COPY

Peer Engineering
Integrated Environmental Solutions

PRELIMINARY ENVIRONMENTAL INVESTIGATION

Former Gopher Ordnance Works
U/More Park
Rosemount, Minnesota

Prepared for:

University of Minnesota

and

Minnesota Pollution Control Agency

August 19, 2003

PRELIMINARY ENVIRONMENTAL INVESTIGATION
FORMER GOPHER ORDNANCE WORKS
U/MORE PARK
ROSEMOUNT, MINNESOTA

AUGUST 19, 2003

Prepared for:

University of Minnesota
Department of Environmental Health & Safety
Boynton Health Service, Room W150
410 Church Street Southeast
Minneapolis, Minnesota 55455

and

Minnesota Pollution Control Agency
Site Assessment Program
Minnesota Pollution Control Agency
520 Lafayette Road North
Saint Paul, Minnesota 55155

Prepared by:

Peer Engineering, Inc.
4801 West 81st Street, Suite 118
Bloomington, Minnesota 55437
(952) 831-3341

Peer File #11717.00

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

Peer Engineering, Inc. (Peer) has been retained by the University of Minnesota (University) to prepare this report regarding the results of a preliminary environmental investigation conducted of the former Gopher Ordnance Works (GOW) facility, located in Rosemount, Minnesota. The former Gopher Ordnance Works (GOW) facility was located on portions of what is now the University of Minnesota (University) Rosemount Empire property or Rosemount Research Center (UMRRC or U/More Park) site. GOW operated on the northern and central portions of the U/More Park site from the early to mid 1940s. In 1947, the University acquired approximately 8,000 acres from the United States government, part of which was previously occupied by the GOW.

Funding for investigation field activities was provided by the Minnesota Pollution Control Agency (MPCA) utilizing both State Superfund resources, and Federal resources that were provided by U.S. Environmental Protection Agency (EPA) through a Cooperative Agreement with the MPCA for the purposes of conducting investigations at potentially contaminated and/or Brownfield sites in Minnesota. This investigation was implemented by the MPCA in cooperation with the University and Dakota County Environmental Services (Dakota County) to evaluate the potential presence of environmental impacts at six primary areas where former GOW operations occurred. The investigation results will be used to determine if further investigation and/or possible environmental remediation related to GOW operations is warranted.

2.0 BACKGROUND

2.1 SITE DESCRIPTION

The former GOW is located on portions of the U/More Park site in Rosemount, Dakota County, Minnesota. Figure 1 shows the approximate boundaries of the UMRCC site (hereafter referred to as "Site") which generally include County Highway 42 to the north, Highway 52 and Clayton Avenue to the east, 190th Street and farm boundaries to the south and Annette Avenue, Biscayne Avenue and farm boundaries to the west. Figure 1 also shows historical areas of concern associated with the former GOW that were evaluated as part as of this investigation. The majority of the Site is currently used for agricultural purposes. University agricultural test plots cover much of the Site. Other portions are leased to private farmers for crop production and other miscellaneous purposes.

The Public Land Survey coordinates for the Site generally include T114N, R19W, Sections 1-4, 9-14; and T115N, R19W, Sections 33, 34, 35 and 36.

2.2 SITE HISTORY

The GOW was constructed on the northern and central portions of the Site in the early 1940s and ceased operation in late 1945. The United States Government deeded portions of the GOW property to the University in 1947. The GOW facility included two identical plants designed to manufacture single-based (nitrocellulose) smokeless munitions powder, oleum and nitric acid. The facility was also used for reworking and destruction of salvaged smokeless powder which was shipped to GOW for reconditioning. One plant was located on the northeastern portion of the Site, and reportedly operated from November 1944 through August 1945. The second plant was located on the north-central portion of the Site. Construction of this second plant was started and partially completed, but reportedly the plant never became operational. A published reference with additional information regarding the construction and operation of GOW is included in Appendix A.

The processes used to generate munitions powder at the GOW facility, along with other operational activities and process equipment, involved use of numerous hazardous substances and petroleum products and may have impacted soil and ground water at various locations on the Site. One record associated with decommissioning of the GOW obtained from the National Archives files in Kansas City, Missouri, identified the presence of a mercury-containing column (manometer) removed from the "Ether Manufacturing and Alcohol Rectifying Unit" in Building 207-A (see Appendix A).

The GOW also had a wastewater treatment plant (WWTP). Such WWTPs typically utilized "trickling filters" as a biological treatment process. Bearings for the distributor arms in the trickling filters of this vintage were likely mercury-containing. The MPCA provided information regarding an environmental assessment conducted of the WWTPs at two Formerly Used Defense Sites (FUDs) located in Saint Bonifacius and Bethel, Minnesota. This assessment identified the presence of mercury in residual wastewater, sediment and soil associated with the WWTPs and trickling filter systems. Detected mercury concentrations in the water samples ranged from 0.015 to 369 milligrams per liter. Detected mercury concentrations in soil and sediment samples ranged from 0.026 to 1.43 milligrams per kilogram. In addition, liquid mercury was observed within the concrete trickling filter structure at the Saint Bonifacius site. A copy of the assessment report dated July 2000 provided by the MPCA is included in Appendix A.

2.3 INVESTIGATION AREAS

In 2002, Peer completed a historical review of readily available information regarding the GOW. Based on the review, Peer identified a number of former GOW operation areas with potential for environmental impacts. Dakota County staff also completed detailed information review, as well as site visits and historical aerial photograph review. Information from the aerial photograph review was mapped using GIS to allow for easy identification of locations in the field. Based on the results of the information review and subsequent discussions between the MPCA, the University and Dakota County, six areas were targeted for initial investigation. The six areas (see Figure 1) included:

1. *Oleum Plant.* The Oleum Plant was for the production of sulphuric acid which was concentrated into "oleum". The manufacturing process used raw sulfur. Remnants of a sulfur melting pit and other building remnants are still present in this area. Other features of this area included a boiler, sulfur storage tanks, oleum and spent acid storage tanks, and associated building structures and sewer system components. Based on published EPA information, wastewater generated from oleum production originated from cooling water contaminated by acid spills and tank car clean-up[1]. Waste characterization data reviewed by EPA indicates that the wastewater would have low pH and high levels of sulfate. Available information reviewed by Peer indicates that some raw sulfur product as well as sulphuric acid contains mercury[2]. Because raw sulfur and sulphuric acid were used at GOW in the production of oleum, it is assumed that the wastewater generated by the oleum production would also have contained mercury. An estimated 81 million pounds of oleum was produced between November 1944 and July 1945. Some of this material was used on-site for nitrocellulose production and the remainder was shipped off-site for use at other munitions plants.

[1] State-of-the Art Military Explosives and Propellants Production Industry, Vol. III - Wastewater Treatment, United States Environmental Protection Agency, EPA-600/2-76-213c, October 1976.
[2] http://.efma.org/Publications/BAT%202000/Bat03/section04.asp; http://www.maineenvironment.org/legislature/testimony/reduce%20mercury%20emissions%20LD1665.htm; http://www.nih.gov/od/ors/ds/nomercury/systems.htm; http://www.dole.nu/lesdoie/TMS2002Hg.pdf

2. *Nitric Acid Plant.* The Nitric Acid Plant area was located west of the Oleum Plant. Nitric acid was produced in this area, which along with sulphuric acid was used in the manufacture of the nitrocellulose. Features associated with this area included anhydrous storage tanks, an ammonia oxidation plant, nitric acid storage tanks, nitric and sulphuric acid concentration facilities, a "change house" (Building 707A - used by workers for personal hygiene), and associated building structures and sewer system components. Some building remnants are still present in this area. Based on published information from the EPA, nitric and sulphuric acid concentration processes conducted in the Nitric Acid Plant area would have generated wastewater which consisted of cooling water contaminated by acid spills[1]. Waste characterization data reviewed by EPA indicates that the wastewater would have low pH and high levels of sulfate. An estimated 51 million pounds were produced between November 1944 and September 1945. Some of this material was used on-site for nitrocellulose production and the remainder was shipped off-site for use at other munitions plants.

3. *Burning Grounds.* The Burning Grounds was reportedly used to dispose of powder that did not meet required specifications. The Burning Grounds consisted of a bermed area that surrounded four nitrocellulose, one dinitrotoluene and other various hazardous waste burn pits. Piles of "Keystone" drum bottoms and tops are currently present to the north and east of the burn pits. Water standpipes, which are still present, were used to flood the areas for fire and explosion control. Potential contaminants associated with powder combustion would include residual explosive compounds, heavy metals and polynuclear aromatic hydrocarbons (PAHs).

