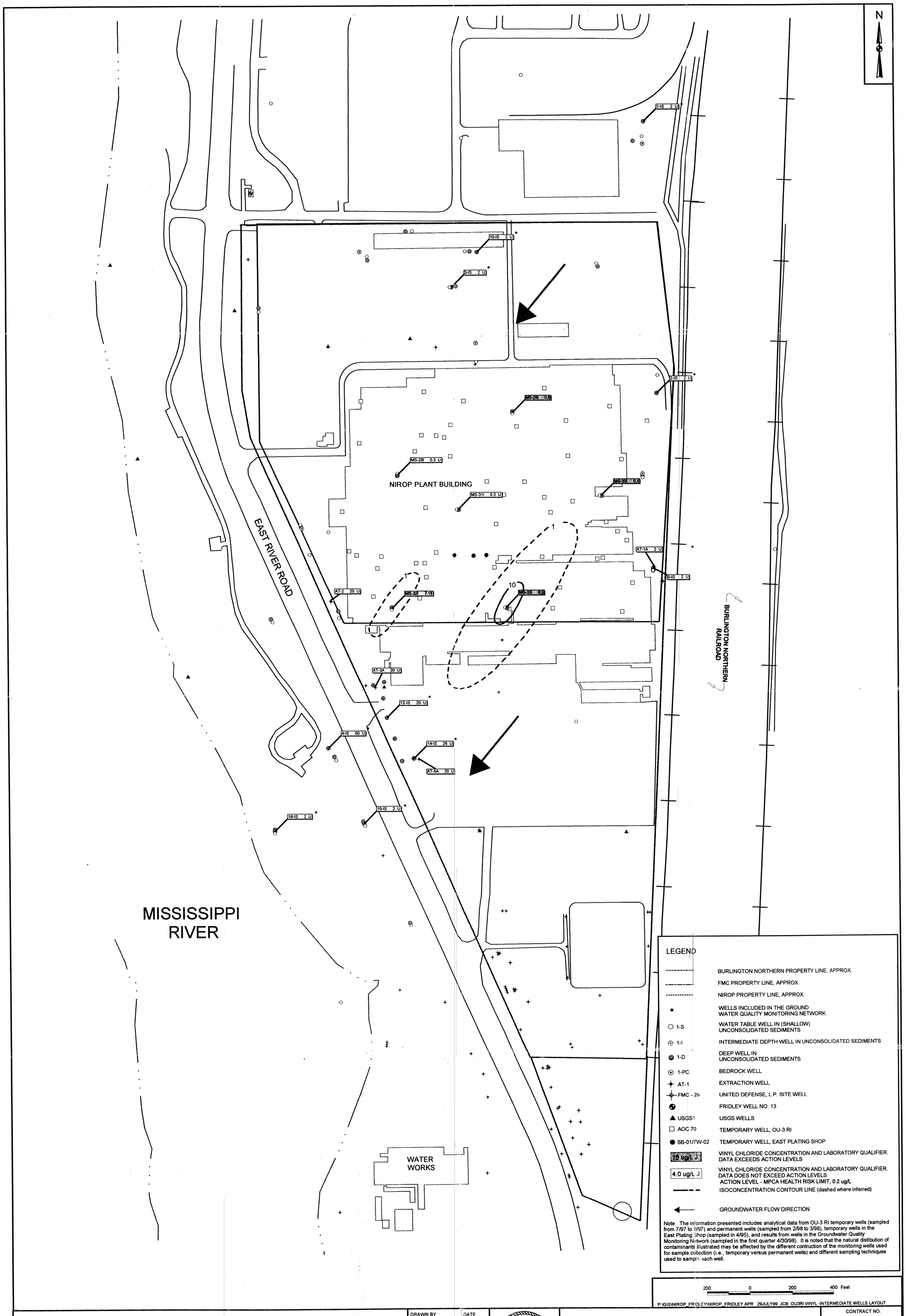


DRAWN BY J. BELLONE	DATE 29 JULY 99	
CHECKED BY K. HENN	DATE 9 AUG 99	
	DATE	
SCALE AS NOTED		

DEPARTMENT OF THE NAVY — SOUTHERN DIV FACILITIES ENGINEERING COMD

VINYL CHLORIDE CONCENTRATIONS IN GROUNDWATER
SHALLOW MONITORING WELLS
OU - 3 REMEDIAL INVESTIGATION
NIROP FRIDLEY
FRIDLEY, MINNESOTA

CONTRACT NO. 57	
OWNER NO.	
APPROVED BY	DATE 8/27/99
DRAWING NO. 4-15	REV. 0



DRAWN BY J. BELLONE	DATE 29 JULY 99	
CHECKED BY K. HENN	DATE 9 AUG 99	
	DATE	
SCALE AS NOTED		

DEPARTMENT OF THE NAVY · NAVAL FACILITIES ENGINEERING COMD

VINYL CHLORIDE CONCENTRATIONS IN GROUNDWATER
INTERMEDIATE MONITORING WELLS
OU - 3 REMEDIAL INVESTIGATION
NIROP FRIDLEY
FRIDLEY, MINNESOTA

CONTRACT NO. 57	
OWNER NO.	
APPROVED BY	DATE 8/12/99
DRAWING NO. 4-16	REV. 0

5.0 CHEMICAL FATE AND TRANSPORT ANALYSIS

Various aspects of contaminant fate and transport at NIROP are discussed in this section. Properties that affect chemical migration are presented in Section 5.1. Section 5.2 presents a brief discussion of chemical persistence. Section 5.3 presents an overview of chemical fate and transport. Site-specific chemical fate and transport is discussed as part of the SESOIL modeling presented in Section 7.0.

5.1 CHEMICAL AND PHYSICAL PROPERTIES

Various chemical and physical properties of all detected site compounds are presented and discussed in this section. These parameters may be used to estimate the environmental behavior of site chemicals. Physical and chemical properties of the organic chemicals found at NIROP are presented in Tables 5-1 and 5-2.

Literature values of the water solubility, octanol/water partition coefficient, organic carbon partition coefficient, vapor pressure, Henry's Law constant, bioconcentration factor, and specific gravity are presented, when available. Calculated values, which were obtained using approximation methods, are presented when literature values are not available. A discussion of the environmental significance of each of these parameters follows.

5.1.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Its primary use is to determine whether a contaminant will have a tendency to float or sink in water if it is present as a pure compound or at very high concentrations. Contaminants with a specific gravity greater than 1 will tend to sink, whereas contaminants with a specific gravity less than 1 will tend to float. This parameter becomes important in discussions regarding the potential presence of free product or NAPLs.

Of the commonly detected chemicals at these sites, the ketones and some monocyclic aromatics have specific gravities less than 1. The halogenated aliphatics, PAHs, PCBs, and phthalate esters have specific gravities greater than 1.

5.1.2 Vapor Pressure

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary importance at environmental interfaces, such as surface soil/air and surface water/air. Volatilization is not as important when evaluating contaminated groundwater and subsurface soils that are not exposed to the atmosphere. Vapor pressures for ketones, monocyclic aromatics, and halogenated aliphatics are generally many times higher than vapor pressures for PCBs. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization is a significant loss process for volatile organics in surface water or surface soil. Volatilization is not significant for inorganics.

5.1.3 Solubility

The rate at which a chemical is leached from a waste deposit by infiltrating precipitation is proportional to its water solubility. More soluble chemicals are more readily leached than less soluble chemicals. The water solubilities presented in Table 5-1 indicate that the VOCs (ketones, monocyclic aromatics, and halogenated aliphatics) are usually several orders of magnitude more water-soluble than PCBs. The groundwater data show that the various types of VOCs are the predominant contaminants.

The solubility of inorganics is strongly influenced by their valence state(s) and forms (hydroxides, oxides, carbonates, etc.). The solubility is also dependent on pH, Eh, and other ionic species in solution (the Debye-Huckel theory). The solubility products reported in the literature vary with the type of complex formed, but generally it can be noted that, for example, cadmium and copper complexes are more soluble than lead and nickel complexes.

5.1.4 Octanol/Water Partition Coefficient

The octanol/water partition coefficient (K_{ow}) is a measure of the equilibrium partitioning of chemicals between octanol and water. A linear relationship between the K_{ow} and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor) has been determined (Lyman et al., 1990). It is also useful in characterizing the sorption of compounds by organic soils where experimental values are not available. PCBs are several orders of magnitude more likely to partition to fatty tissues than the more soluble VOCs. The K_{ow} is also used to estimate bioconcentration factors in aquatic organisms.

5.1.5 Organic Carbon Partition Coefficient

The organic carbon partition coefficient (K_{oc}) indicates the tendency of a chemical to bind to soil particles containing organic carbon. Chemicals with high K_{oc}'s generally have low water solubilities and vice versa. Also, soils with a higher amount of organic carbon will tend to reduce mobility of the contaminants. This parameter, K_{oc}, may be used to infer the relative rates at which the more mobile chemicals (ketones, monocyclic aromatics, and halogenated aliphatics) are transported in the groundwater. Chemicals such as PAHs and PCBs are relatively immobile in the soil and are preferentially bound to the soil. These compounds are not subject to groundwater transport to the extent that compounds with higher water solubilities are. However, these immobile chemicals are easily transported by erosional processes when they are present in surface soils.

5.1.6 Henry's Law Constant

Both the vapor pressure and the water solubility are of use in determining volatilization rates from surface water bodies and from groundwater. The ratio of these two parameters (the Henry's Law constant) is used to calculated the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, chemicals having a Henry's Law constant of less than 1×10^{-5} atm-m^3/mole, such as PCBs, should volatilize very little and be present only in minute amounts in the atmosphere or soil gas. For chemicals with a Henry's Law constant greater than 5×10^{-3} atm-m^3/mole, such as many of the halogenated aliphatics, volatilization and diffusion in soil gas could be significant.

5.1.7 Bioconcentration Factor

The bioconcentration factor (BCF) represent the ratio of aquatic-animal-tissue concentration to water concentration. The ratio is both contaminant- and species-specific. When site-specific values are not measured, literature values are used or the BCF is derived from the octanol/water coefficient. Many of the PCBs will bioconcentrate at levels 3 to 5 orders of magnitude greater than those concentrations found in the water, whereas volatile organics compounds are not as readily bioconcentrated.

5.1.8 Distribution Coefficient

The distribution coefficient (K_d) is a measure of the equilibrium distribution of a chemical or ion in soil/water systems. The distribution of organic chemicals is a function of both the K_{oc} and the amount of organic carbon in the soil. For ions (e.g., metals), K_d is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. Distribution coefficients for metals vary over several orders of

magnitude because the K_d is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Coulomb's Law predicts that the ion with the smallest hydrated radius and the largest charge will be preferentially accumulated over ions with larger radii and smaller charges. Soil and clay distribution coefficients for inorganics are shown in Table 5-2.

5.2 CONTAMINANT PERSISTENCE

The persistence of various classes of chemicals is discussed in this section. Several transformation mechanisms affect chemical persistence, such as hydrolysis, biodegradation, photolysis, and oxidation/reduction reactions. The following general classes of compounds are discussed:

- Ketones
- Monocyclic aromatics
- Halogenated aliphatics
- PAHs
- Phthalate esters
- PCBs
- Metals

5.2.1 Ketones

Ketones are highly volatile and soluble, and these two processes dominate the fate of these compounds in the environment. Ketones are not considered to be persistent in the environment, particularly in comparison to chemicals such as PAHs or PCBs. Hydrolysis is generally not a significant fate process for this class of chemicals, nor is bioconcentration significant, based on the low K_{ow}'s (Howard, 1990).

Acetone is completely miscible in water and is unlikely to adsorb to soil or sediments or bioaccumulate. It has a high vapor pressure and, once released to the air, photolysis and reaction with hydroxyl radicals result in an average half-life of 22 days (Howard, 1990).

2-Butanone will partially evaporate into the atmosphere if released to the soil and may also leach into the groundwater. Once in the groundwater, 2-butanone may slowly degrade. In surface water, 2-butanone has a half-life of approximately 3 to 12 days. Hydrolysis, photolysis, bioconcentration, and adsorption are not significant fate processes for this chemical (Howard, 1990).

4-Methyl-2-pentanone may be removed from soil by direct photolysis, volatilization, or aerobic biodegradation. It is also susceptible to leaching and may be found in groundwater. If released to surface water, it has a volatilization half-life of 15 to 33 hours and is also subject to direct photolysis. This compound does not significantly bioconcentrate, oxidize, hydrolyze, or adsorb to soil (Howard, 1990).

5.2.2 Monocyclic Aromatics

Monocyclic aromatic compounds such as benzene, toluene, chlorobenzene, and xylenes are not considered to be persistent in the environment, particularly in comparison to chemicals such as PCBs. Monocyclic aromatics are subject to degradation via the action of both soil and aquatic microorganisms. The biodegradation of these compounds in the soil matrix is dependent on the abundance of microflora, macronutrient availability, soil reaction (pH), temperature, etc.

Although these compounds are amenable to microbial degradation, it is not anticipated that degradation will occur at an appreciable rate, although macronutrient availability is not known. In the event that these compounds discharge to surface water bodies, volatilization and biodegradation may occur relatively rapidly. For example, a reported first-order biodegradation rate constant for benzene is 0.11 day^{-1} in aquatic systems (Lyman et al., 1990). This corresponds to an aquatic half-life of approximately 6 days. Other monocyclic aromatics are subject to similar degradation processes in aquatic environments (USEPA, December 1982). However, chlorinated monocyclic aromatics such as chlorobenzene are not expected to be as susceptible to microbial degradation. For example, a reported first-order biodegradation rate constant for chlorobenzene is 0.0045 day^{-1} in aquatic systems (Lyman et al., 1990), which corresponds to an aquatic half-life of approximately 150 days. However, biodegradation rates are very site specific, and exact biodegradation values for the NIROP site would require further investigation.

Benzene in groundwater is significantly reduced by the action of aerobic bacteria. A biodegradation rate of 0.95%/day has been reported (Chiang et al., 1989). The amount of benzene, toluene, and xylenes in the groundwater was reported to be directly proportional to the availability of DO.

Additional environmental degradation processes such as hydrolysis and photolysis are considered to be insignificant fate mechanisms for monocyclic aromatics in aquatic systems (USEPA, December 1982). However, some monocyclic aromatics such as benzene and toluene have been shown to undergo clay-, mineral-, and soil-catalyzed oxidation (Dragun, 1988).

5.2.3 Halogenated Aliphatics

Halogenated aliphatic hydrocarbons such as trichloroethene are subject to abiotic dehydrohalogenation. This process is an elimination reaction that results in the formation of an ethene from a saturated halogenated compound (Olsen and Davis, 1990). Therefore, the presence of dichloroethane in groundwater in association with ethanes may be a result of this process. Research indicates that microbial degradation of highly chlorinated ethanes is a relatively slow process. 1,1,1-trichloroethane has been shown to break down to 1,1-dichloroethane and chloroethane (Smith and Dragun, 1984), with half-lives reported on the order of 6 to 8 months. Hydrolysis, photolysis, and oxidation are generally not considered to be significant fate processes for the chlorinated ethanes.

While trichloroethene is reportedly susceptible to degradation, the primary end product is reportedly vinyl chloride. It does not appear that appreciable degradation of halogenated aliphatics occurs in aerobic aquatic systems (USEPA, December 1982) or in unsaturated soils (Lyman et al., 1990).

Photolysis is not considered to be a relevant degradation mechanism for this class of compounds (USEPA, December 1982). Limited hydrolysis of saturated aliphatics (i.e., alkanes) may occur, but it does not appear to be a significant degradation mechanism for unsaturated species (i.e., alkenes) (USEPA, December 1982).

Under certain conditions, volatilization is a significant fate process for these compounds. Volatilization is only significant at the air-soil or air-water interface. Adsorption should not be considered as an important fate for these types of compounds when compared to more hydrophobic compounds (PCBs, for example).

5.2.4 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs have very low solubilities, vapor pressures, and Henry's Law constants and high K_{oc}s and K_{ow}s. The low-molecular-weight PAHs (e.g., acenaphthene, anthracene, fluorene, phenanthrene) may volatilize from surface waters, while the high-molecular-weight PAHs (e.g., benzo(a)pyrene, benzo(a)anthracene, chrysene, etc.) are less likely to volatilize. PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than to go into solution. PAHs are subject to degradation via aerobic bacteria but may be relatively persistent in the absence of microbial population or macronutrients such as phosphorus and nitrogen. The molecular weight of the PAH is a factor which will effect the rate at which biodegradation occurs, with higher molecular weight PAHs being more resistant to biodegration.

Bioconcentration of PAHs in aquatic organisms is greater for the higher-molecular-weight compounds than the lower-molecular-weight compounds. PAHs can be bioaccumulated from water, sediments, or lower organisms in the food chain.

Landspreading applications have indicated that PAHs are highly amenable to microbial degradation in soil. The rate of degradation is influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil (ATSDR, October 1989c).

The most important fate for PAHs in water are photooxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene, chrysene, fluorene, and pyrene are reported to be resistant to photodegradation. PAHs may also be oxidized by chlorination and ozonization, and may be metabolized by microbes under oxygenated conditions (ATSDR, October 1989c).

5.2.5 Phthalate Esters

Phthalate esters are considered to be relatively persistent chemicals in the environment. Although numerous studies have demonstrated that phthalate esters undergo biodegradation, it appears that this is a slow process in both soils and surface waters. Certain microorganisms have been shown to excrete products that increase the solubility of phthalate esters and enhance their biodegradation (Gibbons and Alexander, 1989).

Biodegradation of bis(2-ethylhexyl)phthalate and other phthalates in water is an important fate mechanism, with a half-life of 2 to 3 weeks reported for bis(2-ethylhexyl)phthalate (Howard, 1989). Bioaccumulation is also a significant fate process. Hydrolysis of phthalate esters is very slow, with calculated half-lives of 3 years (dimethylphthalate) to 2,000 years (bis(2-ethylhexyl)phthalate) (USEPA, December 1979). Similarly, photolysis and volatilization are considered to be insignificant degradation mechanisms (USEPA, December 1979; Howard, 1989).

5.2.6 Polychlorinated Biphenyls

PCBs are considered to be very persistent organic chemicals. Biodegradation is the only process known to transform PCBs under environmental conditions, and only the lighter compounds are measurably biodegraded (USEPA, December 1979). Although some microorganisms (e.g., *Phanaerochaete*

chrysosporium) may biodegrade PCBs, such fungi may not exist in local soil. There is experimental evidence to suggest that heavier PCBs (five or more chlorines per molecule) can undergo photolytic degradation, but there are no data to suggest that this process operates under environmental conditions (USEPA, December 1979). Base-, acid-, and neutral-promoted hydrolysis are considered to be inconsequential degradation mechanisms for PCBs (USEPA, December 1982).

5.2.7 Metals

Metals are highly persistent environmental contaminants. They do not biodegrade, photolyze, hydrolyze, etc. The major fate mechanisms for metals are adsorption to the soil matrix (as compared to being part of the soil structure) and bioaccumulation.

The mobility of metals is influenced primarily by their physical and chemical properties in combination with the physical and chemical characteristics of the soil matrix. Factors that assist in predicting the mobility of inorganic species are the soil/pore water pH, soil/pore water Eh, and cation exchange capacity. The mobility of metals generally increases with decreasing soil pH and cation exchange capacity.

5.3 CONTAMINANT FATE AND TRANSPORT

This section presents a brief overview of contaminant fate and transport issues at NIROP. This discussion focuses on some of the major types of contaminants found at the site. As a correlation between TCE and other VOCs at NIROP Fridley has been provided, TCE is used generically throughout this report and is considered to be representative of other VOCs.

5.3.1 Volatile Organics Compounds

VOCs are typically considered to be fairly soluble. They have a low capacity for retention by soil organic carbon and are therefore the organic compounds most frequently detected in groundwater. These types of chemicals may migrate through the soil column after being released by a spill event or by subsurface waste burial as infiltrating precipitation solubilizes them. Some portion of these chemicals is retained by the soil but most will continue migrating downward until they reach the water table. At that time, migration is primarily laterally with the hydraulic gradient. Again, some portion of the chemical may be retained by the saturated soil.

Several of these compounds have specific gravities less than that of water (e.g., benzene, toluene). These compounds are typically found in fuels, and if a large enough fuel spill occurs, these compounds may move through the soil column as a bulk liquid until they reach the water table. There, instead of going

into solution, the majority of the release may remain as a discrete fuel layer on the water table surface, with some of the material going into solution at the water/fuel interface.

Similarly, compounds with specific gravities greater than that of water (e.g., trichloroethene) are often used in various industrial applications such as degreasing. If a large enough spill of these solvents occurs, they may also migrate as a bulk liquid, but they will not stop at the water table.

In this case, transport through the unsaturated zone is probably limited to bulk transport of an initial release. The building covers the site and prevents precipitation from contacting the soil beneath the building. Little, if any, leaching of contaminants from the unsaturated zone by infiltration is expected. As long as the building foundation remains in place and as long as leaks from the storm sewers and sanitary sewers are not significant, little water will pass through the unsaturated soil. Contaminants that have been retained in the unsaturated zone, therefore, are not expected to have a significant, continuing impact on the groundwater.

5.3.2 Polycyclic Aromatic Hydrocarbons

PAHs are generally considered to be fairly immobile chemicals in the environment. They are large molecules with high organic carbon partition coefficients and low solubilities when compared to the VOCs. These compounds, when found in the soil, generally do not migrate vertically to a great extent. Instead, they are more likely to adhere to soil particles and be removed from the site via surface runoff and erosional processes.

5.3.3 Inorganics

Because metals are frequently incorporated into the soil matrix and remain bound to particulate matter, they also migrate from the source areas via bulk movement processes (erosion). The larger particles (>0.45 microns, which are removed via the filtration step prior to water analysis) are not generally considered to be mobile in groundwater. The metals detected in unfiltered groundwater samples are likely to be representative of suspended soil material in the samples.

There are some instances, however, where these metals are found at such concentrations or in such form as to be able to migrate in solution. It is possible that industrial activities could saturate all available exchange sites in soil and hence a metal may be mobilized. Metals are also more mobile under acidic conditions, which may exist in areas where plating-type activities have occurred. Finally, a metal solution

may be utilized in some industrial applications. In these cases, it is possible for metals to migrate vertically through the soil column and reach the groundwater.

5.4 NATURAL ATTENUATION

Natural attenuation is a passive remediation method that can effectively reduce hydrocarbon contamination in soil and groundwater to levels that do not pose a risk to human health and the environment. Source control and performance monitoring are fundamental components of any natural attenuation remedy. The technology works because common hydrocarbon contaminants are readily biodegraded by microorganisms that occur naturally in the subsurface environment.

Natural attenuation results from the combined effects of several natural processes, including biodegradation, dilution, sorption, dispersion, volatilization, chemical and biological stabilization, transformation, and destruction of contaminants (USEPA, 1998). For halogenated hydrocarbons, biodegradation is the most important process because it transforms contaminants to innocuous by-products such as water, carbon dioxide, ethene, and salts while reducing the total mass of the contaminants in the subsurface. The other processes act to lower the concentration of the contaminants in the environment but not to reduce their mass (Kelley et al., 1996).

Natural attenuation processes typically occur at all sites, but they reach varying degrees of effectiveness depending on the types and concentrations of contaminants present and the physical, chemical, and biological characteristics of the soil and groundwater (USEPA, 1998). Natural attenuation processes may reduce the potential risk posed by site contaminants in three ways:

- The contaminant may be converted to a less toxic form through destructive processes such as biodegradation or abiotic transformations.

- Potential exposure levels may be reduced by lowering of concentration levels (through destructive processes or by dilution or dispersion)

- Contaminant mobility may be reduced by sorption to the soil or rock matrix.

The main component of the degreasing fluids that were commonly used at the NIROP Fridley is trichloroethene. Trichloroethene biodegrades anaerobically and sometimes, depending on the conditions, aerobically. Anthropogenic carbon or natural carbon and inorganic electron acceptors are utilized during the natural attenuation of chlorinated hydrocarbons. In some cases iron (III) is used as an electron

acceptor during anaerobic biodegradatoin of organic carbon. During this process iron (III) is reduced to iron (II) so that iron (II) concentrations may be used as an indicator once anaerobic degradation has been determined to be occurring. After DO and nitrate have been depleted, sulfate may also be used as an electron acceptor for anaerobic biodegradation. Because each terminal electron accepting process [i.e. sulfate and iron (III)] has a characteristic hydrogen concentration associated with it, hydrogen concentrations can be an indicator of predominant oxidation reduction processes.

Parameters indicative of biodegradation of chlorinated solvents were collected during the Fridley NIROP RI sampling events to examine the viability of natural attenuation or bioremediation as a feasible remedial alternative for contamination within the groundwater. The parameters were measured in six of the monitoring wells sampled in the three water bearing zones. The parameters that were measured included: dissolved methane, DO, oxidation reduction potential, divalent iron, nitrate, nitrite, sulfate, alkalinity, hardness, orthophosphate, chloride, bromide, dissolved manganese, hydrogen sulfide, and common water quality parameters (i.e., temperature, pH, and specific conductivity).

These data were collected to evaluate the likelihood that natural attenuation is occurring. Typically, the most important electron acceptors in groundwater include DO, nitrate, iron (III), sulfate, and carbon dioxide (Wiedemeier et al., 1998). The biodegradation processes associated with natural attenuation indicators are summarized in Table 5-3. Divalent iron, manganese, nitrate, nitrite, and sulfate were measured to identify a correlation between electron acceptors and metabolic by-products indicative of an oxygen-depleted environment (suggesting past aerobic biodegradation and current anaerobic biodegradation).