4. *Wastewater Treatment Plant (WWTP).* Wastewater from GOW operations was piped to the WWTP via vitrified clay tile pipes. The treatment process included screens, digestion and sludge drying beds. The sludge was removed from the drying beds and disposed of in a shallow borrow pit. Operational components and other areas of potential concern in the vicinity of the WWTP included transformer pads, an above ground secondary containment reservoir, an earthen berm, an underground water holding tank, a wooded area, a rail spur, a firing range, sludge drying beds, a GOW Power Plant A effluent pond (Effluent Pond), and a heavy equipment area. Information provided by Dakota County based on evaluation of a 1945 aerial photograph and review of historic GOW operations indicates the Effluent Pond received discharge from ditches originating at Power Plant A (located to the northwest) and the Ballistics Range and Lab (located to the southwest). Potential contaminants associated with the WWTP area include residual explosive compounds, heavy metals, PAHs, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs) and petroleum constituents.

5. *Maintenance Shops.* This was a large area, which was used primarily for service and maintenance activities, and included numerous shop and garage buildings, parking areas, and petroleum product storage. Potential contaminants in this area include solvent compounds (VOCs), heavy metals, and petroleum constituents.

6. *Primary Settling Basin.* The Primary Settling Basin received treated wastewater effluent generated by GOW operations. The primary basin discharged to the south into a larger detention reservoir (secondary settling basin) that in turn discharged to the Vermillion River channel. The purpose of the primary settling basin was for retention and settlement of suspended sediment and precipitates associated with the wastewater being discharged. Potential contaminants associated with the primary settling basin include residual explosive compounds, heavy metals, and organic contaminants. The pH of the wastewater effluent would have likely been variable, which would have affected the solubility and precipitation of heavy metals.

2.4 INVESTIGATION WORK PLAN

Following the completion of the historical review and several site visits, Peer prepared a "draft" work plan dated November 5, 2002 for the proposed preliminary environmental investigation. The work plan was submitted to the project team which included the University's Department of Environmental Health & Safety (DEHS), Dakota County, the MPCA, and Terracon (the MPCA's environmental consultant for the project). A project team meeting was held on November 12, 2002, which was attended by University, the MPCA, Terracon and Peer. The purpose of the meeting was to discuss the "draft" investigation work plan, determine specific roles of each team member, and to confirm the final investigation scope, methods and procedures. It was determined that the MPCA, Dakota County and DEHS would provide technical input and management of the investigation. Peer, under contract with the University, would assist in coordination of sample locations and intervals, data evaluation and reporting. Terracon, under contract with the MPCA, would conduct field activities including supervision of test pit excavation, sampling, GPS location, preparation of test pit logs, and chain-of-custody documentation, and provide subcontract laboratory testing services.

The final investigation scope was confirmed in a submittal to the MPCA prepared by Terracon dated December 4, 2002. The final investigation scope approved by MPCA included the following components:

- Clearing of public utilities.
- Excavation of test pits.

- Collection of soil samples from the test pits for organic vapor screening and analytical testing.
- Analytical testing of selected soil samples for VOCs, semi-volatile organic compounds (SVOCs) including PAHs, Gasoline Range Organics (GRO), Diesel Range Organics (DRO) by the WDNR Method, total RCRA metals, PCBs, pH, asbestos, aniline, sulfate, nitrogen as nitrate, and nitro-aromatic compounds.
- Documentation of the activities completed including preparation of test pit logs, field notes documenting observed conductions, and chain-of-custody information.

Terracon's approved scope of work also included completion of hand auger borings and grab samples; however, due to the site conditions encountered, these activities were not required and the investigative work was completed using only test pits.

3.0 ENVIRONMENTAL INVESTIGATION

3.1 OVERVIEW

Terracon and its excavation subcontractor conducted the environmental investigation activities at the Site between December 30, 2002 and January 13, 2003 in accordance with the December 4, 2002 scope of work. The investigation activities completed included:

- Performing 56 test pits within the six primary locations.
- Collection of soil samples for analytical testing.
- GPS mapping of test pit locations.
- Completion of test pit logs.
- Field screening of soil samples for the presence of organic vapors.

Per Terracon's MPAC-approved scope of work, field and laboratory activities were completed in accordance with the MPCA's "Superfund Site Assessment/Brownfield Activities in Minnesota Quality Assurance Project Plan (QAPP)", dated September 1998.

3.1.1 Test Pits

Test pits were completed using a track-mounted backhoe. In general, test pits were completed through fill material and into the underlying native soil. Test pits ranged in depth from two feet below ground surface (bgs) to fifteen feet bgs. Samples were visually classified in the field. In addition, soil samples were screened for the presence of organic vapors using a photoionization detector equipped with an 11.8 eV lamp. Soil samples were collected by Terracon from selected intervals for analytical testing based on recommendations provided by Peer and the University. Upon completion, each test pit was backfilled with the excavated soil material.

3.1.2 Analytical Testing Parameters

Peer provided recommendations to Terracon on which parameters each sample was analyzed for based on the information obtained from Peer and Dakota County's reviews of historical GOW operations. The soil samples were submitted for a combination of the following analytical parameters:

- VOCs by EPA Method 8260 – MDH VOC list (A).
- SVOCs including base-neutral and acid extractables by EPA Method 8270 (B).
- GRO by the Wisconsin Department of Natural Resources (WDNR) Method (C).
- DRO by the WDNR Method (D).
- Total RCRA metals using standard EPA methods (E).
- PCBs by EPA Method 8082 (F).
- pH (G).
- Asbestos in soil by EPA Method 600 (H).
- Aniline by EPA Method 8270 (I).
- Sulfate by EPA Method 300 (J).
- Nitrogen as Nitrate by EPA Method 353.2 (K).
- Nitro-Aromatic Compounds by EPA Method 8330 (L).

Terracon submitted the sample to the following laboratories based on the required analytical testing parameters:

- Continental Analytical Services, Salina, Kansas - conducted analyses for Nitro-aromatic Compounds and Aniline.
- International Asbestos Testing Laboratory (IATL), Mt. Laurel, New Jersey - conducted analyses for asbestos.
- EnChem, Inc. (En Chem), Green Bay, Wisconsin - conducted analyses for VOCs, SVOCs, GRO, DRO, total RCRA metals, PCBs, pH, sulfate, and nitrogen as nitrate (nitrate-nitrogen).

3.2 OLEUM PLANT

Six test pits were completed in the vicinity of the Oleum Plant and associated structures. The test pit locations are shown on Figure 2. The investigation areas included the sulfur mixing pit, septic tank, drainage areas and aboveground Oleum storage tank holders.

Test pits OP-TP-1 and OP-TP-2 were completed within the confines of sulfur mixing pit structure. Test pit OP-TP-3 was completed in the general area of a known former septic tank. Test pits OP-TP-4 and OP-TP-5 were completed to the east and south of the concrete base of the former above ground oleum storage tank. Test pit OP-TP-6 was located on the south side of 152nd Street, at the base of the ditch adjacent to the openings of two wooden drainage culverts. These culverts run north to south beneath 152nd Street.

Thirteen soil samples were collected for analytical testing from the six test pits completed in the vicinity of the Oleum Plant. The following table identifies the representative parameters analyzed for each of the samples, depth of each test pit and global positioning system (GPS) coordinates measured by Terracon.

Test Pit	Sample ID	Parameters	GPS Coordinates*	Test Pit Depth
OP-TP-1	OP-TP-1(0-1')	E,G,J	Y17102885.27 X-12124807.81	6'
	OP-TP-1 (1.5')	E,G,J		
	OP-TP-1(1.5-2')	E,G,J		
	OP-TP-1(6')	E		
OP-TP-2	OP-TP-2 (0-1')	E,G,H,J	Y17102866.64 X-12124827.00	6'
	OP-TP-2 Pipe	H		
	OP-TP-2 (4')	H,I,L		
	OP-TP-2 4' (A)	B,E,F,G,J,K		
	OP-TP-2 4' (B)	A,D		
	OP-TP-2A (0-1')	B,E		
OP-TP-3	OP-TP-3 (2')	E	Y17102840.39 X-12124796.92	3'
OP-TP-4	OP-TP-4 (6')	E	Y17102957.86 X-12124881.55	4'
OP-TP-5	OP-TP-5 (4')	E	Y17102934.07 X-12124922.099	4'
OP-TP-6	OP-TP-6 East Culvert (0-1')	E	Y17103009.12 X-12124955.41	3'
	OP-TP-6 East Culvert (0-1')	E		
*Note: Terracon's GPS coordinate data was rectified by Dakota County, and then used to plot the test pit locations as depicted on Figure 2 and subsequent figures.				

3.3 NITRIC ACID PLANT

Four test pits were completed in the vicinity of the Nitric Acid Plant and associated structures. The test pit locations are shown on Figure 3. The investigation areas included the above ground acid tank holders, drainage lines and change house dry wells. Test pit NA-TP-1 was completed on the south side of the southeastern set of above ground acid tank holders. Test pit NA-TP-2 was completed on the south side of a wooden drainage culvert that runs north to south beneath 152nd Street. Test pit NA-TP-3 was completed on the south side of the northwestern set of aboveground acid tank holders. Test pit NA-TP-4 was completed in a dry well located on the west side of a change house that was associated with the nitric acid plant.

Eleven soil samples were collected for analytical testing from the four test pits completed in the vicinity of the Nitric Acid Plant. The following table identifies the representative parameters analyzed for each of the samples, depth of each test pit and global positioning system (GPS) coordinates measured by Terracon.

Test Pit	Sample ID	Parameters	GPS Coordinates	Test Pit Depth
NA-TP-1	NA-TP-1 pipe (4')	E,I,J,K,L	Y17103094.4 X-12125607.81	5'
NA-TP-2	NA-TP-2 (0-1') (B)	I,L	Y17103287.63 X12125598.69	3'
	NA-TP-2 (0-1')	E,J,K		
	NA-TP-2 (2')	E		
NA-TP-3	NA-TP-3 (0-1')	E,J,K	Y17103311.81 X-12125755.33	5'
	NA-TP-3 pipe	E		
	NA-TP-3 gasket	H		
	NA-TP-3 gasket (A)	B		
	NA-TP-3 gasket (B)	D		
	NA-TP-3 brick mortar (A)	B,E		
	NA-TP-3 brick mortar (B)	D		
	NA-TP-3 wood	B		
NA-TP-4	NA-TP-4 dry well	E	Y17103129.86 x-12126040.8	N/A

3.4 BURNING GROUND

Eighteen test pits were completed in the vicinity of the Burning Grounds. The test pit locations are shown on Figure 4. The investigation areas included the west burn pit, east burn pit, drainage culvert and the northern ridge where numerous drum components were present.

Nine test pits BGTP-1 through BGTP-9 were completed in the area of the west burn pit. Two test pits BGTP-10 and BGTP-11 were completed on the northern ridge, in areas that had previously identified remnants of drums used for transport of munitions powder. One test pit BGTP-12 was completed on the west end of a wooden drainage culvert that connected the east and the west burn pits. Seven test pits BGTP-13 through BGTP-18 were completed in the area of the east burn pit.

Thirty-three soil samples were collected for analytical testing from the eighteen test pits completed in the vicinity of the Burning Grounds. The following table identifies the representative parameters analyzed for each of the samples, depth of each test pit and global positioning system (GPS) coordinates measured by Terracon.

Test Pit	Sample ID	Parameters	GPS Coordinates	Test Pit Depth
BG-TP-1	BG-TP-1 (0-1')	E	Y17107206.47 X-12131514.83	4'
	BG-TP-1 (4')	E		
BG-TP-2	BG-TP-2 (0-1')		Y17107080.32 X-12131483.14	6'
	BG-TP-2 (6')	E		
BG-TP-3	BG-TP-3 (0-1')	E	Y17107122.37 X-12131459.93	8'
	BG-TP-3 (8')	E		
BG-TP-4	BG-TP-4 (0-1')	E	Y17107196.59 X-12131378.58	8'
	BG-TP-4 (8')	E		
BG-TP-5	BG-TP-5 (12')	E	Y17107209.51 X-12131391.7	15'
BG-TP-6	BG-TP-6 (0-1')	E	Y17107291.3 X-12131317.84	8'
	BG-TP-6 (2')			
	BG-TP-6 (8')	E		
BG-TP-7	BG-TP-7 (0-1')	E	Y17107291.46 X-12131399.4	12'
BG-TP-8	BG-TP-8 (0-1')	E	Y17107342.85 X-12131383.28	5'
	BG-TP-8 (5')	E		
BG-TP-9	BG-TP-9 (0-1')	E	Y17107371.3 X-12131512.61	5'
BG-TP-10	BG-TP-10 (0-1') (A)	B,E,F,G,H,I,J,K,L	Y17106866.03 X-12130833.43	3'
	BG-TP-10 (0-1') (B)	A,D		
	BG-TP-10 (3-4')	E		
	BG-TP-10 wood	B		
BG-TP-11	BG-TP-11 (0-1)'	E	Y17107298.17 X-12131129.47	2'
BG-TP-12	BG-TP-12 below culvert	B,E,F,G,H,I,J,K,L	Y17107053.7 X-12131120.07	2'
	BG-TP-12 below culvert (B)	A,D		
	BG-TP-12 inside culvert	B,E,I,L		
	BG-TP-12 wood	B		
BG-TP-13	BG-TP-13 (0-1')	E	Y17106988.27 X-12131117.44	4'
BG-TP-14	BG-TP-14 (0-1')	E	Y17107011.34 X-12131141.24	4'
BG-TP-15	BG-TP-15 (0-1')	H,I,.L	Y17107123.05 X-12131110.7	3'
	BG-TP-15 (0-1') (A)	B,E,F,G, J,K		
	BG-TP-15 (0-1') (B)	A,D		
	BG-TP-15 wood	B		
BG-TP-16	BG-TP-16 (0-1')	E	Y17107130.19 X12131076.12	4'
BG-TP-17	N/A	N/A	Y17107184.86 X-12131162.54	4'
BG-TP-18	BG-TP-18 (0-1')	B,E,I,J,K,L	Y17107083.4 X-12131325.62	5'
	BG-TP-18 (4-5')	E		

3.5 WASTEWATER TREATMENT PLANT

Twenty-four test pits were completed in the vicinity of Wastewater Treatment Plant and associated structures. The test pit locations are shown on Figures 5a, 5b, 5c and 5d, and were plotted by Dakota County using Terracon's GPS data after it was rectified. The investigation areas included the transformer pads, aboveground secondary containment reservoir, earthen berm, underground water holding tank, wooded area, rail spur, firing range, sludge drying beds, Effluent Pond and heavy equipment area.

Two surficial test pits WWTP-TP-1 A, B, C and WWTP-TP-2 A, B, C were completed in the area of the former transformer pads. Each test pit consisted of three sub-excavations (labeled A, B and C). Two test pits WWTP-TP-3 and WWTP-TP-4 were completed within the aboveground secondary containment reservoir. Seven test pits WWTP-TP-4 through WWTP-TP-11 were completed in a berm with previously identified surficial traces of coal. One test pit WWTP-TP-12 was completed inside of an underground water holding tank. Two test pits WWTP-TP-13 and WWTP-TP-14 were completed in the wooded area. Test pits WWTP-TP-15 and WWTP-TP-16 were completed in the areas of a former railroad spur and ballistics firing range, respectively. Two test pits WWTP-TP-17 and WWTP-TP-18 were completed in the approximate area of the sludge drying beds.

Three test pits were completed in the Effluent Pond associated with the WWTP. Two of the test pits, WWTP-TP-19 and WWTP-TP-20, were located in the lower elevation areas of the pond (i.e. downstream). The other test pit, WWTP-TP-21, was completed at a higher elevation (i.e. upstream).

Test pits WWTP-TP-22 through WWTP-TP-24 were completed in the heavy equipment area. The test pits were located near former concrete structures associated with past GOW operations.

Thirty-four soil samples were collected for analytical testing from the twenty-four test pits completed in the vicinity of the Wastewater Treatment Plant. The following table identifies the representative parameters analyzed for each of the samples, depth of each test pit and global positioning system (GPS) coordinates measured by Terracon.

Test Pit	Sample ID	Parameters	GPS Coordinates	Test Pit Depth
N/A	WWTP-TP-Stack Sample	H	N/A	N/A
WWTP-TP-1A	WWTP-TP-1C (Composite of A-C)	F	Y17101755.65 X-12126431.35	2'
WWTP-TP-1B			Y17101762.19 X-12126450.57	2'
WWTP-TP-1C			Y17101772.83 X-12126462.58	2'
WWTP-TP-2A	WWTP-TP-2C (Composite of A-C)	F	Y17101801.72 X-12126413.04	2'
WWTP-TP-2B			Y17101810.97 X-12126426.88	2'
WWTP-TP-2C			Y17101816.72 X-12126439.23	2'
WWTP-TP-3	WWTP-TP-3 surface	E	Y17101821.69 X-12126216.94	3'
WWTP-TP-4	WWTP-TP-4 surface	B,E	Y17101818.95 X-12126203.04	3'