Other parameters (i.e., pH, alkalinity, hardness, and orthophosphate) were also collected to assist in determining if natural attenuation is in progress and to determine the levels of possible nutrients available for microorganisms. pH was measured because aerobic and anaerobic processes are pH-sensitive. Alkalinity and hardness are measures of the buffering capacity of the groundwater. In addition, alkalinity tends to increase during aerobic/anaerobic oxidation. Phosphate is a nutrient and electron acceptor for biodegradation. It acts in a similar capacity as divalent iron, nitrate, and sulfate (Schneider and Billingsley, 1990).

General groundwater field parameters such as chloride, specific conductivity, and temperature were collected to verify that the site samples were obtained from the same groundwater system. Higher temperatures (i.e., > 20C) have been shown to assist the natural degradation process. As background chloride values were not available, chloride was not used to determine dehalogenation. The chloride results were utilized to qualitatively access the natural attenuation process.

Table 5-3 indicates the changes that are expected in groundwater chemistry as a result of biodegradation processes (Wiedemeier et al., 1998). Groundwater conditions that are indicative of biodegradation processes are included in Table 5-4 (Wiedemeier et al., 1998). The information provided in these two tables will be used in conjunction with the contaminant concentrations in groundwater to assess the zone-specific OU3 RI data. The goals of the assessment are to determine, on a zone-by zone basis, if natural attenuation is currently occurring in the groundwater and if natural attenuation is a viable process for remediation of halogenated hydrocarbons.

The analytical results were evaluated based on the MPCA guidance. Using this guidance, results were weighted and scored for preliminary screening purposes. This system allows a rapid assessment of the oxidation/reduction status of the groundwater system, with points awarded for those analytical results indicating reducing conditions in water. The points are totaled and compared to the following guidance for evaluation:

0-5	Inadequate evidence for biodegradation
6-14	Limited evidence for biodegradation
15-20	Adequate evidence for biodegradation
>20	Strong evidence for the biodegradation of chlorinated solvents

A score below 15 indicated that pursuing a natural attenuation remedy is probably unwarranted.

5.4.1 Evaluation of Natural Attenuation Data

Soil and groundwater samples were collected in the area defined as OU3 analyzed in the field or by a fixed-base laboratory. The resulting data provide the information necessary to answer the three following questions:

- Are contaminants present in either medium that could be remediated via natural attenuation?
- Is natural attenuation currently in progress in the groundwater?
- Are the conditions in the groundwater favorable for natural attenuation?

The OU3 contaminant concentrations in soil and groundwater were evaluated, and the results are presented on Figures 4-2, 4-3, 4-4, and 4-7. The evaluation of the nature and extent of the contaminants is presented in Sections 4.1 and 4.2. These results indicate that halogenated hydrocarbons (primarily TCE) are present in both the soil and groundwater.

The procedure for evaluating natural attenuation was previously outlined in Section 5.4 and is followed in this section. This evaluation and the scoring of the analytical results were conducted in accordance with the MPCA, draft Guidelines Natural Attenuation of Chlorinated Solvents in Ground Water, December 12, 1997. Table 5-5 presents the analytical results from the natural attenuation evaluation. The following conclusions were reached after review and evaluation/scoring of the data presented in Table 5-5.

- All wells had scores less than 14, which indicates only limited evidence for natural attenuation exists.

- DO levels varied significantly within the three zones. The shallow and deep wells contained DO levels all > 1 mg/L, which is not conducive to reductive dechlorination. The intermediate depth wells contained DO results that were inconclusive; only two wells contained results (<0.5 mg/L) that were conducive to reductive dechlorination.

- Oxidation reduction potential measurements were consistently negative in the majority of the wells throughout all depths, indicating an anaerobic environment. Oxidation reduction potential is typically easier to measure accurately in the field in comparison to DO. Therefore, the groundwater within the three separate ranges of depth indicate an anaerobic environment is present.

- Measured concentrations of nitrate were generally below 1 mg/L for the majority of the wells at all depths, which indicates that denitrification, an anaerobic process, is occurring.

- Concentrations of divalent iron greater than 1 mg/L were detected in all of the shallow depth wells and half of the intermediate and deep wells, suggesting that iron reduction is occurring.

- Concentrations of sulfate were measured in the groundwater throughout all depths. These results (most > 20mg/L) generally indicate that the sulfate concentration may be high enough to cause competitive exclusion of dechlorination.

- Temperatures were measured in all of the wells at the corresponding depths. The majority of the temperatures taken were below 20°C, indicating that the biochemical process would not be accelerated.

The conclusions provided above indicate that natural attenuation is not occurring in the groundwater of OU3. Although, some natural attenuation and degradation may be occurring or may have occurred in the past, the results do not indicate that OU3 would currently be a prime candidate for natural attenuation.

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TABLE 5-1

ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
NIROP FRIDLEY, MINNESOTA

Chemical	Specific Gravity (@ 20/4°C)(2)	Vapor Pressure (mm Hg @ 20°C)(2)	Solubility (mg/L @ 20°C)(2)	Octanol/ Water Partition Coefficient(2)	Organic Carbon Partition Coefficient(4)	Henry's Law Constant (atm-m3/mole)(2)	Bioconcentration Factor (mg/L/mg/kg)(4)
KETONES							
Acetone	0.7899	2.66E+2 (25°C)	1.00+06 (12)	5.75E-01	2.20E+00 (12)	2.10E-05 (12)	3.81E-1(7)
2-Butanone	0.8054	1.0E+2 (25°C)	2.70E+05 (12)	1.82E+00	4.50E+00 (12)	2.7E-05 (12)	9.3E-1(7)
4-Methyl-2-pentanone	0.7978 (20°C)	1.0E+1 (30°C)	1.91E+04	1.23E+01	5.30E+0(10)	1.49E-5 (25°C)	3.9E+0(7)
2-Hexanone	0.8017	6.00E+01	3.50E+04	NA	2.00E+00	1.75E-5 (25°C)	2.50E+00
MONOCYCLIC AROMATICS							
Benzene	0.8765	9.5E+1 (25°C)	1.80E+03 (12)	1.35E+02	6.50E+1 (12)	5.50E-03 (12)	3.70E+01
Chlorobenzene	1.1058	1.18E+1 (25°C)	4.70E+02 (12)	6.92E+02	3.3E+02 (12)	3.70E-03 (12)	1.64E+02
4-Chloro-3-methylphenol	NA	5.00E-02	3.85E+03	1.26E+03	6.04E+02	2.50E-06	4.00E+02
2,4-Dimethylphenol	0.965	9.8E+1 (104°C)	7.868E+3 (25°C)	2.63E+02	2.09E+02 (11)	6.55E-6 (25°C)	7.50E+01
Ethylbenzene	0.867	1E+1 (25.9°C)	1.50+02 (12)	1.41E+03	2.20E+02 (12)	7.90E-03 (12)	4.70E+02
Pentachlorophenol	1.978 (22/4°C)	1.10E-04	1.95E+03 (12)	1.02E+05	5.92E+02 (12)	2.44E-08 (12)	1.60E+04
Phenol	1.0576	3.5E-1 (25°C)	8.28E+04 (12)	2.88E+01	3.00E+01 (12)	3.97E-07 (12)	9.40E+00
Styrene	0.906	5.00E+00	6.80E+02 (12)	1.44E+03	3.60E+02 (12)	2.30E-03 (12)	1.48E+2(7)
Toluene	0.8669	2.8E+1 (25°C)	8.80E+02 (12)	4.90E+02	2.6E+02 (12)	6.60E-03 (12)	1.48E+02
Xylenes (Total)	0.86104 - 0.8801	1E+1 (27.3 - 32.1°C)	2.00E+02 (12)	5.89E+2 - 1.58E+3	2.40+02 (12)	5.30E-03 (12)	7.5E+1 - 1.59E+2(7)
HALOGENATED ALIPHATICS							
Chloroform	1.4832	1.60E+02	9.3E+3 (25°C)	9.33E+01	3.98E+01 (11)	3.39E-3 (25°C)	2.60E+01
Chloromethane	0.9159	3.80E+03	6.36E+03	8.13E+00	4.30E+00	8.82E-3 (24.8°C)	3.20E+00
1,1-Dichloroethane	1.1757	2.34E+2 (25°C)	5.50E+03 (12)	1.67E+01	3.00E+01 (12)	4.30E-03 (12)	1.90E+01
1,2-Dichloroethane	1.2351	7.9E+1 (25°C)	8.70E+03 (12)	2.82E+01	1.4E+01 (12)	1.20E-03 (12)	9.00E+00
1,1-Dichloroethene	1.218	5.91E+2 (25°C)	4.00E+02 (12)	3.02E+01	6.5E+01 (12)	1.50E-01 (12)	5.30E+01
cis-1,2-Dichloroethene	1.2837	2.02E+2 (25°C)	6.30E+03 (12)	NA	5.90E+01 (12)	6.60E-03 (12)	1.4E+1(3)
trans-1,2-Dichloroethene	1.2565	3.31E+2 (25°C)	6.30E+03 (12)	3.02E+01	5.90E+01 (12)	6.60E-03 (12)	4.80E+01
1,2-Dichloroethene, total	NA	NA	NA	NA		NA	NA
Hexachloroethane	2.091	4.00E-01	5.0E+1 (22°C)	1.38E+04	1.78E+03 (11)	2.237E-2 (25°C)	6.75E+03
Methylene chloride	1.3266	4.29E+2 (25°C)	1.32E+04 (12)	1.78E+01	8.8E+00 (12)	2.60E-03 (12)	6.00E+00
Tetrachloroethene	1.6227	1.9E+1 (25°C)	1.50E+02 (12)	3.39E+02	6.60E+02 (12)	2.30E-02 (12)	2.52E+02
1,1,1-Trichloroethane	1.339	1.00E+02	9.80E+02 (12)	2.95E+02	1.5E+02 (12)	2.80E-03 (12)	8.10E+01
1,1,2-Trichloroethane	1.4397	2.5E+1 (25°C)	4.50E+03	1.48E+02	5.01E+01 (11)	9.607E-4 (25°C)	3.30E+01
Trichloroethene	1.4642	7.7E+1 (25°C)	1.00E+03 (12)	3.39E+02	1.30E+02 (12)	8.90E-03 (12)	9.70E+01
Vinyl chloride	0.9106	2.58E+03	1.1E+3 (25°C)	3.98E+00	1.86E+01 (11)	2.78E-2 (25°C)	5.70E+00
MISCELLANEOUS VOLATILE ORGANICS							
Carbon cyclic	1.2632	2.98E+02	2.90E+03 (12)	1.45E+02	5.4E+01 (12)	1.20E-02 (12)	2.6E+1(7)
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)							
Acenaphthene	1.0242 (90/4°C)	1E+1 (131°C)	3.90E+00 (12)	8.32E+03	4.6E+03 (12)	1.20E-03 (12)	1.80E+03
Acenaphthylene	0.8988 (16/2°C)	2.90E-02	3.93E+0 (25°C)	1.17E+04	2.50E+03	1.14E-4 (25°C)	1.00E+03
Anthracene	1.283 (25/4°C)	1.95E-4 (25°C)	7.50E-02 (12)	2.82E+04	1.30E+04 (12)	3.4E-05 (12)	4.70E+03
Benzo(a)anthracene	1.274	5.00E-09	9.40E-03 (12)	4.07E+05	3.58E+05 (12)	3.35E-06 (12)	5.30E+04
Benzo(b)fluoranthene	NA	5.00E-07	1.50E-03 (12)	3.72E+06	1.23E+06 (12)	1.11E-04 (12)	1.40E+05
Benzo(k)fluoranthene	NA	9.59E-11	8.00E-04 (12)	6.92E+06	1.23E+06 (12)	8.29E-07 (12)	1.40E+05
Benzo(g,h,i)perylene	NA	1.00E-10	2.6E-4 (25°C)	1.70E+07	1.60E+06	1.4E-7 (25°C)	3.50E+05
Benzo(a)pyrene	1.351	5.00E-09	1.62E-03 (12)	9.55E+05	9.69E+05 (12)	1.13E-06 (12)	1.40E+05
Chrysene	1.274 (20°C)	6.3E-9 (25°C)	1.60E-03 (12)	4.07E+05	3.98E+05 (12)	9.46E-05 (12)	5.30E+04
Dibenz(a,h)anthracene	1.282	1.00E-10	5E-4 (25°C)	9.33E+05	3.80E+06 (11)	7.3E-8 (25°C)	6.90E+05

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Fluoranthene	1.252	5.0E-6 (25°C)	2.06E-01 (12)	2.14E+05	4.91E+04 (12)	1.61E-05 (12)	1.20E+04
Fluorene	1.202	1E+1 (146°C)	9.00E+1 (12)	1.51E+04	7.90E+03 (12)	7.70E-05 (12)	3.80E+03
Indeno(1,2,3-cd)pyrene	NA	1E-10 (25°C)	2.20E-05 (12)	4.57E+07	3.47E+06 (12)	1.60E-06 (12)	3.50E+05
2-Methylnaphthalene	1.0058	1E+1 (105°C)	2.6E+1 (25°C)	7.24E+03	7.27E+2(10)	4.99E-4 (25°C)	5.1E+2(7)
Naphthalene	1.162	8.2E-2 (25°C)	2.40E+02 (12)	2.34E+03	1.30E+03 (12)	1.30E-03 (12)	4.20E+02
Phenanthrene	0.980 (4°C)	1E+0 (118.2°C)	8.16E-1 (21°C)	2.88E+04	1.40E+04	3.93E-5 (25°C)	4.70E+03
Pyrene	1.271 (23/4°C)	2.5E+0 (200°C)	1.00E+02 (12)	1.51E+05	1.20E+05 (12)	1.00E-05 (12)	1.20E+04
PHTHALATE ESTERS							
Bis(2-ethylhexyl)phthalate	0.99 (20/20°C)	1.2E+0 (200°C)	3.40E-01 (12)	2.00E+05	1.11E+05 (12)	1.02E-07 (12)	2.30E+08
Butylbenzylphthalate	1.1 (25/25°C)	8.60E-06	2.90E+00	6.03E+04	5.75E+04 (11)	8.3E-6(4)	4.70E+04
Di-n-butylphthalate	1.047 (20/20°C)	1E-1 (115°C)	4E+2 (25°C)	1.58E+05	3.39E+04 (11)	2.8E-7 (25°C)	4.70E+04
Diethylphthalate	1.1175	5E-2 (70°C)	1.08E+3 (25°C)	9.12E+02	2.88E+02 (11)	8.46E-07	1.07E+02
Di-n-octylphthalate	0.978	< 2E-1 (150°C)	3E+0 (25°C)	1.58E+09	8.23E+07 (11)	1.41E-12 (25°C)	3.90E+08
MISCELLANEOUS SEMIVOLATILE ORGANICS							
Carbazole	1.1 (18°C/4°C)	4.0E+2 (323°C)	NA	1.95E+3(8)	3.39E+03 (11)	NA	1.86E+2(7)
Dibenzofuran	1.0886 (99°C/4°C)	NA	3.10E+00	1.32E+04	7.80E+03 (12)	1.30E-05 (12)	7.97E+2(7)
PCBs							
Aroclor-1016	NA	4E-4 (25°C)	2.7E-3(4)	1.4E+7(4)	6.70E+06	7.4E-1(4)	1.30E+06
Aroclor-1254	1.50 (25°C)(4)	7.71E-5(4)	4.2E-1 (25°C)	3.8E+5(4)	1.80E+05	3.30E-04	5.00E+04

1 NA - Not Available.
2 USEPA, September 1992, Handbook of RCRA Groundwater Monitoring Constituents: Chemical and Physical Properties.
3 Lyman et al., 1990; Equation 5-3, Handbook of Chemical Property Estimation Methods.
4 USEPA, December 1982, Aquatic Fate Process Data for Organic Priority Pollutants.
5 ATSDR, October 1992, Toxicity Profile for Acetone.
6 ATSDR, October 1989, Toxicity Profile for Xylenes.
7 Lyman et al., 1990, Eq. 5-2.
8 Verschueren, 1983, Handbook of Environmental Data of Organic Chemicals.
9 Howard, 1989, Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume 1.
10 Lyman et al., 1990; Equation 4-5.
11 USEPA, July 1996, Soil Screening Guidance.
12 MPCA, 1998.

TABLE 5-2

ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR INORGANIC CHEMICALS
NIROP FRIDLEY, MINNESOTA

Element	Molecular Weight (g/mole)	Soil / Water Distribution Coefficient (Kd) (mL/g) 1	Bioconcentration Factor (L/kg) 2
Aluminum	26.98	NR	NR
Antimony	121.75	NR	NR
Arsenic	74.92	29 (3)	44
Barium	137.34	41 (3)	NR
Beryllium	9.01	790 (3)	NR
Cadmium	112.4	75 (3)	64
Calcium	40.08	1.2 - 9.8	NR
Chromium III	52	1600000 (3)	16
Chromium VI	52	19 (3)	16
Cobalt	58.93	0.2 - 3,800	NR
Copper	63.54	1.4 - 333	36
Iron	55.847	NR	NR
Lead	207.19	4.5 - 7,640	NR
Magnesium	24.312	1.6 - 13.5	NR
Manganese	54.93	0.2 - 10,000	NR
Mercury	200.59	52 (3)	NR
Nickel	58.71	65 (3)	NR
Potassium	39.1	2.0 - 9.0	NR
Selenium	78.96	5 (3)	4.8
Sodium	22.99	NR	NR
Thallium	204.37	71 (3)	116
Vanadium	50.94	NR	NR
Zinc	65.38	62 (3)	47

1 Dragun, 1988, The Soil Chemistry of Hazardous Materials.
2 USEPA/Army Corps of Engineers, 1991, Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual.
3 USEPA, 1996, Soil Screening Guidance.

TABLE 5-3

SUMMARY OF EXPECTED CHANGES IN GROUNDWATER CHEMISTRY DUE TO BIODEGRADTION PROCESSES NIROP FRIDLEY, MINNESOTA

Analyte	Biodegradation Process	Expected Change
Dissolved Oxygen	Aerobic Oxidation	Decreases
Nitrate	Denitrification	Decreases
Iron (II)	Iron (III) Reduction	Increases
Sulfate	Sulfate Reduction	Decreases
Methane	Methanogenesis	Increases
Alkalinity	Aerobic/Anaerobic Oxidation	Increases
Dissolved Chloride	Anerobic Dehalogenation	Increases
Oxidation Reduction	Aerobic Respiration	Decreases
Dissolved Manganese	Anerobic Reduction	Increases
Hydrogen Sulfide	Sulfate Reducing Conditions	Increases

TABLE 5-4

SUMMARY OF CONDITIONS INDICATIVE OF BIODEGRADATION PROCESSES
NIROP FRIDLEY, MINNESOTA

Parameter	Concentration	Conclusion
Dissolved Oxygen	> 1 mg/L	Aerobic conditions
	< 1 mg/L	Anaerobic conditions
Oxidation Reduction	< 50 mV	Anaerobic conditions
	> 50 mV	Aerobic conditions
Nitrate	> 1 mg/L	Electron acceptor present; denitrification is probably not occurring.
	< 1 mg/L	Reduced electron acceptor availability; denitrification is probably occurring.
Iron (II)	> 1 mg/L	Reduced electron acceptor availability; Iron (III) reduction is probably occurring.
	< 1 mg/L	Electron acceptor available; Iron (III) reduction is probably not occurring.
Sulfate	> 20 mg/L	Electron acceptor present; sulfate reduction is probably not occurring.
	< 20 mg/L	Reduced electron acceptor availability; sulfate reduction is probably occurring.
Methane	> 0.1 mg/L	Methanogenesis is occurring.
	< 0.1 mg/L	Methanogenesis is not occurring at a substantial rate.

TABLE 5-5

SUMMARY OF NATURAL ATTENUATION RESULTS
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER: SAMPLE DATE: LOCATION: FIELD DUPLICATE OF:	003-MS-28D-01 02/17/98 MS-28D	003-MS-28I-01 02/11/98 MS-28I	003-MS-28S-01 02/11/98 MS-28S	003-MS-29D-01 02/16/98 MS-29D	003-MS-29I-01 02/16/98 MS-29I	003-MS-29S-01 02/16/98 MS-29S
ORGANICS (ug/L)						
DISSOLVED METHANE	17.435	11.057	1.984	19.366	4.926	0.547
MISCELLANEOUS PARAMETERS (mg/L)						
ALKALINITY	290	470	440	280	360	420
DISSOLVED FERROUS IRON	1.33	5.1	2.32	0.25	5.08	0.89
DISSOLVED OXYGEN	1.07	0.13	1.69	2.42	1.21	1.99
DISSOLVED REDUCED MANGANESE	0.3	0.6	1.2	0.3	0.4	0.8
HARDNESS as CaCO3	640	1200	740	1100	740	740
HYDROGEN SULFIDE	0.03	0.128	0.021	0.039	0.078	0
NITRATE, AS NITROGEN	0.2 U	0.2 U	0.2 U	9.7	0.2 U	1
NITRITE, AS NITROGEN	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2
SULFATE	180 J	470 J	160 J	130 J	220 J	160 J
REDOX POTENTIAL (mV)	-179.9	-165.3	-68.7	-114.8	-171.3	-112.3
TEMPERATURE (C)	15.05	14.96	16.9	17.61	17.59	20.03
FILTERED MISCELLANEOUS PARAMETERS (mg/L)						
DISSOLVED BROMIDE	1 U	1 U	1 U	1 U	1 U	1 U
DISSOLVED CHLORIDE	62	21	13	90	20	39
ORTHOPHOSPHATE	1 U	1 U	1 U	1 U	1 U	1 U
GENERAL CHEMISTRY						
PH	7.33	7.22	6.79	7.26	7.1	6.95

TABLE 5-5

SUMMARY OF NATURAL ATTENUATION RESULTS
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER: SAMPLE DATE: LOCATION: FIELD DUPLICATE OF:	003-MS-30D-01 03/03/98 MS-30D	003-MS-30I-01 02/24/98 MS-30I	003-MS-30S-01 02/24/98 MS-30S	003-MS-31D-01 02/26/98 MS-31D	003-MS-31I-01 02/18/98 MS-31I	003-MS-31S-01 02/17/98 MS-31S
ORGANICS (ug/L)						
DISSOLVED METHANE	3.864	8.04	0.212	19.244	3.449	0.923
MISCELLANEOUS PARAMETERS (mg/L)						
ALKALINITY	340	390	240	280	360	420
DISSOLVED FERROUS IRON	3.1	1.61	0	1.51	5.1	2.31
DISSOLVED OXYGEN	1.65	0.65	6.48	1.02	0.17	3.12
DISSOLVED REDUCED MANGANESE	0.3	0.6	0	0.4	5.7	1.3
HARDNESS as CaCO3	910	590	290		1500	860
HYDROGEN SULFIDE	0.142	0.384	0	0.072	0.92	0.012
NITRATE, AS NITROGEN	0.2 U	0.2 U	3.5	0.2 U	0.2 U	0.2 U
NITRITE, AS NITROGEN	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
SULFATE	360	120	25	140	960 J	350 J
REDOX POTENTIAL (mV)	-202.1	-169.7	75.6	-203.9	-169.6	-116
TEMPERATURE (C)	11.42	12.35	12.91	18.55	18.71	20.65
FILTERED MISCELLANEOUS PARAMETERS (mg/L)						
DISSOLVED BROMIDE	1 U	1 U	1 U	1 U	1 U	1 U
DISSOLVED CHLORIDE	40	25	20	86	16	17
ORTHOPHOSPHATE	1 U	1 U	1 U	1 U	1 U	1 U
GENERAL CHEMISTRY						
PH	7.37	7.25	7.64	7.41	7.05	6.78

TABLE 5-5

SUMMARY OF NATURAL ATTENUATION RESULTS
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER: SAMPLE DATE: LOCATION: FIELD DUPLICATE OF:	003-MS-32D-01 03/02/98 MS-32D	003-MS-32I-01 03/02/98 MS-32I	003-MS-DP2-02 03/02/98 MS-32I 003-MS-32I-01	003-MS-32S-01 02/27/98 MS-32S	003-MS-33D-01 02/26/98 MS-33D	003-MS-33I-01 02/25/98 MS-33I
ORGANICS (ug/L)						
DISSOLVED METHANE	16.456	661.476	693.207	1.919	15.043	1909.669
MISCELLANEOUS PARAMETERS (mg/L)						
ALKALINITY	300	440	440	360	280	560
DISSOLVED FERROUS IRON	0.94	5.1	5.1	3.87	0.86	5.1
DISSOLVED OXYGEN	1.02	2.79	2.77	2.46	0.81	0.87
DISSOLVED REDUCED MANGANESE	0.2	5.1	2.8	0.7	0	3
HARDNESS as CaCO3	580	900	950	660	520	700
HYDROGEN SULFIDE	0.022	0.045	0.03	0	0.048	0.138
NITRATE, AS NITROGEN	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NITRITE, AS NITROGEN	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
SULFATE	120	360	320	250	140	280
REDOX POTENTIAL (mV)	-165.9	-194.1		-160.7	-169.5	-210.9
TEMPERATURE (C)	18.04	18.12		19.99	17.8	17.78
FILTERED MISCELLANEOUS PARAMETERS (mg/L)						
DISSOLVED BROMIDE	1 U	1 U	1 U	1 U	1 U	1 U
DISSOLVED CHLORIDE	91	19	19	34	72	19
ORTHOPHOSPHATE	1 U	1 U	1 U	1 U	1 U	1 U
GENERAL CHEMISTRY						
PH	7.41	7.16		6.96	7.36	7.32

TABLE 5-5

SUMMARY OF NATURAL ATTENUATION RESULTS
NIROP FRIDLEY, MINNESOTA

SAMPLE NUMBER: SAMPLE DATE: LOCATION: FIELD DUPLICATE OF:	003-MS-DP2-01 02/25/98 MS-33I 003-MS-33I-01	003-MS-33S-01 02/25/98 MS-33S	/ /	/ /	/ /	/ /
ORGANICS (ug/L)						
DISSOLVED METHANE	1827.561	0.542				
MISCELLANEOUS PARAMETERS (mg/L)						
ALKALINITY	570	230				
DISSOLVED FERROUS IRON	5.1	0.54				
DISSOLVED OXYGEN	0.75	3.53				
DISSOLVED REDUCED MANGANESE	2.7	0				
HARDNESS as CaCO3	710	290				
HYDROGEN SULFIDE	0.145	0.043				
NITRATE, AS NITROGEN	0.2 U	0.5				
NITRITE, AS NITROGEN	0.1 U	0.1 U				
SULFATE	280	35				
REDOX POTENTIAL (mV)		-177.5				
TEMPERATURE (C)		19.83				
FILTERED MISCELLANEOUS PARAMETERS (mg/L)						
DISSOLVED BROMIDE	1 U	1 U				
DISSOLVED CHLORIDE	20	14				
ORTHOPHOSPHATE	1 U	1 U				
GENERAL CHEMISTRY						
PH		7.53				

6.0 HUMAN HEALTH RISK ASSESSMENT PROCEDURES

This risk assessment was prepared following MPCA risk assessment protocol (MPCA, 1999) and using risk assessment spreadsheets provided by MPCA (1998a). EPA's Risk Assessment Guidance for Superfund (RAGS) Part D Standardized Planning, Reporting, and Review of Superfund Risk Assessments (EPA, 1998) was not followed as agreed upon between EPA Region V and MPCA. This risk assessment only evaluates exposures to soil located beneath the building by industrial workers and construction workers. OU3 groundwater sampling results will be compared to MPCA health based criteria. Exposures to OU2 soils were evaluated in the Supplemental Remedial Investigation Information Report (Tetra Tech NUS, August 1999).