WWTP-TP-5	WWTP-TP-5 (8')	E	Y17101428.22 X-12126357.05	8'
WWTP-TP-6	WWTP-TP-6 (0-1')	E	Y17101490.14 X-12126428.39	7'
WWTP-TP-7	WWTP-TP-7 (4')	E	Y17101502.36 X-12126584.12	10'
	WWTP-TP-7 (8') (A)	A,D,E,G,H,J,K,L		
	WWTP-TP-7 (8') (B)	B,F		
WWTP-TP-8	WWTP-TP-8 (2')	E	Y17101382.73 X-12126469.77	2'
WWTP-TP-9	N/A	N/A	Y17101524.94 X-12126381.13	N/A
WWTP-TP-10	WWTP-TP-10 (12') (A)	E	Y17101431.07 X-12126401.01	15'
	WWTP-TP-10 (12') (B)	B		
	WWTP-TP-10 (15') (A)	E		
	WWTP-TP-10 (15') (B)	B		
WWTP-TP-11	WWTP-TP-11 (10' (A)	B,D,E,F	Y17101422.05 X-12126531.1	15'
	WWTP-TP-11 (10') (B)	A		
WWTP-TP-12	WWTP-TP-12 slag	B,E,F	Y17101838.12 X-12126363.35	8'
	WWTP-TP-12 tar	B,F		
	WWTP-TP-12 asbestos	H		
	WWTP-TP-12 (4-5') trash pit P12 (A)	B,D,E,F		
	WWTP-TP-12 (4-5') trash pit P12	A		
	WWTP-TP-12 electrical insulation	B,F,H		
WWTP-TP-13	WWTP-TP-13 (0-1') (B)	A,H,I,L	Y17100581.3 X-12126449.92	3'
	WWTP-TP-13 (0-1') (A)	B,D,E,F,G,J,K		
	WWTP-TP-13 (1-2')	E		
WWTP-TP-14	WWTP-TP-14 (0-2')	B,D,E	Y17100443.43 X-12126568.76	3'
WWTP-TP-15	N/A	N/A	Y17100197.22 X-12126389.6	6'
WWTP-TP-16	N/A	N/A	Y17099836.43 X-12126832.07	6'
WWTP-TP-17 & 18	WWTP-TP-17 & 18 (2') (A)	B,D,E,F,G,I,J,K,L	Y17100920.66 X-12126640.37	2'
	WWTP-TP 17 & 18 (2') (B)	A		
WWTP-TP-19	WWTP-TP-19 (2')	B,E	Y17099743.9 X-12125336.31	8'
WWTP-TP-20	WWTP-TP-20 (2') (B)	A,B,D,E,F,G,I,J,K ,L	Y17099710.59 X-12125437.9	3'
WWTP-TP-21	N/A		Y17099856.81 Y-12125197.31	4'
WWTP-TP-22	WWTP-TP-22 (0-2')	E	Y17099378.22 X-12125406.94	3'
WWTP-TP-23	WWTP-TP-23 (0-1')	E	Y17099289.02 X-12125483.56	3'
WWTP-TP-24	WWTP-TP-24 (0-1')	E	Y17099342.49 X-12125468.65	4'

Two surficial test pits WWTP-TP-1 A, B, C and WWTP-TP-2 A, B, C were completed in the area of the former transformer pads. Each test pit consisted of three sub-excavations (labeled A, B and C). Two test pits WWTP-TP-3 and WWTP-TP-4 were completed within the aboveground secondary containment reservoir. Seven test pits WWTP-TP-4 through WWTP-TP-11 were completed in a berm with previously identified surficial traces of coal. One test pit WWTP-TP-12 was completed inside of an underground water holding tank. Two test pits WWTP-TP-13 and WWTP-TP-14 were completed in the wooded area. Test pits WWTP-TP-15 and WWTP-TP-16 were completed in the areas of a former railroad spur and ballistics firing range, respectively. Two test pits WWTP-TP-17 and WWTP-TP-18 were completed in the approximate area of the sludge drying beds.

Three test pits were completed in the Effluent Pond associated with the WWTP. Two of the test pits, WWTP-TP-19 and WWTP-TP-20, were located in the lower elevation areas of the pond (i.e. downstream). The other test pit, WWTP-TP-21, was completed at a higher elevation (i.e. upstream).

Test pits WWTP-TP-22 through WWTP-TP-24 were completed in the heavy equipment area. The test pits were located near former concrete structures associated with past GOW operations.

Thirty-four soil samples were collected for analytical testing from the twenty-four test pits completed in the vicinity of the Wastewater Treatment Plant. The following table identifies the representative parameters analyzed for each of the samples, depth of each test pit and global positioning system (GPS) coordinates measured by Terracon.

Test Pit	Sample ID	Parameters	GPS Coordinates	Test Pit Depth
N/A	WWTP-TP-Stack Sample	H	N/A	N/A
WWTP-TP-1A	WWTP-TP-1C (Composite of A-C)	F	Y17101755.65 X-12126431.35	2'
WWTP-TP-1B			Y17101762.19 X-12126450.57	2'
WWTP-TP-1C			Y17101772.83 X-12126462.58	2'
WWTP-TP-2A	WWTP-TP-2C (Composite of A-C)	F	Y17101801.72 X-12126413.04	2'
WWTP-TP-2B			Y17101810.97 X-12126426.88	2'
WWTP-TP-2C			Y17101816.72 X-12126439.23	2'
WWTP-TP-3	WWTP-TP-3 surface	E	Y17101821.69 X-12126216.94	3'
WWTP-TP-4	WWTP-TP-4 surface	B,E	Y17101818.95 X-12126203.04	3'

WWTP-TP-5	WWTP-TP-5 (8')	E	Y17101428.22 X-12126357.05	8'
WWTP-TP-6	WWTP-TP-6 (0-1')	E	Y17101490.14 X-12126428.39	7'
WWTP-TP-7	WWTP-TP-7 (4')	E	Y17101502.36 X-12126584.12	10'
	WWTP-TP-7 (8') (A)	A,D,E,G,H,J,K,L		
	WWTP-TP-7 (8') (B)	B,F		
WWTP-TP-8	WWTP-TP-8 (2')	E	Y17101382.73 X-12126469.77	2'
WWTP-TP-9	N/A	N/A	Y17101524.94 X-12126381.13	N/A
WWTP-TP-10	WWTP-TP-10 (12') (A)	E	Y17101431.07 X-12126401.01	15'
	WWTP-TP-10 (12') (B)	B		
	WWTP-TP-10 (15') (A)	E		
	WWTP-TP-10 (15') (B)	B		
WWTP-TP-11	WWTP-TP-11 (10' (A)	B,D,E,F	Y17101422.05 X-12126531.1	15'
	WWTP-TP-11 (10') (B)	A		
WWTP-TP-12	WWTP-TP-12 slag	B,E,F	Y17101838.12 X-12126363.35	8'
	WWTP-TP-12 tar	B,F		
	WWTP-TP-12 asbestos	H		
	WWTP-TP-12 (4-5') trash pit P12 (A)	B,D,E,F		
	WWTP-TP-12 (4-5') trash pit P12	A		
	WWTP-TP-12 electrical insulation	B,F,H		
WWTP-TP-13	WWTP-TP-13 (0-1') (B)	A,H,I,L	Y17100581.3 X-12126449.92	3'
	WWTP-TP-13 (0-1') (A)	B,D,E,F,G,J,K		
	WWTP-TP-13 (1-2')	E		
WWTP-TP-14	WWTP-TP-14 (0-2')	B,D,E	Y17100443.43 X-12126568.76	3'
WWTP-TP-15	N/A	N/A	Y17100197.22 X-12126389.6	6'
WWTP-TP-16	N/A	N/A	Y17099836.43 X-12126832.07	6'
WWTP-TP-17 & 18	WWTP-TP-17 & 18 (2') (A)	B,D,E,F,G,I,J,K,L	Y17100920.66 X-12126640.37	2'
	WWTP-TP 17 & 18 (2') (B)	A		
WWTP-TP-19	WWTP-TP-19 (2')	B,E	Y17099743.9 X-12125336.31	8'
WWTP-TP-20	WWTP-TP-20 (2') (B)	A,B,D,E,F,G,I,J,K ,L	Y17099710.59 X-12125437.9	3'
WWTP-TP-21	N/A		Y17099856.81 Y-12125197.31	4'
WWTP-TP-22	WWTP-TP-22 (0-2')	E	Y17099378.22 X-12125406.94	3'
WWTP-TP-23	WWTP-TP-23 (0-1')	E	Y17099289.02 X-12125483.56	3'
WWTP-TP-24	WWTP-TP-24 (0-1')	E	Y17099342.49 X-12125468.65	4'

3.6 MACHINE SHOP

Two test pits MSTP-1 and MSTP-2 were completed in the area of a former 10,000 gallon UST. The test pit locations are shown on Figure 6 (note: locations are approximate and may be revised once GPS coordinate data has been provided by Terracon).

Two soil samples were collected for analytical testing from the two test pits completed in the vicinity of the Machine Shop. The following table identifies the representative parameters analyzed for each of the samples, depth of each test pit and global positioning system (GPS) coordinates measured by Terracon.

Test Pit	Sample ID	Parameters	GPS Coordinates	Test Pit Depth
MS-TP-1	MS-TP-1 (5')	E	*	6'
MS-TP-2	MS-TP-2	D	*	5'
*Note: GPS data was note provided by Terracon. Information will be provided as an addendum to this report if made available.				

3.7 PRIMARY SETTLING BASIN

Two test pits PSB-TP-1 and PSB-TP-2 were completed in the delta area of the primary settling basin. The test pit locations are shown on Figure 7 (note: locations are approximate and may be revised once GPS coordinate data has been provided by Terracon).

Two soil samples were collected for analytical testing from the two test pits completed in the vicinity of the Primary Settling Basin. The following table identifies the representative parameters analyzed for each of the samples, depth of each test pit and global positioning system (GPS) coordinates measured by Terracon.

Test Pit	Sample ID	Parameters	GPS Coordinates	Test Pit Depth
PSB-TP-1	PSB-TP-1 (3-4')	H,I,L	*	5'
PSB-TP-2	PSB-TP-2 (6')	I,L	*	6'
*Note: GPS data was note provided by Terracon. Information will be provided as an addendum to this report if made available.				

4.0 INVESTIGATION RESULTS

4.1 OVERVIEW

Test pits advanced at the Site encountered a wide range of geologic conditions, which varied across the Site. Logs for select test pits prepared by Terracon are included in Appendix B (Note: Terracon did not prepare logs for test pits OP-TP-5 and 6, NA-TP-1 and 4, BP-TP-4, 11, 12, 13, 14, 16, 17 and 18, and WWTP-TP-1, 2, 3, 4, 21 and 24). The test pit logs document subsurface conditions encountered and PID readings for sample intervals that were screened. Copies of Terracon's daily field logs are also included in Appendix B. Photographs of selected test pit locations taken by Peer are included in Appendix C.

Copies of the laboratory analytical reports, chain-of-custody forms and laboratory quality assurance/quality control data are included in Appendix D. The En Chem laboratory report (see Appendix D) also includes a list of footnotes related to the analytical testing results. As indicated in the footnotes to the laboratory report, the mercury analyses for eleven of the samples were performed outside the recommended EPA holding time.

The following is a summary of the investigation results for each area.

4.2 OLEUM PLANT

4.2.1 Subsurface Conditions

Test pit OP-TP-1 identified three distinct layers of residual process media within the sulfur mixing pit. The top layer (0-1') was a dense, firm material with a dark green to black color. The middle layer (1-1.5') was a medium density, greenish colored material. The base (1.5-2.0') located immediately above the brick base, consisted of a light, loose, bright yellow residue with strong sulfur odors. The structural components of the mixing pit consisted of poured concrete walls and a brick base. The walls extended approximately six feet below ground surface (bgs) and were poured on top of a red brick foundation. Based on observations during completion of the test pits, the mixing pit was approximately eight feet wide. Measurements from the 1945 air photograph (Figure 2) indicate the sulfur mixing pit was approximately 100 feet long. Test pit OP-TP-2 was consistent with the findings of OP-TP-1, with the exception that a larger amount of sulfur residue, traces of charred wood and piping components were encountered.

No visual or olfactory evidence of impacts was identified during field observations of test pits OP-TP-3 through OP-TP-6.

4.2.2 Analytical Results

The analytical testing results for soil samples collected from the Oleum Plant are summarized in Table 1. Table 1 also includes MPCA Residential and Industrial Soil Reference Values (SRVs) and Soil Leaching Values (SLVs) for comparison purposes. The following observations are provided regarding the analytical results:

- Two samples were analyzed from the test pits in this area for SVOCs including OP-TP-2A (0-1') and OP-TP-2 4' (A). Five SVOCs were detected in sample OP-TP-2 4' (A) including benzo(g,hi)perylene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene. These compounds, which are polynuclear aromatic hydrocarbons (PAHs), were detected at concentrations ranging from 0.45 milligrams per kilogram (mg/kg) to 0.69 mg/kg. The benzo(a)pyrene (BaP) equivalent concentration for this sample was 0.048 mg/kg. The detected PAH concentrations were below the respective SRVs and SLVs.

- Five samples from the test pits were analyzed for soluble sulfate including OP-TP-1 (0-1'), OP-TP-1 (1-1.5'), OP-TP-1 (1.5-2), OP-TP-2 (0-1') and OP-TP-2 4' (A). Soluble sulfate was detected in each of the five samples at concentrations ranging from 140 mg/kg in OP-TP-1 (0-1') to 30,000 mg/kg in OP-TP-2 (0-1'). Four of these five samples had sulfate concentrations exceeding 10,000 mg/kg.

- Twelve soil samples from the test pits were analyzed for total RCRA metals including OP-TP-1 (0-1'), OP-TP-1 (1-1.5'), OP-TP-1 (1.5-2), OP-TP-1 (6'), OP-TP-2 (0-1'), OP-TP-2A (0-1'), OP-TP-2 4' (A), OP-TP-3 (2'), OP-TP-4 (6'), OP-TP-5 (4'), OP-TP-6 East Culvert, OP-TP-6 West Culvert. Metals detected included arsenic, barium, cadmium, chromium, and lead. Mercury was detected in six of the twelve samples at concentrations ranging from 0.016 to 0.072 mg/kg. Metals concentrations detected were below the respective SRVs or SLVs.

- One sample, OP-TP-2 4' (B), was analyzed for DRO. DRO was detected at a concentration of 33 mg/kg.

- Five of the soil samples were analyzed for pH. The reported pH readings ranged from 4.0 (acidic) to 11.0 standard units (basic).

- No VOCs, Nitro-Aromatic compounds, PCBs, asbestos or nitrate-nitrogen were detected above their respective reporting limits in soil samples analyzed for these parameters.

4.3 NITRIC ACID PLANT

4.3.1 Subsurface Conditions

Test pit NA-TP-3 was completed around a brick structure that surrounded a vitrified clay drainage line associated with the former aboveground acid tanks (located on concrete holders which are still present). This test pit uncovered fill soils with intermixed debris that included black brick mortar, remnants of burnt wood and broken gaskets from the drainage line.

NA-TP-4 was completed within a former Dry Well located northwest of the change house. Based on observations during excavation, the Dry Well appeared to be of brick and mortar construction and was approximately 2 to 3 feet in diameter. The structure extended to at least a depth of 5 to 6 feet (where an analytical testing sample was collected). The structure was open to a depth of 5 feet bgs, below which a deposit of dry, silty material overlain by decomposing vegetative matter was encountered. The full depth of the structure was not determined during the excavation.

No visual or olfactory evidence of impacts was identified during field observations of NA-TP-1, NA-TP-2 or NA-TP-4.

4.3.2 Analytical Results

The analytical testing results for soil and debris samples collected from the Nitric Acid Plant are summarized in Table 2. Table 2 also includes Residential and Industrial SRVs and SLVs for comparison purposes. The following observations are provided regarding the analytical results:

- Seven soil samples were analyzed for RCRA metals. Reported metals concentrations did not exceed their respective SRVs and SLVs with the exception of soil samples "NA-TP-3 Pipe" and "NA-TP-4 Dry Well". Sample NA-TP-3 Pipe consisted of soil material collected from inside the drainage line and had a total arsenic concentration of 14 mg/kg and a total mercury concentration of 0.29 mg/kg. Sample NA-TP-4 Dry Well consisted of dry, silty material with vegetative matter and was collected from inside and at the base of the dry well associated with the acid change house. This sample had a total mercury concentration of 42 mg/kg.

- Soluble sulfate was detected in the three of the soil samples analyzed for this parameter. Concentrations were 54, 68, and 2,900 mg/kg.

- Nitrate-nitrogen was detected in one of three samples analyzed for this parameter. The concentration of nitrate-nitrogen detected in soil sample NA-TP-Pipe 4' was 36 mg/kg. The soil cleanup goal for this compound established by the Minnesota Department of Agriculture is 150-200 mg/kg.

- Asbestos (30% Chrysotile) was detected in the only sample collected for this parameter, NA-TP-3 Gasket (A), which was a pipe gasket material.

- Two samples were analyzed for DRO. The samples identified as NA-TP-3 gasket and NA-TP-3 brick mortar (B) identified concentrations of DRO at 5,100 mg/kg and 5,900 mg/kg, respectively.

- No SVOCs or nitro-aromatic compounds were detected above their respective reporting limits in two soil samples, NA-TP-1 Pipe (4') and NA-TP-2 (0-1'), analyzed for these compounds.

4.4 BURNING GROUNDS

4.4.1 Subsurface Conditions

Test pits BGTP-1 through BGTP-9 were completed in the area of the west burn pit. All test pits with the exception of BGTP-4 and BGTP-5 identified native sandy soils and did not encounter any signs of burning related activities. However, test pits BGTP-4 and BGTP-5 encountered a dark black organic material raging to depths of up to 12 feet bgs. No signs of burning activities or visual impacts to the soil were identified in this material. It is believed that this low-lying isolated area was previously subjected to swamp deposits and/or organic decay.