A risk assessment provides the framework for developing risk information necessary to assist in developing potential remedial alternatives for a site. A baseline human health risk assessment consists of five major components, as follows:

1. Data evaluation/Identification of COPCs
2. Toxicity assessment
3. Exposure assessment and identification of significant exposure pathways
4. Risk characterization and estimation of potential public health risks
5. Characterization of uncertainty in the risk estimates

To assess potential public health risks, three major aspects of chemical contamination and exposure must be considered: (1) chemicals with toxic characteristics must be identified in environmental media and be released by either natural processes or human action; (2) pathways by which actual or potential exposure occurs must be present; and (3) human receptors must be present at the point of exposure to complete the exposure route. Risk is a function of both toxicity and exposure; without one of the factors listed above, there is no risk.

The Data Evaluation, Section 6.1, is primarily concerned with the selection of COPCs that are representative of the type and magnitude of potential human health effects. In turn, these COPCs are used to evaluate potential risks.

The Toxicity Assessment, Section 6.2, presents the available human health criteria for all the selected COPCs. Quantitative toxicity indices are presented where they are available. These include dose-response parameters such as Reference Doses (RfDs) and Cancer Slope Factors (CSFs), enforceable

standards such as Maximum Contaminant Levels (MCLs), and regulatory guidelines such as Drinking Water Health Advisories.

The Exposure Assessment section identifies potential human exposure pathways at the site. Exposure routes are developed from information on source area chemical concentrations, chemical release mechanisms, patterns of human activity, and other pertinent information to develop conceptual site models for each type of source. Section 6.3 presents the equations and relevant input parameters for estimating chemical intake.

The Risk Characterization, Section 6.4, describes how the estimated intakes are combined with the toxicity information to estimate risks. Uncertainties associated with the risk assessment process are discussed qualitatively in Section 6.5.

6.1 DATA EVALUATION

Data evaluation is a site-specific task that uses a variety of information to determine which of the detected chemicals at a site are most likely to present a risk to potential receptors. The end result of this qualitative selection process is a list of COPCs for each medium under consideration.

In accordance with MPCA guidance, the initial list of COPCs for an area under investigation will include any chemical detected at least once in validated environmental samples from the area. Essential human nutrients (iron, magnesium, potassium, calcium, and sodium) present at relatively low concentrations will be eliminated from the initial list of COPCs. The essential nutrients were detected at concentrations exceeding background, therefore, essential nutrients were retained as COPCs for OU3.

For inorganic chemicals, COPCs will be selected based on a comparison of site-specific chemical concentrations to background chemical concentrations. The determination of background concentrations of inorganics was presented in Section 2.6. The maximum detected concentration of inorganics in soil were compared to the background concentrations presented in Table 2-6. If the maximum detected concentration was less than the background concentration, then that inorganic compound was not retained for evaluation in the risk assessment. If the maximum detected concentration was greater than the background concentration, then that inorganic compound was retained for evaluation in the risk assessment. The maximum detected concentrations of all inorganics compounds were greater than their corresponding background concentration; consequently, all inorganic compounds were retained as COPCs.

In general, all available data from the RI investigation were used to identify COPCs for a site. Field screening data, unvalidated data, and analytical results qualified as rejected, R, during the data validation process were not considered because of their potential unreliability. As discussed in Section 4.1, the detection limits for several chemicals in six soil samples exceeded the MPCA SRV's for soil. The impact of the elevated detection limits on the risk assessment will be discussed in the uncertainty analysis. The chemicals being retained as COPCs at the site are summarized in Table 6-1.

6.2 TOXICITY ASSESSMENT

The toxicity assessment for COPCs examines information concerning the potential human health effects of exposure to COPCs. The goal of the toxicity assessment is to provide, for each COPC, a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 6.3) to characterize the potential for the occurrence of adverse health effects (Section 6.4).

The toxicological evaluation consists of a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical, and the probability that a given quantity of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the chemicals of potential concern.

The entire toxicological data base is used to guide the derivation of CSFs for carcinogenic effects and RfDs for noncarcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and comparisons of molecular structure. Data from these sources are reviewed to determine whether a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of toxicity data used to calculate CSFs and RfDs is derived from animal studies.

For noncarcinogenic effects, the most appropriate animal model (i.e., the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern; in the absence of such data, however, an RfD for one route of exposure may be extrapolated from data in a study that used a different route of exposure. Such extrapolation must take

into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect-level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological data base, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect-level (LOAEL) if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicological similarity.

CSFs for weight-of-evidence Group A or B chemicals are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for Group C compounds for which the data are sufficient but are not derived for Group D or E chemicals. No consideration is given to similarity in the animal and human target organ(s) because a chemical capable of inducing cancer in any animal tissue is considered potentially carcinogenic to humans. Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired, and in which exposure occurred during most of the animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

6.2.1 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes: (1) a weight-of-evidence classification and (2) a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of the available data from human and animal studies. A chemical may be placed in one of three groups in EPA's classification system to denote its potential for carcinogenic effects:

1. Group A - known human carcinogen
2. Group B1 or B2 - probable human carcinogen
3. Group C - possible human carcinogen

Chemicals that cannot be classified as a human carcinogen because of a lack of data are placed in Group D, and those for which there is evidence of noncarcinogenicity in humans are in Group E.

The CSF is the toxicity value used to quantitatively express the carcinogenic potency of a chemical. It is defined as the upper bound estimate of the probability of cancer incidence per unit dose averaged over a

lifetime. Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals. They are typically calculated for compounds in Groups A, B1, and B2, although some Group C carcinogens also have slope factors and some B2 carcinogens have none (e.g., lead). Slope factors are specific to a chemical and route of exposure and are expressed in units of $(mg/kg/day)^{-1}$ for both oral and dermal routes. Inhalation cancer toxicity values are usually expressed as inhalation unit risks in units of reciprocal mg/m^3 ($1/mg/m^3$).

CSFs for COPCs at NIROP are presented in Table 6-2. All values were obtained from MPCA (1998). If no CSF is available from any of these sources, carcinogenic risks are not quantified and potential exposures are addressed in the general uncertainty section, Section 6.6.

Dermal CSFs are derived from the corresponding oral values. In the derivation of a dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the absorption efficiency because CSFs are expressed as reciprocal doses.

6.2.2 Noncarcinogenic Effects

For noncarcinogens, it is assumed that there exists a dose below which adverse health effects will not be observed. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. For noncarcinogens, a range of exposure exists that can be tolerated. Toxic effects are manifested only when physiologic protective mechanisms are overcome by exposures to a chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for noncarcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to an RfD. The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs. Separate RfDs are presented for ingestion and inhalation pathways. In particular, Reference Concentrations (RfCs) in units of mg/m^3 are typically presented for the inhalation pathway.

To derive an RfD, the EPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the NOAEL or, if the data are inadequate for such a determination, the LOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that can be administered over a lifetime without inducing observable adverse

effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect." To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for (1) extrapolation of data from laboratory animals to humans (interspecies extrapolation), (2) variation in human sensitivity to the toxic effects of a compound (intraspecies differences), (3) derivation of a chronic RfD based on a subchronic rather than a chronic study, and/or (4) derivation of an RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between 1 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

A dermal RfD is developed from an oral RfD by multiplying by the gastrointestinal tract absorption factor. The resulting dermal RfD is, therefore, based on absorbed dose, which is what is calculated by the dermal exposure algorithms.

RfDs for the COPCs at NIROP are presented in Table 6-3. All values were obtained from MPCA (1998).

6.3 EXPOSURE ASSESSMENT

The exposure assessment defines and evaluates the exposures experienced by a receptor population. In order to have an exposure, several factors must be present. First, there must be a source of contamination; second, there must be a mechanism through which a receptor can come into contact with the contaminants in a contaminated environmental medium; and third, there must actually (or potentially) be a receptor present at the point of contact. The exposure assessment presented in this section of the report consists of several sections that characterize the physical site setting and the receptors of concern, identify the potential chemical migration and exposure pathways, define the chemical concentrations at the point of exposure, and present the equations used to quantify exposure in terms of chemical intake (dose). Appendix G of this report contains sample calculations for the exposure assessment. Tables of intakes are not presented in the body of the report, but the calculated values may be seen within the spreadsheets in Appendix G.

6.3.1 Conceptual Site Model

The development of a conceptual site model (CSM) is an essential component of the exposure assessment. The CSM graphically integrates information regarding the physical characteristics of the site (i.e., the exposure setting), exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors evaluated in the risk assessment. A

well-defined CSM allows for a better understanding of the risks at a site and aids the risk managers in the identification of the potential need for remediation. The CSM for the NIROP study area under investigation is shown in Figure 6-1.

Exposure Setting

The exposure setting consists of a description of the physical characteristics (climate, meteorology, geology, groundwater hydrology, vegetation, and nearby surface water bodies) of a site. A detailed description of the physical characteristics of NIROP is provided in Section 1.0. A synopsis of the information pertinent to the assessment of potential exposure is presented below.

The site is currently active and consists of 82.6 acres of government-owned land, of which approximately 50 acres are paved or covered with buildings. Access to the NIROP site is strictly limited by an 8-foot high fence and security patrols. The NIROP property and adjacent properties to the north, east, and south are zoned heavy industrial. The Mississippi River lies to the west of the site. Also located west of the site is the Anoka County Riverfront Regional Park. The County Park is separated from the NIROP facility by East River Road, a four-lane highway.

The Mississippi River provides active recreational opportunities to boaters and anglers as well as passive recreation because of its aesthetics and historical significance. The Mississippi River also serves as a source of public and private water supply. The City of Minneapolis waterworks facility is located approximately 2,000 feet south (downstream) of the NIROP. The St. Paul water intake is located approximately 3 1/2 miles upstream from the site (RMT, June 1987).

At the NIROP, four aquifers underlie the site as identified by the Minnesota Geological Survey (University of Minnesota, 1979). These aquifers consist of (from deep to shallow) the Mount Simon/Hinckley/Fond du Lac (MHF) aquifer, the Franconia/Ironton/Galesville (FIG) aquifer, the Prairie du Chien/Jordan aquifer (PCJ), and the surficial Quaternary aquifer (Envirodyne, June 1983). The MHF and the FIG are both confined aquifers. Because of the depth of these aquifers (greater than 400 feet bgs), they are not used for water supply purposes in the immediate vicinity of the NIROP. The MHF, however, is used rather extensively as a water supply source north of the site, where it is more shallow (Envirodyne, June 1983).

Sources of Contamination

As discussed in Section 1.2.4, the suspected or known source(s) of contamination for OU3 included near-surface and subsurface soils beneath the plant building.

Contaminant Release and Migration Mechanisms

Three primary chemical release mechanisms have been identified for the soil matrix: (1) leachate generation; (2) fugitive dust generation (after exposure of the soils); and (3) emission of VOCs. Environmental transport media associated with these release mechanisms include air and groundwater. The only secondary chemical release mechanism that has been identified, based on site physical conditions, is the discharge of groundwater to the Mississippi River.

Surface water runoff is not considered a potential migration pathway at OU3 since all of OU3 is located underneath the building.

Volatilization of COPCs from groundwater to outdoor or ambient air will not occur since the building covers all of OU3. Volatilization of COPCs from groundwater to indoor is possible but it is not expected to be a significant exposure pathway. Shallow groundwater at the site is approximately 20 feet below ground surface with the exception of the former east platting shop where shallow groundwater is approximately 15 feet below ground surface. The foundation of the building at NIROP is typically nine to 12 inches thick but can be as thick as 82 inches in some areas. Significant migration of COPCs from groundwater through 15 to 20 feet of soil and nine to 82 inches of concrete is not expected to occur.

Potential Routes of Exposure

A receptor can come into contact with contaminants in a variety of ways, which are generally the result of interactions between a receptor's behavior or lifestyle and an exposure medium. This assessment defines an exposure route as a stylized description of the behavior that brings a receptor into contact with a contaminated medium.

Air

This pathway is based on the scenario that a receptor is immersed in air that contains suspended particulates and volatile organic vapors originating from the source areas as part of daily living. The receptor is exposed upon inhalation of the ambient air.

Direct Contact with Soil

Receptors may come into direct contact with soil contaminated by the release of chemicals from the source areas. During the receptor's period of contact, the individual may be exposed via inadvertent

ingestion of a small amount of soil or via dermal absorption of certain contaminants from the soil. Various factors affect the rate of dermal absorption, including the amount of soil on the skin surface, soil characteristics (moisture, pH, organic carbon content, etc.), skin characteristics (thickness, temperature, hydration, etc.), volatilization losses, and chemical-specific properties.

Potential Receptors

Several receptor groups have been defined for this risk assessment in the Work Plan (B&R Environmental, July 1997). These receptors are as follows:

Typical Industrial Worker - Because the soils being evaluated are underneath the cement slab of the main NIROP Fridley building, this receptor is hypothetical only. The receptor is included for purposes of completeness and because the State of Minnesota has indicated that this receptor should be evaluated to determine if any access restrictions/deed restrictions (i.e., land use restrictions) are necessary.

Major-Infrequent Construction Worker (MPCA Methodology) - Under current site conditions, the construction worker who occasionally contacts soils underlying the building slab is the most plausible receptor for the risk assessment. MPCA exposure assessment methodology will be used to evaluate exposures hypothetically incurred by one type of construction worker, an individual who will be referred to as the major-infrequent construction worker. The exposure estimates developed for this receptor will reflect exposures incurred by independent contractors who perform "major modifications" of the building slab and foundations.

Minor-Frequent Construction Worker (NIROP-Specific) - The second type of construction worker evaluated in the risk assessment will be referred to as the minor-infrequent construction (or maintenance) worker. Exposure estimates developed for this receptor will reflect exposures incurred by a UDLP employee involved in routinely performed "minor maintenance activity" throughout the building.

Under the expected industrial land use scenario and current site conditions, worker exposure to unsaturated soils is limited. Routine worker exposure to soils is limited by a 12-inch reinforced concrete floor inside the building. Thus, typical industrial workers at NIROP Fridley are not currently exposed to soils underlying the cement slab. Routine exposure to soils would only occur if the cement slab was permanently removed. However, construction/utility/maintenance workers may be exposed to soils during construction (e.g., new equipment foundations) or maintenance and repair of underground utilities. Two types of construction/maintenance activities have been described by NIROP personnel: (1) major modifications and (2) minor maintenance activity. A "major construction project or modification" is defined

by NIROP Fridley as a disruption of the flooring of the building for the purposes of installation or modification of a foundation for machine tools. Based on historical data, major modification projects can occur 2 to 3 times per year; the work is performed by independent contractors. Major excavation/construction activities may last for periods exceeding 10 days (60 to 90 days was suggested as an upper bound by NIROP personnel). The depth of a major foundation modification is typically 8 feet. Exposure duration assumptions by MPCA for a construction worker (Table 6-4) are somewhat similar to actual exposure durations experienced by the independent contractors and will be used to calculate exposure estimates for this receptor. In keeping with the MPCA methodology, it will be assumed that the major-infrequent construction worker (working for an independent contractor) is exposed to NIROP soils during one major construction activity only. NIROP personnel indicate that the same contractor and personnel are not used repeatedly. "Minor maintenance activity" is defined by NIROP Fridley as floor modifications where the soil is exposed for periods less than 10 days. Typically, the area exposed is less than 200 square feet. The depth of the soil disruption is around 2 to 4 feet. This type of activity occurs 5 to 8 times a year throughout the building; the work is performed by UDLP employees (i.e., the minor-frequent construction worker). According to NIROP personnel, and in contrast to the major-infrequent construction worker scenario, the same work crews are used repeatedly. Exposure dose assumptions for these industrial worker and construction worker receptors are summarized in Table 6-4.

Additional potential exposure pathways could occur under a residential future land use scenario. Such potential exposure routes include ingestion of groundwater or surface water, inhalation of VOCs emitted from surface water or groundwater during showering or other household uses, and dermal contact with surface water or groundwater used for bathing. In addition, the exposure routes identified for the construction and utility workers could also exist under a residential land use scenario. Both adult and child receptors could be exposed under the residential scenarios. These potential exposure pathways were not identified for the site because: (1) land use will be industrial for the foreseeable future; (2) surface water contamination has not been identified for several years; (3) the Navy controls the property over potential source zones; and (4) the Navy is required, under the OU1 Record of Decision, to provide alternative water sources or treatment in the event there is development of the groundwater within the off-site contaminant plume.

Another potential receptor for the site is a trespasser. Potential exposures to soil by a trespasser are not being evaluated because the site is surrounded by a fence and guarded, thereby making it unlikely for an individual to trespass on the property.

Potential exposures to groundwater by construction workers and typical workers will not be evaluated in the risk assessment. Currently there are no exposures to groundwater at the site. Groundwater is not

used as a potable drinking water supply. As discussed above, based on interviews with NIROP personal, the depth of major excavations is typically 8 feet. Groundwater at the facility is typically encountered at a depth of approximately 20 feet except in the vicinity of the former east platting shop where depth to groundwater is approximately 15 feet. Consequently, there are no direct contact exposures to groundwater.

6.3.2 Estimation of Exposure Point Concentrations

The exposure point concentration for the industrial worker and minor frequent construction worker is defined as the 95 percent upper confidence limit (UCL) of the mean and is calculated using the latest risk assessment guidance from the EPA (EPA, May 1992). A value of one-half the detection limit is substituted in the calculation for nondetect values. Because of potential problems with sample heterogeneity, the maximum detected concentration for field duplicate pair samples was used in the calculation of the exposure point concentration for soil. The Shapiro-Wilk W-Test (Gilbert, 1987) was used to determine the distribution of the dataset. When the results of the test were inconclusive, the distribution was assumed to be lognormal.

For normally distributed data, the calculation of the exposure point concentration (UCL) is a two-step process. First the standard deviation of the sample set must be determined, as follows:

$$S = \left[\frac{\Sigma(X_i - \overline{X})^2}{(n-1)}\right]^{1/2}$$

where: S = standard deviation
X_i = individual sample value
n = number of samples
$\overline{X}$ = mean sample value

The one-sided UCL on the mean is then calculated as follows:

$$UCL = \overline{X} + t\left(\frac{S}{n^{1/2}}\right)$$

where:	UCL	=	95% UCL of the mean
	$\overline{X}$	=	Arithmetic average
	t	=	One-sided t distribution factor ($t_{0.95}$)
	S	=	standard deviation
	n	=	number of samples

For log-normally distributed data sets, the exposure concentration is calculated using the following equation:

$$UCL = \exp\left(\overline{X} + 0.5\,S^2 + \frac{HS}{(n-1)^{1/2}}\right)$$

where:	UCL	=	95% UCL of the mean
	exp	=	Constant (base of the natural log, e)
	$\overline{X}$	=	Mean of the transformed data
	S	=	standard deviation of the transformed data
	H	=	H-statistic (from Gilbert, 1987; $H_{0.95}$)
	n	=	Number of samples

This equation uses individual sample results that have been transformed using the natural logarithm function.

The estimation of exposure point concentrations was determined after consultation with MPCA (1998b) and is follows;

Minor Frequent Construction Worker and Typical Industrial Worker - Since work would be scattered throughout the building and no distinct pattern of contamination is apparent (i.e., contamination appears to be scattered throughout the building) it is reasonable to treat the entire footprint of the building as an exposure area. A conservative estimate of the mean concentration (i.e., 95% upper confidence limit of the mean) will be utilized as the exposure concentration for these receptors. Based on intervals with site personnel it will be assumed that the minor frequent construction worker and typical industrial worker are exposed to soil o to 4 feet bgs.

Major Infrequent Construction Worker - Since it is assumed that this individual will only be exposed to a portion of the building it is not reasonable to average across then entire footprint because it is not known

what section(s) of the building this individual may access. Therefore, the maximum detected concentrations will be utilized as the exposure point concentration for this receptor. It will be assumed that the major infrequent construction worker is exposed to surface and subsurface soil (0 to 12 feet bgs).

The rationale for the location of the soil borings is discussed in detailed in the FSP (Brown & Root Environmental, 1997). The location of the soil borings are shown on Figures 2-1 and 2-2. Soil samples were collected from 57 locations at the site. Soil sample locations were not selected by using a sampling grid but rather soil samples were collected from areas where contamination was most likely to be present. All drywells at the site were sampled. The remaining AOCs at the site were divided into 7 major groupings and 22 miscellaneous AOCs that did not fall into a group. The 7 major groups were (1) 1,1,1-TCA/TCE tank storage, (2) degreasing, (3) heat treatment, (4) machining, (5) plating, (6) Pepset tank storage, and (7) plating. In addition, soil samples were collected from locations not associated with AOCs in areas where sampling points were sparse. As discussed in Section 2.2.2, additional soil samples were collected during the installation of six permanent monitoring wells which were located to obtain the maximum spatial coverage under the NIROP building. Seven soil samples were also collected from the Former East Plating Shop during construction activities in 1999.

Table 6-5 presents the exposure point concentrations for the industrial worker and minor frequent construction worker. Data used in the calculation of the exposure point concentrations for the industrial worker and minor frequent construction worker is presented in Table 4-1. Exposure point concentrations for the major infrequent construction worker are presented in Table 6-6. Data used in the calculation of the exposure point concentrations for the major infrequent construction worker is presented in Tables 4-1 and 4-2. It should be noted that the maximum concentrations presented in Table 6-4 differ from those presented in Table 4-6 due to the way the duplicate samples are handled in each table. In Table 4-6 the results of duplicate samples are reported separately. In Table 6-4 the results of duplicate samples are averaged and the average result is reported.

6.3.3 Quantification of Exposure

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and are based on MPCA guidance (MPCA, 1998b).

Exposure assumptions for the identified receptor groups are presented in Table 6-4. The parameters are based on MPCA guidance and those presented in the Work Plan (B&R Environmental, July 1997). All parameters are referenced in footnotes provided for each table. The parameters in the equations

presented in this section and the exposure point concentrations are used to calculate intakes, which will be used to determine risks.

Air Exposure Via Inhalation. The amount of a chemical a receptor takes in as a result of respiration is determined using the estimated concentration of the contaminant in air. Intakes of both particulates and vapors/gases are calculated using the same equation, as follows (MPCA, 1998b):

$$\text{Intake}_{ai} = \frac{C_s \times \left(\frac{1}{VF} + \frac{1}{PEF}\right) \times EFs}{AT} \qquad \text{Noncancer Subchronic Evaluation}$$

$$\text{Intake}_{ai} = \frac{C_s \times \left(\frac{1}{VF} + \frac{1}{PEF}\right) \times EF \times ED}{AT} \qquad \text{Noncancer Chronic Evaluation}$$

$$Intake_{ai} = \frac{C_s \times \left(\frac{1}{VF} + \frac{1}{PEF}\right) \times EF \times ED \times 1{,}000 \frac{\mu g}{mg}}{AT} \; Cancer\,Evaluation$$

where: Intake_{ai} = intake of chemical "i" from air (PM_{10} or vapor) inhalation (mg/m^3 for subchronic and chronic exposures, $\mu g/m^3$ for cancer evaluation)

C_s = concentration of chemical "i" in soil (mg/kg)

VF = volatilization factor (m^3-air/kg-soil)

PEF = particulate emission factor (m^3-air/kg-soil)

EFs = exposure frequency for subchronic exposures (days)

EF = exposure frequency for chronic and lifetime exposures (days/yr)

ED = exposure duration (yr)

AT = averaging time (days)

noncancer subchronic - Major Construction Workers,
AT = 91 days
noncancer chronic - Minor Construction Workers,
AT = ED*365 days/yr
for carcinogens, AT = 70 yr*365 days/yr = 25,550 days

All exposure factors for the identified receptor groups are outlined in Table 6-3. MPCA recommends calculating the volatilization factor using the following equation for U.S. EPA's Soil Screening Guidance Technical Background Document (EPA, May 1996).

$$VF = \frac{Q/C \times (3.14 \times D_a \times T)^{0.5} \times 10^{-4}\ m^2/cm^2}{(2 \times \rho_b \times D_a)}$$

and

$$D_a = \frac{[(\theta_a^{10/3} \times D_i \times H' + \theta_w^{10/3} \times D_w)/n^2]}{\rho_b \times K_d + \theta_w + \theta_a \times H'}$$

where:	Q/C	=	inverse of the mean concentration at the center of a (46 gm/m^2-sec per kg/m^3 for the major construction worker and 61.03 gm/m^2-sec per kg/m^3 for the minor construction worker.)
	D_a	=	apparent diffusivity, chemical specific, (cm^2/sec)
	θ_w	=	water-filled soil porosity (0.15 L_{air}/L_{soil})
		=	fm x ρ_b
	fm	=	soil moisture content (0.1 cm^3-water/g-soil)
	ρ_b	=	dry bulk soil particle density (1.5 g/cm^3)
	θ_a	=	air-filled soil porosity (0.28 L_{air}/L_{soil})
		=	n - θ_w
	n	=	total soil porosity (0.43 L_{pore}/L_{soil})
		=	1 - (ρ_b/ρ_s)
	ρ_s	=	soil particle density (2.65 g/cm^3)
	D_i	=	diffusivity in air, chemical specific, (cm^2/sec)
	D_w	=	diffusivity in water, chemical specific, (cm^2/sec)
	K_d	=	soil-water partition coefficient, chemical specific
		=	K_{oc} x f_{oc}
	K_{oc}	=	organic carbon partition coefficient, chemical specific
	f_{oc}	=	organic carbon content of soil, (0.005)
	H'	=	dimensionless Henry's law constant, chemical specific
		=	41 x H
	H	=	Henry's Law constant, chemical specific (atm-m^3/mole)
	T	=	exposure interval, exposure specific
			minor frequent construction workers = 7.88E+08 sec
			major infrequent construction workers = 7.86E+06 sec

MPCA recommended values were used for all input parameters for the calculation of the volatilization factor.

The particulate emission factor is also calculated according to EPA Soil Screening Guidance.

$$PEF = Q/C \times \left[\frac{3{,}600 \text{sec}/hr}{0.036 \times (1-V) \times (U_m / U_t)^3 \times F(x)} \right]$$

where: PEF = Particulate Emission Factor,
V = fraction of vegetative cover, (0)
U_m = mean annual wind speed, (4.92 m/s)
U_t = equivalent threshold value of wind speed at 7 meters, (11.32 m/s)
F(x) = function dependent on U_m/U_t, (0.194)

MPCA recommend values were used for all input parameters for the calculation of the particulate emission factor.

Incidental Ingestion of Soil. The intake of chemicals from soil is estimated using the exposure point concentration at the location of interest. In general, intakes associated with soil ingestion are calculated using the following equation:

$$Intake_{si} = \frac{C_{si} \times IR \times 0.75 \times CF \times FI \times EF \times ED}{BW \times AT} \text{ Industrial Workers}$$

$$Intake_{si} = \frac{C_{si} \times IR \times CF \times FI \times EF \times ED}{BW \times AT} \text{ Minor Construction Workers}$$

$$Intake_{si} = \frac{C_{si} \times IR \times CF \times FI \times EFs}{BW \times AT} \text{ Major Construction Workers}$$

where: $Intake_{si}$ = intake of chemical "i" from soil (mg/kg/day)
C_{si} = concentration of chemical "i" in soil (mg/kg)
IR = ingestion rate (mg/day)
FI = fraction ingested from contaminated source (decimal fraction)

EF	=	exposure frequency (days/yr)
EFs	=	exposure frequency for subchronic exposures (days)
ED	=	exposure duration (yr)
CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
		for noncarcinogens - Major Construction Workers, AT = 91 days
		for noncarcinogens - Minor Construction Workers, AT = ED*365 days/yr
		for carcinogens, AT = 70 yr*365 days/yr = 25,550 days

MPCA recommends adjusting the intake for industrial workers using a climate adjustment factor of 0.75. This factor assumes that industrial workers are exposed one half of the time during the winter months (5 months) and precipitation days (1 day a week) and all day during the rest of the year (7 months). All exposure factors for the identified receptor groups are outlined in Table 6-4.

Dermal Contact with Soil. The intake of a chemical from soil as a result of dermal absorption through the skin is estimated using the exposure point concentration. The following equations are used to estimate the dermal exposure dose for soil:

$$Intake_{si} = \frac{C_{si} \times CF \times SA \times AF \times ABS \times EFs}{BW \times AT} \text{Major Construction Workers}$$

$$Intake_{si} = \frac{C_{si} \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} \text{Industrial Minor Construction Worker}$$

where:	$Intake_{si}$	=	amount of chemical "i" absorbed during contact with soil (mg/kg/day)
	C_{si}	=	concentration of chemical "i" in soil (mg/kg)
	CF	=	conversion factor (10^{-6} kg/mg)
	SA	=	skin surface area available for contact (cm^2/day)
	AF	=	skin adherence factor (mg/cm^2)
	ABS	=	absorption factor (decimal fraction)
	EFs	=	exposure frequency for subchronic exposures (days)
	EF	=	exposure frequency (days/yr)
	ED	=	exposure duration (yr)
	BW	=	body weight (kg)

AT = averaging time (days)
for noncarcinogens - Major Construction Workers, AT = 91 days
for noncarcinogens - Minor Construction Workers, AT = ED*365 days/yr
for carcinogens, AT = 70 yr*365 days/yr = 25,550 days

All exposure factors for the identified receptor groups are outlined in Table 6-4.

6.4 RISK CHARACTERIZATION

Potential risks (noncarcinogenic and carcinogenic) for human receptors resulting from the exposures to contaminated media are quantitatively determined during the risk characterization component of the human health risk assessment. COPCs that contribute significantly to elevated risks are identified as "risk drivers" during the interpretive risk discussion.

6.4.1 Risk Estimation Methods

Quantitative estimates of risk are calculated using intake and toxicity values according to risk assessment methods outlined in current EPA guidance (EPA, 1989). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as Incremental Cancer Risks (ICRs), which are derived using published CSFs. Noncarcinogenic risk estimated are presented in the form of Hazard Quotients (HQs) that are derived using published RfDs.

ICR estimates are generated for each COPC as follows for industrial workers from the following equation:

$$ICR = \frac{C}{SRV} \times 1 \times 10^{-5}$$

where: C = exposure point concentration (mg/kg)
SRV = MPCA Soil Reference Value (mg/kg)

The ICR estimates for major and minor construction workers are generated using estimated exposure intakes and published CSFs and Unit Risks from the following equation:

ICR = (Estimated Exposure Intake)(CSF or Unit Risk)

The ICRs for all COPCs in an exposure scenario are summed to give a cumulative ICR. An ICR of 1 x 10^{-6} indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the

defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

Noncarcinogenic risks are assessed using the concept of HQs and Hazard Indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD or RfC. The HQ for an industrial worker is calculated from the following equation:

$$HQ = \frac{C}{SRV} \times THQ$$

where: THQ = Target hazard quotient for SRV

The HQ for a major and minor construction worker is calculated as follows from the following equation:

HQ = (Estimated Exposure Intake) / (RfD or RfC)

An HI is generated by summing the individual HQs for all of the COPCs. It should be noted that HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

6.4.2 Comparison of Quantitative Risk Estimates to Benchmarks

In order to interpret the quantitative risk estimates and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical benchmarks. Risk estimates less than 1 $x10^{-5}$ (1/100,000 or a risk less than 1 in 1 one hundred thousand) are generally considered to be acceptable by the MPCA. The EPA has defined the range of 1 x 10^{-4} to 1 x 10^{-6} as the ICR "target range" for most hazardous waste facilities addressed under CERCLA. Cumulative ICRs greater than 1 x 10^{-4} generally will indicate that some degree of remediation is required, while ICRs below 1 x 10^{-6} will normally indicate that remedial efforts are not necessary. Whenever ICRs fall between 1 $x10^{-4}$ and 1 x 10^{-6}, decisions for remediation are made on a case-specific basis. Individual chemicals contributing significantly to risks above the target range are considered to be COCs.

An HQ or HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. Conservatively, MPCA has set a target level of 0.2 for the HQ. If an HI exceeds unity, target organ effects from individual COPCs contributing to the risk are considered. Only those chemicals that impact the same target organ(s) or exhibit similar critical effect(s) will be regarded as truly additive. Thus, COPCs contributing to an HI greater than 1.0 on the basis of a single target organ/effect are considered to be COCs.

6.4.3 Identification of Other Human Health-Based Criteria

Media-specific regulatory and human health-based criteria for COPCs, other than dose-response parameters, are also provided in this risk assessment. These criteria, which consist of Applicable or Relevant and Appropriate Requirement (ARARs) and To Be Considered (TBC) values, can also be used to indicate the potential for adverse health effects in human receptors. ARARs (i.e., drinking water and ambient water quality criteria) are potential cleanup standards and other environmental protection requirements and criteria promulgated under Federal or State law. TBCs (e.g., RBCs for drinking water) are important standards or criteria that may be helpful in determining what concentration of a particular chemical is protective of human health.

Soil

There are no regulatory standards pertaining to chemical concentrations in soil. However, the following risk-based guidelines have been developed.

- Soil Reference Values (SRVs) are risk-based chemical concentrations in soil which, if exceeded, can represent a level of contamination that may be considered a potential concern. They are based on limited multiply pathway exposure scenarios: direct ingestion of soil, inhalation of volatiles and fugitive dust, and migration to groundwater. MPCA has developed SRVs for industrial and residential land use.

Groundwater

ARARs available for this medium are State Health Risk Limits (HRLs) and Federal MCLs and MCLGs, which are used to assess the drinking water quality of a resource. Table 4-6 contains a summary of the health-based criteria for groundwater.

- State HRLs are promulgated under Minnesota Rules Parts 4717.7100 to 4717.7800. An HRL is the concentration of a groundwater contaminant, or mixture of contaminants, that can be safely consumed for a lifetime. HRLs are risk-based standards derived using U.S. EPA risk assessment methodology and toxicological data. The HRLs reflect health effects data alone. They do not incorporate economic or technological factors as do Federal MCLs. Health Risk Values (HRVs) have been developed for those chemicals for which HRVs are not available. HRVs are developed using the same methodology as HRLs but they have not been promulgated.

- Federal MCLs are promulgated under the Safe Drinking Water Act. MCLs can be risk-based standards derived from laboratory or epidemiology studies. However, these values may also reflect the technical feasibility of removing the contaminant. Federal MCLs are applicable to all community and non-transient water supplies. Since shallow groundwater at the site is not used as a potable water supply, the use of Federal MCLs as enforceable ARARs is not entirely appropriate. However, these values can be used conservatively to infer potential human health impacts.

- MCLGs are nonenforceable guidelines (TBCs) based entirely on health effects; they are generally specified as zero for carcinogenic chemicals. These values are based on the assumption of nonthreshold toxicity and do not consider either the technical or economic feasibility of achieving the specific goal.

6.4.4 Risks to Industrial Workers

Cancer risks and hazard indices for industrial workers were estimated by comparing surface soil (0 to 4 feet) concentrations to the MPCA SRVs using the MPCA spreadsheet and are summarized in Table 6-7. A site-wide upper 95 percentile confidence limit on the mean was used as the exposure point concentration. A copy of the MPCA spreadsheet is included in Appendix G. The cancer risk for industrial workers exposed to surface soil was 3.5×10^{-6}. This risk is within EPA's target risk range of 10^{-4} to 10^{-6} and below the MPCA acceptable level of 1×10^{-5}. The chemical-specific cancer risk for arsenic of 1.4×10^{-6} was greater than the lower end of the EPA target risk range. All other chemical-specific cancer risks were below 1×10^{-6}.

All HQs for each target endpoint were below the EPA acceptable level of 1.0, and MPCA acceptable level of 0.2.

Since it is not known if deeper soils will be excavated at a later date , MPCA required that a screening risk characterization utilizing the maximum detected concentrations detected in soil at 0 to 12 feet below ground surface be conducted using the concentrations presented in Table 6-6. A copy of the spreadsheets used in the analysis are included in Appendix G. The cancer risk for the industrial worker exposed to the maximum detected concentration in soil 0 to 12 feet below ground surface was 2.0×10^{-5} which is within EPA's target risk range of 10^{-4} to 10^{-6}, but slightly exceeds the MPCA acceptable level of 1×10^{-5}. Benzo(a)pyrene, arsenic, and chromium were the major contributors to the cancer risk. The maximum detected concentration for benzo(a)pyrene occurred at SB-017 (0 to 4 feet bgs), the maximum detected concentration of arsenic occurred at SB-071 (0 to 4 feet bgs), and the maximum detected concentration of chromium occurred at SB-02 (4 to 6 feet bgs). The cancer risk for soil sample SB-017

(0 to 4 feet bgs) is 8.9 x 10^{-6}, the cancer risk for soil sample SB-071 (0 to 4 feet bgs) is 6.9 x 10^{-6}, and the cancer risk for soil sample SB-02 (4 to 6 feet bgs) is 4.6 x 10^{-6} which are less than the MPCA acceptable risk. It should also be noted that the maximum detected total chromium concentration of 618 mg/kg exceeds the MPCA SRV of 155 mg/kg for hexavalent chromium.

All HIs for each target endpoint were below the EPA and MPCA acceptable level of 1.0. However, the HQ of 0.80 for hexavalent chromium exceeds the MPCA acceptable level of 0.2 for individual chemicals. The HQ for hexavalent chromium is based on a maximum detected total chromium concentration of 618 mg/kg from sample SB-02 (4 to 6 feet) in the former East Plating Shop. This sample was not analyzed for hexavalent chromium. In accordance with MPCA guidelines this sample was evaluated as hexavalent chromium in the screening risk assessment. Boring SB-02 was installed in the vicinity of a former sump (AOC 44). Discolored soil that was stained blue and green was encountered in SB-02 to a depth of approximately 8 feet. During the installation of SB-02, auger refusal was encountered at approximately 7.5 feet below ground surface. This corresponds to the approximate depth of the bottom of the former sump. The discolored soil encountered in this boring may represent a sump used before the 1973 reconfiguring of the East Plating Shop that was filled without being completely drained. The elevated levels of chromium appear to be limited in extent to this area. Concentrations of total chromium in shallow soil collected from this boring were 20 mg/kg (0 to 2 feet) and 73.6 mg/kg (2 to 4 feet) which are below the SRV of 155 mg/kg for hexavalent chromium.

6.4.5 Major-Infrequent Construction Workers

Cancer risks and HIs for the major-infrequent construction worker exposed to surface and subsurface soil (0 to 12 feet) were estimated using the MPCA spreadsheet and are summarized in Table 6-7. The maximum detected concentration for each chemical detected in soil was used as the exposure point concentration. Example calculations and a copy of the spreadsheet are included in Appendix G. The cancer risk for the major infrequent construction worker was 2.1 x 10^{-6}, but slightly exceeds the MPCA acceptable level of 1 x 10^{-6} for short term exposures. This risk is within EPA's target risk range of 10^{-4} to 10^{-6}, but slightly exceeded MPCA acceptable level of 1 x 10^{-6} for short term exposures. All chemical specific cancer risks were below 1 x 10^{-6}. Chromium (cancer risk = 9.1 x 10^{-7}) was the major contributor to the cancer risk.

The cumulative HI was 2.9, which is above the EPA and MPCA acceptable level of 1.0. Chromium VI (HQ = 1.35) was the major contributor to the hazard index.

The HQ for hexavalent chromium of 1.35 and cancer risk of 9.1 x 10^{-7} are based on a maximum detected total chromium concentration of 618 mg/kg from sample SB-02 (4 - 6 feet) in the former East Plating Shop. This sample was not analyzed for hexavalent chromium. In accordance with MPCA guidelines, this sample was evaluated as hexavalent chromium in the risk assessment. If the sample is treated as trivalent chromium, then the HQ for chromium would be 0.006. Hexavalent chromium was detected infrequently (3 of 50 soil samples, only) in surface and subsurface soil at OU3.

6.4.6 Minor-Frequent Construction Workers

Cancer risks and HIs for the minor construction worker exposed to surface and shallow soil (0 to 4 feet) were estimated using the MPCA spreadsheet and are summarized in Table 6-6. A site wide UCL was used as the exposure point concentration. Example calculations and a copy of the spreadsheet are included in Appendix G. The cancer risk for minor frequent construction workers was 3.6 x 10^{-6}. This risk estimate is within EPA's target risk range of 10^{-4} to 10^{-6} and below the MPCA acceptable level of 1 x 10^{-5}. The chemical-specific cancer risks for arsenic (1.3 x 10^{-6}) and benzo(a)pyrene (1.01 x 10^{-6}) were above 1 x 10^{-6}. All other chemical-specific cancer risks do not exceed 1 x 10^{-6}.

The cumulative HI of 0.045 was below the EPA and MPCA acceptable level of 1.0. All individual HQs were below the MPCA acceptable level of 0.2.

Since it is not known if deeper soils will be excavated at a later date , MPCA required that a screening risk characterization utilizing the maximum detected concentrations detected in soil 0 to 12 feet below ground surface be conducted using the concentrations presented in Table 6-6. A copy of the spreadsheets used in the analysis are included in Appendix G. The cancer risk for the minor frequent construction worker exposed to the maximum detected concentration in soil 0 to 12 feet below ground surface was 1.8 x 10^{-5} which is within EPA's target risk range of 10^{-4} to 10^{-6} but slightly exceeds MPCA acceptable level of 1 x 10^{-5}. Benzo(a)pyrene and arsenic were the major contributors to the cancer risk. The maximum detected concentration for benzo(a)pyrene occurred at SB-017 (0 to 4 feet bgs) and the maximum detected concentration of arsenic occurred at SB-071 (0 to 4 feet bgs). The cancer risk at SB-017 is 1.1 x 10^{-5} and the cancer risk at SB-071 is 5.8 x 10^{-6}.

The cumulative HI for the minor frequent construction worker exposed to the maximum detected concentration in soil 0 to 12 feet below ground surface was 0.65 which is below the EPA and MPCA acceptable level of 1.0. However, the individual HQ for hexavalent chromium was 0.37 which exceeds the MPCA acceptable level of 0.2. The screening evaluation indicated that the HQs exceeded the MPCA acceptable ranges due to the elevated chromium concentrations in boring SB-02 (4 to 6 feet) in the former

East Plating Shop. As previously discussed, soil samples collected from the former East Plating Shop were only analyzed for total chromium, but were treated as hexavalent chromium for the purposes of evaluating exposures to human health. If sample SB-02 is removed from the screening analysis, than all individual HQs are below the MPCA acceptable level of 0.2.

6.4.7 Exposures to Lead

Exposures to lead in surface and subsurface soil by the identified receptor groups could not be evaluated due to a lack of toxicity values for lead. Lead was detected in 111 of 113 surface and subsurface soil samples at the site. The maximum detected lead concentration of 733 mg/kg (SB-017, 0 to 4 feet) exceeds the MPCA industrial SRV of 700 mg/kg. This was the only sample with a concentration of lead that exceeded the MPCA industrial SRV. The second highest detected concentration of lead was 515 (SB-07, 4 to 6 feet) which is below the MPCA industrial SRV. Lead concentrations in the remaining samples were less than 231 mg/kg. In addition, the concentration of lead in all but two samples is less than the OSWER screening level of 400 mg/kg for residential exposures to children (USEPA, 1994). Consequently, exposures to lead in soil by the identified receptor groups are not expected to result in adverse health effects.

6.4.8 Summary of Risk Characterization to Soil

Table 6-7 presents the chemicals being retained as chemicals-of-concern (COCs) in soil. There are no chemicals being retained as COCs in surface soil. Chromium in the former East Plating Shop area was the only chemical retained as a COC in subsurface soil. Although, the maximum detected concentration of lead exceeded the MPCA SRV for industrial exposures and the HQs for arsenic, copper, and mercury exceeded the MPCA acceptable level of 0.2, these chemicals are not being retained as COCs in soil for the following reasons:

- Lead was detected in 111 of 113 surface and subsurface soil samples. The maximum detected lead concentration of 733 mg/kg slightly exceeded the MPCA SRV of 700 mg/kg for industrial exposures. The concentration of lead in all but one of the remaining samples was below the OSWER screening level of 400 mg/kg for residential exposures. Therefore, lead is not considered as a COC since it only slightly exceeded its SRV in one sample and was detected at low concentrations in the remaining samples.

- The HQ of 0.3 for exposure to arsenic in surface and subsurface soil by a major infrequent construction worker slightly exceeded the MPCA acceptable level of 0.2 but was less than the EPA

acceptable level of 1.0. Exposures to arsenic in soil by the industrial worker and minor frequent construction worker were within acceptable levels. Arsenic was only detected in two samples at concentrations which were above background. Concentrations of arsenic in 111 of 113 would result in HQs of less than 0.2. Therefore, arsenic is not considered a COC since the HQ exposures to arsenic by the major infrequent construction worker only slightly exceeded the MPCA acceptable level of 0.2, was less than the EPA acceptable level of 1.0, and was detected at low concentrations across the site.

- The HQ of 0.23 for exposure to copper in surface and subsurface soil by a major infrequent construction worker slightly exceeded the MPCA acceptable level of 0.2 but was less than the EPA acceptable level of 1.0. Exposures to copper in soil by the industrial worker and minor frequent construction worker were within acceptable levels. Concentrations of copper in 112 of 113 would result in HQs of less than 0.2. Therefore, copper is not considered a COC since the HQ exposures to copper by the major infrequent construction worker only slightly exceeded the MPCA acceptable level of 0.2, was less than the EPA acceptable level of 1.0, and was detected at low concentrations across the site.

- The HQ of 0.46 for exposure to mercury in surface and subsurface soil by a major infrequent construction worker exceeded the MPCA acceptable level of 0.2 but was less than the EPA acceptable level of 1.0. Exposures to mercury in soil by the industrial worker and minor frequent construction worker were within acceptable levels. Mercury was only detected in 18 of 113 surface and subsurface soil samples. Therefore, mercury is not considered a COC since the HQ exposures to mercury by the major infrequent construction worker was less than the EPA acceptable level of 1.0 and was infrequently detected at low concentrations across the site.

The human health risk assessment addressed potential direct contact with contaminated soil within the top 12 feet. No potential exposures were identified for soil at depths beyond 12 feet, therefore no risks were calculated for potential exposures to soil greater than 12 feet bgs. Concentrations of all chemicals in soil samples collected at depths beyond 12 feet were less than MPCA SRVs for industrial exposures with the exception of TCE in one soil sample (SB-07, 12 to 16 feet) collected at the former East Plating Shop. The boring logs suggest that this sample was collected from within the saturated zone, consequently this sample may be more representative of groundwater contamination than soil contamination.

6.5 ANALYSIS OF GROUNDWATER

As discussed earlier, on-site groundwater is not currently used as a potable water supply at NIROP Fridley nor is it expected to be used in the future because a public water supply is available. According to MPCA, the city of Minneapolis had developed plans to use groundwater downgradient of NIROP as a backup water supply for Minneapolis, but decided not to install the water supply because of groundwater contamination from NIROP. A screening evaluation of risks associated with potable use of groundwater was performed using a spreadsheet provided by MPCA. The spreadsheet evaluates exposures to groundwater by comparing maximum detected concentrations of compounds in unfiltered groundwater to MPCA HRLs, HRVs, and EPA MCLs. Also the evaluation included a "mixtures" evaluation as required by Minnesota Rule. The maximum detected concentrations of compounds (Table 4-16) in unfiltered groundwater samples from wells installed in the upper portion of the unconfined aquifer, lower portion of the unconfined aquifer, and deep aquifers were used in the analysis. Copies of the spreadsheet are included in Appendix G.

Upper Portion of the Unconfined Aquifer

Table 6-8 lists the compounds detected in unfiltered groundwater samples from wells installed in the upper portion of the unconfined aquifer at concentrations exceeding screening criteria and are therefore retained as COCs in the upper portion of the unconfined aquifer. The cumulative cancer risk was 5.0 x 10^{-2}, which exceeds EPA's target risk range of 10^{-4} to 10^{-6} and MPCA's acceptable level of 1 x 10^{-5}. Arsenic , 1,1-dichloroethene, methylene chloride, pentachlorophenol, PCE, TCE, and vinyl chloride were the main contributors to the cancer risk. The cumulative HI calculated per target endpoint exceeds 1.0 for the cardiovascular or blood system, central or peripheral nervous system, kidneys, and gastrointestinal system or liver. 1,1-Dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, ethylbenzene, 1,1,1-trichloroethane, cobalt, cyanide, manganese, and thallium were the main contributors to the HI.

Lower Portion of the Unconfined Aquifer

Table 6-8 lists the compounds detected in unfiltered groundwater samples from wells installed in the lower portion of the unconfined aquifer at concentrations exceeding screening criteria and are therefore retained as COCs in the lower portion of the unconfined aquifer. The cumulative cancer risk was 2.1 x 10^{-2}, which exceeds EPA's target risk range of 10^{-4} to 10^{-6} and MPCA's acceptable level of 1 x 10^{-5}. Arsenic, TCE, and vinyl chloride were the main contributors to the cancer risk. The cumulative HI calculated per target endpoint exceeds 1.0 for the cardiovascular or blood system, central or peripheral nervous system, and gastrointestinal system or liver. 1,1-Dichloroethene, cis-1,2-dichloroethene, and manganese were the main contributors to the HI.

Deep Aquifer

Table 6-8 lists the compounds detected in unfiltered groundwater samples from the deep zone at concentrations exceeding screening criteria and therefore are retained as COCs in the deep aquifer. The cumulative cancer risk was 5.2×10^{-5}, which is within EPA's target risk range of 10^{-4} to 10^{-6}, but exceeds MPCA's acceptable level of 1×10^{-5}. PCE and TCE were the main contributors to the cancer risk. The HI calculated per target endpoint exceeds 1.0 for the central or peripheral nervous system. Manganese was the main contributor to the HI.