Test pits BGTP-10 and BGTP-11 encountered primarily surficial drum components and miscellaneous charred wood debris. No debris or drum components were identified beyond 2 feet bgs.

Test pit BGTP-12 identified a black coating of material on the exterior of the wood used to construct the culvert. No signs of residual burn media were present in the soil within or below the drainage culvert.

Test pits BGTP-13 through BGTP-18 were completed in the area of the east burn pit. Test pit BGTP-15 encountered traces of coal, wood debris and possible ash from 0-1 feet bgs. Rusted nails, metal and burnt wood was also identified from 1-2 feet bgs. Test pit BGTP-18 identified traces of coal and various metal debris from 0 to 1 foot bgs. No visual or olfactory evidence of impacts was identified during field observations of the other test pits completed in the east burn pit.

4.4.2 Analytical Results

The analytical testing results for soil samples collected from the Burning Ground are summarized in Table 3. Table 3 also includes Residential and Industrial SRVs and SLVs for comparison purposes. The following observations are provided regarding the analytical results:

- Thirteen SVOCs were detected in three of the eight soil samples analyzed for these parameters. All of the SVOCs detected were PAH compounds. Concentrations identified in samples BG-TP-12 below culvert and BG-TP-12 inside culvert were all below their respective SRVs and SLVs. Concentrations identified in sample BG-TP-12 wood, ranged from 330 mg/kg to 2,300 mg/kg. Three of the identified compounds exceeded their representative residential SRVs and the sample had a calculated Benzo(a)pyrene (BaP) equivalent of 424.5 mg/kg.

- Twenty-five soil samples were analyzed for RCRA metals. Metals were detected in each sample analyzed. Total mercury was detected in 19 of the 25 samples at concentrations ranging from 0.013 mg/kg [BG-TP-9 (0-1')] to 16 mg/kg in BG-TP-8 (0-1'). Metals concentrations exceeded the SRVs and/or SLVs in the following samples:

  - 14 mg/kg arsenic in sample BG-TP-10 (0-1')(A).
  - 3,100 mg/kg lead in sample BG-TP-15 (0-1')(A).
  - 1,000 mg/kg lead in sample BG-TP-1 (0-1').
  - 16 mg/kg mercury in sample BG-TP-8 (0-1').

- Soluble sulfate was detected in three of the four soil samples analyzed for this parameter. Concentrations ranged from 52 mg/kg to 64 mg/kg.

- Nitrate-nitrogen was detected in one of four samples analyzed for this parameter. The concentration of nitrate-nitrogen detected in soil sample BG-TP-10 (0-1') (A)' was 29 mg/kg.

- Three soil samples were analyzed for pH. The reported pH readings ranged from 7.2 to 7.3 standard units.

No VOCs, nitro-aromatic compounds, PCBs, asbestos or DRO, were detected above their respective reporting limits in soil samples analyzed for these parameters.

4.5 WASTEWATER TREATMENT PLANT

4.5.1 Subsurface Conditions

Transformer Pads

Test pits WWTP-TP-1 A, B, C and WWTP-TP-2 A, B, C were completed around each of the two transformer pads to obtain surficial soil samples. No evidence of soil staining or electrical components was present in any of the surficial areas immediately adjacent to the pads.

Aboveground Reservoir

Test Pits WWTP-TP-3 and WWTP-TP-4 were completed within the aboveground secondary containment reservoir. The test pits did not encounter a concrete slab at the base of the containment reservoir. However, no visual or olfactory evidence was observed in the underlying soil.

Earthen Berm

Test pits WWTP-TP-5 through WWTP-TP-11 were completed in an earthen berm that previously identified surficial traces of coal. The approximate dimensions of the earthen berm are 15 feet high, 35 to 50 feet wide and 150 to 200 feet long. The test pits were completed in a number of areas and the following is a summary of the berm's stratigraphy:

- The upper media deposition of the berm consisted of traces of coal and ranged in depth from 0 to 4 feet bgs.
- The intermediate media of the berm consisted of a dark black material that appeared to have the characteristics of sewage and/or organic decay. This material continued to the base of the berm, ranging in depths of up to 15 feet bgs.
- The base of the berm identified what appeared to be a 1-1/2 foot concentrated layer of red to rusty colored dense soil.

Underground Water Holding Tank

Test pit WWTP-TP-12 was completed inside of an underground water holding tank. This tank was constructed of concrete and connected via piping to the adjacent aboveground water reservoir associated with Power Plant A. The test pit uncovered a large amount of miscellaneous demolition debris that was apparently dumped into the holding tank. The debris consisted of electrical components, brick, slag, tar and asbestos containing material. No soil was identified within the confines of the holding tank.

Wooded Area to South-Southeast of WWTP

Test pits WWTP-TP-13 and WWTP-TP-14 were completed in the wooded area which is located south-southeast of the WWTP and south of the earthen berm. The ground surface in the wooded area and surrounding farm fields was observed to have uniformly distributed accumulations of coal, ash, slag, and vitrified material/klinkers. The test pits revealed the presence of this material to depths of up to 1 foot bgs. Native sandy soil was encountered at depths below one foot in the test pits.

Railroad Spur and Ballistics Range

Test pits WWTP-TP-15 and WWTP-TP-16 were completed in the areas of a former railroad spur and ballistics firing range, respectively. No visual or olfactory evidence of impacts was identified during field observations of test pits WWTP-TP-15 and WWTP-TP-16.

Sludge Drying Bed Area

It was originally intended that test pits WWTP-TP-17 and WWTP-TP-18 would be completed within the former sludge drying beds. However, due to technical difficulties with the GPS equipment, the test pits were actually completed approximate 50 feet south-southeast of the sludge drying beds. Thick frost that the location of the test pits limited excavation to a depth of 2 feet bgs. No visual or olfactory evidence of impacts was identified during field observations of test pits WWTP-TP-17 and WWTP-TP-18.

Effluent Pond

Test Pits WWTP-TP-19 and WWTP-TP-20 completed in the Effluent Pond identified a depositional area of gray-black finer grained sediment material from 0-2 feet bgs. The presence of the fine gray-black material suggests that this area was a settling point of lighter, less dense material from the drainage that entered the pond from Power Plant A and the Ballistics Range and Lab. No visual or olfactory evidence of impacts was identified during field observations of test pit WWTP-TP-21.

Heavy Equipment Area

Three test pits WWTP-TP-22 through WWTP-TP-24 were completed in an area formerly used for heavy equipment activity. No visual or olfactory evidence of impacts was identified during field observations of these test pits.

4.5.2 Analytical Results

The analytical testing results for soil samples collected from the Waste Water Treatment Plant are summarized in Table 4. Table 4 also includes Residential and Industrial SRVs and SLVs for comparison purposes. The following observations are provided regarding the analytical results:

Transformer Pad Area

- Composite surficial soil samples WWTP-TP-1 A, B, C and WWTP-TP-2 A, B, C were collected immediate area of each transformer pad were analyzed for PCBs. Arochlor 1260 was identified in both samples at concentrations of 0.3 and 0.11 mg/kg, respectively.

Aboveground Reservoir

- Samples WWTP-TP-3 Surface and WWTP-TP-4 Surface were analyzed for RCRA metals. Both samples contained total arsenic, barium, cadmium, chromium and lead. Total mercury was also detected in sample WWTP-TP-3 Surface at a concentration of 0.014 mg/kg. Metals concentrations detected were below the respective SRVs or SLVs.
- No SVOCs were detected above their respective reporting limits in soil sample WWTP-TP-4 Surface.

- Two samples were analyzed for RCRA metals. One sample, WWTP-TP-12 4-5' trash pit P12 (A), identified a concentration of 84 mg/kg arsenic. No other metals were detected above their respective residential SRVs.

- Asbestos was identified in two of three samples analyzed for this parameter. Percentage of asbestos containing material ranged from a trace to 30%.

- DRO was detected at a concentration of 56,000 mg/kg in sample WWTP-TP-12 4-5' TRASH PIT P12 (A). This was a sample of tar-like material collected from debris in holding tank.

Wooded Area to South-Southeast of WWTP

- Fourteen types of VOCs were identified in the only sample analyzed for this parameter, and concentrations ranged from 0.041 mg/kg to 4.7 mg/kg.

- Three soil samples were analyzed for RCRA metals. Two of the three soil samples, WWTP-TP-13 (0-1') (A) and WWTP-TP-14 (0-2'), detected concentrations of mercury at 29 mg/kg and 30 mg/kg, respectively. No other metals were identified above their respective residential SRVs.