6.6 UNCERTAINTY ANALYSIS

The goal of the uncertainty analysis is to identify important uncertainties and limitations associated with the human health risk assessment. Uncertainties related to each component of the assessment (i.e., field screening data, data evaluation, exposure assessment, toxicity assessment, and risk characterization) are presented in the site-specific assessments. In addition, the effect of a particular uncertainty on the outcome of the assessment (i.e., risk estimates) is also indicated, where possible.

6.6.1 Uncertainty in the Field Screening Data

Analyzing environmental samples real time in the field is an invaluable tool that may be used to help delineate an AOC and control project spending. The majority of the soil samples collected at NIROP Fridley were initially analyzed by gas chromatography in the field. VOC sample results from the fixed-base laboratory were compared with field screening results from the same locations. Because of the problems with linearity and coelutions, the degree of correlation of screening and confirmation results was found to be qualitative rather than quantitative. If a compound was detected in the field screening data at a given location, then it was also detected in the fixed-based laboratory data at the same location and if a compound was not detected in the field screening at a given location, then it was not detected in the fixed-base laboratory data for the same location. However, when a compound was detected in both the field screening data and fixed-based laboratory data for the same location there was not a strong correlation(low calculated r value) between the results. Qualitative agreement was best illustrated for TCE, one of the primary compounds of concern at NIROP Fridley. Although acceptable qualitative agreement was found, that is TCE was detected in both the field screening data and fixed-based laboratory data for a given location, the quantitative correlation was marginal, which is a reflection of the fact that TCE results by one method were often up to an order of magnitude higher or lower than corresponding results of the companion method. The risk assessment was based on in the fixed-base laboratory data.

6.6.2 Uncertainty in Selection of Chemicals of Potential Concern

In accordance with MPCA guidance all chemicals that were detected at the site were retained as COPCs which serves to reduce most of the uncertainty associated with the selection of COPCs. Some chemicals were detected at the site for which there are no MPCA SRVs. Also as discussed in Section 4, the detection limits for some chemicals were higher than their respective SRVs. The uncertainty associated with these issues are discussed below.

Uncertainty Associated with Chemicals without Toxicity Values

MPCA has not derived SRV's for acenaphthylene, 2-methylnaphthalene, phenanthrene, and 4-chloro-3-methylphenol due to a lack of toxicity values for these chemicals. In general, these chemicals were detected infrequency and at low concentrations in surface and subsurface soil. Acenaphthylene was detected in 2 of 55 surface soil samples at a maximum concentration of 706 µg/kg and 1 of 65 subsurface soil samples at a concentration of 20 µg/kg. 2-Methylnaphtahlene was detected in 4 of 55 surface soil samples at a maximum concentration of 1,000 µg/kg and 5 of 65 subsurface soil samples at a maximum concentration of 720 µg/kg. Phenanthrene was detected in 12 of 53 surface soil samples at a maximum concentration of 5,000 µg/kg and 7 of 62 subsurface soil samples at a maximum concentration of 570 µg/kg. 4-Chloro-3-methylphenol was not detected in surface soil and was only detected in 1 of 65 subsurface soil samples at a concentration of 11,000 µg/kg. The maximum concentrations of acenaphthylene, 2-methylnaphthalene, and phenanthrene are less than the SRV for pyrene (5,300,000 µg/kg) which can be used as a surrogate for these chemicals. 2-Chlorophenol can be used as a surrogate for 4-chloro-3-methylphenol. No SRV is available for 2-chlorophenol, but EPA Region IX has developed a Preliminary Remedial Goal (PRG) for 2-chlorophenol. The maximum detected 4-chloro-3-methylphenol concentration of 11,000 µg/kg is less than the EPA Region IX PRG of 240,000 µg/kg for 2-chlorophenol. Consequently, the absence of SRV's for 4-chloro-3-methylphenol, acenaphthylene, 2-methylnaphthalene, and phenanthrene does not results in an underestimation of risk.

Uncertainty Associated with Elevated Detection Limits

Section 4.1 presented an evaluation comparing the reported detection limits for organic and inorganic chemicals to MPCA SRVs for soil and MPCA HRLs and HRVs and EPA MCLs for groundwater. The results of the soil comparison are presented in Tables 4-8 and 4-9. As discussed in section 4.1 the reported detection limits for 3 VOCs (1,1-DCE, carbon tetrachloride, and vinyl chloride) exceeded their respective SRVs in 1 out of 141 soil samples collected from the 0 to 12 foot depth. Sample SB-03, which contained the elevated VOC detection limits, was collected at a depth for 10 to 12 feet in the Former East

Plating Shop. The reported detection limits for these VOCs were below their respective SRVs in soil samples collected above and below the 10 to 12 foot depth. Since the industrial worker is only exposed to surface soil and the minor construction worker is only exposed to soil to a depth of 4 feet, the elevated VOC detection limits for sample SB-03 does not result in any uncertainty for these receptors. The major construction worker is assumed to be exposed to soil to a depth of 12 feet therefore there is some uncertainty in the estimated risk for this receptor. Although the uncertainty is expected to be small since the reported detection limits were elevated in only one sample, these VOCs were not detected in other samples at this location, and the reported detections exceeded their respective SRVs by less than an order of magnitude.

The detection limits for SVOCs analysis for samples 003-SB-028-01 (AOC 28) and 003-SB-046-03 (AOC 46) were elevated as a result of sample dilution due to the presence of high hydrocarbon concentrations in these samples. AOC 28 was a dry well located in the diesel room and was approximately 3 feet in diameter and 5 feet deep. Detection limits for SVOCs were elevated in sample 003-SB-028-01 which was collected from a depth of 0 to 4 feet. Acenaphthene (650 J µg/kg), anthracene (110 J µg/kg), fluoranthene (100 J µg/kg), fluorene (760 J µg/kg), phenanthrene (1,200 J µg/kg), and pyrene (340 J µg/kg) were the only SVOCs detected in sample 003-SB-028-01. The reported detection limit of 3,500 µg/kg for benzo(a)pyrene was equal to the SRV for benzo(a)pyrene. The reported detection limits for the other SVOCs were below their respective SRVs. Detection limits were normal for sample 003-SB-028-02 which was collected at a depth of 4 to 8 feet. 2-Methylnaphthalene (13 J µg/kg) and phenanthrene (23 J µg/kg) were the only SVOCs detected in sample 003-SB-028-02, consequently it appears that the SVOC contamination at AOC 28 is confined to surface soil. Also, since the elevated detection limits are equal to or less than their respective SRV's it does not appear that SVOCs at AOC 28 are present at concentrations that would pose a significant risk to the identified receptor groups. Therefore, the elevated detection limits for sample 003-SB-028-01 do not result in significant uncertainty in the risk assessment.

AOC 46 was a dry well located in the heat treat area. Detection limits were normal for sample 003-SB-046-01 and its duplicate 003-SB-DP1-08 which was collected at a depth of 0 to 4 feet. No SVOCs were detected in sample 003-SB-046-01 and phenol (54 J µg/kg) was the only SVOC detected in sample 003-SB-DP1-08. Detection limits were elevated for sample 003-SB-046-03 which was collected at a depth of 8 to 12 feet. No SVOCs were detected in sample 003-SB-046-03 but detection limits for all SVOCs exceeded their respective SRVs. It appears that the potential SVOC contamination at AOC 46 is confined to the subsurface soil since phenol was the only SVOC detected in surface soil. Since the industrial worker is only exposed to surface soil and the minor construction worker is only exposed to soil to a depth of 4 feet, the elevated detection limits for sample 003-SB-046-03 does not result in any uncertainty for these receptors. The major construction worker is exposed to subsurface soil to a depth of 12 feet,

therefore, the elevated detection limits for sample 003-SB-046-03 may result in an underestimation of risk for the major construction worker.

As discussed in Section 4.1, VOCs exceeded the reported detection limits at two locations (SB-01/TW-01 and SB-07) in soils from greater than 12 feet depth. No potential exposure pathways were identified for soils below 12 feet deep, therefore the elevated detection limits for these two samples do not results in any uncertainty in the human health risk assessment. Soil samples SB-01/TW-01 and SB-07 were collected from within the former East Plating Shop. Both of these samples were collected at a depth of 14 to 16 feet. Groundwater at the East Plating Shop is encounter at a depth of approximately 15 feet. The boring logs for both of these samples describe them as being "moist". In addition a temporary monitoring well was install at SB-01/TW-01 and screened at a depth of 13.5 to 23.5 feet. This suggests that these samples may have been collected from within the water table and therefore are more representative of groundwater contamination than soil contamination.

The results of the comparison of reported detection limits to groundwater criteria are presented in Tables 4-9 to 4-14. As discussed in Section 4.1, 24 VOCs in shallow groundwater had reported detection limits which exceeded MPCA screening criteria. Eight of these 24 VOCs were identified as COCs in the human health risk assessment (1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCA, ethylbenzene, methylene chloride, PCE, and vinyl chloride). The VOC exceedances were generally attributed to the analysis protocol requiring sample dilutions in order to obtain usable data within the calibrated range for TCE, which historical sampling has identified as the major COC in groundwater at the site. The reported detection limits for TCE were less than the MPCA groundwater criteria in all non-detected samples. The cumulative cancer risk for exposure to shallow groundwater was 5×10^{-2} which exceeds MPCA and EPA acceptable risk levels. TCE was the major contributors to the estimated cancer risk. Consequently, the elevated detection limits for VOCs do not results in any significant uncertainty in the conclusions of the risk assessment.

Vinyl chloride was the only VOC with a reported detection limit (0.3 µg/L) which exceeded the MPCA screening criteria (0.2 µg/L) in groundwater samples from the intermediate and deep aquifers. This does not significantly effect the conclusions of the risk assessment since vinyl chloride was retained as a COC in both the intermediate and deep aquifers.

Seventeen SVOCs in the shallow aquifer, 8 SVOCs in the intermediate aquifer, and 14 SVOCs in the deep aquifer had reported detection limits which exceeded MPCA groundwater criteria. As discussed in Section 4.1, the exceedances were attributable to an inherent limitation of detection limits when using GC/MS low

concentration methods. The impact of these exceedances is not expected to be significant for groundwater because SVOCs were not detected or prevalent at notable levels in soil.

Six inorganics (aluminum, antimony, beryllium, cadmium, iron, and manganese) in the shallow aquifer, 3 inorganics (antimony, beryllium, and thallium) in the intermediate and deep aquifers in the deep aquifer had report detection limits which exceeded MPCA groundwater criteria. Concentrations of antimony, beryllium, cadmium, and thallium were low or non-detect in soil samples indicating that a potential source area for these inorganics do not exist. Also these inorganics were detected in frequently in groundwater. Iron and aluminum were detected frequently in groundwater so there is not likely to be a significant data gap resulting from the reported detection limit for these compounds exceeding MPCA groundwater criteria.

6.6.3 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises for the methods used to determine land use conditions, calculate exposure point concentrations, select receptors, and select exposure parameters. Each of these is discussed below.

Determination of Land Use.

The current land use patterns are known and expected future land use patterns are expected to remain industrial in the future. Therefore there is little uncertainty associated with the determination of land use.

Calculation of Exposure Point Concentrations.

The exposure point concentrations for COPCs evaluated for the major infrequent construction worker are based on the maximum detected chemical concentration in surface and subsurface soil. Risks based on the maximum detected concentrations assume that the construction worker is only exposed to the highest concentrations the entire time they are at the site regardless of where the samples are located. For example, arsenic, copper, chromium, and mercury were identified as the major contributors to the HI calculated for the major construction worker. The maximum detected arsenic concentration occurred at boring SB-71, which is located in the outdoor tank area in the northeast quadrant of the site. The maximum concentration of copper occurred at boring SB-35 in the southeast quadrant of the site. The maximum detected concentration of total chromium occurred at boring SB-02 located in the former East Plating Shop in the southwest quadrant of the site. It is very unlikely that a construction worker would be exposed to all three locations during excavation activities at the site. Consequently, the use of the

maximum detected concentration as the exposure point concentration for the major infrequent construction worker may result in an over estimation of the risk.

Exposure Routes and Receptor Identification.

Since the future use of the site is expected to remain industrial, the exposure routes and receptor groups were fairly well defined. In this report, an attempt was made to simplify the various groups identified, as well as to determine a single set of exposure parameters to apply to each group. The exposure routes identified for receptors in this risk assessment are fairly conservative. For example, the exposure routes identified for the industrial worker assume that the entire foundation for the buildings has been removed, which is very unlikely to occur. Therefore the exposure routes identified for the receptors evaluated in this risk assessment most likely overestimate the risks.

Selection of Exposure Parameters.

Each exposure factor selected for use in this risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, the MPCA and EPA guidelines were used, which generally consist of the 95th percentile for most parameters. Therefore, the selected values represent the upper bound of the observed or expected habits of the majority of the population.

6.6.4 Uncertainty in the Toxicological Evaluation

The toxicological data used as the basis for all risk assessments contain uncertainty in the following areas:

- Nonthreshold (carcinogenic) effects are extrapolated from the high doses administered to laboratory animals to the low doses received under more common human exposure scenarios.

- Results of laboratory animal studies are extrapolated to human or environmental receptors.

- There is considerable interspecies variation in toxicological endpoints used in characterizing potential health effects resulting from exposure to a chemical.

- There is considerable variability in sensitivity among individuals of any particular species.

- Short-time toxicological studies are used to predict long-term effects.

The lack of dermal toxicity values for chemicals is another source of uncertainty in the risk assessment. EPA's draft supplemental dermal guidance states that the lack of dermal toxicity values is considered to be a significant gap in the evaluation of the dermal pathway, particularly for carcinogenic PAHs. The draft EPA's draft supplemental guidance also states that the statement in RAGS claiming that "it is inappropriate to use the oral slope factor to evaluate the risks associated with exposure to carcinogens such as benzo(a)pyrene, which causes skin cancer through direct action at the point of application" should not be interpreted to mean that the systemic effects from exposure to dermally active chemicals should not be evaluated. EPA's new draft supplemental dermal guidance recommends using the oral toxicity values to evaluate dermal exposures for PAHs. MPCA guidance recommends adjusting the oral toxicity values for PAHs by dividing by 0.8 for the purposes of evaluating dermal exposures. Consequently MPCA's methodology will results in higher risks from exposures to PAHs than EPA's methodology. Overall this does not introduce any uncertainty in the risk assessment since PAHs were not identified as COCs.

6.6.5 Uncertainty in the Risk Characterization

Uncertainty in risk characterization results primarily from assumptions made regarding additivity of effects from exposure to multiple compounds from various exposure routes. High uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity is made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, this uncertainty cannot be discussed for its impact on the risk assessment since it may either underestimate or overestimate potential human health risk.

TABLE 6-1

CHEMICALS OF POTENTIAL CONCERN (COPCs)
NIROP FRIDLEY, MINNESOTA

Chemical	Surface Soil (<4 Feet)	Subsurface Soil (4 to 12 Feet)	Subsurface Soil (>12 Feet)	Shallow Groundwater	Intermediate Groundwater	Deep Groundwater
Volatile Organic Compounds						
1,1,1-Trichloroethane	X	X	X	X		
1,1,2-Trichloroethane		X		X		
1,1-Dichloroethane	X	X	X	X	X	X
1,1-Dichloroethene				X	X	X
1,2-Dichloroethane				X	X	
1,2-Dichloroethene (total)	X	X	X	X		
2-Butanone	X	X	X	X		
2-Hexanone	X	X	X			
4-Methyl-2-pentanone	X	X	X			
Acetone	X	X	X	X		
Benzene		X		X		
Bromomethane	X	X				
Carbon Disulfide	X	X	X	X		
Chlorobenzene			X			
Chloroform				X		
Chloromethane			X	X	X	X
cis-1,2-dichloroethene				X	X	X
Ethylbenzene	X	X	X	X	X	
Methylene Chloride				X		
Styrene	X	X	X			
Tetrachloroethene	X	X	X	X	X	X
Toluene	X	X	X	X	X	X
Trans-1,2-dichloroethene				X	X	X
Trichloroethene	X	X	X	X	X	X
Vinyl Chloride				X	X	
Xylenes, Total	X	X	X	X	X	
Semivolatile Organic Compounds						
2,4-Dimethylphenol				X		
2-Methylnaphthalene	X	X		X		
2-Methylphenol				X		
4-Chloro-3-methylphenol		X		X		
4-Methylphenol			X	X		
Acenaphthene	X	X				
Acenaphthylene	X	X				
Anthracene	X	X				
Benzo(a)anthracene	X	X				
Benzo(a)pyrene	X	X				
Benzo(b)fluoranthene	X	X				
Benzo(g,h,i)perylene	X	X				
Benzo(k)fluoranthene	X	X				
Bis(2-Ethylhexyl)phthalate	X	X	X	X		
Butylbenzyl Phthalate	X	X		X		
Carbazole	X	X				
Chrysene	X	X				
Di-n-butyl phthalate	X	X	X	X		X
Di-n-octyl phthalate	X	X		X		
Diethyl Phthalate				X		
Dibenzo(a,h)anthracene	X	X				
Dibenzofuran	X	X				
Fluoranthene	X	X				
Fluorene	X	X				
Indeno(1,2,3-cd)pyrene	X	X				
Naphthalene	X	X		X		
Pentachlorophenol		X		X		
Phenanthrene	X	X				
Phenol	X	X		X	X	

TABLE 6-1

CHEMICALS OF POTENTIAL CONCERN (COPCs)
NIROP FRIDLEY, MINNESOTA

Chemical	Surface Soil (<4 Feet)	Subsurface Soil (4 to 12 Feet)	Subsurface Soil (>12 Feet)	Shallow Groundwater	Intermediate Groundwater	Deep Groundwater
Pyrene	X	X				
Polychlorinated Biphenyls						
Aroclor-1016	X					
Aroclor-1254	X					
Inorganics						
Aluminum	X	X	X	X	X	X
Antimony	X					
Arsenic	X	X	X	X	X	
Barium	X	X	X	X	X	X
Beryllium	X	X	X	X		
Cadmium	X	X				
Calcium	X	X	X	X	X	X
Chromium	X	X	X	X	X	X
Cobalt	X	X	X	X		
Copper	X	X	X	X	X	
Cyanide	X	X	X	X	X	X
Hexavalent Chromium	X					
Iron	X	X	X	X	X	X
Lead	X	X	X	X		X
Manganese	X	X	X	X	X	X
Manganese	X	X	X	X	X	X
Mercury	X	X		X	X	
Nickel	X	X	X	X	X	
Potassium	X	X	X	X	X	X
Selenium	X	X		X		
Sodium	X	X	X	X	X	X
Thallium	X			X		
Vanadium	X	X	X	X	X	
Zinc	X	X	X	X	X	X

Notes:
In accordance with MPCA guidance any chemical detected in at least one sample is considered a COPC.
An X indicates that the chemical was retained as a chemical of potential concern.

TABLE 6-2

CANCER SLOPE FACTORS[1]
NIROP FRIDLEY, MINNESOTA
PAGE 1 OF 3

Chemical	Dermal Absorption Factor	Gastrointestinal Absorption Factor	Cancer Slope Factor		Inhalation Unit Risk $(ug/m^3)^{-1}$	Weight of Evidence
			Oral $(mg/kg\text{-}day)^{-1}$	Dermal $(mg/kg\text{-}day)^{-1}$		
Volatile Organic Compounds						
1,1,1-Trichloroethane	0.05	0.9	NA	NA	NA	NA
1,1-Dichloroethane	0.05	0.9	5.7E-03	6.3E-03	1.6E-06	C
1,2-Dichloroethene (Total)	0.05	0.9	NA	NA	NA	D
2-Butanone	0.1	0.9	NA	NA	NA	D
2-Hexanone	NA	NA	NA	NA	NA	NA
Acetone	0.1	0.9	NA	NA	NA	D
Benzene	0.01	0.9	2.9E-02	3.2E-02	8.3E-06	A
Bromomethane	0.05	0.9	NA	NA	NA	NA
Carbon Disulfide	0.05	0.9	NA	NA	NA	NA
Chlorobenzene	0.05	0.9	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	B2
Chloromethane	NA	NA	NA	NA	NA	NA
Ethylbenzene	0.05	0.85	NA	NA	NA	D
Methylene Chloride	0.05	0.9	7.0E-03	7.8E-03	4.7E-07	B2
Styrene	0.05	0.9	3.0E-02	3.3E-02	5.7E-07	B2
Tetrachloroethene	0.05	0.9	5.2E-02	5.8E-02	5.8E-08	B2/C
Toluene	0.05	0.9	NA	NA	NA	D
Trichloroethene	0.05	0.9	1.1E-02	1.2E-02	1.7E-06	B2/C
Vinyl Chloride	NA	NA	NA	NA	NA	A
Xylenes (Total)	0.05	0.9	NA	NA	NA	D
Semivolatile Organic Compounds						
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA
4-Chloro-3-Methylphenol	NA	NA	NA	NA	NA	NA
4-Methyl-2-Pentanone	0.05	0.9	NA	NA	NA	NA
Acenaphthene	0.05	0.8	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA	NA
Anthracene	0.1	0.8	NA	NA	NA	D

TABLE 6-2

CANCER SLOPE FACTORS[1]
NIROP FRIDLEY, MINNESOTA

Chemical	Dermal Absorption Factor	Gastrointestinal Absorption Factor	Cancer Slope Factor		Inhalation Unit Risk	Weight of Evidence
			Oral $(mg/kg\text{-}day)^{-1}$	Dermal $(mg/kg\text{-}day)^{-1}$	$(ug/m^3)^{-1}$	
Benzo(a)anthracene	0.13	0.8	7.3E-01	9.1E-01	1.7E-04	B2
Benzo(a)pyrene	0.13	0.8	7.3E+00	9.1E+00	1.7E-03	B2
Benzo(b)fluoranthene	0.13	0.8	7.3E-01	9.1E-01	1.7E-04	B2
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	0.13	0.8	7.3E-02	9.1E-02	1.7E-05	B2
Bis(2-ethylhexyl)phthalate	0.05	0.7	1.4E-02	2.0E-02	4.0E-06	B2
Butylbenzyl phthalate	0.1	0.9	NA	NA	NA	NA
Carbazole	0.1	0.9	2.0E-02	NA	NA	NA
Chrysene	0.13	0.8	7.3E-03	9.1E-03	1.7E-06	B2
di-n-Butyl Phthalate	0.1	0.9	NA	NA	NA	D
di-n-Octyl Phthalate	0.1	0.9	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.13	0.8	7.3E+00	9.1E+00	1.7E-03	B2
Dibenzofuran	0.1	0.9	NA	NA	NA	NA
Diethyl Phthalate	NA	NA	NA	NA	NA	NA
Fluoranthene	0.13	0.8	NA	NA	NA	NA
Fluorene	0.1	0.8	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.13	0.8	7.3E-01	9.1E-01	1.7E-04	B2
Naphthalene	0.05	0.8	NA	NA	NA	NA
Pentachlorophenol	0.25	0.9	1.2E-01	1.3E-01	3.4E-05	B2
Phenanthrene	NA	NA	NA	NA	NA	NA
Phenol	0.8	0.9	NA	NA	NA	D
Pyrene	0.1	0.8	NA	NA	NA	D
PCBs						
Aroclor-1016	0.15	0.9	2.0E+00	2.2E+00	2.2E-03	B2
Aroclor-1254	0.15	0.9	2.0E+00	2.2E+00	2.2E-03	B2
Metals						
Aluminum	0.001	0.01	NA	NA	NA	NA
Antimony	0.001	0.05	NA	NA	NA	D
Arsenic	0.03	0.9	1.5E+00	1.7E+00	4.0E-03	A
Barium	0.001	0.05	NA	NA	NA	D

TABLE 6-2

CANCER SLOPE FACTORS[1]
NIROP FRIDLEY, MINNESOTA

Chemical	Dermal Absorption Factor	Gastrointestinal Absorption Factor	Cancer Slope Factor		Inhalation Unit Risk $(ug/m^3)^{-1}$	Weight of Evidence
			Oral $(mg/kg\text{-}day)^{-1}$	Dermal $(mg/kg\text{-}day)^{-1}$		
Beryllium	0.001	0.01	NA	NA	2.4E-03	B2
Cadmium	0.01	1	NA	NA	1.8E-03	B1
Calcium	NA	NA	NA	NA	NA	NA
Chromium III	0.01	0.05	NA	NA	NA	NA
Chromium VI	0.01	0.05	NA	NA	1.2E-02	A
Cobalt	0.01	0.5	NA	NA	NA	NA
Copper	0.01	0.6	NA	NA	NA	D
Cyanide	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	B2
Magnesium	NA	NA	NA	NA	NA	NA
Manganese	0.001	0.05	NA	NA	NA	D
Mercury (inorganic)	0.05	0.2	NA	NA	NA	D
Nickel	0.01	0.05	NA	NA	4.8E-04	D
Potassium	NA	NA	NA	NA	NA	NA
Selenium	0.01	0.9	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA
Thallium	0.01	0.9	NA	NA	NA	NA
Vanadium	0.01	0.1	NA	NA	NA	D
Zinc	0.01	0.3	NA	NA	NA	D

Notes:
1 - MPCA, 1998b.
NA - Not available.
Cancer Class:
Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Group D - Not Classifiable

TABLE 6-3

REFERENCE DOSES[1]
NIROP FRIDLEY, MINNESOTA
PAGE 1 OF 2

Chemical	Absorption Factor	Gastrointestinal Absorption Factor	Subchronic Toxicity Criteria			Chronic Toxicity Criteria			Target Organ for Noncarcinogenic Effect (2)
			Reference Dose		Inhalation RfC	Reference Dose		Inhalation RfC	
			Oral (mg/kg-day)	Dermal (mg/kg-day)	(mg/m^3)	Oral (mg/kg-day)	Dermal (mg/kg-day)	(mg/m^3)	
Volatile Organic Compounds									
1,1,1-Trichloroethane	0.05	0.9	NA	NA	4.0E+00	3.5E-02	3.2E-02	1.0E+00	CNS/PNS; LIV/GI
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	CV/BLD; IMMUNE; LIV/GI; CANCER
1,1-Dichloroethane	0.05	0.9	1.0E+00	9.0E-01	5.0E+00	1.0E-01	9.0E-02	5.0E-01	KIDN; CANCER
1,2-Dichloroethene (Total)	0.05	0.9	9.0E-03	8.1E-03	8.0E-01	9.0E-03	8.1E-03	3.5E-02	LIV\GI
2-Butanone	0.1	0.9	2.0E+00	1.8E+00	1.0E+00	6.0E-01	5.4E-01	1.0E+00	REPROD
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Acetone	0.1	0.9	1.0E+00	9.0E-01	3.1E+01	1.0E-01	9.0E-02	3.5E-01	CNS/PNS; KID; LIV/GI
Benzene	0.01	0.9	NA	NA	6.0E-02	NA	NA	6.0E-03	CV/BLD; CANCER
Bromomethane	0.05	0.9	3.0E-03	2.7E-03	2.0E-01	1.4E-03	1.3E-03	5.0E-03	LIV/GI; RESP
Carbon Disulfide	0.05	0.9	1.0E-01	9.0E-02	7.0E-01	1.0E-01	9.0E-02	7.0E-01	CNS/PNS; REPROD
Chlorobenzene	0.05	0.9	4.0E-01	3.6E-01	2.0E-01	2.0E-02	1.8E-02	2.0E-02	KIDN; LIV/GI
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	REPROD
Chloroform	NA	NA	NA	NA	NA	NA	NA	NA	LIV/GI; CANCER
Chloromethane	NA	NA	NA	NA	NA	NA	NA	NA	WHOLE BODY; CANCER (?)
Ethylbenzene	0.05	0.85	NA	NA	1.3E+00	1.0E-01	8.5E-02	1.0E+00	KIDN; LIV/GI; REPROD
Methylene Chloride	0.05	0.9	6.0E-02	5.4E-02	1.0E-01	6.0E-02	5.4E-02	3.0E+00	LIV/GI; CANCER
Styrene	0.05	0.9	NA	NA	3.0E+00	2.0E-01	1.8E-01	2.0E-01	CV/BLD; CNS/PNS; LIV/GI; CANCER
Tetrachloroethene	0.05	0.9	1.0E-01	9.0E-02	NA	1.0E-02	9.0E-03	4.0E-01	CNS/PNS; KIDN; LIV/GI; CANCER
Toluene	0.05	0.9	2.0E+00	1.8E+00	1.0E+00	2.0E-01	1.8E-01	4.0E-01	CNS/PNS; KIDN; LIV/GI; RESP
Trichloroethene	0.05	0.9	2.0E-03	1.8E-03	5.0E-01	NA	NA	NA	CANCER
Xylenes (Total)	0.05	0.9	2.0E-01	1.8E-01	3.0E+00	2.0E+00	1.8E+00	3.0E-01	CNS/PNS; RESP; WHOLE BODY
Semivolatile Organic Compounds									
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	NA	NA	CV/BLD; CNS/PNS
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	Not available
4-Chloro-3-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	Not available
4-Methyl-2-Pentanone	0.05	0.9	8.0E-01	NA	8.0E-01	8.0E-02	NA	8.0E-02	Not available
Acenaphthene	0.05	0.8	6.0E-01	4.8E-01	NA	6.0E-02	4.8E-02	2.1E-01	LIV/GI
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Anthracene	0.1	0.8	3.0E+00	2.4E+00	NA	3.0E-01	2.4E-01	NA	NOT AVAILABLE
Benzo(a)anthracene	0.13	0.8	NA	NA	NA	NA	NA	NA	CANCER
Benzo(a)pyrene	0.13	0.8	NA	NA	NA	NA	NA	NA	CANCER
Benzo(b)fluoranthene	0.13	0.8	NA	NA	NA	NA	NA	NA	CANCER
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Benzo(k)fluoranthene	0.13	0.8	NA	NA	NA	NA	NA	NA	CANCER
Bis(2-ethylhexyl)phthalate	0.05	0.7	NA	NA	NA	2.0E-02	1.4E-02	NA	LIV/GI; CANCER
Butylbenzyl phthalate	0.1	0.9	2.0E+00	1.8E+00	NA	2.0E-01	1.8E-01	NA	LIV/GI
Carbazole	0.1	0.9	NA	NA	NA	NA	NA	NA	Not available
Chrysene	0.13	0.8	NA	NA	0.0E+00	NA	NA	NA	CANCER
di-n-Butyl Phthalate	0.1	0.9	1.0E+00	9.0E-01	NA	1.0E-01	9.0E-02	NA	WHOLE BODY
di-n-Octyl Phthalate	0.1	0.9	2.0E-02	1.8E-02	NA	2.0E-02	1.8E-02	NA	KIDN; LIV/GI
Dibenzo(a,h)anthracene	0.13	0.8	NA	NA	NA	NA	NA	NA	CANCER
Dibenzofuran	0.1	0.9	NA	NA	NA	4.0E-03	3.6E-03	NA	Not available

TABLE 6-3

REFERENCE DOSES[1]
NIROP FRIDLEY, MINNESOTA

Chemical	Absorption Factor	Gastrointestinal Absorption Factor	Subchronic Toxicity Criteria			Chronic Toxicity Criteria			Target Organ for Noncarcinogenic Effect (2)
			Reference Dose		Inhalation RfC	Reference Dose		Inhalation RfC	
			Oral (mg/kg-day)	Dermal (mg/kg-day)	(mg/m^3)	Oral (mg/kg-day)	Dermal (mg/kg-day)	(mg/m^3)	
Fluoranthene	0.13	0.8	4.0E-01	3.2E-01	NA	4.0E-02	3.2E-02	NA	CV/BLD; KIDN; LIV/GI
Fluorene	0.1	0.8	4.0E-01	3.2E-01	NA	4.0E-02	3.2E-02	1.4E-01	CV/BLD
Indeno(1,2,3-cd)pyrene	0.13	0.8	NA	NA	NA	NA	NA	NA	CANCER
Naphthalene	0.05	0.8	2.0E-02	1.6E-02	4.0E-01	4.0E-02	3.2E-02	1.0E-03	CV/BLD; EYE; RESP
Pentachlorophenol	0.25	0.9	3.0E-02	2.7E-02	NA	3.0E-02	2.7E-02	2.0E-04	KIDN; LIV/GI; CANCER
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Phenol	0.8	0.9	6.0E-01	5.4E-01	NA	6.0E-01	5.4E-01	NA	REPRO
Pyrene	0.1	0.8	3.0E-01	2.4E-01	NA	3.0E-02	2.4E-02	1.1E-01	KIDN
Polychlorinated biphenyls									
Aroclor-1016	0.15	0.9	5.0E-05	4.5E-05	NA	2.0E-05	1.8E-05	NA	EYE; IMMUNE; REPROD; CANCER
Aroclor-1254	0.15	0.9	5.0E-05	4.5E-05	NA	2.0E-05	1.8E-05	NA	EYE; IMMUNE; REPROD; CANCER
Metals									
Aluminum	0.001	0.01	NA	NA	NA	1.0E+00	1.0E-02	NA	CNS/PNS/REPROD
Antimony	0.001	0.05	4.0E-04	2.0E-05	2.0E-04	4.0E-04	2.0E-05	2.0E-04	CV/BLD; WHOLE BODY
Arsenic	0.03	0.9	3.0E-04	2.7E-04	NA	3.0E-04	2.7E-04	5.0E-04	CV/BLD; CNS/PNS; SKIN; CANCER
Barium	0.001	0.05	7.0E-02	3.5E-03	5.0E-03	7.0E-02	3.5E-03	5.0E-04	CB/BLD; REPROD
Beryllium	0.001	0.01	5.0E-03	5.0E-05	NA	2.0E-03	5.0E-05	4.8E-06	Not available; CANCER
Cadmium	0.01	1	NA	NA	NA	1.0E-03	1.0E-03	2.0E-04	KIDN; CANCER
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Chromium III	0.01	0.05	1.0E+00	5.0E-02	NA	1.0E+00	5.0E-02	NA	Not available
Chromium VI	0.01	0.05	2.0E-02	1.0E-03	2.0E-05	5.0E-03	2.5E-04	2.0E-06	Not available; CANCER
Cobalt	0.01	0.5	NA	NA	3.0E-05	6.0E-02	3.0E-02	1.0E-03	CV/BLD; IMMUN; RESP
Copper	0.01	0.6	3.7E-02	2.2E-02	NA	3.7E-02	2.2E-02	NA	LIV/GI
Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	CNS/PNS; THYROID; WHOLE BODY
Iron	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Lead	NA	NA	NA	NA	NA	NA	NA	NA	CV/BLD; CNS/PNS; REPRO; CANCER
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Manganese	0.001	0.05	1.4E-01	7.0E-03	NA	4.7E-02	2.4E-03	5.0E-05	CNS/PNS
Mercury (inorganic)	0.05	0.2	3.0E-03	6.0E-04	3.0E-04	3.0E-04	6.0E-05	3.0E-04	CNS/PNS; IMMUNE
Nickel	0.01	0.05	2.0E-02	1.0E-03	NA	2.0E-02	1.0E-03	NA	WHOLE BODY; CANCER
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Selenium	0.01	0.9	5.0E-03	4.5E-03	NA	5.0E-03	4.5E-03	NA	CV/BLD; CNS/PNS; LIV/GI; SKIN
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	Not available
Thallium	0.01	0.9	8.0E-04	7.2E-04	NA	8.0E-05	7.2E-05	NA	CV/BLD; HAIR; REPROD
Vanadium	0.01	0.1	7.0E-03	7.0E-04	NA	7.0E-03	7.0E-04	NA	Not available
Zinc	0.01	0.3	3.0E-01	9.0E-02	NA	3.0E-01	9.0E-02	NA	CV/BLD

Notes:

1 - MPCA, 1998b,

2 - ADREN - adrenal; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; WHOLE BODY - increased mortality, decreased growth rate, etc.

RfC - Reference concentration.

TABLE 6-4

EXPOSURE SCENARIOS
NIROP FRIDLEY, MINNESOTA
PAGE 1 OF 3

Utilization of Site and Adjoining Areas	Environmental Media	Route of Exposure	Example of Exposure	Exposure Model Assumptions[1]	Comments/References
The NIROP Fridley facility is an industrial facility. The reasonably anticipated future land use for the property underlying the NIROP facility is also industrial.	Soils	Ingestion	Incidental ingestion while eating or smoking.	• Soil intake rate (IR) - Typical adult worker - 100 mg/day - Major Infrequent Construction worker - 480 mg/day - Minor Frequent Construction worker - 200 mg/day • Exposure Frequency (EF) - Typical adult worker - 250 days/year - Major Infrequent Construction Worker - 78 days/year - Minor Frequent Construction Worker - 80 days/year • Exposure Duration (ED) - Typical adult worker - 25 years - Major Infrequent Construction worker - 0.25 year - Minor Frequent Construction worker - 25 years • Body Weight (BW) - Adult - 70 kg • Fraction Ingested from Contaminated Area - Worker - 1.0 • AT - Carcinogens - 25,500 days - Noncarcinogens Major Infrequent Construction Worker - 91 days Minor Frequent Construction Worker - 9,125 days	• Exposure assumptions per MPCA guidance except that the ingestion rate for the minor frequent construction worker is based on professional judgment. The exposure frequency for the minor frequent construction worker is based on NIROP- specific information.

TABLE 6-4

EXPOSURE SCENARIOS
NIROP FRIDLEY, MINNESOTA

Utilization of Site and Adjoining Areas	Environmental Media	Route of Exposure	Example of Exposure	Exposure Model Assumptions[1]	Comments/References
(Continued)		Dermal Contact	Dermal Contact with soils/dust while working.	• Skin Surface Area (SA) - Typical adult worker - 3,000 cm^2 - Construction workers - 4,900 cm^2 • Adherence factor of soil to skin (AF) - 0.3 mg/cm^2-event • EF - Typical adult worker - 90 days/year - Major Infrequent Construction Worker - 78 days/year - Minor Frequent Construction Worker - 80 days/year • ED - Typical adult worker - 25 years - Major Infrequent Construction Worker - - 0.25 year - Minor Frequent Construction Worker - - 25 years • BW - Adult - 70 kg • AT - Carcinogens - 25,500 days - Noncarcinogens Major Infrequent Construction Worker - 91 days Minor Frequent Construction Worker - 9,125 days	• Exposure assumptions per MPCA guidance except that the exposure frequency for the minor frequent worker is based on NIROP specific conditions. Chemical absorption factors will be chemical specific.

TABLE 6-4

EXPOSURE SCENARIOS
NIROP FRIDLEY, MINNESOTA
PAGE 3 OF 3

Utilization of Site and Adjoining Areas	Environmental Media	Route of Exposure	Example of Exposure	Exposure Model Assumptions[1]	Comments/References
(Continued)	Soils (Continued)	Inhalation	Inhalation of volatile organics and particulates emitted from soils.	• Inhalation Rate (IR) - Typical adult worker - 20 m^3 - Construction workers - 20 m^3 • EF - Typical adult worker - 250 days/year - Major Infrequent Construction Worker - 78 days/year - Minor Frequent Construction Worker - 80 days/year • ED - Typical adult worker - 25 years - Major Infrequent Construction Worker - 0.25 year - Minor Frequent Construction Worker - 25 years • BW - Adult - 70 kg • Volatilization Factor - Chemical and site specific • Particulate Emission Factor - Chemical and site specific • AT - Carcinogens - 25,500 days - Noncarcinogens Major Infrequent Construction Worker - 91 days Minor Frequent Construction Worker - 9125 days	• Exposure assumptions per MPCA guidance except that the exposure frequency for the NIROP worker is based on NIROP specific conditions.

1 MPCA, 1998b.

TABLE 6-5

EXPOSURE POINT CONCENTRATIONS FOR INDUSTRIAL WORKERS AND MINOR FREQUENT CONSTRUCTION WORKERS
NIROP FRIDLEY, MINNESOTA

Parameter	Units	Frequency of Detection	Average Concentration	W Statistic Normal Distribution	W Statistic Lognormal Distribution	W TEST	UCL Normal Distribution	UCL Lognormal Distribution	Maximum Detected Concentration	Distribution (1)	Exposure Point Concentration (2)
Volatile Organic Compounds											
1,1,1-Trichloroethane	µg/kg	3/61	26.5	0.7557	0.7927	0.9820	31.3	44.7	28.0	Undefined	28.0
1,1-Dichloroethane	µg/kg	1/61	26.2	0.7308	0.7294	0.9820	31.1	40.0	5.50	Undefined	5.50
1,2-Dichloroethene (Total)	µg/kg	4/61	26.5	0.7470	0.7655	0.9820	31.3	40.3	15.0	Undefined	15.0
2-Butanone	µg/kg	36/61	36.8	0.7007	0.9123	0.9820	46.9	70.9	210	Undefined	70.9
2-Hexanone	µg/kg	3/61	25.6	0.7509	0.7930	0.9820	30.5	42.5	26.0	Undefined	26.0
4-Methyl-2-Pentanone	µg/kg	34/61	28.1	0.8091	0.9260	0.9820	34.5	54.2	120	Undefined	54.2
Acetone	µg/kg	30/61	119	0.6312	0.9767	0.9820	158	226	960	Undefined	226
Bromomethane	µg/kg	1/61	26.2	0.7367	0.7561	0.9820	31.1	40.7	2.00	Undefined	2.00
Carbon Disulfide	µg/kg	8/61	24.1	0.7407	0.8305	0.9820	29.0	44.3	13.0	Undefined	13.0
Ethylbenzene	µg/kg	5/61	24.5	0.7378	0.8057	0.9820	29.4	40.6	19.0	Undefined	19.0
Styrene	µg/kg	4/61	25.9	0.7375	0.7498	0.9820	30.7	39.2	54.0	Undefined	39.2
Tetrachloroethene	µg/kg	9/61	27.4	0.7872	0.8427	0.9820	32.6	51.6	90.0	Undefined	51.6
Toluene	µg/kg	25/61	17.4	0.7100	0.8948	0.9820	21.9	34.1	14.0	Undefined	14.0
Trichloroethene	µg/kg	24/61	40.0	0.5418	0.9202	0.9820	52.5	82.4	640	Undefined	82.4
Xylenes, Total	µg/kg	23/61	20.5	0.7441	0.8873	0.9820	25.2	38.0	71.0	Undefined	38.0
Semivolatile Organic Compounds											
2-Methylnaphthalene	µg/kg	4/55	184	0.1989	0.3157	0.9800	210	209	1000	Undefined	209
Acenaphthene	µg/kg	8/55	174	0.4588	0.4881	0.9800	193	224	650	Undefined	224
Acenaphthylene	µg/kg	2/55	212	0.1851	0.3169	0.9800	263	228	760	Undefined	228
Anthracene	µg/kg	9/53	175	0.4640	0.5815	0.9800	198	214	640	Undefined	214
Benzo(a)anthracene	µg/kg	14/53	300	0.2830	0.6289	0.9800	440	340	3500	Undefined	340
Benzo(a)pyrene	µg/kg	13/53	238	0.3235	0.6358	0.9800	319	281	1700	Undefined	281
Benzo(b)fluoranthene	µg/kg	13/53	291	0.2737	0.6053	0.9800	424	318	3600	Undefined	318
Benzo(g,h,i)perylene	µg/kg	13/53	199	0.3463	0.6954	0.9800	257	264	820	Undefined	264
Benzo(k)fluoranthene	µg/kg	14/53	214	0.3535	0.6935	0.9800	281	270	1300	Undefined	270
Bis(2-ethylhexyl)phthalate	µg/kg	10/53	350	0.1381	0.6345	0.9800	646	325	1200	Undefined	325
Butylbenzyl Phthalate	µg/kg	1/53	202	0.1338	0.2554	0.9800	252	219	16.0	Undefined	16.0
Carbazole	µg/kg	7/53	202	0.2595	0.5488	0.9800	254	247	530	Undefined	247
Chrysene	µg/kg	15/53	238	0.3310	0.6549	0.9800	321	306	1700	Undefined	306
Di-N-Butyl Phthalate	µg/kg	3/53	197	0.1712	0.3896	0.9800	248	230	28.0	Undefined	28.0
Di-N-Octyl Phthalate	µg/kg	2/53	199	0.1484	0.3131	0.9800	249	223	40.0	Undefined	40.0
Dibenzo(a,h)anthracene	µg/kg	9/53	195	0.2570	0.5928	0.9800	247	238	400	Undefined	238
Dibenzofuran	µg/kg	3/53	203	0.1447	0.2767	0.9800	253	225	250	Undefined	225
Fluoranthene	µg/kg	18/53	368	0.2298	0.7144	0.9800	601	405	5600	Undefined	405
Fluorene	µg/kg	8/53	183	0.4977	0.5439	0.9800	207	243	760	Undefined	243
Indeno(1,2,3-cd)pyrene	µg/kg	12/53	213	0.3398	0.6572	0.9800	276	260	1100	Undefined	260
Naphthalene	µg/kg	2/55	200	0.1361	0.3030	0.9800	248	206	78.0	Undefined	78.0

TABLE 6-5

EXPOSURE POINT CONCENTRATIONS FOR INDUSTRIAL WORKERS AND MINOR FREQUENT CONSTRUCTION WORKERS
NIROP FRIDLEY, MINNESOTA

Parameter	Units	Frequency of Detection	Average Concentration	W Statistic Normal Distribution	W Statistic Lognormal Distribution	W TEST	UCL Normal Distribution	UCL Lognormal Distribution	Maximum Detected Concentration	Distribution (1)	Exposure Point Concentration (2)
Phenanthrene	µg/kg	12/53	365	0.2324	0.5395	0.9800	570	339	5000	Undefined	339
Phenol	µg/kg	2/55	199	0.1399	0.3163	0.9800	248	208	54.0	Undefined	54.0
Pyrene	µg/kg	19/53	324	0.2379	0.7259	0.9800	513	373	4800	Undefined	373
Polychlorinated biphenyls											
Aroclor-1016	µg/kg	1/51	21.3	0.1866	0.2511	0.9800	26.2	22.0	150	Undefined	22
Aroclor-1254	µg/kg	2/51	27.6	0.2222	0.2864	0.9800	38.3	27.0	290	Undefined	27
Inorganics											
Aluminum	mg/kg	55/55	3419	0.9386	0.8777	0.9800	3705	3835	7830	Undefined	3835
Antimony	mg/kg	5/49	2.11	0.6874	0.7821	0.9470	2.36	2.32	3.40	Undefined	2.32
Arsenic	mg/kg	52/55	2.34	0.6798	0.9549	0.9800	2.81	3.08	13.8	Undefined	3.08
Barium	mg/kg	55/55	43.8	0.8099	0.9795	0.9800	52.2	56.4	201	Undefined	56.4
Beryllium	mg/kg	34/55	0.165	0.7282	0.9689	0.9800	0.187	0.186	0.700	Undefined	0.186
Cadmium	mg/kg	3/55	0.253	0.4626	0.6395	0.9800	0.301	0.273	0.750	Undefined	0.273
Calcium	mg/kg	55/55	10632	0.9116	0.9588	0.9800	12480	15437	34100	Undefined	15437
Chromium	mg/kg	55/55	14.5	0.4591	0.7870	0.9800	18.5	15.7	91.0	Undefined	15.7
Hexavalent Chromium	mg/kg	3/27	1.37	0.3464	0.3678	0.9230	1.77	1.55	6.00	Undefined	1.55
Cobalt	mg/kg	52/55	5.33	0.9752	0.8148	0.9800	5.73	6.09	10.4	Undefined	6.09
Copper	mg/kg	50/55	35.3	0.1242	0.8762	0.9800	76.4	24.2	1360	Undefined	24.2
Cyanide	mg/kg	2/55	1.72	0.0979	0.3186	0.9800	4.29	0.377	90.4	Undefined	0.377
Iron	mg/kg	55/55	9474	0.5850	0.9376	0.9800	10991	10576	48400	Undefined	10576
Lead	mg/kg	55/55	26.1	0.2014	0.7860	0.9800	49.2	18.9	733	Undefined	18.9
Magnesium	mg/kg	55/55	4043	0.8793	0.9280	0.9800	4648	5182	14100	Undefined	5182
Manganese	mg/kg	55/55	421	0.7018	0.9892	0.9800	522	591	2490	Lognormal	591
Mercury	mg/kg	9/55	0.034	0.4673	0.6373	0.9800	0.042	0.037	0.190	Undefined	0.037
Nickel	mg/kg	51/55	12.3	0.8529	0.9794	0.9800	13.7	13.8	33.5	Undefined	13.8
Potassium	mg/kg	55/55	346	0.7997	0.9644	0.9800	381	380	1130	Undefined	380
Selenium	mg/kg	1/47	0.167	0.5577	0.7081	0.9460	0.209	0.190	1.05	Undefined	0.19
Sodium	mg/kg	54/55	118	0.8284	0.9727	0.9800	134	136	364	Undefined	136
Thallium	mg/kg	4/53	0.147	0.5823	0.7120	0.9800	0.175	0.164	0.240	Undefined	0.164
Vanadium	mg/kg	55/55	14.0	0.8874	0.8774	0.9800	15.2	15.6	35.6	Undefined	15.6
Zinc	mg/kg	51/55	29.6	0.2219	0.8299	0.9800	43.9	30.0	479	Undefined	30

Notes:

The Shapiro-Wilk W-test (Gilbert, 1987) was used to to determine the distribution of the dataset.

UCL = 95th percentile upper confidence limit on the mean concentration.

1 - The data is consider to be normally distributed if the W statistic for a normal distribution is greater than the W-test statistic and the data is considered to be lognormally distributed if the W statistic for a lognormal distribution is greater than the W-test statistic. If both the W statistic for the normal distribution and lognormal distribution are less than the W-test statistic then the distribution is undefined.

2 - The exposure point concentration is the UCL for a normal distribution if the data is normally distributed or the UCL for a lognormal distribution if the data is lognormally distributed.

TABLE 6-5

EXPOSURE POINT CONCENTRATIONS FOR INDUSTRIAL WORKERS AND MINOR FREQUENT CONSTRUCTION WORKERS
NIROP FRIDLEY, MINNESOTA

Parameter	Units	Frequency of Detection	Average Concentration	W Statistic Normal Distribution	W Statistic Lognormal Distribution	W TEST	UCL Normal Distribution	UCL Lognormal Distribution	Maximum Detected Concentration	Distribution (1)	Exposure Point Concentration (2)

If the distribution is undefined then the UCL for a lognormal distribution is used for the exposure point concentration. If the UCL exceeded the maximum detected concentration then the maximum detected concentration was used as the exposure point concentration.

The following samples were used in the calculation of the exposure point concentration.