- One soil sample, WWTP-TP-13 (0-1') (A), was analyzed for soluble sulfate and had a concentration of 50 mg/kg.

- One soil sample, WWTP-TP-13 (0-1') (A), was analyzed for pH, and had a reading of 7.0 standard units.

- One soil sample, WWTP-TP-13 (0-1') (A), was analyzed for DRO, and had a concentration of 24 mg/kg.

- No SVOCs, nitro-aromatic compounds, or asbestos, were detected above their respective reporting limits in soil samples analyzed for these parameters.

Railroad Spur and Ballistics Range

No samples were collected for analytical testing from this area.

Sludge Drying Bed Area

- One soil sample, WWTP-TP-17 & 18 2' (A), was analyzed for RCRA metals, and detected a concentration of mercury at 23 mg/kg. No other metals were identified above their respective residential SRVs.

- One soil sample, WWTP-TP-17 & 18 2' (A), was analyzed for soluble sulfate and had a concentration of 51 mg/kg.

- One soil sample, WWTP-TP-17 & 18 2' (A), was analyzed for pH, and had a reading of 7.7 standard units.

- No VOCs, SVOCs, PCBs, nitro-aromatic compounds, nitrate-nitrogen, DRO, or asbestos were detected above their respective reporting limits in soil samples analyzed for these parameters.

Effluent Pond

- Soil samples WWTP-TP-19 (2') and WWTP-TP-20 2' (B) were analyzed for RCRA metals. Total mercury was detected in the samples at concentrations of 420 mg/kg and 590 mg/kg, respectively. Both samples also contained total arsenic, barium, cadmium, chromium, lead and silver. Total mercury concentrations exceeded the SRV and SLV. The concentrations of other metals detected were below the respective SRVs and SLVs.

- Sample WWTP-TP-20 2' (B), was analyzed for soluble sulfate and had a concentration of 69 mg/kg. Soluble sulfate was detected at higher concentrations in samples from the Oleum Plant and Nitric Acid Plant areas.

- Soil sample WWTP-TP-20 2' (B) was analyzed for pH and had a reading of 7.7 standard units.

- Sample WWTP-TP-20 2' (B) was analyzed for DRO and had a concentration of 8.0 mg/kg.

- No VOCs, nitro-aromatic compounds, nitrate-nitrogen, or asbestos, were detected above their respective reporting limits in soil samples analyzed for these compounds.

Heavy Equipment Area

- Three soil samples were analyzed for RCRA metals including WWTP-TP-22 (0-2'), WWTP-TP-23 (0-1') and WWTP-TP-24 (0-1'). Total mercury was detected in all three samples at concentrations of 20, 0.027 and 0.032, respectively. TP-22 was located on the southeast edge of the ash disposal area. Total arsenic, barium, cadmium, chromium and lead were also detected in the samples at concentrations below the SRVs and SLVs.

Power Plant A Smoke Stacks

- One sample, labeled WWTP-Stack, of suspect asbestos-containing "transite" board was collected from the interior concrete base of the smoke stacks for Power Plant A which is located north of the WWTP. This material originated from the interior liner of the stacks. The sample contained 20% asbestos.

4.6 MAINTENANCE SHOPS

4.6.1 Subsurface Conditions

Two test pits MSTP-1 and MSTP-2 were completed in the area of a former 10,000 gallon UST. No visual or olfactory evidence of impacts was identified during field observations of the test pits.

4.6.2 Analytical Results

The analytical testing results for soil samples collected from the Maintenance Shops area are summarized in Table 5. Table 5 also includes Residential and Industrial SRVs and SLVs for comparison purposes. Two samples, MS-TP-1 (5') and MS-TP-2, were submitted for analytical testing. The samples were collected from a depth of 5 to 6 feet. The following observations are provided regarding the analytical results:

- Sample MS-TP-1 (5') contained concentrations of total arsenic, barium, cadmium, chromium and lead. Total mercury was detected also detected at a concentration of 0.022 mg/kg. The metals concentrations were below the respective SRVs and SLVs.
- DRO was not detected in either sample.

4.7 PRIMARY SETTLING BASIN

4.7.1 Subsurface Conditions

Two test pits PSBTP-1 and PSBTP-2 were completed in the delta area of the primary settling basin. The test pits identified a dark black organic top soil to depths of 6 feet bgs. The topsoil was underlain by native sand. No visual or olfactory evidence of impacts was identified during field observations of the test pits.

4.7.2 Analytical Results

The analytical testing results for soil samples collected from the Primary Settling Basin Area are summarized in Table 5. Table 5 also includes Residential and Industrial SRVs and SLVs for comparison purposes. Two samples PSB-TP-1 (3-4') and PSB-TP-2 (6'), were submitted for analytical testing. The following observations are provided regarding the analytical results:

- Concentrations of dinitrotoluene and nitrotoluene compounds were detected in both samples analyzed. Detected compounds included 2,4-dinitrotoluene, 2,6-dinitrotoluene, m-nitrotoluene and o-nitrotoluene. The concentrations ranged from 0.33 to 6.03 mg/kg. Dinitrotoluene concentrations were below the SRVs but exceeded the SLVs. No SRVs or SLVs are currently established by the MPCA for nitrotoluene compounds. Aniline was not detected in either sample.
- Both samples contained concentrations of total arsenic, barium, cadmium, chromium and lead. Total mercury was detected also detected at a concentration of 0.022 mg/kg. The metals concentrations were below the respective SRVs and SLVs, with the exception of sample PSB-TP-1 (3-4'). The total chromium concentration in PSB-TP-1 (3-4') was 23 mg/kg, which exceeds the SLV of 18 mg/kg.

5.0 CONCLUSIONS

5.1 OLEUM PLANT

The Oleum Plant was for the production of sulphuric acid which was concentrated into "oleum". The manufacturing process used raw sulfur. Remnants of a sulfur melting pit and other building remnants are still present in this area. Other features of this area included a boiler, sulfur storage tanks, oleum and spent acid storage tanks, and associated building structures and sewer system components. Published EPA information indicates wastewater generated from oleum production originated from cooling water contaminated by acid spills and tank car clean-up. Waste characterization data reviewed by EPA indicates that the wastewater would have a low pH and high levels of sulfate. Published information reviewed by Peer indicates that some raw sulfur product contains mercury. Because raw sulfur as well as sulphuric acid was used at GOW in the production of oleum, it is assumed that the wastewater generated by the oleum production would also have contained mercury. An estimated 81 million pounds of oleum was produced between November 1944 and July 1945. Some of this material was used on-site for nitrocellulose production and the remainder was shipped off-site for use at other munitions plants.

A total of six test pits were completed in the vicinity of the Oleum Plant and associated structures. The areas of investigation included the sulfur mixing pit, septic tank, drainage areas and above ground Oleum storage tank holders. Key findings included:

- The two pits (OP-TP-1 and OP-TP-2) completed within the former sulfur mixing pit identified residual sulfur at a depth of approximately 2 feet. No visual or olfactory evidence of impacts were identified in the other four test pits in the Oleum Plant area.

- Analytical testing of shallow soils from the Oleum Plant area identified concentrations of polynuclear aromatic hydrocarbons (PAHs), DRO, and soluble sulfates.

- Mercury was detected in six of the twelve samples at concentrations ranging from 0.016 to 0.072 mg/kg. Metals concentrations detected were below the respective SRVs or SLVs.

5.2 NITRIC ACID PLANT

The Nitric Acid Plant area was located west of the Oleum Plant. Nitric acid was produced in this area, which along with sulphuric acid was used in the manufacture of the nitrocellulose. Features associated with this area included anhydrous storage tanks, an ammonia oxidation plant, nitric acid storage tanks, nitric and sulphuric acid concentration facilities, a change house (used by workers for personal hygiene), and associated building structures and sewer system components. Some building remnants are still present in this area. Published EPA information indicates nitric and sulphuric acid concentration processes conducted in the Nitric Acid Plant area would have generated wastewater which consisted of cooling water contaminated by acid spills. Waste characterization data reviewed by EPA indicates that the wastewater would have low pH and high levels of sulfate. An estimated 51 million pounds were produced between November 1944 and September 1945. Some of this material was used on-site for nitrocellulose production and the remainder was shipped off-site for use at other munitions plants.

Four test pits were completed in the vicinity of the Nitric Acid Plant and associated structures. The areas of investigation included the aboveground acid tank holders, drainage lines and a change house dry well. Key findings included:

- One of the test pits (NATP-3) was completed around a brick structure that surrounded a vitrified clay drainage line associated with the above ground acid tank holders. This test pit uncovered fill soils with intermixed innocuous debris that included black brick mortar, remnants of burnt wood and broken gaskets from the drainage line. No visual or olfactory evidence of impacts were identified in field observations from the other three test pits.