003-SB-003-01	003-SB-030-01	003-SB-063-01	003-SB-P08-01
003-SB-004-01-AVG	003-SB-032-01	003-SB-068-01	003-SB-P09-01-AVG
003-SB-006-01	003-SB-033-01	003-SB-070-01	003-SB-P10-01-AVG
003-SB-007-01	003-SB-034-01	003-SB-071-01	003-SB-P11-01-AVG
003-SB-008-01	003-SB-035-01	003-SB-073-01	003-SB-P12-01
003-SB-013-01	003-SB-036-01	003-SB-074-01-AVG	SB-01-0001-AVG
003-SB-015-01-AVG	003-SB-037-01-AVG	003-SB-30D-01	SB-02-0001
003-SB-016-01	003-SB-038-01	003-SB-32D-01	SB-02-0204-AVG
003-SB-017-01	003-SB-039-01	003-SB-P01-01	SB-03-0001
003-SB-018-01	003-SB-046-01-AVG	003-SB-P02-01	SB-04-0001
003-SB-023-01	003-SB-047-01	003-SB-P03-01	SB-05-0001
003-SB-026-01	003-SB-050-01-AVG	003-SB-P04-01	SB-06-0002
003-SB-027-01	003-SB-054-01	003-SB-P05-01	
003-SB-028-01	003-SB-055-01	003-SB-P06-01	
003-SB-029-01	003-SB-058-01-AVG	003-SB-P07-01	

TABLE 6-6

EXPOSURE POINT CONCENTRATIONS
FOR MAJOR INFREQUENT CONSTRUCTION WORKERS
NIROP FRIDLEY, MINNESOTA

Parameter	Maximum Detected Concentration	Location of Maximum
Volatile Organic Compounds (ug/kg)		
1,1,1-Trichloroethane	56	003-SB-058-01
1,1,2-Trichloroethane	9	SB-02-0406
1,1-Dichloroethane	11 J	003-SB-032-03
1,2-Dichloroethene (total)	15000	003-SB-032-03
2-Butanone	210 J	003-SB-29D-01
2-Hexanone	26 J	003-SB-P11-01-D
4-Methyl-2-pentanone	150	003-SB-028-02
Acetone	1700	003-SB-032-03
Benzene	24 J	003-SB-032-03
Bromomethane	2 J	003-SB-054-01
Carbon Disulfide	14	003-SB-054-02
Ethylbenzene	720	003-SB-032-03
Styrene	54 J	003-SB-29D-01
Tetrachloroethene	760	SB-02-0406
Toluene	1000	003-SB-032-03
Trichloroethene	1100	SB-05-1012
Xylenes, Total	7300	003-SB-032-03
Semivolatile Organic Compounds (ug/kg)		
2-Methylnaphthalene	1000 J	003-SB-028-01
4-Chloro-3-methylphenol	11000	003-SB-032-03
Acenaphthene	650 J	003-SB-028-01
Acenaphthylene	760	003-SB-017-01
Anthracene	640	003-SB-017-01
Benzo(a)anthracene	3500	003-SB-P03-01
Benzo(a)pyrene	1700	003-SB-017-01
Benzo(b)fluoranthene	3600	003-SB-P03-01
Benzo(g,h,i)perylene	820	003-SB-P03-01
Benzo(k)fluoranthene	1300	003-SB-017-01
Bis(2-Ethylhexyl)phthalate	4400	SB-02-0406
Butylbenzyl Phthalate	3600 J	003-SB-032-03
Carbazole	530	003-SB-P03-01
Chrysene	1700	003-SB-017-01
Di-n-butyl phthalate	140	SB-02-0406
Di-n-octyl phthalate	84 J	003-SB-030-02
Dibenzo(a,h)anthracene	400	003-SB-017-01
Dibenzofuran	250 J	003-SB-017-01
Fluoranthene	5600	003-SB-017-01
Fluorene	760 J	003-SB-028-01
Indeno(1,2,3-cd)pyrene	1100	003-SB-P03-01
Naphthalene	2300 J	003-SB-032-03

TABLE 6-6

EXPOSURE POINT CONCENTRATIONS
FOR MAJOR INFREQUENT CONSTRUCTION WORKERS
NIROP FRIDLEY, MINNESOTA

Parameter	Maximum Detected Concentration	Location of Maximum
Pentachlorophenol	50 J	003-SB-054-02
Phenanthrene	5000	003-SB-P03-01
Phenol	120 J	003-SB-058-03
Pyrene	4800	003-SB-P03-01
Polychlorinated biphenyls (ug/kg)		
Aroclor-1016	150	003-SB-030-01
Aroclor-1254	290	003-SB-050-01-D
Inorganics (mg/kg)		
Aluminum	7830	003-SB-037-01-D
Antimony	3.4 J	003-SB-017-01
Arsenic	13.8	003-SB-071-01
Barium	201	SB-03-0001
Beryllium	0.7 J	003-SB-058-01
Cadmium	0.75	003-SB-035-01
Calcium	46500 J	003-SB-038-03
Chromium	618	SB-02-0406
Hexavalent Chromium	6	003-SB-035-01
Cobalt	11.4 J	003-SB-P09-03
Copper	1360	003-SB-035-01
Cyanide	148	SB-07-0406
Iron	48400 J	003-SB-017-01
Lead	733 J	003-SB-017-01
Magnesium	20000 J	003-SB-038-03
Manganese	2490	SB-03-0001
Mercury	0.32 J	003-SB-013-02
Nickel	33.5 J	003-SB-035-01
Potassium	1350 J	003-SB-035-02
Selenium	1.3 J	003-SB-058-01
Sodium	487 J	003-SB-068-03
Thallium	0.24 J	003-SB-047-01
Vanadium	35.6 J	003-SB-058-01-D
Zinc	479 J	003-SB-035-01

TABLE 6-6

EXPOSURE POINT CONCENTRATIONS
FOR MAJOR INFREQUENT CONSTRUCTION WORKERS
NIROP FRIDLEY MINNESOTA

Samples used to deteremine the exposure point concentrations were:

003-SB-003-01	003-SB-033-01	003-SB-070-01	003-SB-P09-02
003-SB-003-02	003-SB-033-03	003-SB-070-03	003-SB-P09-03
003-SB-004-01	003-SB-034-01	003-SB-071-01	003-SB-P10-01
003-SB-004-01-D	003-SB-034-03	003-SB-071-03	003-SB-P10-01-D
003-SB-004-03	003-SB-035-01	003-SB-073-01	003-SB-P10-03
003-SB-006-01	003-SB-035-02	003-SB-073-03	003-SB-P11-01
003-SB-006-03	003-SB-036-01	003-SB-074-01	003-SB-P11-01-D
003-SB-007-01	003-SB-036-02	003-SB-074-01-D	003-SB-P11-03
003-SB-007-02	003-SB-036-03	003-SB-074-03	003-SB-P12-01
003-SB-007-03	003-SB-037-01	003-SB-28D-01	003-SB-P12-03
003-SB-008-01	003-SB-037-01-D	003-SB-29D-01	003-SU-B01-01
003-SB-008-02	003-SB-037-02	003-SB-30D-01	003-SU-B02-01
003-SB-013-01	003-SB-037-03	003-SB-31D-01	003-SU-B03-01
003-SB-013-02	003-SB-038-01	003-SB-31D-02	003-SU-B04-01
003-SB-015-01	003-SB-038-03	003-SB-32D-01	003-SU-B05-01
003-SB-015-01-D	003-SB-039-01	003-SB-33D-01	003-SU-B05-01-D
003-SB-015-03	003-SB-039-03	003-SB-33D-02	003-SU-B06-01
003-SB-016-01	003-SB-046-01	003-SB-P01-01	003-SU-B07-01
003-SB-016-03	003-SB-046-01-D	003-SB-P01-02	003-SU-B08-01
003-SB-017-01	003-SB-046-03	003-SB-P01-03-BR	003-SU-B09-01
003-SB-017-03	003-SB-047-01	003-SB-P02-01	003-SU-B10-01
003-SB-018-01	003-SB-047-03	003-SB-P02-02	SB-01-0001
003-SB-018-02	003-SB-050-01	003-SB-P02-03	SB-01-0001-D
003-SB-023-01	003-SB-050-01-D	003-SB-P03-01	SB-01-0608
003-SB-023-03	003-SB-050-02	003-SB-P03-03	SB-02-0001
003-SB-026-01	003-SB-054-01	003-SB-P04-01	SB-02-0204
003-SB-026-03	003-SB-054-02	003-SB-P04-03	SB-02-0204-D
003-SB-027-01	003-SB-055-01	003-SB-P05-01	SB-02-0406
003-SB-027-02	003-SB-055-02	003-SB-P05-02	SB-02-0608
003-SB-027-03	003-SB-055-03	003-SB-P06-01	SB-03-0001
003-SB-028-01	003-SB-058-01	003-SB-P06-02-BR	SB-03-1012
003-SB-028-02	003-SB-058-01-D	003-SB-P06-03	SB-04-0001
003-SB-029-01	003-SB-058-02	003-SB-P07-01	SB-04-1012
003-SB-029-02	003-SB-058-03	003-SB-P07-03	SB-05-0001
003-SB-030-01	003-SB-063-01	003-SB-P08-01	SB-05-1012
003-SB-030-02	003-SB-063-03	003-SB-P08-03	SB-06-0002
003-SB-030-03	003-SB-068-01	003-SB-P09-01	SB-06-0608
003-SB-032-01	003-SB-068-03	003-SB-P09-01-D	SB-07-0406
003-SB-032-03			

TABLE 6-7

SUMMARY OF SOIL RISK CHARACTERIZATION AND IDENTIFICATION OF COCS FOR OU3
NIROP FRIDLEY, MINNESOTA

Receptor	Cancer Risk			Noncancer Risk				
	Target Risk (1)	Calculated Risk	COCs (2)	Target Hazard Index (3)	Calculated Hazard Index	Target Hazard Quotient (3)	Calculated Hazard Quotient	COCs (2)
Baseline Evaluation								
0 - 4 feet depth: Chronic exposure to 95% UCL average concentration throughout building								
Typical Industrial Worker	1×10^{-5}	0.35×10^{-5}	--	1	< 1	0.2	< 0.2	--
Minor Frequent Construction Worker	1×10^{-5}	0.36×10^{-5}	--	1	< 1	0.2	< 0.2	--
0 - 12 feet depth: Short-term exposure to maximum concentration in localized areas								
Major Infrequent Construction Worker	1×10^{-6}	2.1×10^{-6}	Maximum concentrations at different locations. Risks at individual locations less than 1×10^{-6}.	1	2.9	1	1.35	Chromium (located > 4 feet deep in East Plating Shop AOC. Evaluated as hexavalent chromium)
Screening Evaluation								
0 - 12 feet depth: Chronic exposure to maximum concentrations in localized areas								
Typical Industrial Worker	1×10^{-5}	2×10^{-5}	Maximum concentrations at different locations. Risks at individual locations less than 1×10^{-5}.	1	< 1	0.2	0.8	Chromium (located > 4 feet deep in East Plating Shop AOC. Evaluated as hexavalent chromium)
Minor Frequent Construction Worker	1×10^{-5}	1.8×10^{-5}	Maximum concentrations at different locations. Risks at individual locations less than 1×10^{-5}.	1	< 1	0.2	0.37	Chromium (located > 4 feet deep in East Plating Shop AOC. Evaluated as hexavalent chromium)

Notes:

1 Values presented are MPCA acceptable cancer risk levels. USEPA target risk range is 1×10^{-6} to 1×10^{-4}.

2 COPCs significantly contributing to calculated risks exceeding target risk levels were identified as COCs.

3 Values presented are MPCA acceptable levels. USEPA target noncancer risk levels are a Hazard Index of 1 for multiple contaminants and a Hazard Quotient of 1 for individual contaminants.

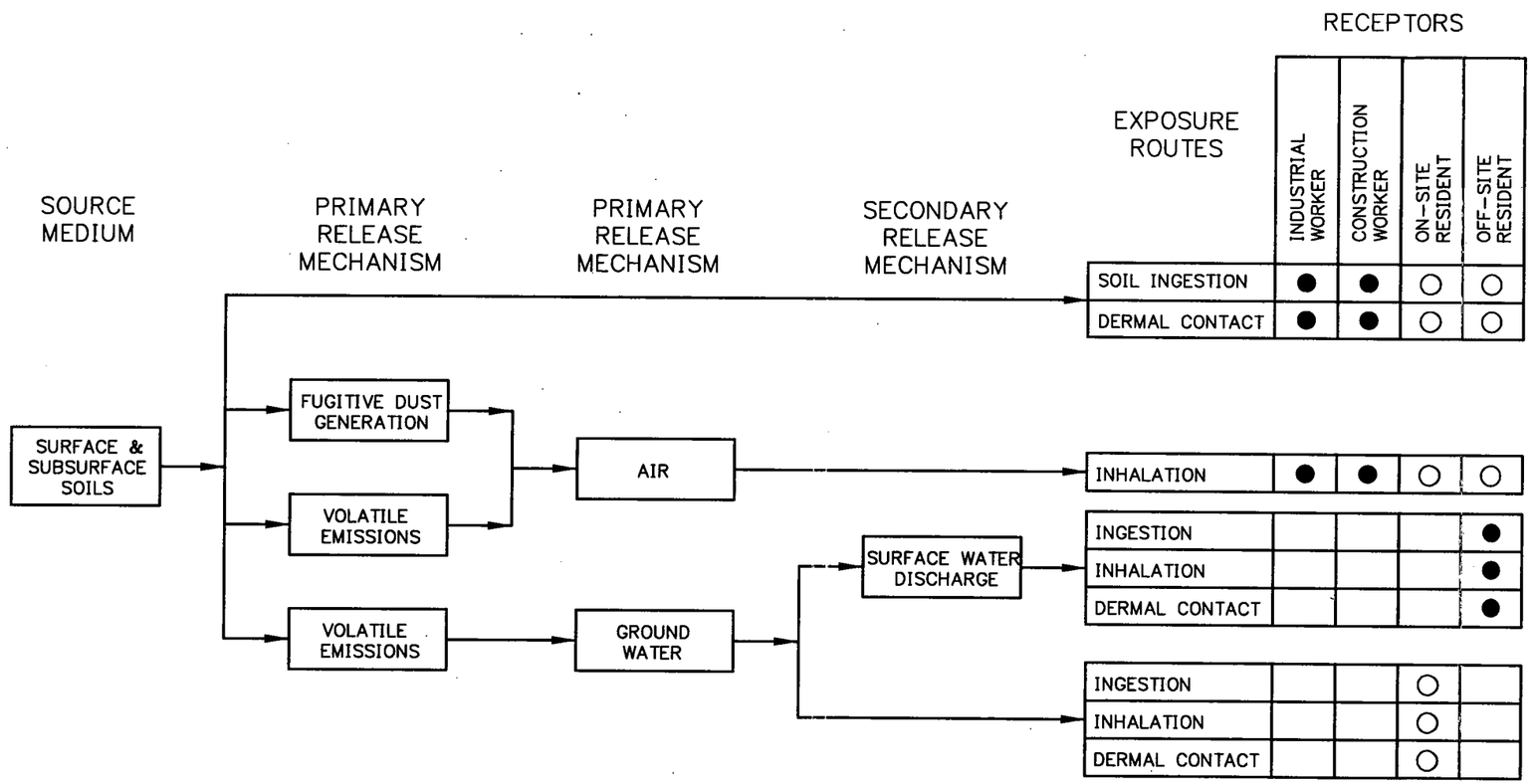
TABLE 6-8

CHEMICALS OF CONCERN (COCs)
GROUNDWATER
NIROP FRIDLEY, MINNESOTA

Chemical	Shallow Groundwater	Intermediate Groundwater	Deep Groundwater
Volatile Organic Compounds			
1,1,1-Trichloroethane	X		
1,1-Dichloroethane	X		
1,1-Dichloroethene	X	X	
1,2-Dichloroethane	X		
cis-1,2-dichloroethene	X	X	
Ethylbenzene	X		
Methylene Chloride	X		
Tetrachloroethene	X		X
Trans-1,2-dichloroethene	X	X	
Trichloroethene	X	X	X
Vinyl Chloride	X	X	X
Semivolatile Organic Compounds			
4-Methylphenol	X		
Inorganics			
Aluminum	X	X	
Beryllium	X		
Chromium	X		
Cobalt	X		
Cyanide	X		
Iron	X	X	X
Manganese	X	X	X
Selenium	X		
Thallium	X		
Vanadium	X		

Notes:
An X indicates that the chemical was retained as a chemical of concern.
The chemicals of concern are those chemicals with maximum detected concentrations which exceed MPCA Health Risk Limits, Health Risk Values, and EPA Maximum Contaminant Levels.

ACAD:6966KN03.dwg 05/10/00 MF



LEGEND:

● POTENTIALLY COMPLETE EXPOSURE PATHWAY

○ INCOMPLETE HYPOTHETICAL EXPOSURE PATHWAY

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 5/10/00
CHECKED BY DATE
COST/SCHED-AREA
SCALE NONE

CONCEPTUAL SITE MODEL
OPERABLE UNIT 3
NIROP, FRIDLEY

CONTRACT NO. 6966
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 6-1
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

7.0 SUMMARY AND CONCLUSIONS

This RI relies on data collected for the OU2 RI Report. This section describes the conclusions and summarizes the results for OU3.

7.1 CONCLUSIONS FROM THE OU2 RI REPORT

The conclusions of the OU2 RI Report (RMT, 1993) are summarized below. For a detailed discussion of the conclusions, refer to that report.

In the OU2 RI, there were several areas and sub-areas of investigation. Sub-Areas A1, A2, A3, and A4 were on the northern part of the property, in the general vicinity of the North 40. Sub-Areas B1 and B2 were in the northeast corner of the property. Area D was on the east side of the property, north of the tank farm. Sub-Areas E1 and E2 were on the east side of the property, south of the tank farm. Sub-Areas F1 and F2 were located near the southwest corner of the building.

The conclusions from the OU2 field investigation are as follows:

- Soils within Sub-Area A1 have not been impacted by site activities.

- Sub-Area A2 has been impacted by site activities. Analytical results indicate that elevated VOC concentrations in the shallow soils are present. Results indicate that the problem may be related to a surface spill rather than to buried wastes since concentrations are highest in the near surface (1' to 3') samples and decrease with depth.

- Investigation results indicate two major areas of concern in Sub-Area A3, which includes the area around unexcavated anomalies #13 and #14. Elevated concentrations of contaminants, particularly VOCs, remain in soils in these areas as a result of wastes buried prior to 1983. The area delineated as containing VOCs at concentrations greater than 10 µg/kg included more than one-half of Sub-Area A3. Unexcavated Anomalies #12 and #15 do not have significantly impacted soils in Sub-Area A3.

- Much of Sub-Area A4 has been impacted by site activities with the greatest impacts being located at previously excavated Anomaly #3. Previously excavated Anomalies #3 and #6 and unexcavated Anomalies #2 and #4 appear to be the major sources of these impacts.

- Sub-Area B1 has been slightly impacted by site activities.

- Sub-Area B2 has not been significantly impacted by site activities.

- Area D is the site of a previously unidentified disposal trench. The reported impacts are considerably less than those observed in Sub-Areas A2, A3, and A4.

- Although Sub-Area E1 has been slightly impacted by site activities, this area does not appear to be the source of contamination reported in nearby monitoring wells.

- Sub-Area E2 has been slightly impacted by site activities. However, this sub-area is not the source of VOCs identified in nearby monitoring wells.

- Results of this investigation show that there have been slight or no impacts to the soils in Sub-Area F1.

- Residual hydrocarbon-impacted soils remain in Sub-Area F2.

The conclusions for the OU2 ecological risk assessment were as follows:

- Although constituents are present at the site that are potentially toxic to terrestrial biota, the lack of suitable habitat and access restrictions makes it unlikely that large numbers of organisms will be affected.

Based on the overall conclusions from the OU2 RI, proceeding to the Feasibility Study was recommended. In the North 40 Removal Action in 1996 (Morrison Knudsen, 1996), several excavations coincided with some of the anomalies in the OU2 RI. Excavations in the removal action occurred at or near Anomalies #2, #3, #4, #6, #14, and #15.

Supplemental Remedial Investigation Information Report

The Supplemental Remedial Investigation Information Report, dated September 2001 evaluated unsaturated soils outside of the buildings and other structures in September of 2001. In this report, ten sub areas were evaluated: sub areas A1, A2, A3, and A4 located on the northern part of the property in the general vicinity of the North 40; sub areas B1 and B2 located in the northeast corner of the property; sub area D, a previously unidentified disposal trench and former storage area C located on the east side

of the property, north of the tank farm; sub area E located on the east side of the property south of the tank farm; sub area F located near the southwest corner of the building; and an additional sub area designated as "Other" located west of sub area A4 and between sub areas A1 and A2 which includes all samples not located in any of the above listed sub areas. The locations of the ten sub areas are presented in Figure 2-1 of the Supplemental Remedial Investigation Information Report.

The following is a summary of the conclusions from the supplemental Remedial Investigation Information Report.

- The results of the screening analysis indicated that HQs and/or ICRs for residential receptors exceeded MPCA and EPA risk acceptable levels at all sub areas with the exception of the "Other" sub area.

- HQs and ICRs for typical industrial workers exposed to surface soil and subsurface soil were within MPCA and EPA acceptable risk levels for all sub areas with the exception of subsurface soil at sub area A3 and surface soil at sub area A4. Tetrachloroethane, 1,1,1-trichloroethane, and xylenes in sample AT009D1 (8 to 10 feet bgs) and iron and manganese in sample AT007C (6 to 8 feet bgs) were the major contributors to the risk for subsurface soil at A3. The ICR for typical industrial workers exposed to surface soil at sub area A4 slightly exceeded the MPCA acceptable risk level but was within EPA's target risk range. Carcinogenic PAHs at boring AB032A (1 to 3 feet bgs) were the major contributor to the risk in surface soil at sub area A4.

- HQs and ICRs for minor frequent construction workers exposed to surface soil and subsurface soil were within MPCA and EPA acceptable risk levels for all sub areas with the exception of subsurface soil at sub area A3, surface soil at sub area A4, and surface soil at sub area E. Carcinogenic PAHs in sample AB043D (8 to 10 feet bgs); tetrachloroethene and 1,1,1-trichloroethane in sample AT009D1 (8 to 10 feet bgs); and iron and manganese in sample AT007C (6 to 8 feet bgs) were the major contributors to the risk for subsurface soil at sub area A3. The ICRs for minor frequent construction workers exposed to surface soil at sub areas A4 and E slightly exceed the MPCA acceptable risk level, although the ICRs were within EPA's target risk range. Carcinogenic PAHs at sampling location AB032A (1 to 3 feet bgs) in sub area A4 and EB004 A (1 to 3 feet bgs) in sub area E were the major contributors to the ICR.

- HQs and/or ICRs for major infrequent construction workers exposed to surface soil and subsurface soil were within MPCA and EPA acceptable risk levels for all sub areas with the exception of sub areas A3 and A4. Antimony, 2-butanone, 1,1-dichloroethane, iron, tetrachloroethene,

1,1,1-trichloroethane, trichloroethene, and xylenes were the major contributors to the risk at sub area A3. Carcinogenic PAHs and trichloroethene were the major contributors to the risk at sub area A4.

- Based on the results of the risk assessment, sub areas A1, A2, B1, B2, D, F, and "Other" are not a concern under industrial/restricted commercial use.

- In sub area A3 contamination in the vicinity of sample locations AT009, AT007, and AB042 at depths of approximately 6 to 10 feet bgs were mainly responsible for exceedances of the acceptable risk levels. These sample locations are located in the vicinity of where the drum removal occurred during the OU2 field investigation and where a decontamination pad exists.

- In sub area A4 contamination in the vicinity of sample locations AB032 and AT001 at depths of less than 3 feet bgs and AT004 at depths of 3 to 5 feet were mainly responsible for exceedances of the acceptable risk levels.

- In sub area E contamination in the vicinity of sample location EB004 at a depth of 1 to 3 feet bgs was mainly responsible for exceedances of the acceptable risk levels.

- Based on the bulleted results above residual contamination in sub areas A1, A2, B1, B2, D, F and "Other" are not of concern if the land use is limited to industrial/restricted commercial use. In the remaining sub areas (i.e., A3, A4, and E) localized areas of contamination (i.e., hot spots) result in potential risk levels that exceed levels of concern.

- In sub area A3, VOC contamination in the vicinity of sample locations AT009 and AB043 at depths of 8-10 feet bgs and iron at AT007 at depths of 6-8 feet bgs are largely responsible for the risk exceedance. These sapling locations are located in and near the area where drum removal occurred and where a decontamination pad exists. Examination of these samples indicates a localized area with significantly elevated levels of contamination. For example, at AT009 the concentrations of 1,1,1-trichloroethane, 1,1-dichloroethane, 2-butanone, tetrachloroethene, toluene, trichloroethene, and xylenes correspond to ICR 15 times higher than the acceptable target risk level and hazard indices from approximately 3-14 times the target risk level. The concentrations of these contaminants at this location are also significantly (11-360 times) higher than the next highest concentration in sub area A3 suggesting a hot spot of contamination. In addition, the concentrations of 1,1,1-trichloroethane, tetrachloroethene, and xylenes exceed the default soil saturation limit suggesting that free product may be present. Removal of these sampling data points and recalculation of the 95 percent UCL mean exposure concentration produces risks within target risk levels.

- In subs area A4, cPAH contamination at AB032 at a depth of 1-3 feet bgs is largely responsible for the risk exceedance. Examination of this location indicates a localized are with significantly elevated levels. The concentration of cPAHs (as BaP equivalents) at this location corresponds to risk levels 10-20 times higher than the acceptable target risk level. The concentration is six times higher than the next highest concentration in sub area A4. Removal of this sampling data point and recalculation of the 95 percent UCL mean exposure concentration produces risks within target risk levels.

- In sub area E the number of sampling data points was insufficient to calculate a 95 percent UCL of the mean and therefore maximum concentrations were utilized as exposure concentrations in depth refined risk assessment. Carcinogenic PAHs (as BaP equivalents) at sample location EB004 at a depth of 1-3 feet bgs is largely responsible for the risk exceedance. The concentration of cPAHs (as BaP equivalents) corresponds to approximately 1.5 times the target risk and is approximately two times higher than the next highest concentration in sub area E. Based on the limited data available EB004 does not appear to be a hot spot and the risk level associated with this specific location slightly exceeds the target risk.

7.2 NATURE AND EXTENT OF CONTAMINATION

Prior to establishing the extent of contamination, an evaluation was performed to determine whether there is any likelihood of significant data gaps or false negatives in the soils and groundwater analytical results. The evaluation consisted of comparing detection limits for organic and inorganic substances to MPCA State Reference Values (SRVs) for soil and MPCA Health Risk Limits (HRLs) and Health Rick Values (HRVs) for groundwater. Additionally the detection limits were also compared to EPA MCLs for groundwater. In most circumstances, when the detection limits exceeds the established regulatory values, it is a result of analysis protocol that requires sample dilution in order to obtain usable data. In other cases, the regulatory values are risk based numbers and the required analytical method can not achieve these values. The results of the evaluation indicate it is not likely that there are significant data gaps resulting from elevated detection limits.

The following items summarize the nature and extent of contamination at NIROP Fridley OU3.

- Among the seven categories of AOCs developed in the Work Plan, no AOC Group is more likely than another to be reasonable for releases in OU3 soils. Some COCs that contribute to significant risk are associated with a small subset of AOCs. Although the AOC groups do not show an increased potential for contamination, only about 20 of 71 AOCs fit neatly into groups.

- Several VOCs (primarily chlorinated hydrocarbons, aromatic compounds, and ketones) were detected in surface (0 to 4 feet bgs), shallow subsurface (4 to 12 feet bgs), and deep subsurface (>12 feet bgs) soil samples. In general, three ketones (acetone, 2-butanone, and 4-methyl-2-pentanone) were detected with the greatest frequency; however, these ketones are common laboratory contaminants associated with the analysis of soil samples for VOCs. Therefore, the reported results for these compounds may or may not reflect actual site conditions. Relative detection frequencies for VOCs were similar among surface, shallow subsurface, and deep subsurface soil samples. However, as illustrated in the following table for VOCs (excluding ketones and compounds detected in only one or two samples), no consistent pattern of concentrations was evident among the three categories of soil samples. COCs do not seem to indicate wide spread contamination that exceeds risk based thresholds.

Analyte	Concentration Range (μg/kg)		
	Surface Soils	Shallow Subsurface Soils	Deep Subsurface Soils
1,1,1-Trichloroethane	1-56	1-2	4
1,1-Dichloroethane	2-9	1-11	1
1,2-Dichloroethene (total)	3-15	1-15000	1-290
Bromomethane	2	1-2	ND
Carbon disulfide	1-13	5-14	1-18
Ethylbenzene	1-10	4-720	9-34
Styrene	4-33	1-54	10-72
Tetrachloroethene	1-90	1-760	1-3800
Toluene	1-14	1-1000	1-24
Trichloroethene	1-640	1-1100	1-100000
Xylenes, Total	1-45	1-7300	1-120

ND - not detected

Concentrations of 1,1-dichloroethane and carbon disulfide were at the same order of magnitude for all three categories of soil samples. The maximum concentration of 1,1,1-trichloroethane was detected in a surface soil sample. Maximum concentrations of 1,2-dichloroethene (total), ethylbenzene, toluene, and xylenes were detected in shallow subsurface soil samples. Maximum concentrations of styrene, tetrachloroethene, and TCE were detected in deep subsurface soil samples. Maximum concentrations of TCE and tetrachloroethene in all three categories of soil samples were detected in samples collected from the East Plating Shop, indicating the possible presence of a "hot spot" of TCE and tetrachloroethene in this area and the likelihood that these areas are the source area for TCE (and chromium). The TCE is present mainly in shallow and intermediate depth groundwater.

- Several SVOCs, primarily PAHs, were sporadically detected in surface and shallow subsurface soil samples. With few exceptions, concentrations and detection frequencies of SVOCs in surface soil samples exceeded those reported for shallow subsurface soil samples. 4-Chloro-3-methylphenol was detected in a single shallow subsurface soil sample (collected from AOC32, the location of an oil/water separator sump) at a concentration of 11,000 μg/kg. Concentrations of PAHs in shallow subsurface soil samples ranged from 11 µg/kg to 2,300 μg/kg, while concentrations of PAHs in surface soil samples ranged from 10 µg/kg to 5,600 μg/kg. Only the seven deep subsurface soil samples collected from the East Plating Shop were analyzed for SVOCs; positive results for 4-methylphenol and two phthalates were detected in one to four of these samples. AOC 17 showed disproportionate responsibility for total site PAH contamination.

- Aroclor-1016 and Aroclor-1254 were detected in one and two surface soil samples, respectively, at concentrations ranging from 150 μg/kg to 290 μg/kg. No other PCBs were detected in any of the soil samples.

- All 22 TAL metals and cyanide were detected in surface soil samples, and cyanide and all but two TAL metals were detected in the shallow subsurface soil samples. Concentrations and detection frequencies of metals detected in surface and shallow subsurface samples were very similar. A majority of the metals were frequently detected (i.e., in greater than 90 percent of the samples). Concentrations of most metals and cyanide exceeded background concentrations in one or more soil samples. Of the deep subsurface soil samples, only the seven samples collected from the East Plating Shop were analyzed for metals and cyanide; positive results for 4-methylphenol and two phthalates were detected in one to four of these samples. Seventeen metals and cyanide were detected in the deep soil samples, with concentrations of 13 of these metals and cyanide exceeding background in 1 to 7 samples.

- The maximum concentrations of all detected chemicals in soil (0- to 12-feet in depth) were less than the MPCA SRVs for industrial exposures with the exception of lead in one surface soil sample and chromium in one subsurface soil sample. Estimated cumulative excess cancer risks slightly exceed MPCA target risk levels.

- Based upon the field screening tests and analytical results for soil it is unlikely that NAPLs are present in any of the subsurface soil sample locations. However, based on groundwater contaminant concentrations, it is apparent that DNAPLs are likely somewhere under the building.

- Chlorinated hydrocarbons were the primary chemicals detected in groundwater samples. TCE was detected most frequently and at the greatest concentrations in shallow, intermediate, and deep groundwater samples. Concentrations of TCE in groundwater samples ranged from 0.6 μg/L to 140,000 μg/L. The maximum concentration of TCE was detected in a shallow groundwater sample collected from monitoring well GW-01, located in the East Plating Shop. Review of the data collected from the six shallow, six intermediate, and six deep permanent wells, however, indicates that the greatest VOC concentrations are generally associated with the intermediate wells.

- Concentrations of TCE in shallow and intermediate groundwater samples and 1,2-dichloroethene in shallow groundwater samples collected from wells in the former East Plating Shop exceeded 1 percent of their solubility limits indicating that potential DNAPL is present in the local vicinity of these wells.

- Since the area targeted in the OU3 investigation is either under roof or paved, the area is not conductive for wildlife. Within the OU3 investigation area, there are no known grass areas. The area is a fenced, highly industrialized area. Therefore, the lack of suitable habitat makes it unlikely that terrestrial receptors, if any, will actually be impacted.

Although formal Data Quality Objectives (DQOs) were not used in design of the sampling program, the investigation produced adequate information to evaluate the decision rules.

7.3 HUMAN HEALTH RISK ASSESSMENT

Chemicals of potential concern evaluated in the risk assessment are presented in Table ES-2 for soil and Table ES-3 for groundwater.

OU3 Soil Risk Assessment:

The human health risk assessment considered exposures to industrial workers, major-infrequent construction workers, and minor-frequent construction workers. Potential exposure pathways for all receptors included incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive and volatile compounds. Cancer risks and hazard indices were estimated following MPCA methodology. The following bullets summarize the results of the human health risk assessment for soil:

- *Potential Risks to Industrial Workers* – The potential health risks for the industrial worker were estimated by comparing surface soil (0 – 4 feet) concentrations to the MPCA Soil Reference Values

(SRVs). A site-wide upper 95 percentile confidence limit of the mean was used as the exposure point concentration. An incremental Excess Lifetime Cancer Risk (ELCR) of 0.35×10^{-5} was calculated for industrial workers. The calculated ELCR is below both the U.S. Environmental Protection Agency's (U.S. EPA) acceptable ELCR range of 1×10^{-4} to 1×10^{-6} and MPCA's acceptable chronic ELCR of 1×10^{-5}.

The noncancer endpoint specific hazard indices (HI) ranged from 0.001 to 0.053. The noncancer chemical specific hazard quotients (HQ) ranged from <0.001 to 0.027. The calculated endpoint specific HI were below both the U.S. EPA and MPCA acceptable HI of 1 and the chemical specific HQs were below the MPCA acceptable HQ of 0.2.

Since it is not known if deeper soils will be excavated at a later date, a screening risk evaluation utilizing the maximum detected concentration in soil within the top 12 feet was conducted. The screening HI (i.e., chemical specific HQs summed regardless of target endpoint) was below the acceptable level of 1, but the chemical specific HQ for chromium exceeded the acceptable HQ of 0.2. The calculated ELCR, 2×10^{-5}, was within U.S. EPA's acceptable ELCR range of 1×10^{-4} to 1×10^{-6} but exceeded the MPCA acceptable ELCR is 1×10^{-5}. Carcinogenic PAHs (cPAHs) (0.8×10^{-5}), arsenic (0.6×10^{-5}) and hexavalent chromium (0.4×10^{-5}) were the major contributors to the ELCR. It should be noted that the maximum detected concentrations for these three contaminants occurred in different locations (different horizontally and vertically); arsenic concentrations exceeded background concentrations in only two percent of the 0 – 12 feet soil samples; and the chromium present was assumed to be in the more toxic hexavalent form.

- *Potential Risks to Major-Infrequent Construction Worker* – The potential health risks for the major-infrequent construction worker were estimated using Excel spreadsheets supplied by the MPCA staff. The maximum detected concentration in soil within the top 12 feet, regardless of spatial location, was utilized as the exposure point concentration. An incremental excess lifetime cancer risk (ELCR) of 2.1×10^{-6} was calculated. The calculated ELCR is within the U.S. EPA's acceptable ELCR range is 1×10^{-4} to 1×10^{-6} and but exceeds the MPCA's acceptable subchronic ELCR of 1×10^{-6}. The major contributors to the ELCR were cPAHs (0.7×10^{-6}), arsenic (0.5×10^{-6}), and hexavalent chromium (0.9×10^{-6}).

  The calculated noncancer screening HI (summed regardless of target endpoint) was 2.9, which exceeded both the EPA and MPCA acceptable HI of 1. The major contributors to the cumulative HI were hexavalent chromium (1.35), arsenic (0.3), copper (0.2) and mercury (0.46). The cumulative HI was estimated by adding all chemical specific HQs together regardless of target endpoint. The target

endpoint specific HIs do not exceed 1. The noncancer chemical specific hazard quotients (HQ) ranged from <0.001 to 1.35. Only hexavalent chromium produced a HQ which exceeded the MPCA acceptable subchronic HQ of 1.

It should be noted that the maximum detected concentrations for the major contributing contaminants occurred in different locations (different horizontally and vertically), arsenic concentrations exceeded background concentrations in only two percent of the 0 – 12 feet soil samples, and chromium was assumed to be in the more toxic hexavalent form.

- *Potential Risks to the Minor-Frequent Construction Workers* – The potential health risks for the minor-frequent construction worker were estimated using Excel spreadsheets supplied by the MPCA staff. A site-wide upper 95 percentile confidence limit of the mean concentration within the top four feet of soil was used as the exposure point concentration. An incremental ELCR of 0.36×10^{-5} was calculated. The calculated ELCR is below the U.S. EPA's acceptable ELCR range of 1×10^{-4} to $1\text{-}10^{-6}$ and MPCA acceptable chronic ELCR of 1×10^{-5}. The calculated screening noncancer HI (i.e., summed regardless of target endpoint) was 0.045. The calculated noncancer chemical specific HQ ranged from <0.001 to 0.016. The calculated HI was below both the U.S. EPA and MPCA acceptable HI of 1 and the chemical specific HQs were below the MPCA acceptable HQ of 0.2.

  Since it is not known if deeper soil will be excavated at a later date, a screening risk evaluation (i.e., methodology is intended to overestimated the potential risk) utilizing the maximum detected concentration in soil within the top 12 feet was conducted. The screening HI (0.646) and the chemical specific HQs (<0.001 to 0.37) were below the acceptable HI and HQ values with the exception of hexavalent chromium. The calculated ELCR, 1.8×10^{-5}, was within U.S. EPA's acceptable ELCR range of 1×10^{-4} to 1×10^{-6} but exceeded the MPCA acceptable ELCR is 1×10^{-5}. Carcinogenic PAHs (cPAHs) (1×10^{-5}), arsenic (0.6×10^{-5}) and hexavalent chromium (0.2×10^{-5}) were the major contributors to the ELCR. It should be noted that the maximum detected concentrations for these three contaminants occurred in different locations (different horizontally and vertically). Arsenic concentrations exceeded background concentrations in only two percent of the 0 – 12 feet soil samples and the chromium present was assumed to be in the more toxic hexavalent form.

Conclusion for Soil:

Based on the results of the human health risk assessment no Contaminant of Potential Concerns (COPCs) were retained as Contaminant of Concerns (COCs) in surface soil. In the absence of chemical

speciation information, chromium was retained as a COC in 0 – 12 foot subsurface soil in the Former East Plating Shop area.

The risk evaluation for the industrial worker indicates that under the industrial land use scenario, there is not a need for controls to limit exposure of workers to surface soil (0 – 4 feet). The risk evaluations for the activities that involved contact with soils beyond four feet suggest that the need for exposure controls should be evaluated. The need for institutional controls (e.g., zoning restrictions, deed notifications) to ensure that future property uses or activities that may result in higher exposures or exposures to different receptors not occur without proper oversight should also be evaluated. The human health risk assessment addressed potential direct contact with contaminated soil within the top 12 feet. No potential exposures were identified for soil at depths beyond 12 feet, therefore no risks were calculated for potential exposures to soil greater than 12 feet bgs. Concentrations of all chemicals in soil samples collected at depths beyond 12 feet were less than MPCA SRVs for industrial exposures with the exception of TCE in one soil sample (SB07, 12 to 16 feet) collected at the former East Plating Shop. The boring logs suggest that this sample was collected from within the saturation zone, consequently this sample may be more representative of groundwater contamination than soil contamination.

OU-3 Ground Water Risk Assessment:

On-site ground water is not currently used as a potable water supply at NIROP Fridley. It may not be used in the future because a public water supply is available. Contaminated on-site ground water is a potential source of contamination for surface water in the Mississippi River. A screening evaluation of groundwater was performed following methodology and the Excel spreadsheet (DW1097.xls) supplied by MPCA staff. The following bullets summarize the results of the groundwater screening evaluation:

- *Upper Portion of the Unconfined Aquifer* – TCE, tetrachloroethene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, dichloromethane, 4-methylphenol, ethylbenzene, 1,1,1-trichloroethane, vinyl chloride, aluminum, beryllium, chromium, cobalt, cyanide, manganese, iron, selenium, thallium, and vanadium were present at concentrations exceeding screening levels and therefore were retained as COCs for the upper portion of the unconfined aquifer (see Table ES-5).

- *Lower Portion of the Unconfined Aquifer* – TCE, 1,1-dichloroethene, cis-1, 2-dichloroethene, vinyl chloride, aluminum, manganese, and iron were present at concentrations exceeding screening levels and therefore were retained as COCs for the lower portion of the unconfined aquifer (see Table ES-5).

- *Deep Aquifer* – Tetrachloroethene, TCE, and iron were present at concentrations exceeding screening levels and therefore were retained as COCs for the deep aquifer (see Table ES-5). Vinyl chloride will be retained as a COC for groundwater in the deep aquifer since it is a breakdown product of TCE and PCE and the detection limit of 0.3ug/l exceed the MPCA HRL of 0.2ug/l, although it should be noted that the reported detection limit for vinyl chloride is less than the EPA MCL of 2ug/l.

7.4 INITIAL SCREENING OF POSSIBLE ALTERNATIVE RESPONSE ACTIONS

Operable Unit 3, Major Infrequent Construction Worker

For OU3, unacceptable risks were identified in subsurface soil under the main NIROP building. For subsurface soil, chromium was retained as a COC. Soil contaminated with chromium at an unacceptable level was found under the former East Plating Shop of the main NIROP building for the major infrequent construction worker scenario. Chromium exceeds the acceptable (target) risk number based on the assumption that all the chromium is present in the hexavalent form. This assumption was made because soil samples analyzed for chromium were not speciated.

One remedial action alternative to address subsurface soil contamination beneath the former East Plating Shop would be a no-action remedial alternative. Under this alternative, there would be no requirement for the owner to leave the existing East Plating Shop floor in place and there would be no institutional control to restrict access to subsurface soil beneath the East Plating Shop floor that present an unacceptable risk.

A second remedial action alternative to address subsurface soil contamination beneath the former East Plating Shop would be an institutional control restricting subsurface activity in the area.

A third remedial action alternative to address unacceptable risks under this risk scenario would be an engineering-control response action combined with institutional controls. Currently, the presence of the existing floor in the former East Plating Shop constitutes an engineering -control response action. The existing floor in the East Plating Shop acts as a barrier to prevent the type of risk exposures that were found unacceptable in the risk assessment for OU3. Implementation of this response action would consist of a requirement to leave the existing floor of the former East Plating Shop in place. In addition, chromium likely is not mobile so long as the floor above it is in place. The engineering-control response action would be combined with other institutional controls that restrict access to contaminated soil and call for additional remedial actions if the floor is removed and an exposure route for chromium is established.

Operable Unit 2

The OU3 risk exposure scenarios for the main NIROP building were also applied to the OU2 areas to provide for consistency in remedy evaluation. OU2 areas where calculated risk exceeds allowable levels include sub areas A3, A4, and E (see Figure 2-1 of the Supplemental Remedial Investigation Information Report).

Operable Unit 2, Typical Industrial Worker

For the typical industrial worker exposure scenario (0-5 feet bgs) for OU2, the calculated cancer risk in sub area A4 exceeds allowable levels. Carcinogenic PAHs (cPAH) at sample location AB032A (1-3 feet bgs) was the primary driver of the calculated risk. Selected VOCs and metals at two subsurface sample locations in sub area A3, AT009D1 (8-10 feet below ground surface (bgs)) and AT007C (6-8 ft bgs) also pose an unacceptable risk to the typical industrial worker if the soil was accessed.

One remedial action alternative for surface soil contaminated cPAHs in sub area A4 and subsurface soils contaminated with VOCs and metals in sub area A3 would be the no-action alternative. Under this remedial action alternative surface contamination in sub area A4 would be left in place and continue to present an unacceptable risk to the typical industrial worker. Access to subsurface soil contaminated with VOCs and metals in sub area A3 would not be restricted and would continue to present an unacceptable risk.

A second remedial action alternative to address surface soil contamination in sub area A4 and subsurface soil contamination in sub area A3 would be an institutional control to restrict surface and subsurface activity in the areas of concern.

A third remedial action alternative to address unacceptable risks from surface soil in sub area A4 would be a response action. Surface soil (0-3 feet) contaminated with cPAHs would be removed from sub area A4, disposed of off-site in an appropriate facility and replaced with clean fill.

Operable Unit 2, Minor Frequent Construction Worker

For the minor frequent construction worker exposure scenario (0 to 5 feet bgs), the calculated risk in sub areas A4 and E exceeds allowable levels for carcinogenic PAHs. The risk is primarily driven by sample AB032A (1 to 3 ft bgs) in sub area A4 and sample EB004A (1 to 3 ft bgs) in sub area E.

One remedial action alternative for surface soil contaminated cPAHs in sub area A4 would be the no-action alternative. Under this remedial action alternative surface contamination in sub area A4 would be left in place and continue to present an unacceptable risk to the minor frequent construction worker. .

In sub area E the number of sampling data points was insufficient to calculate a 95 percent UCL of the mean and therefore maximum concentrations were utilized as exposure concentrations in the refined risk assessment. Carcinogenic PAHs (as BaP equivalents) at sample location EB004 at a depth of 1-3 feet bgs are largely responsible for the risk exceedance. This concentration of cPAHs (as BaP equivalents) corresponds to approximately 1.5 times the target risk and is approximately 2 times higher than the next highest concentration in sub area E. (EB004, with a 4.1 mg/kg concentration of cPAHs, does not appear to be a hot spot given that this location only slightly exceeds the target level cPAH concentration of 4.0 mg/kg.) Therefore, given the highly conservative nature of this approach, and the fact that only one location slightly exceeds the target risk, a risk-based decision has been made not to address the cPAHs found at sub area E.

A second remedial action alternative to address unacceptable risks found in surface and subsurface soil contamination in sub area A4 would be an institutional control to restrict surface and subsurface activity in the areas of concern.

Again, in sub area E the number of sampling data points was insufficient to calculate a 95 percent UCL of the mean and therefore maximum concentrations were utilized as exposure concentrations in the refined risk assessment. Carcinogenic PAHs (as BaP equivalents) at sample location EB004 at a depth of 1-3 feet bgs are largely responsible for the risk exceedance. This concentration of cPAHs (as BaP equivalents) corresponds to approximately 1.5 times the target risk and is approximately 2 times higher than the next highest concentration in sub area E. (EB004, with a 4.1 mg/kg concentration of cPAHs does not appear to be a hot spot given that this location only slightly exceeds the target level cPAH concentration of 4.0 mg/kg.) Therefore, given the highly conservative nature of this approach, and the fact that only one location slightly exceeds the target risk, a risk-based decision has been made not to address the cPAHs found at sub area E.

A third remedial action alternative to address unacceptable risks from surface soil in sub area A4 would be a response action. Surface soil concentrations of cPAHs found in sub area A4 were significantly (60 mg/kg compared to 4.0 mg/kg) above the target level concentrations. For the interim remedial action, surface soil (0-3 feet) contaminated with cPAHs would be removed from sub area A4, disposed of off-site at an appropriate facility, and replaced with clean fill.

Again, for sub area E the number of sampling data points was insufficient to calculate a 95 percent UCL of the mean and therefore maximum concentrations were utilized as exposure concentrations in the refined risk assessment. Carcinogenic PAHs (as BaP equivalents) at sample location EB004 at a depth of 1-3 feet bgs are largely responsible for the risk exceedance. This concentration of cPAHs (as BaP equivalents) corresponds to approximately 1.5 times the target risk and is approximately 2 times higher than the next highest concentration in sub area E. (EB004, with a 4.1 mg/kg concentration of cPAHs does not appear to be a hot spot given that this location only slightly exceeds the target level cPAH concentration of 4.0 mg/kg.) Therefore, given the highly conservative nature of this approach, and the fact that only one location slightly exceeds the target risk, a risk-based decision has been made not to address the cPAHs found at sub area E.

Operable Unit 2, Major Infrequent Construction Worker

OU2 areas where calculated risk exceeds allowable levels for the major infrequent construction worker exposure scenario (0-12 feet bgs) include sub areas A3 and A4. In sub area A3, 1,1,1-trichloroethane, 1,1-dichloroethane, 2-butanone, tetrachloroethene, toluene, trichloroethene, and xylenes contamination in the vicinity of sample location AT009 (8-10 feet bgs) and iron at AT007 (6-8 feet bgs) were the primary risk drivers. In sub area A4, cPAHs at sample location AB032A (1-3 feet bgs) were the primary risk driver. In addition, the concentrations of 1,1,1-trichloroethane, tetrachloroethene, and xylenes exceed the default soil saturation limit suggesting that free product may be present.

Sub Area A3

One remedial action alternative for subsurface soils contaminated with VOCs and metals in sub area A3 would be the no-action alternative. Under this remedial action alternative access to subsurface soils contaminated with VOCs and metals in sub area A3 would not be restricted and continue to present an unacceptable risk.

A second remedial action alternative to address subsurface soil contamination in sub area A3 would be an institutional control to restrict subsurface activity in the areas of concern.

A third remedial action alternative to address unacceptable risks from subsurface soil in sub area A3 is an engineering-control response action combined with other institutional controls. Currently, the presence of the existing soil cover down to 5 feet below the surface in sub area A3 constitutes an engineering-control response action. The existing soil cover acts as a barrier to prevent the type of risk exposures that were found unacceptable in the risk assessment for OU3. Implementation of this response action would consist

of a requirement to leave the existing soil cover beginning at 3 feet below the surface to 5 feet below the surface in place. This response action would be combined with an institutional control that restricts access to contaminated soil and calls for additional remedial actions if the soil cover is removed and an exposure route for VOCs and metals is established.

Sub Area A4

One remedial action alternative for surface soil contaminated with cPAHs in sub area A4 would be the no-action alternative. Under this remedial action access to surface soils contaminated with cPAHs in sub area A4 would not be restricted and continue to present an unacceptable risk under the major infrequent construction worker risk scenario.

A second remedial action alternative for surface soil contaminated with cPAHs in sub area A4 would be an institutional control to restrict surface activity in sub area A4.

A third remedial action alternative for contaminated surface soil in sub area A4 that presents an unacceptable risk to major infrequent construction workers is a response action. Surface soil (0-3 feet) contaminated with cPAHs would be removed and disposed of off-site in an appropriate facility.

Other Characteristics Common to all Possible Alternative Response Actions

The OU2 and OU3 investigations were adequate to determine if significant contamination sources were present at NIROP Fridley. However, should any additional sources of contamination be found in the future, these sources would be addressed consistent with the FFA and CERCLA.

A steel hurricane fence prevents trespass to the NIROP facility, and access is limited to those passing through staffed security gates. Land use is not expected to change from industrial use.

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