- Analytical testing of sediment within the drainage line, a gasket from the line, and mortar from the brick structure in the Nitric Acid Plant area identified concentrations of DRO and soluble sulfates.

- Analytical testing of a soil sample from the base of a dry well in the Nitric Acid Plant area adjacent to a change house (Building 707A), identified mercury at a concentration of 42 mg/kg, which would likely exceed the hazardous waste criteria if a Toxicity Characteristic Leaching Procedure (TCLP) test was performed.

5.3 BURNING GROUNDS

The Burning Grounds was reportedly used to dispose of powder that did not meet required specifications. The Burning Grounds, which is located on the southern edge of a large wetland, consisted of a bermed area that surrounded four nitrocellulose, one dinitrotoluene and other various hazardous waste burn pits. Piles of "Keystone" drum bottoms and tops are currently present to the north and east of the burn pits. Water standpipes, which are still present, were used to flood the areas for fire and explosion control.

Eighteen test pits were completed in the vicinity of the Burning Grounds. The areas of investigation included the west burn pit, east burn pit, drainage culvert and the northern ridge where numerous drum components were present. Key findings included:

- Two of the test pits (BGTP-10 and BGTP-11) were completed in areas that had remnants of drums used for transport of munitions powder. These test pits encountered primarily surficial drum components and miscellaneous charred wood debris. No debris or drum components were identified below a depth of two feet bgs.

- Test pit BG-TP-15, completed in the east burn pit, encountered traces of coal, wood debris and possible ash from 0-1 feet bgs. Rusted nails, metal and burnt wood were also identified from 1-2 feet bgs.

- Polynuclear Aromatic Hydrocarbons (PAHs) were identified in samples BG-TP-12 "below culvert" and BG-TP-12 "inside culvert" at concentrations below their respective Soil Reference Values (SRVs) and Soil Leaching Values (SLVs) established by the MPCA. PAHs were detected at concentrations exceeding the SRVs, and SLVs in sample BG-TP-12 "wood", which consisted of charred drum components.
- Total lead was detected in shallow soils at concentrations exceeding the industrial SRV and SLV in two samples including 3,100 mg/kg in BG-TP-15 (0-1')(A) and 1,000 mg/kg in sample BG-TP-1 (0-1'). Total mercury was detected at concentration exceeding the industrial SRV and SLV in one sample BG-TP-8 (0-1') (16 mg/kg).

5.4 WASTEWATER TREATMENT PLANT

Wastewater from GOW operations was piped to the WWTP via vitrified clay tile pipes. The treatment process included screens, digestion and sludge drying beds. The sludge was removed from the drying beds and disposed of in a shallow borrow pit. Operational components and other areas of potential concern in the vicinity of the WWTP included transformer pads, an above ground secondary containment reservoir, an earthen berm, an underground water holding tank, a wooded area, a rail spur, a firing range, drying beds, a "effluent pond", and a heavy equipment area. Information provided by Dakota County based on evaluation of the 1945 aerial photograph and review of historical GOW operations indicates that the Effluent Pond received discharges from ditches originating at Power Plant A (located to the northwest) and potentially the Ballistics Range and Lab (located to the southwest). Potential contaminants associated with the WWTP area include residual explosive compounds, heavy metals, PAHs, PCBs, VOCs and petroleum constituents.

Twenty-four test pits were completed in the vicinity of the WWTP and associated structures. The areas of investigation included the transformer pads, the aboveground secondary containment reservoir, the earthen berm, the underground water holding tank, the wooded area, the rail spur, the firing range, the drying beds, the ash disposal area and heavy equipment area. Key findings included:

Transformer Pad Area

- PCBs were detected at measurable concentrations in the surficial soil samples from the transformer pad area.

Earthen Berm

- Seven of the test pits (WWTP-TP-5 through WWTP-TP-11) were completed in an earthen berm in the treatment plant area. The berm stratigraphy encountered included coal from depths of 0 to 4 feet bgs, underlain by dark black material that appeared to have the characteristics of sewage and/or organic decay to depths of up to 15 feet bgs. The base of the berm consisted of what appeared to be a 1-1/2 foot concentrated layer of red to rusty colored dense soil.

- Total mercury was detected at concentration (25 mg/kg) which exceeded the SRV and SLV in a sample WWTP-TP-11 10'(B) collected at 10 feet bgs within the earthen berm.

Underground Water Holding Tank

- Test pit WWTP-TP-12 was completed inside of an underground water holding tank. The test pit uncovered a large amount of miscellaneous demolition debris that was apparently dumped into the holding tank. The debris consisted of electrical components, brick, slag, tar and asbestos containing material.

- Samples of materials collected from the underground water holding tank detected naphthalene, SVOCs, PCBs, arsenic, DRO and asbestos.

Wooded Area to South-Southeast of WWTP

- Test pits WWTP-TP-13 and WWTP-TP-14 were completed in the wooded area. Significant deposits of coal and ash klinkers were prevalent in the surficial soils from 0-1 feet bgs. The coal and klinkers were underlain by native sandy soil.

- Shallow soil samples WWTP-TP-13 (0-1')(A) and WWTP-TP-14 (0-2') were collected from the wooded area and contained total mercury at concentrations of 29 and 30 mg/kg. These concentrations exceed the SRV and SLV, and would potentially exceed the hazardous waste criteria.

Railroad Spur and Ballistics Range

- Test pits WWTP-TP-15 and WWTP-TP-16 were completed in the areas of a former railroad spur and ballistics firing range, respectively. No visual or olfactory evidence of impacts was identified during field observations of test pits WWTP-TP-15 and WWTP-TP-16.

Sludge Drying Bed Area

- Shallow soil sample WWTP-TP-17 & 18 2'(A), collected from the sludge drying beds area, contained total mercury at a concentration of 23 mg/kg, which exceeded the SRV and SLV, and would potentially exceed the hazardous waste criteria.

Effluent Pond

- Shallow soil samples WWTP-TP-19(2') and WWTP-TP-20 2'(B) were collected from the Effluent Pond and contained total mercury concentrations of 420 mg/kg and 590 mg/kg, which exceeded the SRV and SLV and would likely exceed the hazardous waste criteria.

Heavy Equipment Area

- One shallow soil sample [WWTP-TP-22 (0-2')], collected from the heavy equipment area contained a total mercury at a concentration (20 mg/kg), which exceeded the SRV and SLV, and would potentially exceed the hazardous waste criteria. This sample was collected from the southeast edge of the adjacent Effluent Pond.

Power Plant A Smoke Stacks

- One sample of suspect asbestos-containing "transite" board was collected from the interior concrete base of the smoke stacks for Power Plant A. This material, which originated from the interior liner of the stacks, contained asbestos.

5.5 MAINTENANCE SHOPS

The Maintenance Shops area was used primarily for service and maintenance activities, and included numerous shop and garage buildings, parking areas, and petroleum product storage. Potential contaminants in this area include solvent compounds (VOCs), heavy metals, and petroleum constituents.

Two test pits MSTP-1 and MSTP-2 were completed in the area of a former 10,000 gallon UST. Key findings included:

- No visual/olfactory evidence of contamination or elevated PID readings was identified in soil samples collected from these test pits.
- No petroleum related constituents (i.e. DRO) were detected in the soil samples collected from a depth of 5 to 6 feet in this area. Detectable concentrations of RCRA metals (below SRVs and SLVs) were detected in one of the samples. Mercury was detected at a concentration of 0.022 mg/kg.

5.6 PRIMARY SETTLING BASIN

The Primary Settling Basin received treated wastewater effluent generated by GOW operations. The primary basin discharged to the south into a larger detention reservoir (secondary settling basin) that in turn discharged to the Vermillion River channel. The purpose of the primary settling basin was for retention and settlement of suspended sediment and precipitates associated with the wastewater being discharged. Potential contaminants associated with the primary settling basin include residual explosive compounds, heavy metals, and organic contaminants. The pH of the wastewater effluent would have likely been variable, which would have affected the solubility and precipitation of heavy metals.

Two test pits PSBTP-1 and PSBTP-2 were completed in the delta area of the primary settling basin. Key findings included:

- The test pits identified a dark black organic top soil to depths of 6 feet bgs. The topsoil was underlain by native sand. No visual or olfactory evidence of contamination was identified in the test pits.
- Concentrations of dinitrotoluene and nitrotoluene compounds were detected in the two soil samples collected from depths of 3 to 6 feet bgs in this area. Dinitrotoluene concentrations were below the SRVs but exceeded the SLVs. No SRVs or SLVs are currently established by the MPCA for nitrotoluene compounds.
- RCRA metals were also detected in these samples at concentrations below respective SRVs and SLVs, with the exception of selenium which was detected at a concentration just above the SLV in one of the samples. The samples had mercury concentrations of 0.11 and 0.22 mg/kg.